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14. ABSTRACT

The purpose of this work plan addendum is to provide the technical approach for execution and completion of the Performance Work Statement (PWS) objectives for the second 7 funded Munitions Response Sites (MRSs) at the RVAAP. The PWS objectives consist of completing remedial investigations (RI) for the following MRSs: Erie Burning Grounds (RVAAP-002-R-01), Fuze and Booster Quarry (RVAAP-016-R-01), 40mm Firing Range (RVAAP-032-R-01), Sand Creek Dump (RVAAP-034-R-01), Block D Igloo-TD (RVAAP-061-R-01), Water Works #4 Dump (RVAAP-062-R-01) and Group 8 (RVAAP-063-R-01). This work plan has been prepared to achieve the following objectives; (1) determine the nature and extent of munitions and explosives of concern (MEC), (2) determine the nature and extent of munitions constituents (MC), (3) determine the risk posed to human health and the environmental by MEC and MC, and (4) collected or develop additional data for the Feasibility Study (FS), as appropriate, to determine remediation alternatives for mitigation, including evaluation of no action. This work plan was prepared in accordance with the Army's Final Munitions Response RI/FS guidance dated November 2009.

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Work Plan, Military Munitions Response Program, MEC, MC

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Final Work Plan Addendum for
Military Munitions Response Program Remedial Investigation Environmental Services
Version 1.0

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912DR-09-D-0005
Delivery Order 0002

Prepared for:

U.S. Army Corps of Engineers
Baltimore District
10 S. Howard Street, Room 7000
Baltimore, MD 21201

Prepared by:

Shaw Environmental & Infrastructure, Inc.
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December 7, 2011

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OHARNG/Camp Ravenna	1	1
NGB Program Manager	0	1
AEC Program Manager	0	1
BRACD Program Manager	0	1
Shaw Project Manager	3	3

RVAAP—Ravenna Army Ammunition Plant
USACE—U.S. Army Corps of Engineers
Ohio EPA—Ohio Environmental Protection Agency
OHARNG—Ohio Army National Guard
NGB—National Guard Bureau
AEC—U.S. Army Environmental Command
BRACD—Base Realignment and Closure Division
Shaw—Shaw Environmental & Infrastructure, Inc.

CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Shaw Environmental & Infrastructure, Inc. has completed the *Final Work Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services, Ravenna Army Ammunition Plant, Ravenna, Ohio*. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy, principles and procedures, utilizing justified and valid assumptions, was verified. This included review of technical assumptions; methods, procedures and materials to be used; and whether the product meets customer's needs consistent with law and existing Corps policy.

Reviewed/Approved by: _____ Date: December 7, 2011
David Cobb
Project Manager

Reviewed/Approved by: _____ Date: December 7, 2011
David Crispo, P.E.
Technical/Regulatory Lead

Prepared/Approved by: _____ Date: December 7, 2011
Laura O'Donnell
Project Engineer

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Acronyms and Abbreviations

1D	one dimensional
2D	two dimensional
AEDB-R	Army Environmental Database-Restoration
AOC	Area of Concern
APP	Accident Prevention Plan
ASR	Archive Search Report
ATF	Bureau of Alcohol, Tobacco, and Firearms
BERA	baseline ecological risk assessment
BIP	blown-in-place
BRACD	Base Realignment and Closure Division
Camp Ravenna	Camp Ravenna Joint Military Training Center
CD	compact disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHE	Chemical Warfare Materiel Hazard Evaluation
CHMM	Certified Hazardous Materials Manager
CIH	Certified Industrial Hygienist
cm	centimeter
cm/s	centimeters per second
COC	chemical of concern
COPC	chemical of potential concern
COPEC	constituent of potential ecological concern
CSM	conceptual site model
CSP	Certified Safety Professional
CTT	Closed, Transferring, and Transferred
CWM	chemical warfare materiel
DDESB	DOD Explosives Safety Board
DERP	Defense Environmental Restoration Program
DFFO	Director's Final Findings and Orders
DGM	digital geophysical mapping
DID	Data Item Description
DMM	discarded military munitions
DO	Delivery Order
DOD	Department of Defense
DODI	Department of Defense Instructions
DQO	data quality objective
DVD	digital versatile disc
e^2M	engineering-environmental Management, Inc.
EHE	Explosive Hazard Evaluation
EM	Engineering Manual
ER	Engineer Regulation
ERA	ecological risk assessment
EOD	explosives and ordnance disposal

Acronyms and Abbreviations (continued)

EP	Engineer Pamphlet
EPA	United States Environmental Protection Agency
EPP	Environmental Protection Plan
EPC	exposure point concentration
ESP	Explosive Site Plan
EZ	exclusion zone
FS	Feasibility Study
FSA	Field Staging Area
FSAP	Facility-Wide Sampling and Analysis Plan
FUDS	Formerly Used Defense Sites
FWCUG	Facility-Wide Cleanup Goal
GIS	Geographic Information System
GPO	Geophysical Prove-Out Plan
GPS	Global Positioning System
H	horizontal
HA	hazard assessment
HE	high explosive
HFD	Hazard Fragment Distance
HHE	health hazard evaluation
HHRA	human health risk assessment
HHRAM	Human Health Risk Assessor Manual
HQ	hazard quotient
HRR	Historical Records Review
HSM	Health and Safety Manager
Hz	Hertz
I	inclined
IDW	investigation-derived waste
IRP	Installation Restoration Program
IS	incremental sample
ISO	industry standard object
IVS	instrument verification strip
K	K-factor (328 for intentional detonations)
lb	pound
MC	munitions constituents
MD	munitions debris
MDAS	material documented as safe
MDEH	material documented as an explosive hazard
MEC	munitions and explosives of concern
MFD-H	maximum fragment distance-horizontal
MGFD	munitions with the greatest fragmentation distance
mg/kg	milligrams per kilogram
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	materiel potentially presenting an explosive hazard
MRS	Munitions Response Site

Acronyms and Abbreviations (continued)

MRSPP	Munitions Response Sites Prioritization Protocol
MSD	minimum separation distance
mV	millivolt
NA	not applicable
NAD 83	North American Datum 1983
NCP	National Contingency Plan
NEW	Net Explosive Weight
NFA	no further action
NGB	National Guard Bureau
NRL	Naval Research Laboratory
OB	open burning
OE	ordnance and explosives
OESS	Ordnance and Explosives Safety Specialist
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
PBA	Performance-Based Acquisition
PCB	polychlorinated biphenyls
PDA	personal digital assistant
PE	Professional Engineer
PG	Professional Geologist
PGP	Professional Geophysicist
PM	Project Manager
PP	Proposed Plan
PPE	personal protective equipment
PRG	Region 9 Preliminary Remediation Goals
PWS	Performance Work Statement
QAPP	Quality Assurance Project Plan
QC	quality control
QCP	Quality Control Plan
QSM	Quality Systems Manual
RA	remedial action
RD	remedial design
RDX	royal demolition explosive
RI	Remedial Investigation
RIP	remedy in place
ROD	Record of Decision
ROE	Right-of-Entry
RSL	Regional Screening Level
RTK	real-time kinematic
RTS	robotic total station
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Application and International Corporation
SDZ	safety danger zone
Shaw	Shaw Environmental & Infrastructure, Inc.
SI	Site Inspection

Acronyms and Abbreviations (continued)

SLERA	screening level ecological risk assessment
SNR	Signal to Noise Ratio
SSHP	Site Safety and Health Plan
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	semivolatile organic compound
TAL	Target Analyte List
TBD	to be determined
TDEM	Time Domain Electromagnetics
TM	Technical Manual
TNT	2,4,6-trinitrotoluene
TP	Technical Paper
TPP	Technical Project Planning
UCL	upper confidence limit
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Safety Officer
V	vertical
VSP	Visual Sample Plan

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1.0 Introduction

Shaw Environmental & Infrastructure Inc. (Shaw) is submitting this *Final Work Plan Addendum for Military Munitions Response Program Remedial Investigation Services*; hereafter, referred to as the "work plan addendum," to the United States Army in accordance with the *Performance Work Statement* (PWS) included in the Performance-Based Acquisition (PBA) Contract No. W912DR-09-D-005, Delivery Order (DO) 002. This Delivery Order is for performance-based, firm-fixed price environmental services at 14 Military Munitions Response Program (MMRP) sites at the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio. The Delivery Order was issued by the U.S. Army Corps of Engineers (USACE), North Atlantic Baltimore District on May 27, 2009.

This work plan addendum describes the activities planned to perform a Remedial Investigation (RI) at the seven remaining Munitions Response Sites or MRSs under this DO. The MRSs are shown on **Figure 1-1** and **Figure 1-2** and consist of the following sites:

- Erie Burning Grounds (RVAAP-002-R-01)
- Fuze and Booster Quarry (RVAAP-016-R-01)
- 40mm Firing Range (RVAAP-032-R-01)
- Sand Creek Dump (RVAAP-034-R-01)
- Block D Igloo-TD (RVAAP-061-R-01)
- Water Works #4 Dump (RVAAP-062-R-01)
- Group 8 (RVAAP-063-R-01)

As part of the RI process, Shaw relied on previous investigations, such as the *Final Site Inspection Report* and *Historical Records Review* (HRR) (engineering-environmental Management, Inc. [e^2M], 2008), in order to understand the past munitions activities performed at each MRS. Based on this knowledge, Shaw will perform a field investigation, consisting of instrument-assisted visual surveys, digital geophysical mapping (DGM) surveys, and environmental sampling, to further define the nature and extent of munitions activities. The results of the initial field investigation activities will guide several aspects of the follow-on technical approaches in this work plan addendum such as intrusive investigation locations and sample locations. Prior to performing these activities, Shaw will receive approval from USACE and the Ohio Environmental Protection Agency (Ohio EPA).

U.S. ARMY
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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER	RVAAP SITE LOCATION MAP RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO
1-1	

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RVAAP-061-R-01 Block D Igloo-TD

RVAAP-002-R-01 Erie Burning Ground

RVAAP-034-R-01 Sand Creek Dump

RVAAP-062-R-01 Water Works #4 Dump

RVAAP-016-R-01 Fuze and Booster Quarry

RVAAP-032-R-01 40mm Firing Range

RVAAP-063-R-01 Group 8

North Patrol Road
Smalley Road (C.H. 228)
Blackberry Lane
South Patrol Road
Newton Falls Road
Remalia Road
South Service Road
North D Road
South D Road
North Line Road
Lab Road
Road 20-X-2
Road 10-X-8
Pallet Road E West
Pallet Road E East
Pallet Road C West
Pallet Road C East
Pallet Road B East
Pallet Road A West
Wadsworth Road
George Road
Road AA
Snow Road
East Patrol Road
Ramsdell Road
Irons Road
Smallisreed Road
Wilcox Wayland Road
Load Line No. 3 Road
Load Line No. 1 Road
Paris Windham Road
Kelly's Pond Road
Detonator Spur Road
Fuse Booster Spur Road
Fuse & Booster Road
Greenleaf Road
State Route 80 Freedom Road
Sand Creek
South Fork Eagle Creek
Hinkley Creek
Market Pond
West Branch Mahoning River
West Branch State Park

Ravenna Army Ammunition Plant Boundary
BRAC/NGB Properties
BRAC Properties
NGB Properties
Non-DoD Control
Operational Range
Surface Water
Stream

0 1,500 3,000 6,000 Feet

Projection : NAD_1983_UTM_Zone_17N

U.S. ARMY
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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-2

RVAAP MUNITIONS RESPONSE SITE LOCATIONS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 133616

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1.1 Project Authorization

The Department of Defense (DOD) has established the MMRP to address DOD sites suspected of containing Munitions and Explosives of Concern (MEC) or Munitions Constituents (MC) to obtain a better understanding of munitions response requirements and gain better visibility of total potential costs (Army, 2009). Pursuant to USACE's Engineer Regulation (ER) 200-3-1, *Environmental Quality Formerly Used Defense Sites (FUDS) Program Policy* (USACE, 2004a) and the Management *Guidance for the Defense Environmental Response Program (DERP)* (Office of the Deputy Under Secretary of Defense [Installations and Environment], September 2001), the USACE is conducting MRS response activities at the RVAAP in accordance with the DERP statute (10 USC 2701 et seq.), *Comprehensive Environmental Response, Compensation and Liability Act* (CERCLA) (42 USC 9620), Executive Orders 12580 and 13016, and the *National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) (Title 40, Part 300 of the Code of Federal Regulations [40 CFR 300]). While not all MEC/MC constitutes CERCLA hazardous substances, pollutants or contaminants, the DERP statute provides the DOD the authority to respond to releases of MEC/MC, and DOD policy states that such responses shall be conducted in accordance with CERCLA and the NCP. Although the munitions response activities at the RVAAP are being performed in accordance with CERCLA and the NCP, the RVAAP is not on the National Priority List.

The Ohio EPA is the lead regulatory agency with respect to all the MMRP MRSs. Planning and performance of all elements of this PBA are in accordance with requirements of the Ohio EPA *Director's Final Findings and Orders* (DFFO) for RVAAP (Ohio EPA, 2004).

1.2 Purpose and Scope

The objective of this work plan addendum is to outline Shaw's approach to conducting RI activities at the remaining seven MRSs under this DO. Two of the MRSs, Sand Creek Dump (RVAAP-034-R-01) and Water Works #4 Dump (RVAAP-062-R-01), require the attainment of Remedy In Place (RIP), which at a minimum will require the development of a Feasibility Study (FS), Proposed Plan (PP), and Record of Decision (ROD). Depending on the outcome of the RI, remedy implementation (Remedial Design/Remedial Action [RD/RA]) documents may also be required for the MRSs required to attain RIP.

The purpose of the RI is to determine whether these MRSs warrant further response action pursuant to CERCLA and NCP. The RI will accomplish the following objectives:

- Determine the nature and extent of MEC.
- Determine the nature and extent of MC.
- Determine the risk posed to human health and the environment by MEC and MC.

- Collect or develop additional data for the FS, as appropriate, to determine remediation alternatives, including evaluation of no action.

1.3 Work Plan Addendum Organization

This document is intended to serve as an addendum to the *Final Work Plan for Military Munitions Response Program Remedial Investigation for Environmental Services* (Shaw, 2011b), herein referred to as the "work plan." This work plan addendum presents the RI activities for the seven remaining MRSs at RVAAP that were not funded at the time the original work plan was generated. Where applicable, this work plan addendum will reference sections discussed in the work plan that are not MRS-specific. However, MRS-specific approaches and activities are discussed herein. This work plan addendum includes the following sections:

- Section 1.0 Introduction
- Section 2.0 Technical Management Plan
- Section 3.0 Field Investigation Plan
- Section 4.0 Quality Control Plan (QCP)
- Section 5.0 Explosives Management Plan
- Section 6.0 Explosives Site Plan (ESP)
- Section 7.0 Environmental Protection Plan (EPP)
- Section 8.0 Property Management Plan
- Section 9.0 Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel Projects
- Section 10.0 Physical Security Plan for Recovered Chemical Warfare Materiel Project Sites
- Section 11.0 References (guidance, regulations, and other policies)

Appendices included at the end of this work plan addendum are as follows: *Munitions Constituents Sampling and Analysis Plan* (SAP)*/Quality Assurance Project Plan* (QAPP) *Addendum* (**Appendix A**), the Minimum Separation Distance (MSD) calculation sheets (**Appendix B**), and the Ohio EPA Comment Response Tables (**Appendix C**). The *Sampling and Analysis Plan* (SAP)*/Quality Assurance Project Plan* (QAPP) *Addendum*; hereafter referred to as the "SAP addendum" is an attachment to the original SAP/QAPP presented in **Appendix A** of the work plan (Shaw, 2011b).

1.4 Project Location

The RVAAP (Federal Facility Identification number: OH213820736) is located in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 kilometers (3 miles) east-

northeast of the city of Ravenna. All MRSs are solely located within Portage County. The Installation is approximately 17.7 kilometers (11 miles) long and 5.6 kilometers (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east. The Installation is surrounded by several communities: Windham on the north, Garrettsville 9.6 kilometers (6 miles) to the northwest, Newton Falls 1.6 kilometers (1 mile) to the southeast, Charlestown to the southwest, and Wayland 4.8 kilometers (3 miles) to the south (**Figure 1-1**).

As of February 2006, administrative control of 20,403 acres of the former 21,683-acre RVAAP has been transferred to the National Guard Bureau (NGB) and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as the Camp Ravenna Joint Military Training Center (Camp Ravenna). Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of Camp Ravenna. These 1,280 acres consist of former industrial facilities that are being remediated and managed by the Base Realignment and Closure Division (BRACD) that have, among other responsibilities, the task of overseeing inactive status installations. The MMRP work will be performed on both NGB and BRAC parcels at the RVAAP/Camp Ravenna (**Figure 1-2**). **Table 1-1** identifies the agency currently responsible for each of the MRSs presented in this work plan addendum.

Table 1-1
MRS Management Responsibilities at RVAAP

MRS Name	AEDB-R MRS Number	Management Responsibility
Erie Burning Grounds	RVAAP-002-R-01	NGB
Fuze and Booster Quarry	RVAAP-016-R-01	BRACD
40mm Firing Range	RVAAP-032-R-01	BRACD
Sand Creek Dump	RVAAP-034-R-01	NGB
Block D Igloo-TD	RVAAP-061-R-01	non-DOD Control
Water Works #4 Dump	RVAAP-062-R-01	NGB
Group 8 MRS	RVAAP-063-R-01	NGB

Notes:
AEDB-R = Army Environmental Database- Restoration Module
BRACD = Base Realignment and Closure Division
DOD = Department of Defense
MRS = Munitions Response Site
NGB = National Guard Bureau
RVAAP = Ravenna Army Ammunition Plant

During the operational years, prior to Camp Ravenna, the entire 21,683-acre property was a government-owned, contractor-operated industrial facility. The RVAAP MMRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP.

Therefore, references to the RVAAP in this work plan addendum are considered to be inclusive of the historical extent of the RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

1.5 Site Description

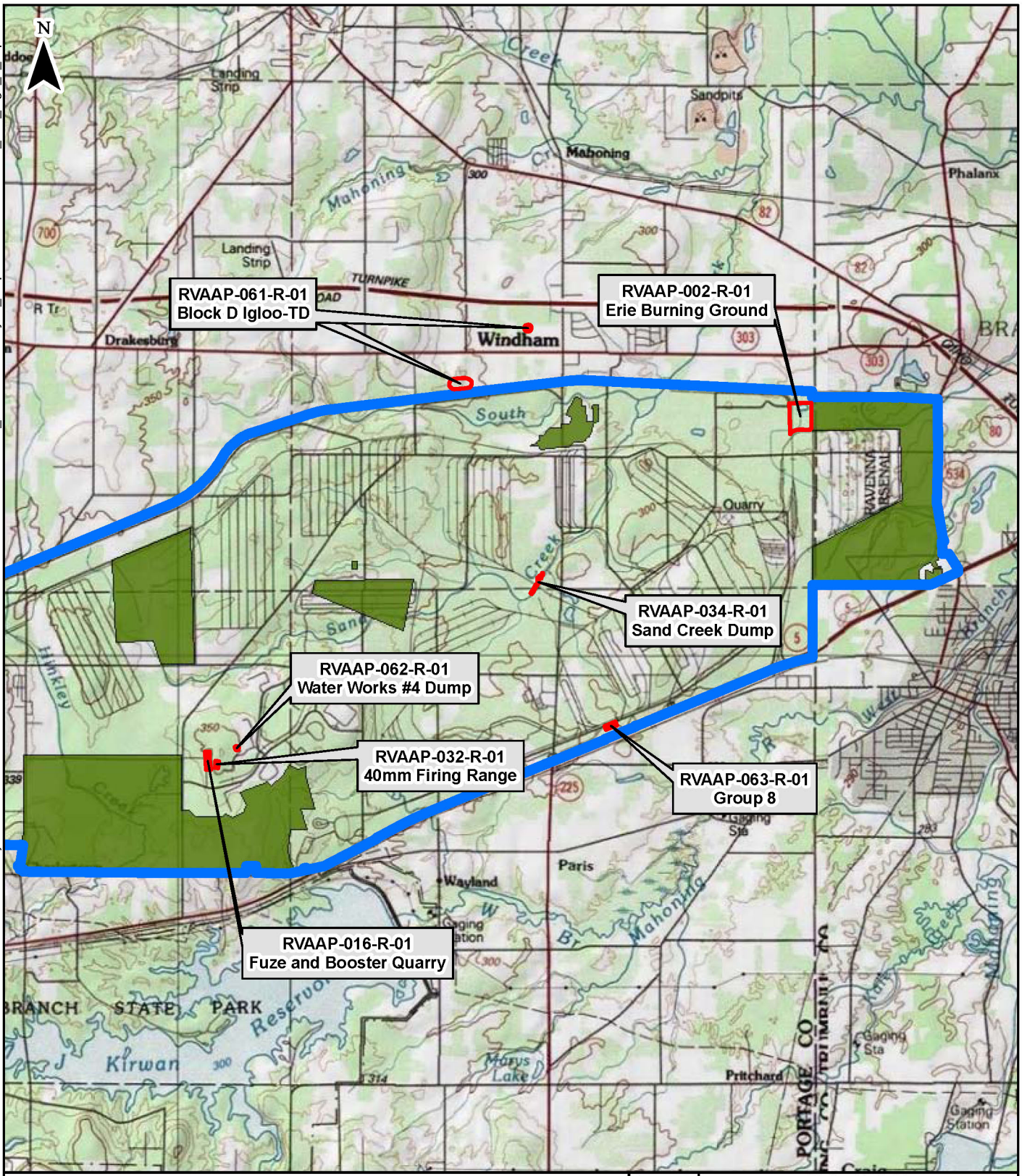
Section 1.5 in the work plan (Shaw, 2011b) presents a facility-wide discussion of topographical, climate, vegetation, site geology and soil type conditions at RVAAP. The reader is referred to the work plan for general discussion regarding topography, vegetation, geology, and soil types at the RVAAP. **Figure 1-3** identifies the topography at the RVAAP MRSs included in this work plan addendum.

1.6 Site History

Industrial operations at the former RVAAP consisted of 12 munitions assembly facilities, referred to as "load lines." Load Lines 1 through 4 were used to melt and load 2,4,6-trinitrotoluene (TNT) and Composition B into large caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. Following cleaning, the "pink water" waste water, which contained TNT and Composition B, was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuzes, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds, and explosives. From 1946 to 1949, Load Line 12 was used to produce ammonium nitrate for explosives and fertilizers prior to use as a weapons demilitarization facility.

In 1950, the facility was placed in standby status and operations were limited to renovation, demilitarization, and normal maintenance of equipment, along with storage of munitions. Production activities were resumed from July 1954 to October 1957 and again from May 1968 to August 1972. In addition to production missions, various demilitarization activities were conducted at facilities constructed at Load Lines 1, 2, 3, and 12. Demilitarization activities included disassembly of munitions and explosives melt-out and recovery operations using hot water and steam processes. Periodic demilitarization of various munitions continued through 1992.

In addition to production and demilitarization activities at the load lines, other facilities at RVAAP include MRSs that were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consist of large parcels of open space or abandoned quarries. Potential contaminants at these MRSs include explosives, propellants, metals, and waste oils. Other Areas of Concern (AOCs) present at RVAAP include landfills, an aircraft fuel


N
RVAAP-061-R-01
Block D Igloo-TD
RVAAP-002-R-01
Erie Burning Ground
RVAAP-034-R-01
Sand Creek Dump
RVAAP-062-R-01
Water Works #4 Dump
RVAAP-032-R-01
40mm Firing Range
RVAAP-063-R-01
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RVAAP-016-R-01
Fuze and Booster Quarry
Windham
Drakesburg
Paris
Wayland
Pritchard
Phalanx
Mahoning
South
Quarry
Sandpits
Landing Strip
TURNPIKE
Hinkley
Kirwan
Reservoir
Mosys Lake
BRANCH STATE PARK
PORTAGE CO
Gaging Sta
Gaging Station
Ravenna Army Ammunition Plant Boundary
MRS Boundary
Operational Ranges
300
Elevation in Feet Above Mean Sea Level
0
7,000
Feet
Projection : NAD_1983_UTM_Zone_17N
U.S. ARMY
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LOUISVILLE DISTRICT
MILITARY MUNITIONS RESPONSE PROGRAM
FIGURE NUMBER
1-3
TOPOGRAPHIC MAP
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
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Project Number: 136147

tank testing facility, and various general industrial support and maintenance facilities. The MRSs to be addressed in this work plan addendum are described below and presented on **Figure 1-2**.

The RVAAP MMRP encompasses investigation and cleanup of past activities. It should be noted that many of the RVAAP MRSs have overlapping Installation Restoration Program (IRP) AOCs. **Table 1-2** identifies the MRSs included in this work plan that have known IRP site overlap:

Table 1-2
RVAAP MRSs with IRP Overlap

MRS Name	AEDB-R MRS Number	AEDB-R IRP Number
Erie Burning Grounds	RVAAP-002-R-01	RVAAP-02
Fuze and Booster Quarry	RVAAP-016-R-01	RVAAP-16
40mm Firing Range	RVAAP-032-R-01	RVAAP-32
Sand Creek Dump	RVAAP-034-R-01	RVAAP-34
Block D Igloo-TD	RVAAP-061-R-01	NA
Water Works #4 Dump	RVAAP-062-R-01	NA
Group 8 MRS	RVAAP-063-R-01	NA

Notes:
AEDB-R = Army Environmental Database-Restoration Module
IRP = Installation Restoration Program
MRS = Munitions Response Site
NA = not applicable, there is no IRP overlap
RVAAP = Ravenna Army Ammunition Plant

Based on the findings presented in the *Final Site Inspection Report* (e^2M, 2008), hereafter referred to as the "SI" or "SI Report," RIs will be conducted at all seven of the MRSs. Two of the MRSs, Sand Creek Dump (RVAAP-034-R-01) and Water Works #4 Dump (RVAAP-062-R-01), will be required to attain RIP. The following sections are brief site descriptions for the RVAAP MRSs addressed under this work plan addendum.

1.6.1 Erie Burning Grounds (RVAAP-002-R-01)

Erie Burning Grounds is a 33.93-acre MRS located in northeast portion of the RVAAP. Erie Burning Grounds is co-located with an IRP AOC (Army Environmental Database Restoration Module [AEDB-R] #RVAAP-02). Approximately 60 percent of the MRS is considered a high-quality wetlands (SAIC, 2007). From 1941 to 1951, Erie Burning Grounds was used to thermally treat bulk, obsolete, off-spec propellants, conventional explosives, rags, and large explosive contaminated items (e.g., railcars) by open burning on the ground surface. During operations, open boxcars were staged at the end of Track 49 and items were tipped out of the car in order to be burned. Ash residue from OB activities was left on site. In addition to OB activities, bomb bodies were transported to Erie Burning Grounds for flashing after they were cleaned out.

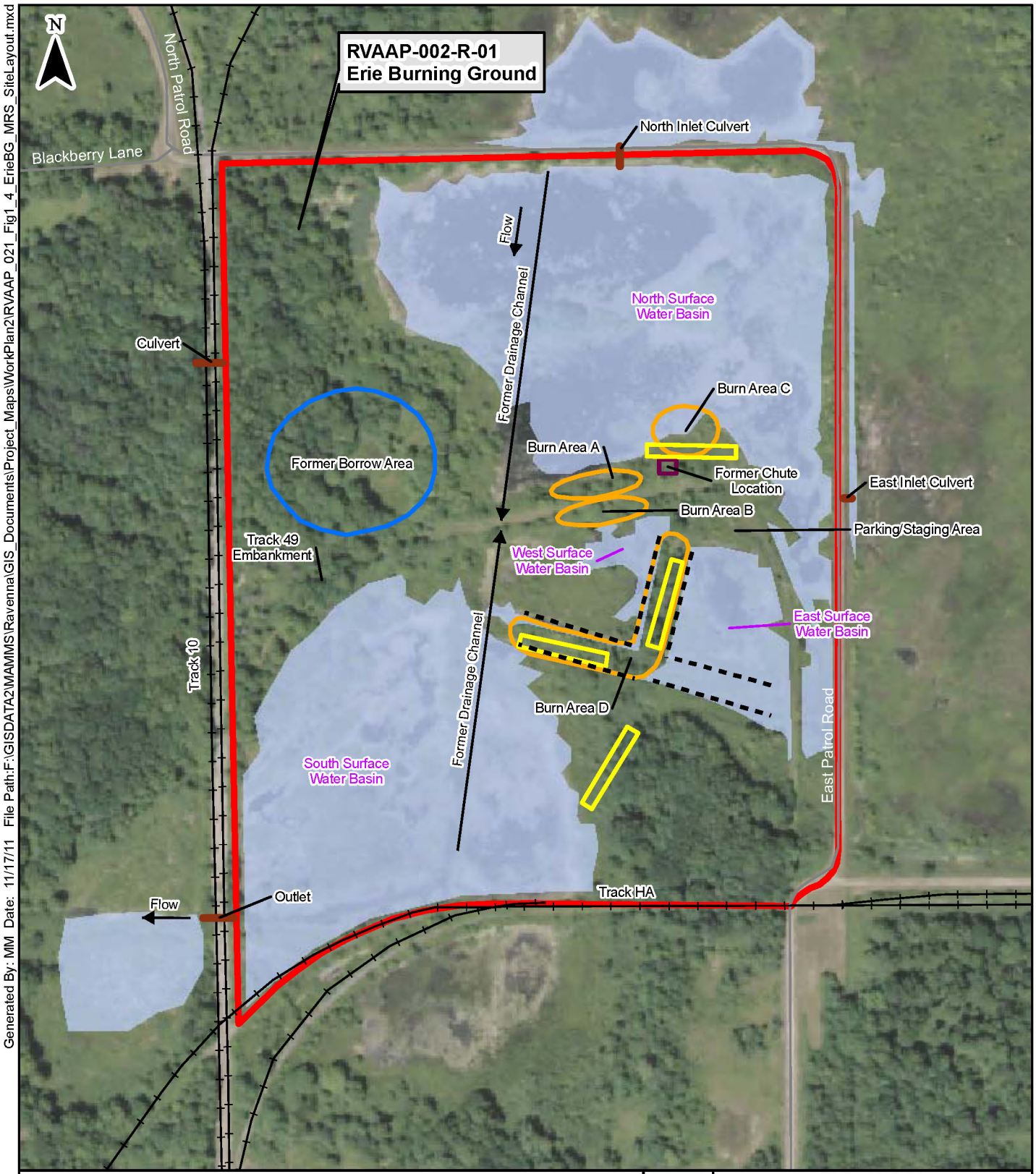
According to the Archive Search Report (ASR), the MRS is located too close to the installation boundary to burn filled bombs. The HRR identified several former burn areas at Erie Burning Grounds: Burn Area A, Burn Area B, Burn Area C, and Burn Area D. The Former Borrow Area, which is located in the western portion of the MRS, was also used for bomb flashing activities. Partially buried debris (i.e., munitions debris), tentatively identified by Installation and USACE personnel as remnants of burned out bombs (size and type not identified), have been observed across the MRS. According to installation and USACE personnel, partially buried munitions debris (MD) items from the burned out bombs have been observed in the MRS. **Figure 1-4** depicts the site layout of Erie Burning Grounds MRS.

1.6.2 Fuze and Booster Quarry (RVAAP-016-R-01)

The Fuze and Booster Quarry MRS is a 4.92-acre site located south of Newton Falls Road and north of Fuze and Booster Road. The MRS is collocated on an IRP AOC (RVAAP-16). The majority of the MRS consists of three elongated ponds, which are separated by berms, that were previously constructed in an abandoned rock quarry. The Fuze and Booster Quarry was used for open burning of sawdust waste from 1945 to 1949. Following these activities, the Fuze and Booster Quarry was a landfill that reportedly accepted fuze and booster assemblies, projectiles, residual ash, and sanitary waste. According to the HRR, any munitions present at RVAAP could be found at the MRS. The ponds were constructed in 1976 after the landfill material was removed from the MRS and placed at Ramsdell Quarry Landfill or an existing burning ground. According to installation personnel, MEC items are visible in the northern pond when the water level is low as well as on the banks of the southern pond. **Figure 1-5** depicts the site layout at the Fuze and Booster Quarry MRS.

1.6.3 40mm Firing Range (RVAAP-032-R-01)

The 40mm Firing Range MRS encompasses an area of approximately 1.27 acres that is collocated with an IRP AOC (RVAAP-32). The 40mm Firing Range was reportedly used from 1969 to 1971 to test 40mm grenade cartridges. Rounds tested may have included both the M407A1 practice round and the M406 high-explosive (HE) round. Practice rounds contain yellow marker dye, M9 propellant, and royal demolition explosive (RDX) booster pellets. The M406 HE rounds contain Composition B and double base M9 propellant for use in ignition cartridges. Grenades were fired from a fixed position, which is estimated to be located east of the current MRS boundary, to the west. The impact area was well defined with a berm that has since been removed from the site. The current MRS boundary was revised based on visual survey findings identified during the SI and the conclusions presented in the SI Report (e^2M, 2008). It should be noted that the suspected impact area and firing point are not located within the current MRS boundary. Figure 1-6 depicts the site layout at the 40mm Firing Range MRS.



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Project Number: 136147

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-4

ERIE BURNING GROUNDS MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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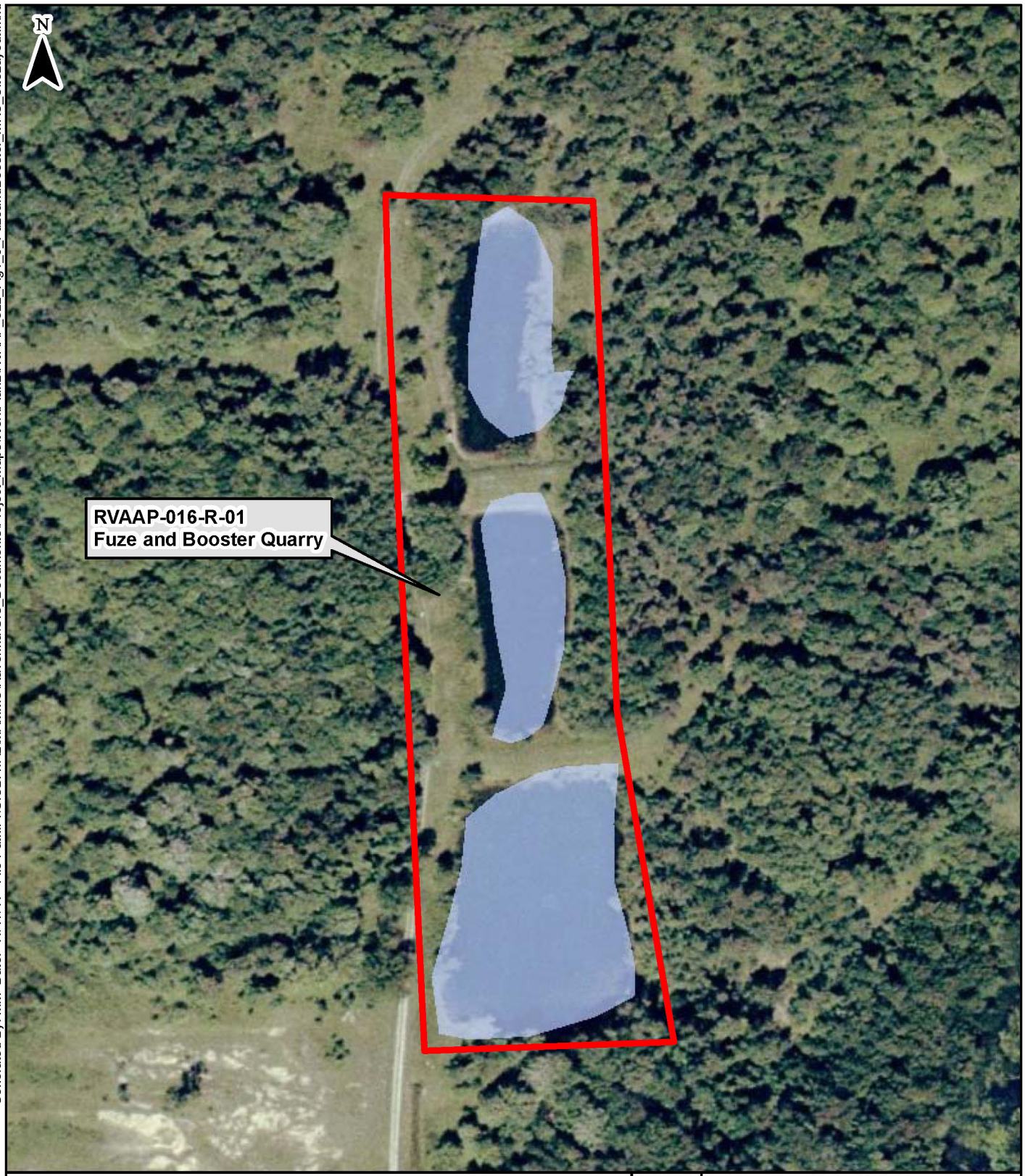

MRS Boundary

Surface Water

0 150

Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-5

FUZE & BOOSTER QUARRY MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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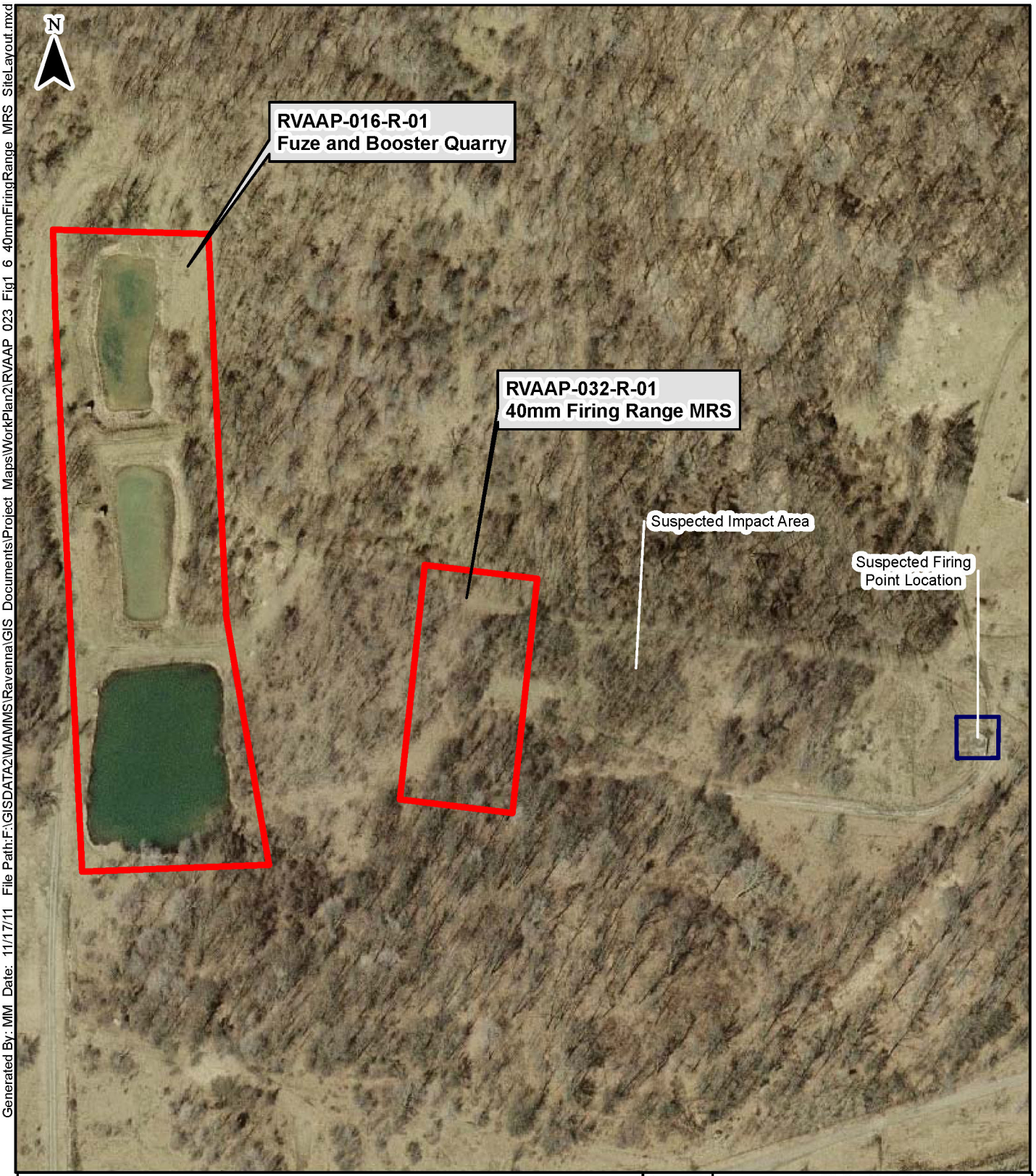

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Project Number: 136147

MRS Boundary

Suspected Firing Point Location

0 200 Feet

Projection : NAD_1983_UTM_Zone_17N

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LOUISVILLE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-6

40MM FIRING RANGE MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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1.6.4 Sand Creek Dump (RVAAP-034-R-01)

The Sand Creek Dump MRS, which is co-located with an IRP AOC (AEDB-R #RVAAP-34), consists of 0.85 acres of undeveloped land that stretches approximately 1,000 feet along the banks of Sand Creek. The dump, which operated from 1950 to 1960, reportedly held construction debris (i.e., concrete, wood, asbestos debris, lab bottles, and fluorescent light tubes).

A removal action was conducted at the site under the IRP in 2003 to remove surface debris and limited subsurface debris associated with former use of the site as a construction dump. During confirmation sampling following the removal action, two MD items (75mm projectile shells) were discovered at the northern portion of the site. Although no MEC was identified at the MRS during the SI MEC survey, one empty 105mm projectile MD was found in Sand Creek at the most northern portion of the MRS. **Figure 1-7** depicts the Sand Creek Dump MRS layout.

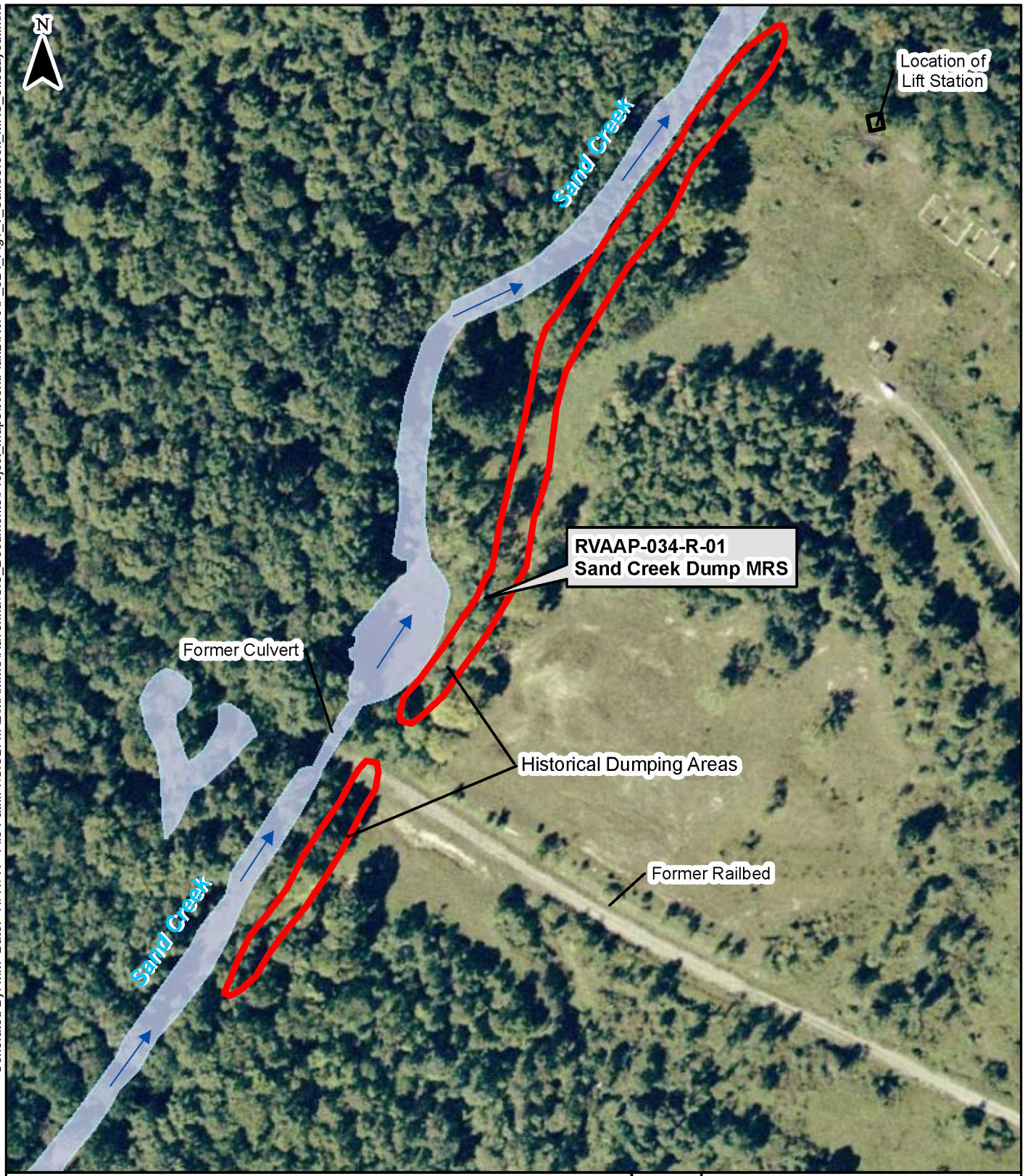
1.6.5 Block D Igloo-TD (RVAAP-061-R-01)

The Block D Igloo-TD MRS is located off-site on private property. It consists of the areas where potential MEC or MD may be present as a result of an accidental explosion of Igloo 7-D-15 in 1943. The SI Report (e^2M, 2008) concluded that the MRS should be revised to include two off-post, noninvestigated areas (Area 1 and Area 2) northeast of Igloo 7-D-15 where concrete fragments were historically found after the explosion. The current MRS encompasses 14.13 acres; Area 1 consists of 12 acres of agricultural land and Area 2 is 2.13 acres of densely wooded land. **Figure 1-8** identifies the current MRS boundaries at the Block D Igloo–TD.

1.6.6 Water Works #4 Dump (RVAAP-062-R-01)

The Water Works #4 Dump MRS site originally encompassed approximately 6.15-acres of mostly forested area that included a small clearing, located immediately north of the Water Works #4 and west of Load Line #7 in the southwestern portion of the RVAAP. The MRS was reportedly used for disposal from 1941 to 1949. Prior to the SI activities, large caliber casings were reportedly found scattered throughout the wooded portion of the former MRS boundaries lying on the ground surface and partially buried, as were metal parts defined as ogives from World War I-era 155mm shrapnel projectiles.

During the SI field work, 20 inert ogives with no energetic material were found scattered through the northern wooded area of the original MRS area. Several closely spaced subsurface anomalies were detected during the SI in the open field portion of the MRS. It was recommended in the SI Report (e^2M, 2008) and subsequently approved by the stakeholders that the MRS footprint be reduced from 6.15 to 0.77 acres to include only the open field area of the MRS where subsurface anomalies were detected. Figure 1-9 depicts the site layout at the Water Works #4 Dump MRS.



MRS Boundary
Stream
Direction of Flow

0 150
Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER
1-7

SAND CREEK DUMP MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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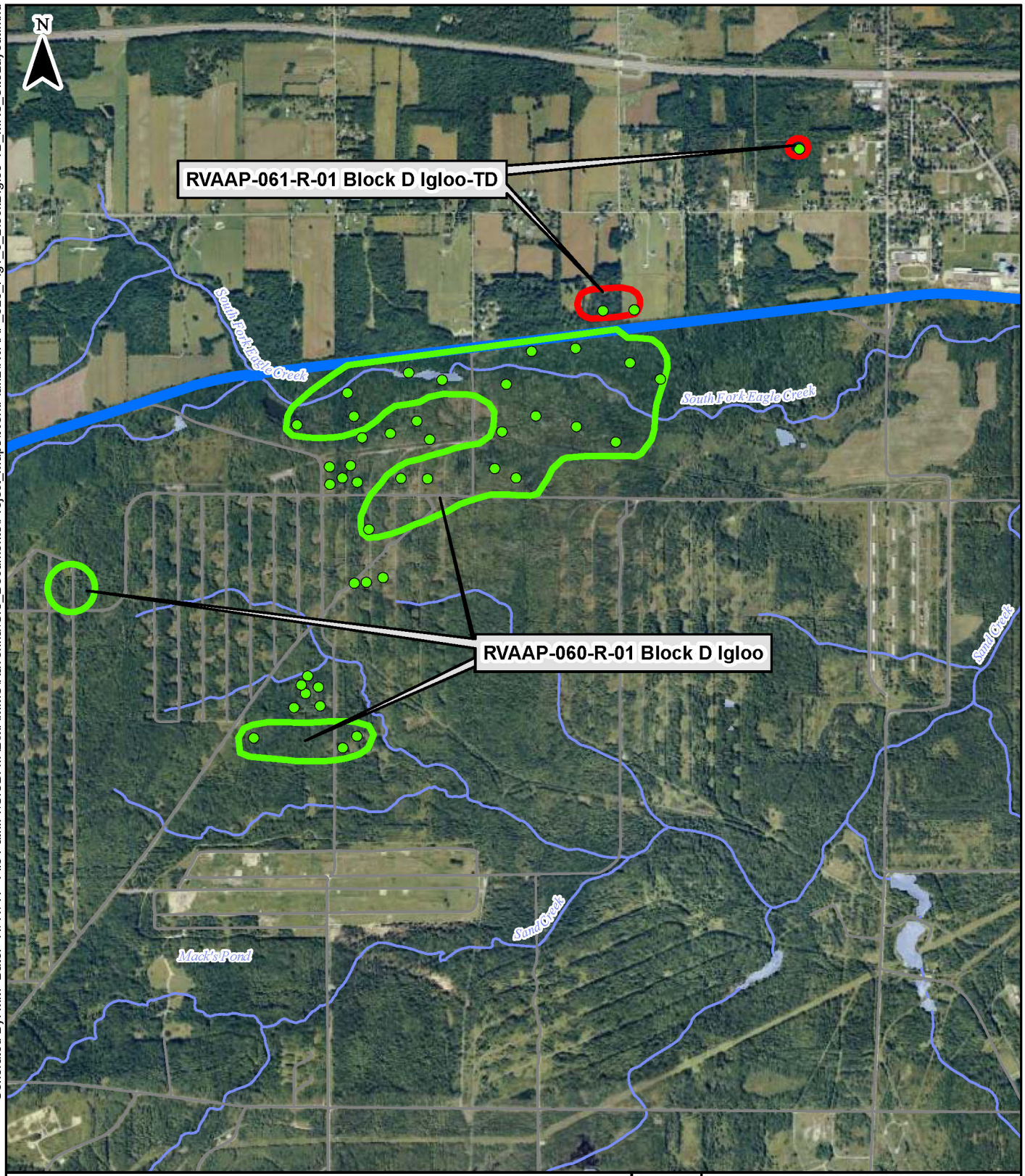
Project Number: 136147



Ravenna Army Ammunition Plant

Block D Igloo-TD MRS Boundary

Block D Igloo MRS Boundary

Historical Non-Munitions Related Debris

Stream

0 2,500 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-8

BLOCK D IGLOO-TD MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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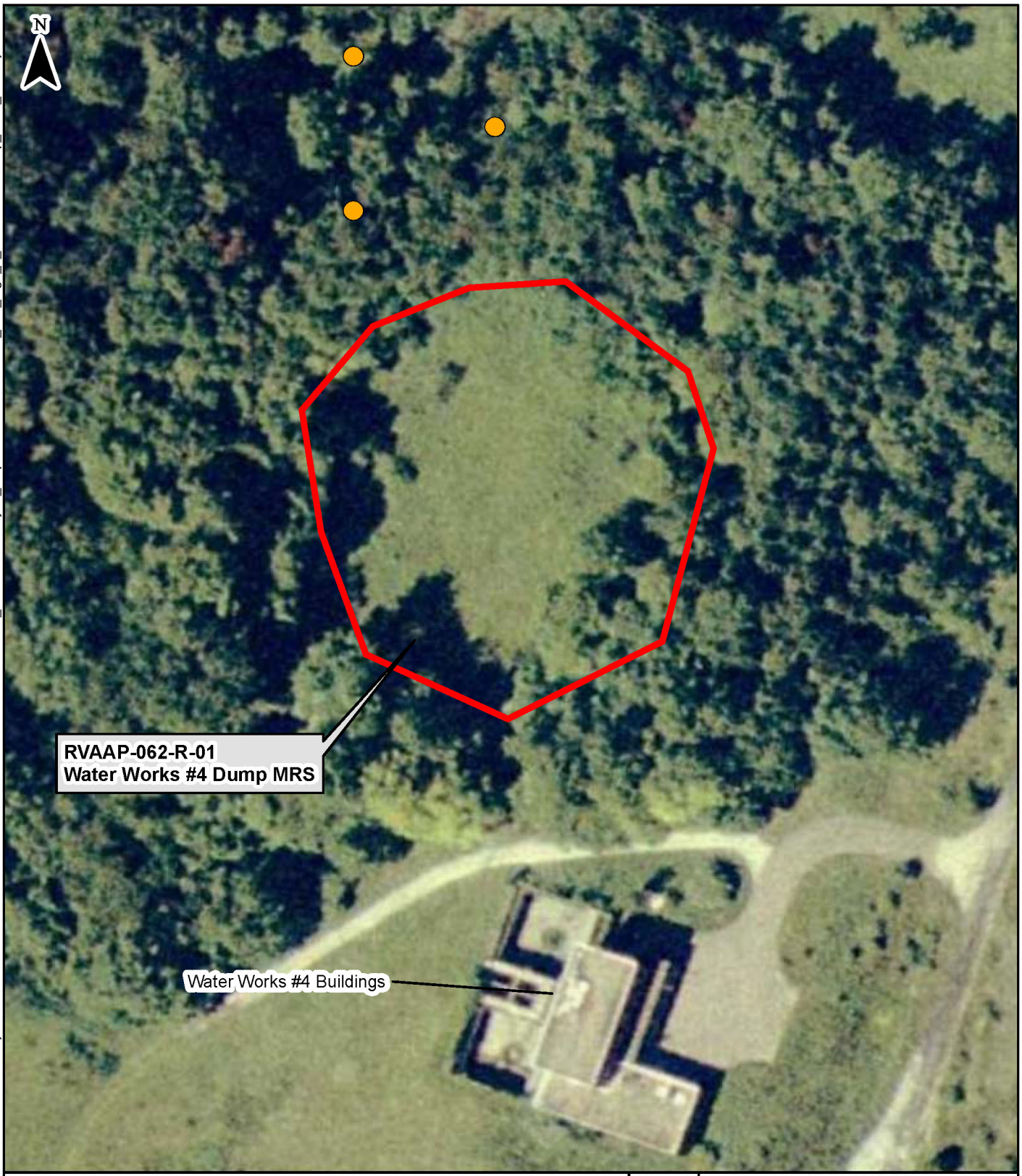
Project Number: 136147



MRS Boundary

MD Items Identified in 2007 Site Inspection Report

0 70 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-9

WATER WORKS #4 DUMP MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

1.6.7 Group 8 MRS (RVAAP-063-R-01)

The 2.65-acre Group 8 MRS consists of the area between Buildings 846 and 849 near the southern Installation boundary. This MRS consists of disturbed land that is not currently being used due to its status as an MRS, though it may have historically been used for burning construction debris and rubbish. In 1996, one anti-personnel fragmentation bomb loaded with HE was found at the MRS. In addition, one demilitarized 175mm projectile was found on the ground surface at the MRS. During the SI field activities, numerous MD items were identified in the MRS. **Figure 1-10** depicts the site layout at the Group 8 MRS.

1.7 Previous Site Investigations

Section 1.8 in the work plan (Shaw, 2011b) briefly summarizes the investigations and actions that have been performed at the RVAAP MRSs to date that include an ASR, HRR and an SI Report (e^2M, 2008). The following subsections summarize the SI investigation activities, conclusions, and recommendations at the seven remaining MRSs included in this work plan addendum. **Table 1-3** provides the SI Report (e^2M, 2008) recommendations of whether or not further characterization of MEC and/or MC is required at an MRS and the basis of those recommendations.

Table 1-3
Site Inspection Report Recommendations for Further Characterization of MEC and MC

MRS Name	Site Inspection Report Recommendation	Basis for Recommendation	
		MEC	MC
Erie Burning Grounds MRS	Further characterization of MEC and MC in wet sediments and surface water and MEC on land.	MEC possibly buried. MEC potentially present in submerged areas.	MC in wet sediments and surface water will require further characterization work. All other media addressed under IRP AOC RVAAP-2.
Fuze and Booster Quarry MRS	Further characterization of MEC at reduced MRS footprint.	MEC potentially buried and present in ponds.	MC in wet sediments will require further characterization work based on IRP sediment results that exhibited elevated metal concentrations. All other media addressed under IRP AOC RVAAP-16.
40mm Firing Range MRS[1]	Further characterization of MEC and MC at reduced MRS footprint.	MEC potentially present	Presence of MC is not fully known.
Sand Creek Dump MRS	Further characterization of MEC.	MEC potentially buried.	MC is covered under the IRP AOC RVAAP-34.

MRS Name	Site Inspection Report Recommendation	Basis for Recommendation	
		MEC	MC
Block D Igloo–TD MRS[1]	Further characterization at revised MRS footprint.	No MEC present.	No MC detected above screening criteria.
Water Works #4 Dump MRS[1]	Further characterization of MEC at reduced MRS footprint.	MEC potentially present in subsurface.	No MC detected above screening criteria.
Group 8 MRS	Further characterization of MEC and MC.	MEC present.	MC detected above screening criteria.

Notes:
AOC = Area of Concern
IRP = Installation Response Program
MC = munitions constituents
MEC = munitions and explosives of concern
MRS = Munitions Response Site
[1]The location, size, and description of the Block D Igloo–TD MRS has been revised to capture the documented debris locations outside the installation boundary to the northeast. These locations were not included in the US Army Closed, Transferring, and Transferred (CTT) Range/Site Inventory and HRR defined MRS footprint, and were not investigated during this SI.

1.7.1 Erie Burning Grounds (RVAAP-002-R-01)

The MMRP SI conducted at this MRS included a meandering path magnetometer and metal-detector assisted MEC survey conducted in the dry portions of Erie Burning Grounds. During the investigation, subsurface anomalies were recorded in the northwest, central, and southwest portions of the MRS. The nature of anomalies was not determined since an intrusive investigation was not performed as part of the SI. One MD item, a 250-pound (lb) bomb, was found partially buried in the south-central portion of the MRS. Based on historical findings and SI field observations made, there is a potential for MEC at the MRS and further characterization is required.

MC sampling was not performed during the SI since chemical contamination in environmental media at the Erie Burning Grounds was addressed under the IRP. The *Final Record of Decision Soil and Dry Sediment at the Erie Burning Grounds* (Science Application and International Corporation [SAIC], 2007) recommended no further action (NFA) for soil and dry sediment at the MRS.

1.7.2 Fuze and Booster Quarry (RVAAP-016-R-01)

The MMRP SI conducted at the Fuze and Booster Quarry included a meandering path magnetometer and metal-detector assisted MEC survey that was conducted on the pond banks and surrounding area. No MEC items were observed at the MRS. However, MD (casing fragments) was found along the southeast portion of the southern pond. In addition, numerous closely spaced subsurface anomalies were detected primarily to the east of the ponds. Since an intrusive investigation was not performed at the Fuze and Booster Quarry, the nature of

MRS Boundary

Former Railroad

0 125

Feet

Projection : NAD_1983_UTM_Zone_17N

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FIGURE NUMBER
1-10

GROUP 8 MRS LAYOUT
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

anomalies remains unknown. The SI Report (e^2M, 2008) stated that RVAAP personnel have reportedly observed munitions items in the northern and southern ponds when water levels are low. Based on historical information and the SI findings, further characterization of subsurface MEC surrounding the ponds as well as within the submerged portions of the ponds is recommended.

MC sampling was not performed during the SI since chemical contamination in environmental media at the Fuze and Booster Quarry MRS is being addressed under the IRP. The SI did not recommend further MC sampling under the MMRP.

1.7.3 40mm Firing Range (RVAAP-032-R-01)

As part of the SI activities at the 40mm Firing Range, meandering path magnetometer and metal detector assisted MEC surveys were completed at the down range target area, overshot area, and firing point and covered approximately 3 acres in total. The RVAAP personnel have reportedly observed MEC items beyond the impact point, on the slope that leads down to the Fuze and Booster Quarry MRS. During the SI field activities, numerous MD items (aluminum 40mm nose caps and casings) were identified approximately 100 feet beyond the impact area. The majority of the items identified were covered by leaves and other forest detritus. No MEC or MD was observed at the firing point or in the area between the firing point and impact area. The SI recommended further characterization of MEC at the MRS.

Soil samples were not collected during the SI because chemical contamination was previously addressed under the IRP. The site was deferred to the MMRP in February 2008. The presence of MC is not fully known at the MRS and the SI Report (e^2M, 2008) recommended further investigation under the MMRP.

It was concluded in the SI Report (e^2M, 2008) that the MRS footprint should be reduced to 0.77 acres that includes the target area and 100 feet beyond where MD items were observed. **Table 1-4** presents the acreage revisions to RVAAP MRSs from the U.S. Army Closed, Transferring, and Transferred (CTT) Range/Site Inventory, and the HRR and SI Report (e^2M, 2008).

Table 1-4
Summary of the Site Inspection Report MRS Boundary Revisions

MRS Name	AEDB-R Site ID	CTT Acreage	HRR Acreage	SI Report Acreage	SI Report Rationale for Revision
Erie Burning Grounds	RVAAP-002-R-01	33.93	33.93	33.93	No revision to MRS footprint or acreage.
Fuze & Booster Quarry	RVAAP-016-R-01	12.74	12.74	4.92	Acreage removed due to lack of MEC concern.

MRS Name	AEDB-R Site ID	CTT Acreage	HRR Acreage	SI Report Acreage	SI Report Rationale for Revision
40mm Firing Range	RVAAP-032-R-01	5.17	5.17	1.27	Acreage removed due to lack of MEC concern.
Sand Creek Dump	RVAAP-034-R-01	0.85	0.85	0.85	No revision to MRS footprint or acreage.
Block D Igloo-TD	RVAAP-061-R-01	19.25	19.25	14.13	Acreage removed due to lack of MEC concern. New areas identified and added to the MRS.
Water Works #4 Dump	RVAAP-062-R-01	6.15	6.15	0.77	Acreage removed due to lack of MEC concern.
Group 8 MRS	RVAAP-063-R-01	2.65	2.65	2.65	No revision to MRS footprint or acreage.

Notes:
CTT = Closed, Transferring, and Transferred
HRR = Historical Records Review
SI = Site Inspection
MRS = Munitions Response Site

1.7.4 Sand Creek Dump (RVAAP-034-R-01)

During the SI field activities, a meandering path magnetometer and metal-detector assisted MEC survey was performed at all open areas of the Sand Creek Dump. Multiple subsurface anomalies were recorded. However, the nature of the anomalies could not be determined since an intrusive investigation was not performed. Although no MEC was identified at the MRS during the SI, one MD item (105mm projectile) was found in Sand Creek adjacent to the most northern portion of the MRS. Based on historical findings and SI field observations made, there is a potential for MEC at the MRS that requires further characterization. Samples for MC were not collected during the SI because chemical contamination is being addressed under the IRP (e^2M, 2008).

In 2010, Shaw completed a DGM survey at the Sand Creek IRP AOC and has documented the investigation findings in a *Final Digital Geophysical Mapping Report* (Shaw, 2011a). The AOC and MRS boundaries are primarily collocated; however, the MRS boundary extends an additional 150 feet north of the AOC boundaries where the 105mm projectile was found in the Sand Creek. This portion of the MRS (approximately 0.13 acres) was not surveyed during the 2010 DGM investigation.

The DGM survey was conducted over the steep slopes of the AOC as well the low floodplain areas and upgradient locations adjacent to the MRS at the top of slope where dump activities most likely occurred. In all, approximately 3 acres were investigated using DGM. Shaw used a Geonics EM61-MK2A electromagnetic induction detector (EM61) to detect shallow ferrous and nonferrous metals, and a Geometrics G858G cesium vapor magnetometer (G-858G) to detect

ferrous metals. The EM61 and G858G survey data indicate that the largest portion of the metal debris at the AOC is present northeast of the site access road in the oval shaped area that is approximately 0.8 acres in size. **Figure 1-11** presents the results of the 2010 DGM investigation at the Sand Creek AOC.

1.7.5 Block D Igloo-TD (RVAAP-061-R-01)

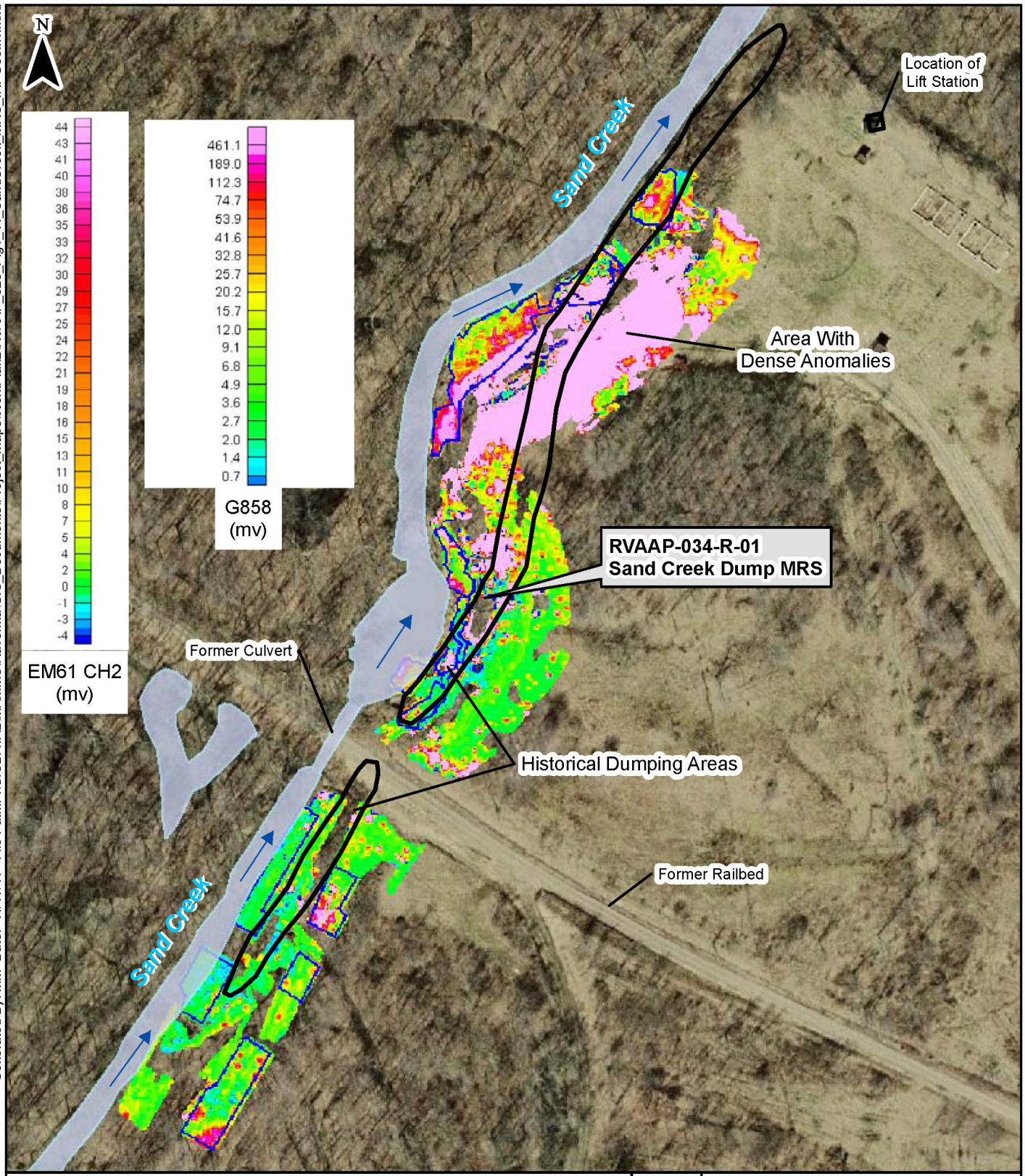
As part of the SI, a meandering path magnetometer assisted MEC survey was performed in the off-site areas surrounding the former igloo as well as four residential areas where debris was reportedly found after the explosion. The MRS area outside the Installation boundaries was 19.25 acres. No evidence of MEC/MD was observed during the SI.

During the SI, no samples were collected within the current MRS boundary. However, two samples were collected in areas where MC contamination may have been a result of the 1943 explosion. The samples were analyzed for Target Analyte List (TAL) metals and explosives. Lead was detected at a concentration of 41.9 milligrams per kilogram (mg/kg) that exceeded background (26.1 mg/kg) and one-tenth the noncarcinogenic United States Environmental Protection Agency (USEPA) Preliminary Remediation Goals (PRGs) of 400 mg/kg. The PRGs were the screening criteria used for the SI Report (e^2M, 2008). However, the lead impacts were considered anthropogenic due to the adjacent roadway and were not considered to be MC.

At the conclusion of the SI, the 19.25-acre area located outside of the Installation was removed as the MRS and two new off-post areas were identified where MEC/MD may be present as a result of the accidental explosion at Igloo 7-D-15. These new areas, which are locations where concrete fragments were identified after the explosion, were not investigated during the SI. Therefore, the MRS footprint was revised to include these new locations, sizes, and shapes. The MRS is composed of two separate areas (Area 1 and Area 2) located outside the Installation boundary to the northeast of Igloo 7-D-15. Area 1 consists of privately owned agricultural land that includes approximately 12 acres. Area 2 is a densely wooded area encompassing 2.131 acres. The total combined acreage of the MRS is 14.131 acres.

1.7.6 Water Works #4 Dump (RVAAP-062-R-01)

A magnetometer-assisted MEC survey was conducted during the SI field activities at the Water Works #4 Dump MRS. Approximately twenty 155mm shrapnel ogives were scattered throughout the wooded area to the north of the current MRS boundary. Multiple subsurface anomalies were documented in the open field area, located at the current MRS boundary. Since an intrusive investigation was not performed, the nature of anomalies at Water Works #4 Dump remains unknown.



MRS Boundary

Stream

Direction of Flow

mv = millivolts

0 150

Feet

Projection : NAD_1983_UTM_Zone_17N

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 1-11

SAND CREEK DUMP IRP GEOPHYSICAL INVESTIGATION MAPPING RESULTS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

Shaw a world of Solutions

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Project Number: 136147

A single composite soil sample was collected from the MRS and analyzed for explosives, propellants, and TAL metals. No explosives, propellants, or MEC metals were detected in the sample.

Further MEC characterization was recommended at Water Works #4 Dump based on the results of the MC data collected during the SI field work. The SI Report (e^2M, 2008) concluded that the MRS footprint be reduced to the 0.77 acres of open field where subsurface anomalies were detected (**Table 1-3**). The remaining portion of the MRS was removed since there was no MEC identified and no evidence of a burial area was observed.

1.7.7 Group 8 MRS (RVAAP-063-R-01)

A magnetometer and metal detector assisted visual survey was performed during the SI field work to assess the presence of MEC/MD at the Group 8 MRS. Two unidentifiable T-bar fuzes were identified in the western portion of the MRS. In addition, large amounts of debris, consisting of MD, metal, trash, fencing materials, and wood scraps, were identified in portions of the MRS. Five incremental sample (IS) locations were collected and analyzed for metals and explosives. Lead, thallium, antimony, arsenic, aluminum, cadmium, copper, iron, and manganese were detected in at least one sample above background and one-tenth the noncarcinogenic USEPA PRGs. The SI Report (e^2M, 2008) recommended further characterization at this MRS to address MEC and MC concerns.

1.8 Initial Summary of Risk from Munitions and Explosives of Concern

There are several documented findings of MEC at RVAAP. Historical documentation indicated conventional munitions were used at RVAAP, including small arms, explosives, pyrotechnics, propellants, mortars, medium and large caliber munitions, landmines, hand grenades, flares, bombs, detonators, or fuzes. During the visual surveys at RVAAP, the SI field team identified several MD items (250-lb bomb, caps and casings [40mm rounds], 105mm projectile, 155mm projectile, casing and projectile fragments, burster tubes, and fuze fragments). Two MEC items (unidentifiable T-bar fuzes) were identified at the Group 8 MRS during the SI. Based on the historical information and SI observations, MEC and MD remain at the Installation.

Human receptors have been identified for potential MEC and MC exposure at the RVAAP. These receptors include the Residential Farmer (adult and child) and the National Guard land users (Trainee, Dust/Fire Control Worker, Security Guard/Maintenance Worker, Range Maintenance Soldier, and/or Engineering School Instructor).

The Munitions Response Site Prioritization Protocol (MRSPP) ranking applies to all seven MRSs and an evaluation was performed in the SI Report (e^2M, 2008). The Explosive Hazard Evaluation (EHE) factors include the details of the hazard, accessibility to the MRSs, and receptor information. The Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)

evaluated the history of CWM use at the individual MRSs. The Health Hazard Evaluation (HHE) included an evaluation of MC and any non-munitions-related incidental contaminants present, receptor information, and details pertaining to environmental migration pathways. Each MRS's priority was then determined by comparing the EHE, CHE, and HHE ratings. The MRSPP priority can range from 1 to 8, with 1 indicating the highest potential hazard and 8 indicating the lowest potential hazard. These MRSPP scores are then used to help sequence future MRS response actions. The MRSPP performed in the SI Report (e^2M, 2008) resulted in an overall MRS Priority between 3 and 6 for the seven MRSs in this work plan addendum based on the three hazard evaluation modules. **Table 1-5** summarizes the MRSPP ranking process performed for each of the MRSs in the SI Report (e^2M, 2008).

Table 1-5
Summary of the Site Inspection Report Munitions Response Site Prioritization Protocol

MRS Name	EHE Module Rating	CHE Module Rating	HHE Module Rating	Overall Priority Rating
Erie Burning Ground	3	No Known or Suspected CWM Hazard	5	3
Fuze & Booster Quarry	5	No Known or Suspected CWM Hazard	No Longer Required[1]	5
40mm Firing Range	5	No Known or Suspected CWM Hazard	No Known or Suspected MC Hazard	5
Sand Creek Dump	4	No Known or Suspected CWM Hazard	No Longer Required[1]	4
Block D Igloo-TD	4	No Known or Suspected CWM Hazard	8	4
Water Works #4 Dump	6	No Known or Suspected Hazard	8	6
Group 8 MRS	4	No Known or Suspected Hazard	4	4

Notes:
CHE = Chemical Warfare Materiel Hazard Evaluation
CWM = Chemical Warfare Materiel
EHE = Explosive Hazard Evaluation
HHE = Health Hazard Evaluation
[1] The Fuze & Booster Quarry and Sand Creek Dump MRSs received a HHE Module Rating "No Longer Required "in the SI Report (e^2M, 2008) because they are covered under the IRP. However, additional investigation under the RI has been evaluated for these MRSs and the proposed investigation strategies are presented in Section 3.0 of this work plan addendum.

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2.0 Technical Management Plan

2.1 Project Objectives

The overall objective of this task order is to conduct an RI for seven MRSs at RVAAP covered in this work plan addendum. The RI will accomplish the following objectives:

- Determine the nature and extent of MEC.
- Determine the nature and extent of MC.
- Determine the risk posed to human health and the environment by MEC and MC.
- Collect or develop additional data for the FS, as appropriate, to determine remediation alternatives, including evaluation of no action.

The results of the RI will provide additional information to determine whether two of the MRSs, Sand Creek Dump (RVAAP-034-R-01) and Water Works #4 Dump (RVAAP-062-R-01), which are required to achieve RIP, will warrant further response action pursuant to CERCLA and the NCP.

2.2 Project Organization

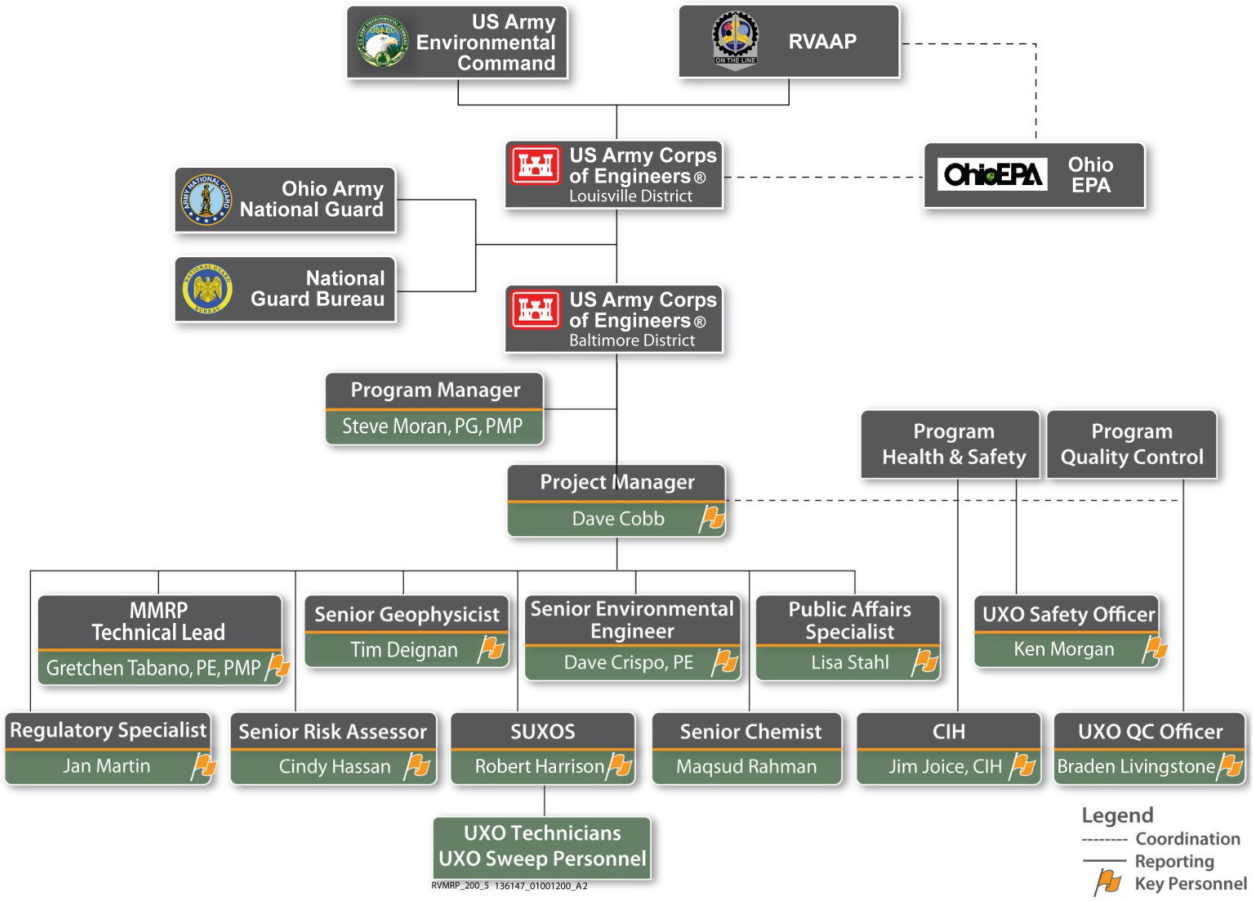
Safety responsibilities, accountability, and lines of authority are discussed in the *Accident Prevention Plan* (APP) *Addendum* provided under separate cover. The Shaw Project Manager (PM), Field Team Leader, Senior Unexploded Ordnance Supervisor (SUXOS), Unexploded Ordnance Safety Officer (UXOSO), and the Health and Safety Manager (HSM) are responsible for formulating and enforcing health and safety requirements and implementing the *Site Safety and Health Plan* (SSHP) *Addendum*. **Figure 2-1** presents the project organizational chart for the work to be performed at RVAAP by Shaw under the MMRP.

2.3 Project Personnel

The following positions are identified as key personnel for this project:

- **Project (Task Order) Manager:** Dave Cobb
- **Senior UXO Supervisor:** Robert Harrison
- **UXO Safety Officer:** Ken Morgan
- **UXO Quality Control (QC) Specialist:** Braden Livingstone
- **Senior Geophysicist:** Tim Deignan, Professional Geophysicist (PGP)
- **Senior Environmental Engineer:** David Crispo, Professional Engineer (PE)
- **Certified Industrial Hygienist:** James Joice, Certified Industrial Hygienist (CIH) , Certified Safety Professional (CSP), Certified Hazardous Materials Manager (CHMM)

Figure 2-1
RVAAP Organizational Chart



- **Regulatory Specialist:** Jan Martin
- **Senior Chemist:** Maqsud Rahman
- **Senior Risk Assessor:** Cindy Hassan
- **Senior Geologist:** Bill Foss, Professional Geologist (PG)
- **Public Affairs Specialist:** Lisa Stahl

Job descriptions for each of the personnel identified are presented in Section 2.3 of the work plan. The USACE PM and Ohio EPA will be notified in advance of changes in key personnel.

2.4 Project Communications and Reporting

All communication to stakeholders and regulators will be coordinated with USACE. Shaw will keep a record of phone conversations and written correspondence affecting decisions relating to the performance of the RI activities. Shaw will prepare and submit minutes of all significant meetings attended. Status reports will be submitted according to Section 2.7.

2.5 Project Deliverables

All project submittals will be submitted in accordance with the most recent version of the *RVAAP Submission Format Guidelines, Version 18.0* (Vista, 2009). At a minimum each report shall be issued in preliminary draft, draft, and final versions. The preliminary draft is typically for Army review and comment only. Following Army approval of the preliminary draft version, the draft versions will then be submitted for regulatory (Ohio EPA) review and comment. The final version will be submitted to all the stakeholders and is accessible for public viewing following approval of the draft version by the Ohio EPA. The draft versions of all project deliverables are available for public viewing as well. All final major submittals will be submitted in both hard copy and electronic format. The electronic copy will be a compact disc (CD) or digital versatile disc (DVD) that includes the report and all data and maps produced.

Project deliverables will consist of the following documents:

- RI work plan addendum, and
- RI Report.

In addition, for the MRSs where RIP is the performance goal, the following deliverables will be created:

- FS Report
- Proposed Plan
- Record of Decision

- RD/RA Work Planning Documents (if necessary)
- Remedial Action Reports (if necessary)

2.6 Project Schedule

An overall project schedule is provided in the work plan as **Figure 2-2**.

2.7 Periodic Reporting

2.7.1 Monthly Progress Reports

Shaw will provide monthly progress reports. The monthly report will provide summarized cost and performance information, including percent complete for program management purposes. In addition, a monthly conference call, to include any interested stakeholders, may be arranged to update project status.

2.7.2 Field Status Reports

Shaw will prepare and submit weekly status reports during field activities to document field activities completed and planned. The report will be delivered electronically via e-mail or posted to a project website.

2.8 Costing and Billing

Shaw will submit invoices based on achievement of milestones in accordance with the terms and conditions of this PBA.

2.9 Project Public Relations Support

Shaw will not make available or publicly disclose any project data or reports generated or reviewed under this contract unless specifically authorized by USACE and the RVAAP. Shaw will support USACE, RVAAP and the Ohio EPA with managing public affairs related to all RI activities. The support will include preparation of a community relations plan that relates to MMRP activities at RVAAP and Shaw will provide information for public meetings, fact sheets, etc. on an as needed basis.

2.10 Subcontractor Management

Each subcontractor working on the Installation for Shaw under the MMRP will be required to adhere to the APP and SSHP addendums, and will be subject to the same training and medical surveillance requirements as Shaw personnel depending on job activity. All activities involving the potential for exposure to hazardous waste materials will require medical and training certification as mandated by 29 CFR 1910.120 and 1926.65.

2.11 Management of Field Operations

Fieldwork will be coordinated within the Shaw Stoughton office. Field teams may be composed of Shaw staff from throughout the United States (e.g., UXO Technicians, geophysicists, etc.). Such resources, as well as any necessary subcontractor support, will be managed by the PM and/or Field Team Leader (SUXOS). The Field Team Leader will be responsible for identifying appropriate field staff through local office managers and will confirm that proposed project personnel have the necessary experience and required training for the project.

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Shaw - MAMMS - Ravenna

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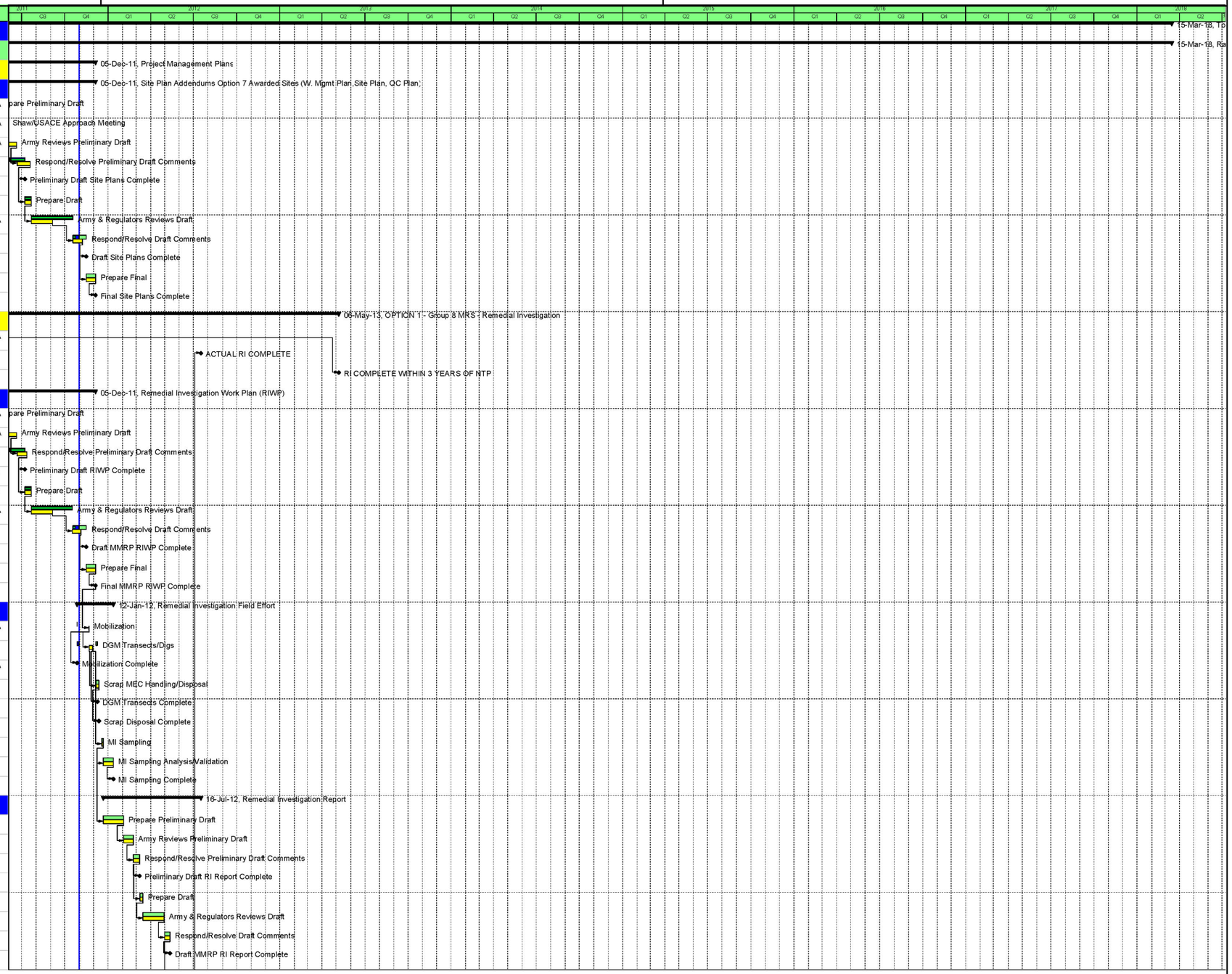
Activity Name	Original Duration	Start	Finish
Total	1974	30-Apr-10 A	15-Mar-18
Ravenna - MAMMS - Current	1974	30-Apr-10 A	15-Mar-18
Project Management Plans	340	02-Aug-10 A	05-Dec-11
Site Plan Addendums Option 7 Awarded Sites (W. Mgmt Plan,Site Plan, QC Plan)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	30	02-Aug-10 A	29-Apr-11 A
Shaw/USACE Approach Meeting	1	10-Jan-11 A	10-Jan-11 A
Army Reviews Preliminary Draft	20	30-Apr-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	20	06-Jun-11 A	07-Jul-11 A
Preliminary Draft Site Plans Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft Site Plans Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final Site Plans Complete	0		05-Dec-11
OPTION 1 - Group 8 MRS - Remedial Investigation	742	30-Apr-10 A	06-May-13
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL RI COMPLETE	0		16-Jul-12
RI COMPLETE WITHIN 3 YEARS OF NTP	0		06-May-13
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	0	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	35	27-Oct-11 A	12-Jan-12
Mobilization	1	27-Oct-11 A	27-Oct-11 A
DGM Transects/Digs	4	27-Oct-11 A	09-Dec-11
Mobilization Complete	0		27-Oct-11 A
Scrap MEC Handling/Disposal	5	06-Dec-11	12-Dec-11
DGM Transects Complete	0		09-Dec-11
Scrap Disposal Complete	0		12-Dec-11
MI Sampling	3	19-Dec-11	21-Dec-11
MI Sampling Analysis/Validation	14	22-Dec-11	12-Jan-12
MI Sampling Complete	0		12-Jan-12
Remedial Investigation Report	144	22-Dec-11	16-Jul-12
Prepare Preliminary Draft	30	22-Dec-11	03-Feb-12
Army Reviews Preliminary Draft	20	03-Feb-12	23-Feb-12
Respond/Resolve Preliminary Draft Comments	10	24-Feb-12	08-Mar-12
Preliminary Draft RI Report Complete	0		08-Mar-12
Prepare Draft	5	09-Mar-12	15-Mar-12
Army & Regulators Reviews Draft	45	15-Mar-12	29-Apr-12
Respond/Resolve Draft Comments	10	30-Apr-12	11-May-12
Draft MMRP RI Report Complete	0		11-May-12



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary

Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

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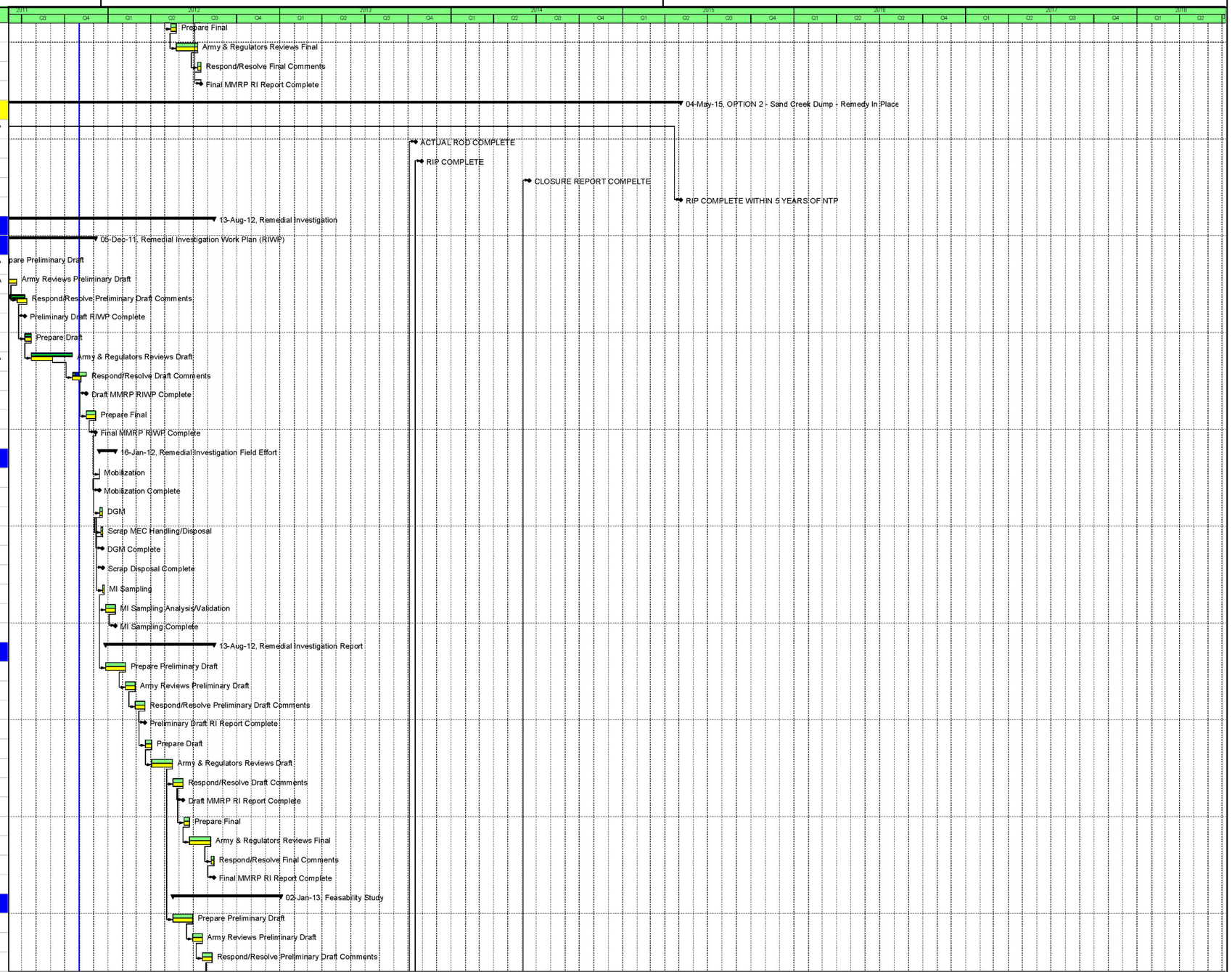
Activity Name	Original Duration	Start	Finish
Prepare Final	10	14-May-12	25-May-12
Army & Regulators Reviews Final	45	25-May-12	09-Jul-12
Respond/Resolve Final Comments	5	10-Jul-12	16-Jul-12
Final MMRP RI Report Complete	0		16-Jul-12
OPTION 2 - Sand Creek Dump - Remedy In Place	1248	30-Apr-10 A	04-May-15
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL ROD COMPLETE	0		17-Oct-13
RIP COMPLETE	0		29-Oct-13
CLOSURE REPORT COMPELTE	0		16-Jun-14
RIP COMPLETE WITHIN 5 YEARS OF NTP	0		04-May-15
Remedial Investigation	516	02-Aug-10 A	13-Aug-12
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	0	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	23	13-Dec-11	16-Jan-12
Mobilization	1	13-Dec-11*	13-Dec-11
Mobilization Complete	0		13-Dec-11
DGM	4	14-Dec-11	19-Dec-11
Scrap MEC Handling/Disposal	3	16-Dec-11	20-Dec-11
DGM Complete	0		19-Dec-11
Scrap Disposal Complete	0		20-Dec-11
MI Sampling	3	21-Dec-11	23-Dec-11
MI Sampling Analysis/Validation	14	27-Dec-11	16-Jan-12
MI Sampling Complete	0		16-Jan-12
Remedial Investigation Report	162	27-Dec-11	13-Aug-12
Prepare Preliminary Draft	30	27-Dec-11	07-Feb-12
Army Reviews Preliminary Draft	20	07-Feb-12	27-Feb-12
Respond/Resolve Preliminary Draft Comments	15	28-Feb-12	19-Mar-12
Preliminary Draft RI Report Complete	0		19-Mar-12
Prepare Draft	10	20-Mar-12	02-Apr-12
Army & Regulators Reviews Draft	45	02-Apr-12	17-May-12
Respond/Resolve Draft Comments	15	18-May-12	08-Jun-12
Draft MMRP RI Report Complete	0		08-Jun-12
Prepare Final	10	11-Jun-12	22-Jun-12
Army & Regulators Reviews Final	45	22-Jun-12	06-Aug-12
Respond/Resolve Final Comments	5	07-Aug-12	13-Aug-12
Final MMRP RI Report Complete	0		13-Aug-12
Feasability Study	157	18-May-12	02-Jan-13
Prepare Preliminary Draft	30	18-May-12	29-Jun-12
Army Reviews Preliminary Draft	20	29-Jun-12	19-Jul-12
Respond/Resolve Preliminary Draft Comments	15	20-Jul-12	09-Aug-12



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary

Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

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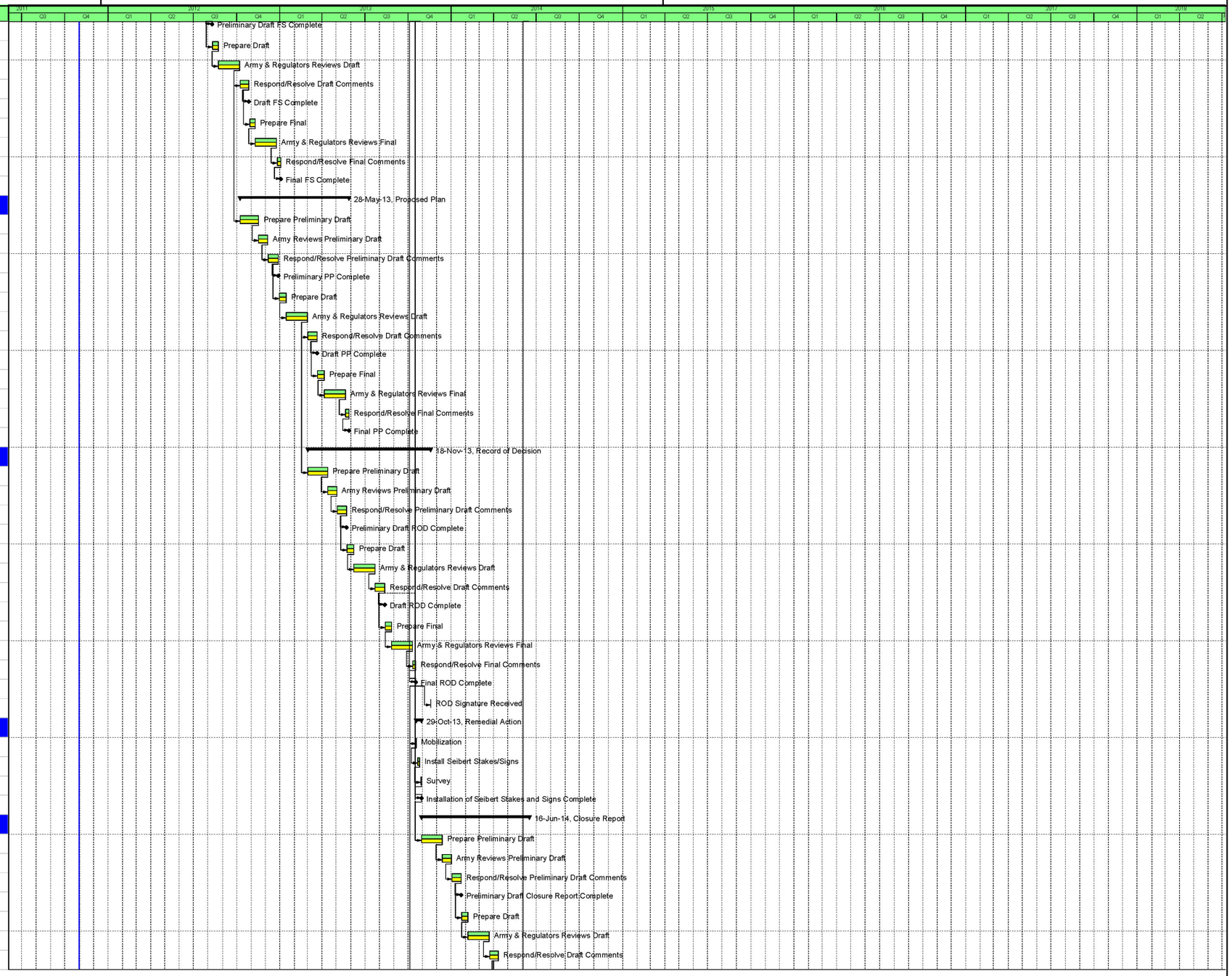
Activity Name	Original Duration	Start	Finish
Preliminary Draft FS Complete	0		09-Aug-12
Prepare Draft	10	10-Aug-12	23-Aug-12
Army & Regulators Reviews Draft	45	23-Aug-12	07-Oct-12
Respond/Resolve Draft Comments	15	08-Oct-12	26-Oct-12
Draft FS Complete	0		26-Oct-12
Prepare Final	10	29-Oct-12	09-Nov-12
Army & Regulators Reviews Final	45	09-Nov-12	24-Dec-12
Respond/Resolve Final Comments	5	26-Dec-12	02-Jan-13
Final FS Complete	0		02-Jan-13
Proposed Plan	161	08-Oct-12	28-May-13
Prepare Preliminary Draft	30	08-Oct-12	16-Nov-12
Army Reviews Preliminary Draft	20	16-Nov-12	06-Dec-12
Respond/Resolve Preliminary Draft Comments	15	07-Dec-12	28-Dec-12
Preliminary PP Complete	0		28-Dec-12
Prepare Draft	10	31-Dec-12	14-Jan-13
Army & Regulators Reviews Draft	45	14-Jan-13	28-Feb-13
Respond/Resolve Draft Comments	15	01-Mar-13	21-Mar-13
Draft PP Complete	0		21-Mar-13
Prepare Final	10	22-Mar-13	05-Apr-13
Army & Regulators Reviews Final	45	05-Apr-13	20-May-13
Respond/Resolve Final Comments	5	21-May-13	28-May-13
Final PP Complete	0		28-May-13
Record of Decision	183	01-Mar-13	18-Nov-13
Prepare Preliminary Draft	30	01-Mar-13	12-Apr-13
Army Reviews Preliminary Draft	20	12-Apr-13	02-May-13
Respond/Resolve Preliminary Draft Comments	15	03-May-13	23-May-13
Preliminary Draft ROD Complete	0		23-May-13
Prepare Draft	10	24-May-13	07-Jun-13
Army & Regulators Reviews Draft	45	07-Jun-13	22-Jul-13
Respond/Resolve Draft Comments	15	23-Jul-13	12-Aug-13
Draft ROD Complete	0		12-Aug-13
Prepare Final	10	13-Aug-13	26-Aug-13
Army & Regulators Reviews Final	45	26-Aug-13	10-Oct-13
Respond/Resolve Final Comments	5	11-Oct-13	17-Oct-13
Final ROD Complete	0		17-Oct-13
ROD Signature Received	1	18-Nov-13	18-Nov-13
Remedial Action	8	18-Oct-13	29-Oct-13
Mobilization	1	18-Oct-13	18-Oct-13
Install Seibert Stakes/Signs	5	21-Oct-13	25-Oct-13
Survey	2	28-Oct-13	29-Oct-13
Installation of Seibert Stakes and Signs Complete	0		29-Oct-13
Closure Report	159	30-Oct-13	16-Jun-14
Prepare Preliminary Draft	30	30-Oct-13	12-Dec-13
Army Reviews Preliminary Draft	20	12-Dec-13	01-Jan-14
Respond/Resolve Preliminary Draft Comments	15	02-Jan-14	22-Jan-14
Preliminary Draft Closure Report Complete	0		22-Jan-14
Prepare Draft	10	23-Jan-14	05-Feb-14
Army & Regulators Reviews Draft	45	05-Feb-14	22-Mar-14
Respond/Resolve Draft Comments	15	24-Mar-14	11-Apr-14



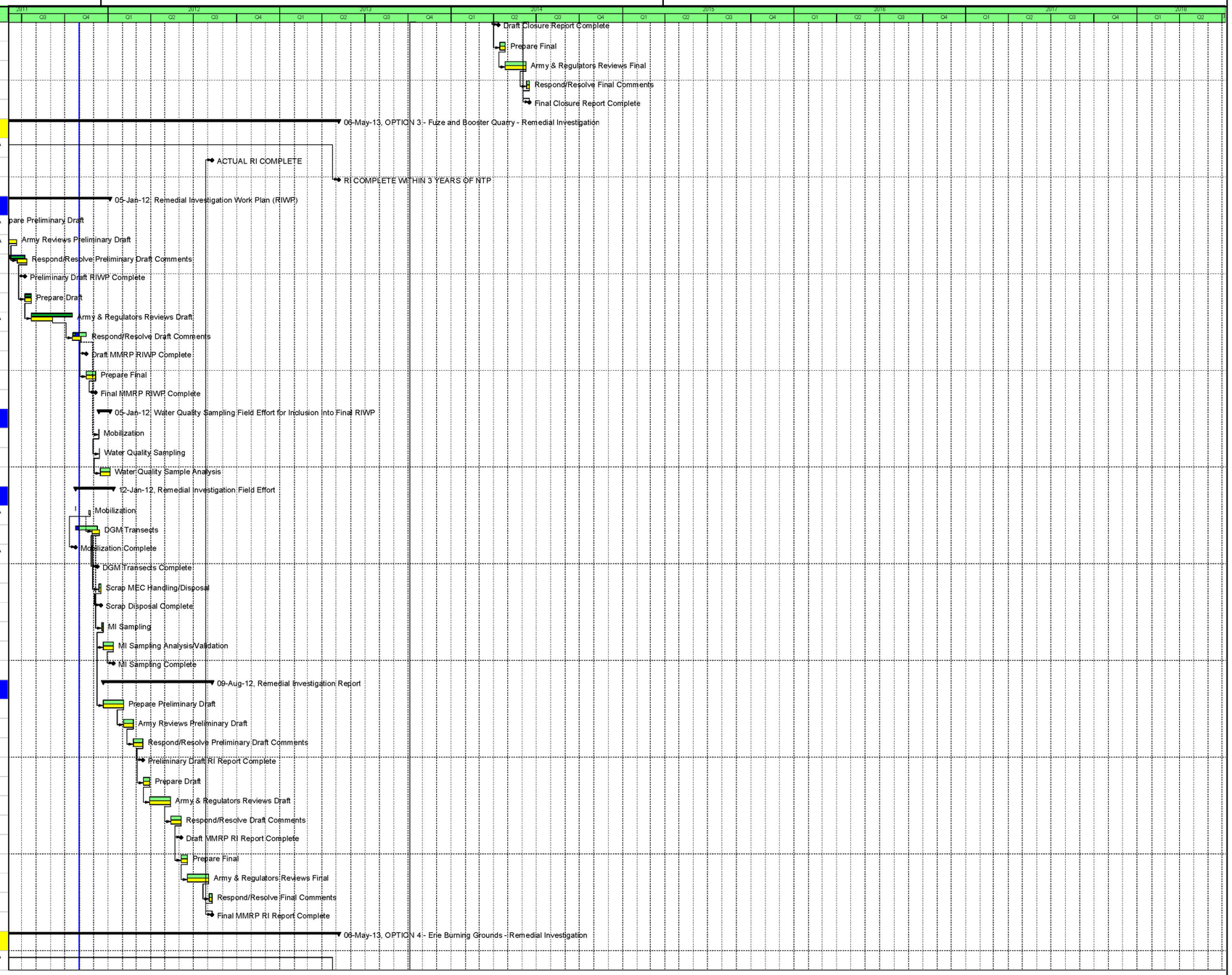
Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary

Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

06-Dec-11 11:47

Activity Name	Original Duration	Start	Finish
Draft Closure Report Complete	0		11-Apr-14
Prepare Final	10	14-Apr-14	25-Apr-14
Army & Regulators Reviews Final	45	25-Apr-14	09-Jun-14
Respond/Resolve Final Comments	5	10-Jun-14	16-Jun-14
Final Closure Report Complete	0		16-Jun-14
OPTION 3 - Fuze and Booster Quarry - Remedial Investigation	742	30-Apr-10 A	06-May-13
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL RI COMPLETE	0		09-Aug-12
RI COMPLETE WITHIN 3 YEARS OF NTP	0		06-May-13
Remedial Investigation Work Plan (RIWP)	361	02-Aug-10 A	05-Jan-12
Prepare Preliminary Draft	0	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Water Quality Sampling Field Effort for Inclusion Into Final RIWP	17	12-Dec-11	05-Jan-12
Mobilization	1	12-Dec-11*	12-Dec-11
Water Quality Sampling	1	13-Dec-11	13-Dec-11
Water Quality Sample Analysis	14	15-Dec-11	05-Jan-12
Remedial Investigation Field Effort	35	24-Oct-11 A	12-Jan-12
Mobilization	3	24-Oct-11 A	24-Oct-11 A
DGM Transects	12	24-Oct-11 A	09-Dec-11*
Mobilization Complete	0		24-Oct-11 A
DGM Transects Complete	0		09-Dec-11
Scrap MEC Handling/Disposal	5	12-Dec-11*	16-Dec-11
Scrap Disposal Complete	0		16-Dec-11
MI Sampling	3	19-Dec-11	21-Dec-11
MI Sampling Analysis/Validation	14	22-Dec-11	12-Jan-12
MI Sampling Complete	0		12-Jan-12
Remedial Investigation Report	162	22-Dec-11	09-Aug-12
Prepare Preliminary Draft	30	22-Dec-11	03-Feb-12
Army Reviews Preliminary Draft	20	03-Feb-12	23-Feb-12
Respond/Resolve Preliminary Draft Comments	15	24-Feb-12	15-Mar-12
Preliminary Draft RI Report Complete	0		15-Mar-12
Prepare Draft	10	16-Mar-12	29-Mar-12
Army & Regulators Reviews Draft	45	29-Mar-12	13-May-12
Respond/Resolve Draft Comments	15	14-May-12	04-Jun-12
Draft MMRP RI Report Complete	0		04-Jun-12
Prepare Final	10	05-Jun-12	18-Jun-12
Army & Regulators Reviews Final	45	18-Jun-12	02-Aug-12
Respond/Resolve Final Comments	5	03-Aug-12	09-Aug-12
Final MMRP RI Report Complete	0		09-Aug-12
OPTION 4 - Erie Burning Grounds - Remedial Investigation	742	30-Apr-10 A	06-May-13
ANTICIPATED NTP	0		30-Apr-10 A

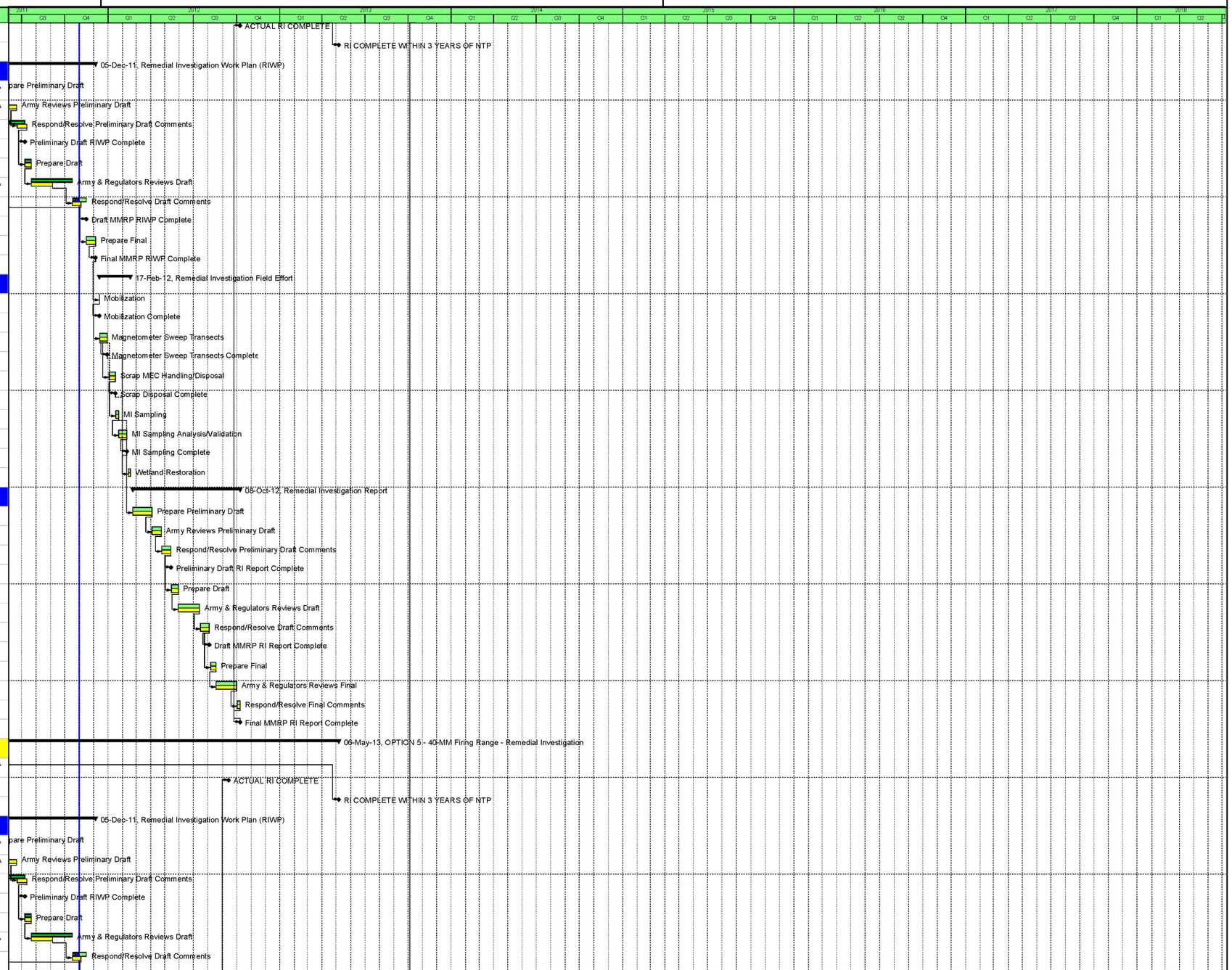


Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary
Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

06-Dec-11 11:48

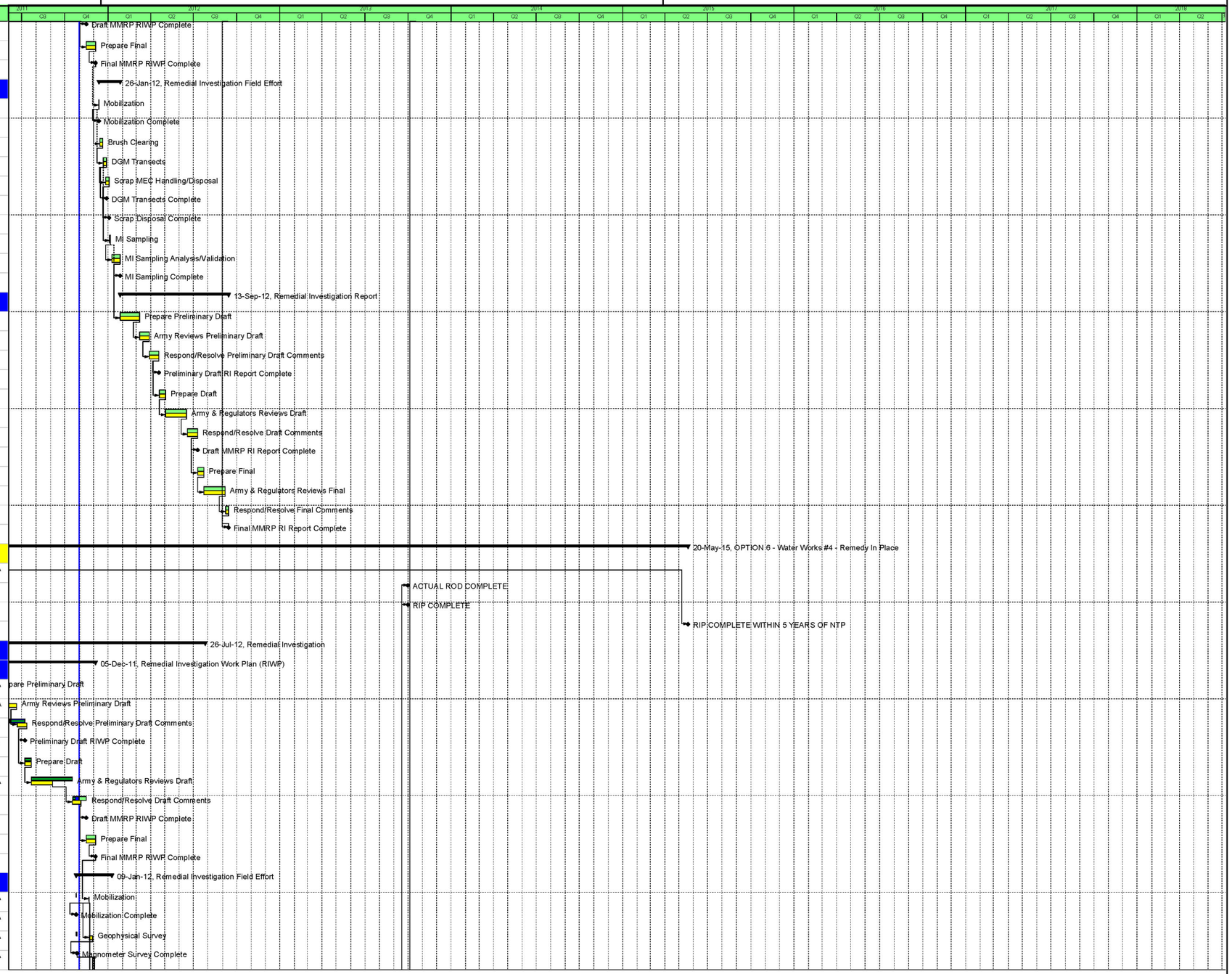
Activity Name	Original Duration	Start	Finish
ACTUAL RI COMPLETE	0		08-Oct-12
RI COMPLETE WITHIN 3 YEARS OF NTP	0		06-May-13
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	0	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	47	13-Dec-11	17-Feb-12
Mobilization	1	13-Dec-11*	13-Dec-11
Mobilization Complete	0		13-Dec-11
Magnetometer Sweep Transects	12	14-Dec-11	30-Dec-11
Magnetometer Sweep Transects Complete	0		30-Dec-11
Scrap MEC Handling/Disposal	10	03-Jan-12	16-Jan-12
Scrap Disposal Complete	0		16-Jan-12
MI Sampling	5	17-Jan-12	23-Jan-12
MI Sampling Analysis/Validation	14	24-Jan-12	10-Feb-12
MI Sampling Complete	0		10-Feb-12
Wetland Restoration	5	13-Feb-12	17-Feb-12
Remedial Investigation Report	161	22-Feb-12	08-Oct-12
Prepare Preliminary Draft	30	22-Feb-12	03-Apr-12
Army Reviews Preliminary Draft	20	03-Apr-12	23-Apr-12
Respond/Resolve Preliminary Draft Comments	15	24-Apr-12	14-May-12
Preliminary Draft RI Report Complete	0		14-May-12
Prepare Draft	10	15-May-12	29-May-12
Army & Regulators Reviews Draft	45	29-May-12	13-Jul-12
Respond/Resolve Draft Comments	15	16-Jul-12	03-Aug-12
Draft MMRP RI Report Complete	0		03-Aug-12
Prepare Final	10	06-Aug-12	17-Aug-12
Army & Regulators Reviews Final	45	17-Aug-12	01-Oct-12
Respond/Resolve Final Comments	5	02-Oct-12	08-Oct-12
Final MMRP RI Report Complete	0		08-Oct-12
OPTION 5 - 40-MM Firing Range - Remedial Investigation	742	30-Apr-10 A	06-May-13
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL RI COMPLETE	0		13-Sep-12
RI COMPLETE WITHIN 3 YEARS OF NTP	0		06-May-13
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	0	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	03-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary
Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

Activity Name	Original Duration	Start	Finish
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	32	12-Dec-11	26-Jan-12
Mobilization	1	12-Dec-11*	12-Dec-11
Mobilization Complete	0		12-Dec-11
Brush Clearing	5	14-Dec-11	20-Dec-11
DGM Transects	5	22-Dec-11	29-Dec-11
Scrap MEC Handling/Disposal	5	27-Dec-11	03-Jan-12
DGM Transects Complete	0		29-Dec-11
Scrap Disposal Complete	0		03-Jan-12
MI Sampling	3	04-Jan-12	06-Jan-12
MI Sampling Analysis/Validation	14	09-Jan-12	26-Jan-12
MI Sampling Complete	0		26-Jan-12
Remedial Investigation Report	162	27-Jan-12	13-Sep-12
Prepare Preliminary Draft	30	27-Jan-12	08-Mar-12
Army Reviews Preliminary Draft	20	08-Mar-12	28-Mar-12
Respond/Resolve Preliminary Draft Comments	15	29-Mar-12	18-Apr-12
Preliminary Draft RI Report Complete	0		18-Apr-12
Prepare Draft	10	19-Apr-12	02-May-12
Army & Regulators Reviews Draft	45	02-May-12	16-Jun-12
Respond/Resolve Draft Comments	15	18-Jun-12	09-Jul-12
Draft MMRP RI Report Complete	0		09-Jul-12
Prepare Final	10	10-Jul-12	23-Jul-12
Army & Regulators Reviews Final	45	23-Jul-12	06-Sep-12
Respond/Resolve Final Comments	5	07-Sep-12	13-Sep-12
Final MMRP RI Report Complete	0		13-Sep-12
OPTION 6 - Water Works #4 - Remedy In Place	1218	30-Apr-10 A	20-May-15
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL ROD COMPLETE	0		30-Sep-13
RIP COMPLETE	0		30-Sep-13
RIP COMPLETE WITHIN 5 YEARS OF NTP	0		20-May-15
Remedial Investigation	504	02-Aug-10 A	26-Jul-12
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	20	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	17-Oct-11 A
Respond/Resolve Draft Comments	15	18-Oct-11 A	15-Nov-11
Draft MMRP RIWP Complete	0		15-Nov-11
Prepare Final	12	16-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	32	25-Oct-11 A	09-Jan-12
Mobilization	1	25-Oct-11 A	25-Oct-11 A
Mobilization Complete	0		25-Oct-11 A
Geophysical Survey	4	25-Oct-11 A	27-Oct-11 A
Magnometer Survey Complete	0		27-Oct-11 A



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary
Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

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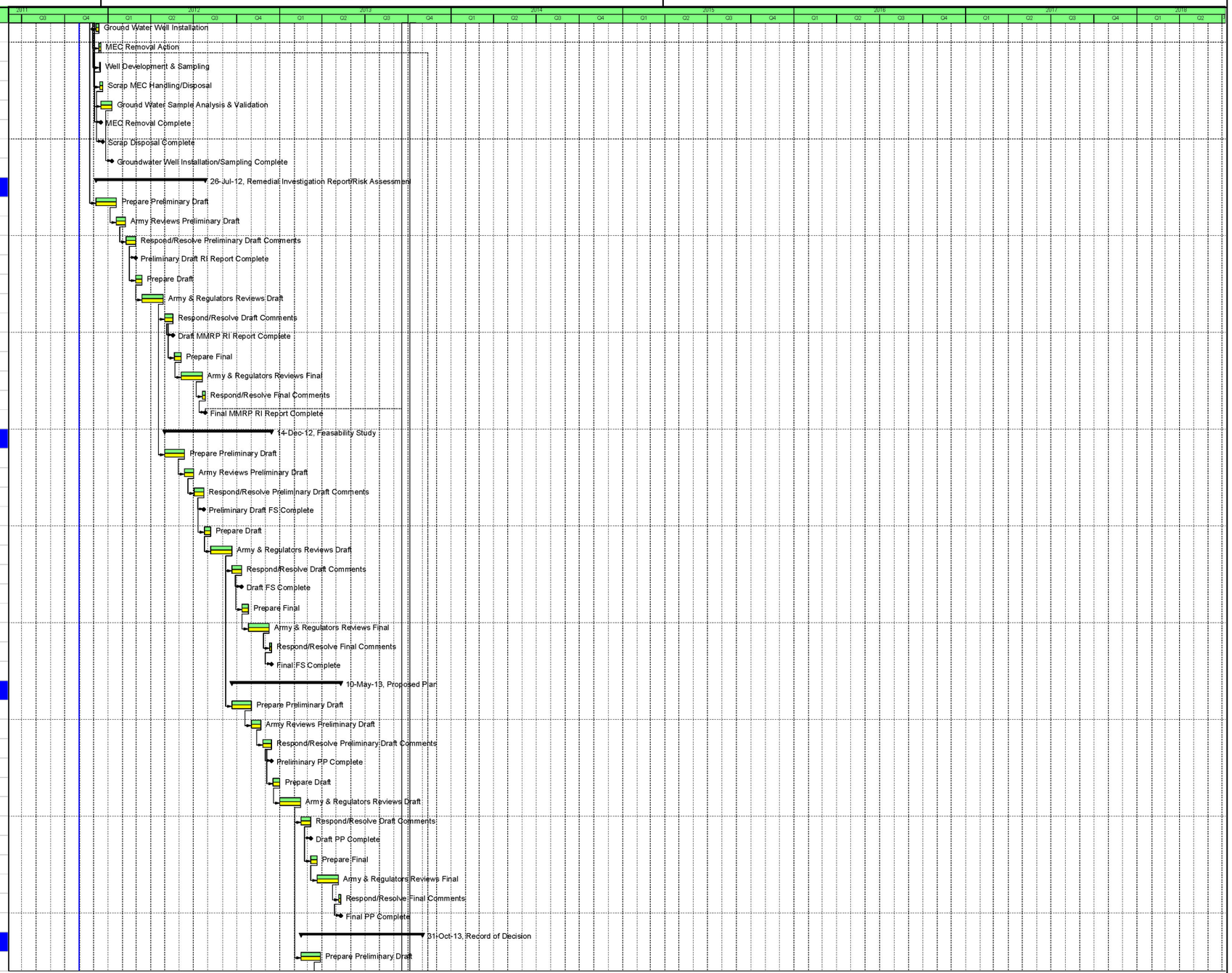
Activity Name	Original Duration	Start	Finish
Ground Water Well Installation	5	06-Dec-11	12-Dec-11
MEC Removal Action	5	12-Dec-11*	16-Dec-11
Well Development & Sampling	3	13-Dec-11	15-Dec-11
Scrap MEC Handling/Disposal	5	14-Dec-11	20-Dec-11
Ground Water Sample Analysis & Validation	15	16-Dec-11	09-Jan-12
MEC Removal Complete	0		16-Dec-11
Scrap Disposal Complete	0		20-Dec-11
Groundwater Well Installation/Sampling Complete	0		09-Jan-12
Remedial Investigation Report/Risk Assessment	164	06-Dec-11	26-Jul-12
Prepare Preliminary Draft	30	06-Dec-11	18-Jan-12
Army Reviews Preliminary Draft	20	18-Jan-12	07-Feb-12
Respond/Resolve Preliminary Draft Comments	15	08-Feb-12	28-Feb-12
Preliminary Draft RI Report Complete	0		28-Feb-12
Prepare Draft	10	29-Feb-12	13-Mar-12
Army & Regulators Reviews Draft	45	13-Mar-12	27-Apr-12
Respond/Resolve Draft Comments	15	30-Apr-12	18-May-12
Draft MMRP RI Report Complete	0		18-May-12
Prepare Final	10	21-May-12	04-Jun-12
Army & Regulators Reviews Final	45	04-Jun-12	19-Jul-12
Respond/Resolve Final Comments	5	20-Jul-12	26-Jul-12
Final MMRP RI Report Complete	0		26-Jul-12
Feasability Study	160	30-Apr-12	14-Dec-12
Prepare Preliminary Draft	30	30-Apr-12	11-Jun-12
Army Reviews Preliminary Draft	20	11-Jun-12	01-Jul-12
Respond/Resolve Preliminary Draft Comments	15	02-Jul-12	23-Jul-12
Preliminary Draft FS Complete	0		23-Jul-12
Prepare Draft	10	24-Jul-12	06-Aug-12
Army & Regulators Reviews Draft	45	06-Aug-12	20-Sep-12
Respond/Resolve Draft Comments	15	21-Sep-12	11-Oct-12
Draft FS Complete	0		11-Oct-12
Prepare Final	10	12-Oct-12	25-Oct-12
Army & Regulators Reviews Final	45	25-Oct-12	09-Dec-12
Respond/Resolve Final Comments	5	10-Dec-12	14-Dec-12
Final FS Complete	0		14-Dec-12
Proposed Plan	161	21-Sep-12	10-May-13
Prepare Preliminary Draft	30	21-Sep-12	01-Nov-12
Army Reviews Preliminary Draft	20	01-Nov-12	21-Nov-12
Respond/Resolve Preliminary Draft Comments	15	26-Nov-12	14-Dec-12
Preliminary PP Complete	0		14-Dec-12
Prepare Draft	10	17-Dec-12	31-Dec-12
Army & Regulators Reviews Draft	45	31-Dec-12	14-Feb-13
Respond/Resolve Draft Comments	15	15-Feb-13	07-Mar-13
Draft PP Complete	0		07-Mar-13
Prepare Final	10	08-Mar-13	21-Mar-13
Army & Regulators Reviews Final	45	21-Mar-13	05-May-13
Respond/Resolve Final Comments	5	06-May-13	10-May-13
Final PP Complete	0		10-May-13
Record of Decision	181	15-Feb-13	31-Oct-13
Prepare Preliminary Draft	30	15-Feb-13	28-Mar-13



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary

Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

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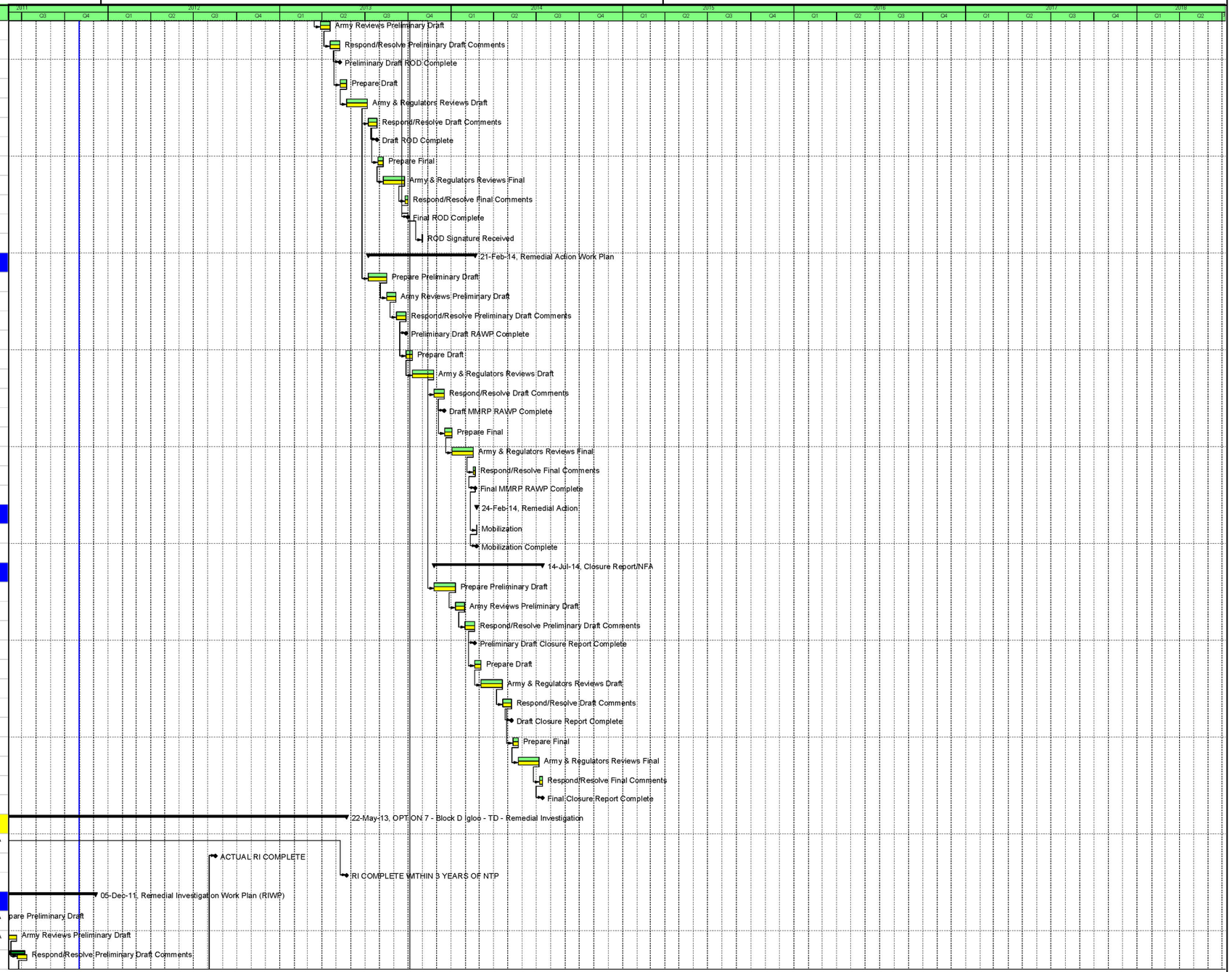
Activity Name	Original Duration	Start	Finish
Army Reviews Preliminary Draft	20	28-Mar-13	17-Apr-13
Respond/Resolve Preliminary Draft Comments	15	18-Apr-13	08-May-13
Preliminary Draft ROD Complete	0		08-May-13
Prepare Draft	10	09-May-13	22-May-13
Army & Regulators Reviews Draft	45	22-May-13	06-Jul-13
Respond/Resolve Draft Comments	15	08-Jul-13	26-Jul-13
Draft ROD Complete	0		26-Jul-13
Prepare Final	10	29-Jul-13	09-Aug-13
Army & Regulators Reviews Final	45	09-Aug-13	23-Sep-13
Respond/Resolve Final Comments	5	24-Sep-13	30-Sep-13
Final ROD Complete	0		30-Sep-13
ROD Signature Received	1	31-Oct-13	31-Oct-13
Remedial Action Work Plan	160	08-Jul-13	21-Feb-14
Prepare Preliminary Draft	30	08-Jul-13	16-Aug-13
Army Reviews Preliminary Draft	20	16-Aug-13	05-Sep-13
Respond/Resolve Preliminary Draft Comments	15	06-Sep-13	26-Sep-13
Preliminary Draft RAWP Complete	0		26-Sep-13
Prepare Draft	10	27-Sep-13	10-Oct-13
Army & Regulators Reviews Draft	45	10-Oct-13	24-Nov-13
Respond/Resolve Draft Comments	15	25-Nov-13	17-Dec-13
Draft MMRP RAWP Complete	0		17-Dec-13
Prepare Final	10	18-Dec-13	02-Jan-14
Army & Regulators Reviews Final	45	02-Jan-14	16-Feb-14
Respond/Resolve Final Comments	5	17-Feb-14	21-Feb-14
Final MMRP RAWP Complete	0		21-Feb-14
Remedial Action	1	24-Feb-14	24-Feb-14
Mobilization	1	24-Feb-14	24-Feb-14
Mobilization Complete	0		24-Feb-14
Closure Report/NFA	160	25-Nov-13	14-Jul-14
Prepare Preliminary Draft	30	25-Nov-13	09-Jan-14
Army Reviews Preliminary Draft	20	09-Jan-14	29-Jan-14
Respond/Resolve Preliminary Draft Comments	15	30-Jan-14	19-Feb-14
Preliminary Draft Closure Report Complete	0		19-Feb-14
Prepare Draft	10	20-Feb-14	05-Mar-14
Army & Regulators Reviews Draft	45	05-Mar-14	19-Apr-14
Respond/Resolve Draft Comments	15	21-Apr-14	09-May-14
Draft Closure Report Complete	0		09-May-14
Prepare Final	10	12-May-14	23-May-14
Army & Regulators Reviews Final	45	23-May-14	07-Jul-14
Respond/Resolve Final Comments	5	08-Jul-14	14-Jul-14
Final Closure Report Complete	0		14-Jul-14
OPTION 7 - Block D Igloo - TD - Remedial Investigation	712	30-Apr-10 A	22-May-13
ANTICIPATED NTP	0		30-Apr-10 A
ACTUAL RI COMPLETE	0		16-Aug-12
RI COMPLETE WITHIN 3 YEARS OF NTP	0		22-May-13
Remedial Investigation Work Plan (RIWP)	340	02-Aug-10 A	05-Dec-11
Prepare Preliminary Draft	20	02-Aug-10 A	29-Apr-11 A
Army Reviews Preliminary Draft	20	02-May-11 A	03-Jun-11 A
Respond/Resolve Preliminary Draft Comments	15	06-Jun-11 A	07-Jul-11 A



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary
Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

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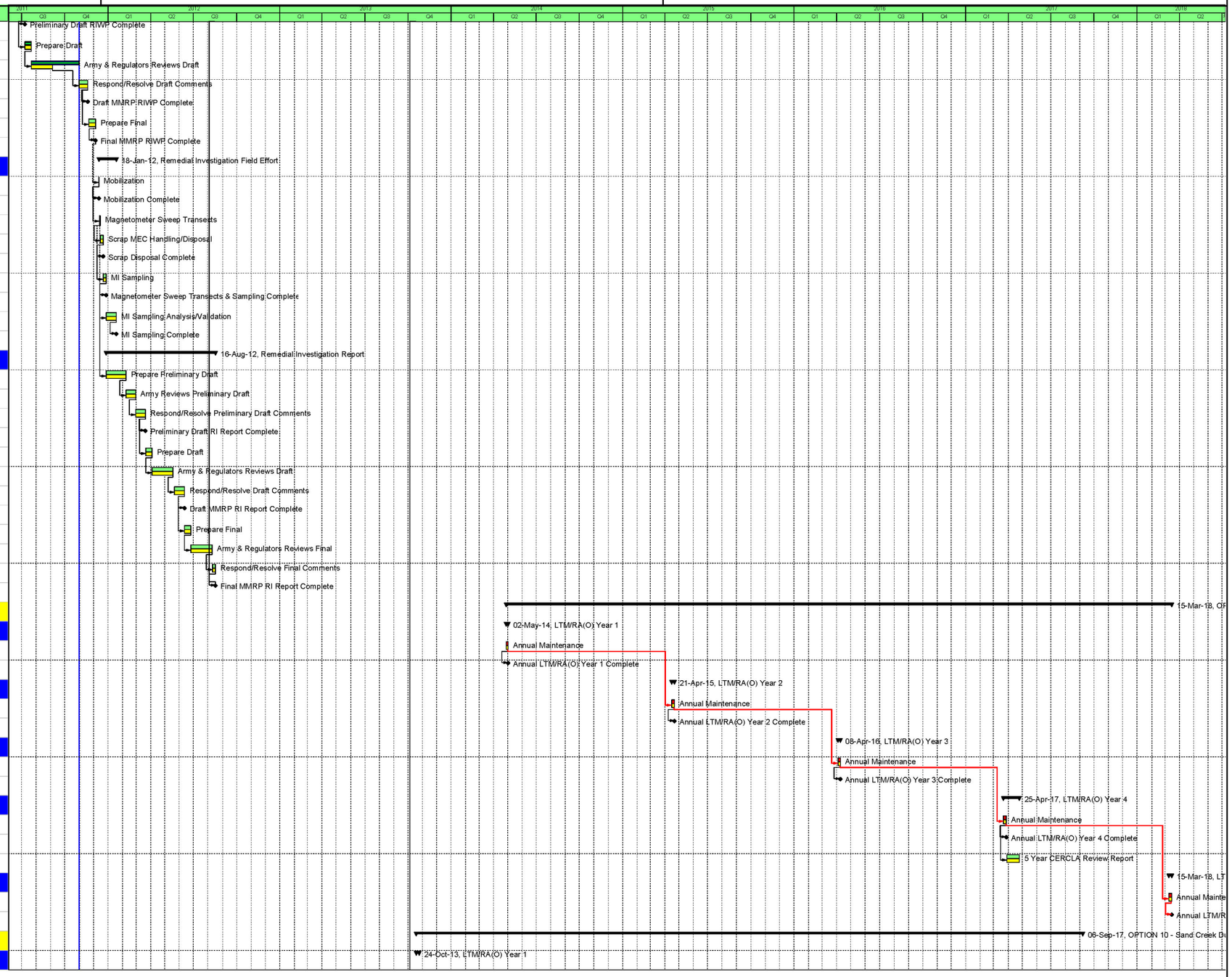
Activity Name	Original Duration	Start	Finish
Preliminary Draft RIWP Complete	0		07-Jul-11 A
Prepare Draft	10	08-Jul-11 A	21-Jul-11 A
Army & Regulators Reviews Draft	45	21-Jul-11 A	31-Oct-11
Respond/Resolve Draft Comments	15	31-Oct-11	18-Nov-11
Draft MMRP RIWP Complete	0		18-Nov-11
Prepare Final	9	21-Nov-11	05-Dec-11
Final MMRP RIWP Complete	0		05-Dec-11
Remedial Investigation Field Effort	25	12-Dec-11	18-Jan-12
Mobilization	1	12-Dec-11*	12-Dec-11
Mobilization Complete	0		12-Dec-11
Magnetometer Sweep Transects	3	13-Dec-11	15-Dec-11
Scrap MEC Handling/Disposal	5	15-Dec-11	21-Dec-11
Scrap Disposal Complete	0		21-Dec-11
MI Sampling	3	22-Dec-11	27-Dec-11
Magnetometer Sweep Transects & Sampling Complete	0		27-Dec-11
MI Sampling Analysis/Validation	14	28-Dec-11	18-Jan-12
MI Sampling Complete	0		18-Jan-12
Remedial Investigation Report	164	28-Dec-11	16-Aug-12
Prepare Preliminary Draft	30	28-Dec-11	08-Feb-12
Army Reviews Preliminary Draft	20	08-Feb-12	28-Feb-12
Respond/Resolve Preliminary Draft Comments	15	29-Feb-12	20-Mar-12
Preliminary Draft RI Report Complete	0		20-Mar-12
Prepare Draft	10	21-Mar-12	03-Apr-12
Army & Regulators Reviews Draft	45	03-Apr-12	18-May-12
Respond/Resolve Draft Comments	15	21-May-12	11-Jun-12
Draft MMRP RI Report Complete	0		11-Jun-12
Prepare Final	10	12-Jun-12	25-Jun-12
Army & Regulators Reviews Final	45	25-Jun-12	09-Aug-12
Respond/Resolve Final Comments	5	10-Aug-12	16-Aug-12
Final MMRP RI Report Complete	0		16-Aug-12
OPTION 9 - Firestone Test Facility Remedial Investigation 5yrs from A	985	28-Apr-14	15-Mar-18
LTM/RA(O) Year 1	5	28-Apr-14	02-May-14
Annual Maintenance	5	28-Apr-14	02-May-14
Annual LTM/RA(O) Year 1 Complete	0		02-May-14
LTM/RA(O) Year 2	5	15-Apr-15	21-Apr-15
Annual Maintenance	5	15-Apr-15	21-Apr-15
Annual LTM/RA(O) Year 2 Complete	0		21-Apr-15
LTM/RA(O) Year 3	5	04-Apr-16	08-Apr-16
Annual Maintenance	5	04-Apr-16	08-Apr-16
Annual LTM/RA(O) Year 3 Complete	0		08-Apr-16
LTM/RA(O) Year 4	25	22-Mar-17	25-Apr-17
Annual Maintenance	5	22-Mar-17	28-Mar-17
Annual LTM/RA(O) Year 4 Complete	0		28-Mar-17
5 Year CERCLA Review Report	20	29-Mar-17	25-Apr-17
LTM/RA(O) Year 5	5	09-Mar-18	15-Mar-18
Annual Maintenance	5	09-Mar-18	15-Mar-18
Annual LTM/RA(O) Year 5 Complete	0		15-Mar-18
OPTION 10 - Sand Creek Dump Remedial Investigation 5yrs from Awa	985	18-Oct-13	06-Sep-17
LTM/RA(O) Year 1	5	18-Oct-13	24-Oct-13



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary

Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

Shaw - MAMMS - Ravenna

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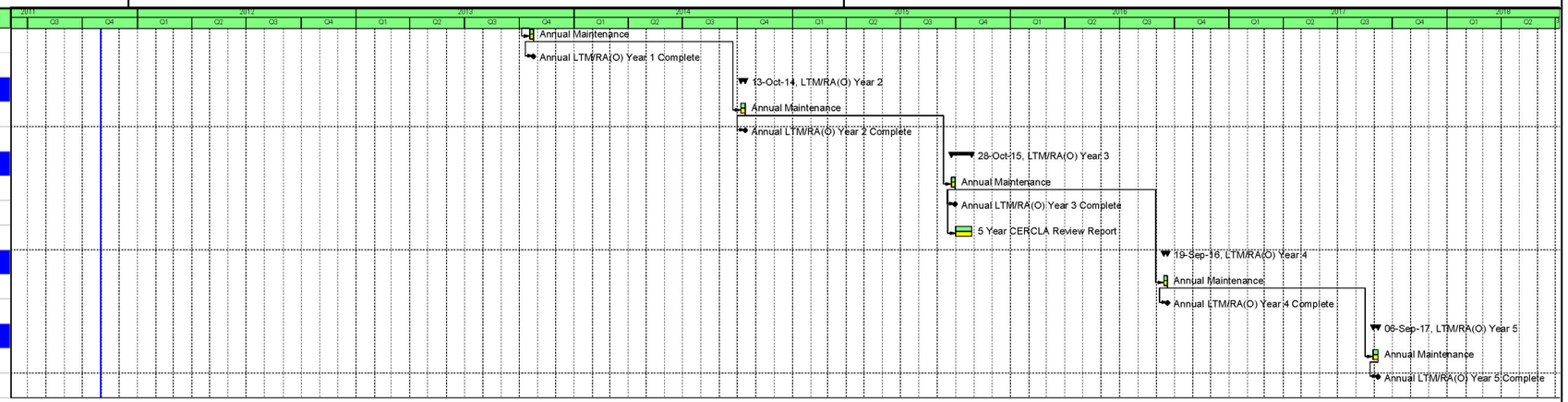
Activity Name	Original Duration	Start	Finish
Annual Maintenance	5	18-Oct-13	24-Oct-13
Annual LTM/RA(O) Year 1 Complete	0		24-Oct-13
LTM/RA(O) Year 2	5	07-Oct-14	13-Oct-14
Annual Maintenance	5	07-Oct-14	13-Oct-14
Annual LTM/RA(O) Year 2 Complete	0		13-Oct-14
LTM/RA(O) Year 3	25	24-Sep-15	28-Oct-15
Annual Maintenance	5	24-Sep-15	30-Sep-15
Annual LTM/RA(O) Year 3 Complete	0		30-Sep-15
5 Year CERCLA Review Report	20	01-Oct-15	28-Oct-15
LTM/RA(O) Year 4	5	13-Sep-16	19-Sep-16
Annual Maintenance	5	13-Sep-16	19-Sep-16
Annual LTM/RA(O) Year 4 Complete	0		19-Sep-16
LTM/RA(O) Year 5	5	30-Aug-17	06-Sep-17
Annual Maintenance	5	30-Aug-17	06-Sep-17
Annual LTM/RA(O) Year 5 Complete	0		06-Sep-17



Remaining Level of Effort | Primary Baseline | Remaining Work | Milestone | Summary
Actual Level of Effort | Actual Work | Critical Remaining Work | % Complete

3.0 Field Investigation Plan

3.1 Overall Approach to Munitions Response Activities

The primary objective of the RI field investigation is to determine the nature and extent of MEC and MC at the RVAAP MRSs. A combination of visual surveys, DGM and intrusive investigations, and MC sampling will be performed during the RI field work. Based on limited information collected during the SI phase in 2007, there is a potential for MEC/MD at the 40mm Firing Range and Water Works #4 Dump in areas outside of the revised MRS boundaries; therefore, additional visual and/or DGM surveys may be performed at these outside areas. In the event that concentrated areas of MEC/MD are identified at any MRS, MC sampling will be required. A more detailed discussion of this approach, including the areas to sample, is provided below in Section 3.2.

3.1.1 Site Characterization Goals

The primary MRS characterization goals are to collect sufficient data to determine:

- The nature and extent of MEC, including:
  - Types,
  - Location,
  - Depth, and
  - Density;
- The nature and extent of MC, including:
  - Specific chemicals of concern, and
  - Distribution and concentrations by media;
- The risk posed to human health and the environment by MEC and MC; and
- What additional data to collect or develop for the FS, as appropriate, to determine remediation alternatives, including evaluation of no action.

This data obtained during the RI will be used at Sand Creek Dump and Water Works #4 Dump in order to achieve RIP, which at minimum will require the development of a FS, PP, and ROD. Depending on the outcome of the RI, remedy implementation (RD/RA) documents may also be required for the RIP MRSs.

3.1.2 Data Quality Objectives

Data quality objectives (DQOs) were developed for MEC and followed the *Data Quality Objectives Process for Hazardous Waste Site Investigations,* EPA QA/G-4HW (EPA, 2000). Shaw developed the DQOs for each of the RVAAP MRSs utilizing the following process:

1. State the Problem
2. Identify the Decision
3. Identify inputs to the Decision
4. Define the Study Boundaries
5. Develop a Decision Rule
6. Specify Limits on Decision Error
7. Optimize the Design for Obtaining Data

Table 3-1 identifies the DQO process for the seven MRSs at the RVAAP. The MRS specific DQOs are provided in Section 3.2. The DQOs proposed for geophysical investigations are identified in Section 3.3.12. The DQOs for MC sampling were developed in accordance with the systematic planning process in Worksheet #11 of the SAP (**Appendix A**).

Table 3-1
Data Quality Objective Process at the RVAAP MRSs

Step	Data Quality Objectives
1. State the problem.	There is a potential for MEC and MC at the seven MRSs included in this work plan addendum. RVAAP was a former load, assemble, and pack facility for munitions. The MRSs identified in this work plan addendum were used for burning, storage, burial, and testing of munitions. In addition, Block D Igloo–TD, which is located off-site, is a debris area where concrete fragments were found after an accidental igloo explosion in 1943. Approximately 94 percent of the RVAAP property has been transferred to NGB for use by the OHARNG as a military training site. The human receptors identified at RVAAP include: the residential farmer (adult and child) as well as the National Guard (trainee, dust/fire control worker, security guard/maintenance worker, range maintenance soldier, and/or engineering school instructor). Based on the source of munitions activities, there may be potential for MEC/MD in the surface and subsurface at the RVAAP MRSs. In addition, there is a potential for MC contamination based on the previous munitions activities.
2. Identify the decision	The goal of the RI is to define the nature and extent of MEC and MC at each MRS based on what is known about the site history and usage. In addition, the RI will determine the risk and hazard posed to human health and the environment by MEC and MC.
3. Identify inputs to the decision	• Historical information • DGM survey and Intrusive Investigation • Magnetometer-assisted visual surveys • MC Sampling

Step	Data Quality Objectives
4. Define the study boundaries	This work plan addendum covers seven MRSs identified at RVAAP (see **Figure 1-2**). In addition, it was determined during the TPP meeting that the MRS boundaries at Block D Igloo–TD, Water Works #4 Dump, and the 40mm Firing Range were inconclusive. Based on the limited SI activities performed, there is a potential for MEC/MD at the 40mm Firing Range and Water Works #4 Dump in areas outside of the revised MRS boundaries. Shaw proposes investigation of assumed areas outside of these MRSs in addition to the defined MRS boundaries.
5. Develop a decision rule	Shaw will collect sufficient data through visual surveys, DGM/intrusive investigations, and MC sampling of environmental media in order to evaluate the need for future response actions and/or determine if areas exist that are applicable for an NFA decision. In addition, the data will be used in order to evaluate alternatives during the FS at Sand Creek Dump and Water Works #4 Dump.
6. Specify limits of decision errors	The data will be of the quantity and quality necessary to provide technically sound and defensible assessments of potential risks and hazards to human health and the environment.
7. Optimize the design for obtaining data	The technical approach for the RI activities was discussed during the TPP meeting. Section 3.2 identifies the technical approach for each individual MRS. The data obtained from the MC sampling will be used to perform a RVAAP site specific HHRA and SLERA. In addition, the results from the MEC characterization will be input into the MEC HA to evaluate MEC hazards. If unacceptable risks and hazards are determined to exist at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
DGM = digital geophysical mapping
FS = feasibility study
HHRA = human health risk assessment
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
NFA = no further action
NGB = National Guard Bureau
OHARNG = Ohio Army National Guard
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SLERA = screening level ecological risk assessment
TPP = Technical Project Planning

3.1.3 Data Incorporation into the RI

Whenever possible, existing data will be incorporated into the RI. The following is a summary of existing data and how it will be used:

- **Historical Records Review**—The HRR provides historical documentation regarding the MRSs and identify the types of activities conducted, the types of munitions used, and historical finds and incidents. This data is used to identify the expected baseline conditions, to assess risk, and to identify the Munitions with the Greatest Fragmentation Distance (MGFD) and other hazards that may be present.

- **SI Data**—The SI conducted at RVAAP in 2007 and the subsequent SI Report (e^2M, 2008) provides reconnaissance data identifying surface Materiel Potentially Presenting an Explosive Hazard (MPPEH) that will be used in conjunction with historical aerial photography data to preliminarily delineate areas with munitions-related activity. MC sampling was also performed during the SI and under the IRP at several MRSs. These data sets may be incorporated with sampling data collected during the RI in order to identify data gaps.
- **IRP Data**—The incorporation of IRP data into the RI will be evaluated on a site by site basis in accordance with decision logic presented in the SAP and with approval of the Ohio EPA.

3.1.4 MEC Exposure Analysis

MEC exposure analysis compiles all known information into an illustration of exposure pathways. The *Ordnance and Explosives (OE) Conceptual Site Model* document (USACE, 2003a) divides the analysis into four components: source, activity, access, and receptor. Each component is briefly discussed in the following sections.

3.1.4.1 Source

A MEC source area is the location where UXO, discarded military munitions (DMM) or other forms of ordnance are expected to be found. A preliminary assessment of potential MEC source areas was provided by the ASR, HRR, and the SI Report (e^2M, 2008). MEC can be found on the surface or in the subsurface, and may have impacted both land and water areas as discussed below.

Erie Burning Grounds (RVAAP-002-R-01)

The Erie Burning Grounds MRS, which is located in the northeastern portion of RVAAP, was used from 1941 to 1951. Bodies of bombs were brought to the MRS after washing for flashing. According to the ASR, Erie Burning Grounds is located too close to the installation boundary to have burned filled bombs. Erie Burning Grounds also served as an OB area for propellants, explosives, rags, and explosives contaminated items. During the SI, one MD item (250-lb bomb) was found partially buried. In addition, subsurface anomalies were identified in the MRS. However, the nature of anomalies are unknown since an intrusive investigation was not performed. MEC is also suspected in the flooded portions of the MRS. Therefore, there is a potential for MEC/MD on the surface, subsurface, and wetlands areas. The depth at which there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Erie Burning Grounds MRS.

Fuze and Booster Quarry (RVAAP-016-R-01)

The Fuze and Booster Quarry MRS is located in the south central portion of RVAAP and consists of three elongated ponds separated by berms that were constructed within an abandoned

rock quarry. Prior to the construction of the ponds in 1976, the quarry was used as a landfill for various types of munitions. During the SI, no MEC was discovered during the survey. However, two MD items (casing fragments) were found on the southeastern side of the southern pond. In addition, subsurface anomalies were identified around the ponds. The nature of anomalies are unknown since an intrusive investigation was not performed. RVAAP personnel have reported the presence of potential MEC in the northern and southern ponds when the water levels are low. Therefore, there is a potential for MEC/MD on the surface as well as buried MEC/MD on the banks of the three ponds and in the submerged portions of the three ponds at this MRS. The depth at which there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Fuze and Booster Quarry MRS.

40mm Firing Range (RVAAP-032-R-01)

The 40mm Firing Range MRS is located in the southwestern portion of RVAAP. The MRS was used from approximately 1969 to 1971 to test 40mm grenade cartridges. The impact area reportedly consisted of a single impact berm located to the east of the current MRS boundary. Rounds tested at the 40mm Firing Range MRS may have included both the M407A1 practice round and the M406 HE round. No MEC was discovered during the SI field work. However, numerous MD items (40mm rounds) were found scattered approximately 100 feet beyond the former impact area. The MRS footprint was revised to the target area and 100 feet beyond based on the SI survey results and the recommendations in the SI Report (e^2M, 2008). Historical documentation and aerial photographs indicate there is a potential for MEC/MD on the surface and shallow subsurface at the 40mm Firing Range MRS as well as beyond the current MRS boundary.

Sand Creek Dump (RVAAP-034-R-01)

The Sand Creek Dump MRS was formerly used as a disposal area for primarily construction debris. Two 75mm projectiles MD items were discovered during a 2003 RA at the northern portion of the Sand Creek Dump MRS. Although no MEC was identified at the site during the SI, one 105mm projectile MD item was found in Sand Creek adjacent to the northern portion of the MRS. In addition, multiple subsurface anomalies were recorded during the SI, which was expected due to the presence of the dump.

In May and June 2010, Shaw conducted a DGM survey under the IRP at the Sand Creek Dump AOC. The AOC and MRS boundaries are primarily collocated; however, the MRS boundary extends an additional 150 feet north of the AOC boundaries where the 105mm projectile was found in the Sand Creek. This portion of the MRS (approximately 0.13 acres) was not surveyed during the 2010 DGM investigation.

The DGM investigation was performed along the slopes of the AOC, adjacent floodplains and at upgradient locations at the top of the slope where dumping activities occurred, in order to

evaluate the presence of potential buried debris. The DGM survey identified a large mass of buried anomalies at the northern portion of the site with an area of approximately 0.8 acres. Smaller and isolated areas with buried anomalies were scattered throughout the remainder of the AOC. Based on the previously discovered MD and results of the 2010 DGM survey, the potential exists for buried MEC/MD at the MRS portions of the site. It should be noted that the depth at which there is a potential for MEC/MD will not be known until DGM is conducted on the remaining portions of the MRS, target anomaly areas are identified, and the intrusive investigation is performed.

Block D Igloo-TD (RVAAP-061-R-01)

The Block D Igloo-TD MRS is located north of the Installation boundary. The Igloo 7-D-15 was used as a storage magazine. On 24 March 1943, Igloo 7-D-15 exploded as a result of 2,516 clusters of 20-lb fragmentation bombs accidentally detonating. The Block D Igloo-TD consists of private properties that have the potential for MEC/MD associated with the explosion. During the SI, no evidence of MEC was observed at the 19.25-acre portion of the MRS area that extended northwest beyond the Installation boundary. This 19.25-acre area was not carried forward following the SI; however, the SI Report (e^2M, 2008) did recommend two new areas totaling 14.131 acres be included in the revised MRS boundary for the Block-D Igloo TD. The current MRS is located to the northeast of Igloo 7-D-15, the primary direction of the explosion. The MRS has been divided into two areas, Area 1 (12 acres) and Area 2 (2.131 acres). Shaw reevaluated the MRS boundaries based on the maximum fragmentation distance of the M41 bomb and it was concluded that MEC/MD associated with the 1943 explosion is not expected outside of the installation. Further details on the boundary evaluation are presented in Section 3.2.5 and the *Technical Memorandum and Rationale for Reduction in Investigation Area for the Block D Igloo MRS (RVAAP-060-R-001)* in **Appendix C** in the work plan (Shaw, 2011b).

Water Works #4 Dump (RVAAP-062-R-01)

The Water Works #4 Dump MRS is a 0.77-acre open area located immediately north of Water Works #4 and west of Load Line 7 in the southwestern portion of RVAAP. The MRS was reportedly used as a disposal site from 1941 to 1949. However, the type and origin of MEC/MD present at the MRS is unknown. During the SI field work, approximately twenty 155mm shrapnel projectile MD items were scattered throughout the wooded area to the north of the current MRS. Since the MD items did not have an explosive hazard and subsequent surface soil sampling did not detect any related MC, this portion of the MRS was removed from further consideration. Subsurface anomalies were detected in the open area of the current MRS during the SI field work and may represent potential buried MEC. However, the nature of anomalies remains unknown since an intrusive investigation was not performed. Based on available information, there is a potential for MEC/MD on the surface and subsurface at the current MRS boundary as well as the area where MEC/MD items were previously found. The depth at which

there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Water Works #4 Dump MRS.

Group 8 MRS (RVAAP-063-R-01)

The Group 8 MRS consists of disturbed land used by the OHARNG as a vehicle staging area. The 2.65-acre MRS may have been historically used for debris and rubbish burning. One HE anti-personnel fragmentation bomb and one demilitarized 175mm projectile were previously found at the MRS. During the SI, potential MEC consisting of unidentifiable T-bar fuzes were identified. In addition, a large amount of MD was found at this MRS. Based on historical evidence and the findings from the SI field activities, there is a potential for MEC/MD on the ground surface and buried in the shallow subsurface at the Group 8 MRS. The depth at which there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Group 8 MRS.

3.1.4.2 Activity

The hazard from MEC arises from direct contact as a result of some human activity, including RVAAP personnel and OHARNG. This human activity could be moving or somehow disturbing MEC that could cause it to detonate. This could occur during construction, recreational, maintenance, and training activities at the installation as well as residential, recreational, and farming activities at Block D Igloo-TD. OHARNG, authorized installation personnel, contractors, residents, recreational users, farmers, visitors, and trespassers in the area could all deliberately or inadvertently disturb MEC.

3.1.4.3 Access

With the exception of the Block D Igloo–TD, the RVAAP MRSs specified for this work plan addendum are remote but still readily accessible to members of OHARNG and other authorized and unauthorized users. The OHARNG would have direct access to MEC lying on the ground surface during authorized use of the MRSs. The Block D Igloo–TD MRS is located on residential and farm property. Therefore, all residents, farmers, and recreational users would have direct access to MEC lying on the ground surface.

3.1.4.4 Receptors

Human receptors are delineated by both their ability to access the MRS and the activities they engage in that may result in contact with MEC. Currently, receptors using the RVAAP MRSs that have the potential to come into contact with MEC are OHARNG, RVAAP personnel, Ohio EPA personnel, residents, farmers, contractors, recreational users (e.g., hunters/trappers, fishers), visitors, and trespassers. Future receptors at these MRSs with the exception of the Block D Igloo–TD will include the receptors for the planned future land use by the National Guard that may include the Trainee, Dust/Fire Control Worker, Range Maintenance Soldier, Engineering School Instructor, and/or Security Guard/Maintenance Worker. Future receptors at the Block D

Igloo–TD MRS include residents, farmers, and recreational users. A discussion of the screening risk assessment process for human health for the future land use receptors is presented in Section 3.11.2.

In addition to human health receptors, areas within the MRSs may contain sensitive habitats that are valuable and may be impacted by potential contamination. The impact to these areas will be evaluated by completing an ecological screening assessment as discussed in Section 3.11.3.

3.1.5 Use of Time Critical Removal Actions during the Munitions Response Project

Implementation of a time critical removal action (TCRA) is not anticipated during the RI. If there is a need for a removal action, the requirements noted in Section 4-5 of Engineering Regulation (ER) 200-3-1, *Environmental Quality Formerly Used Defense Sites (FUDS) Program Policy* (USACE, 2004a) and in the NCP will be followed. The selection of the appropriate type of removal action is based on the evaluation of the following site-specific features:

- The nature of the MEC or the presence of MC contamination
- The urgency/threat of release or potential release of MEC or MC contamination
- The timeframe required for initiating a removal action

Based on the evaluation of these features, an emergency, time critical, or non-TCRA could be selected.

3.2 Investigation Strategy

The MRSs selected for investigation as part of the RI include the Erie Burning Grounds (33.93 acres), Fuze and Booster Quarry (4.92 acres), 40mm Firing Range (1.27 acres), Sand Creek Dump (0.85 acres), Block D Igloo-TD (14.131 acres), Water Works #4 Dump (0.77 acres), and Group 8 MRS (2.65 acres). A combination of magnetometer assisted visual surveys, DGM surveys, and intrusive investigations will be performed to determine the locations, depths, density, and condition of MEC and MD. Media sampling and analysis will be performed to determine levels of MC contamination as described in detail in the SAP addendum provided in **Appendix A**. The types of media to be sampled, locations and number of samples, methods of sampling, and analyses to be performed will be determined in conjunction with the USACE and Ohio EPA based on the results of the visual survey, DGM surveys, and intrusive investigations. The analytical methods selected to address chemical contaminants will be based on the types of MEC items known or suspected to exist at each MRS. Other analyses may be added based on the visual survey, DGM survey, and intrusive investigation findings and input from the USACE and Ohio EPA. The approach is specified in the SAP addendum, which includes a QAPP that was prepared in accordance with *DOD Quality Systems Manual (QSM), Version 4.2* (DOD, 2009). The QAPP is comprehensive and includes discussion of problem definition and data use, quality

objectives and planning process statements, measurement performance criteria, sampling design and rationale, sampling locations and methods, QC sampling, analytical methods, and sample handling and custody.

Existing information provides a preliminary estimate of munitions activity areas based on historical documentation. In addition, historical aerial photographs provide identification of potential ground features at the MRSs. RVAAP was an industrial facility used for munitions assembly. In addition to production and demilitarization activities at the load lines, other facilities at RVAAP include MRSs that were used for the burning, burial, storage, and testing of munitions. Potential contaminants at the MRSs may include explosives, propellants, and metals. A primary objective of the RI is to determine if each MRS requires further response action due to the presences of MEC or MC.

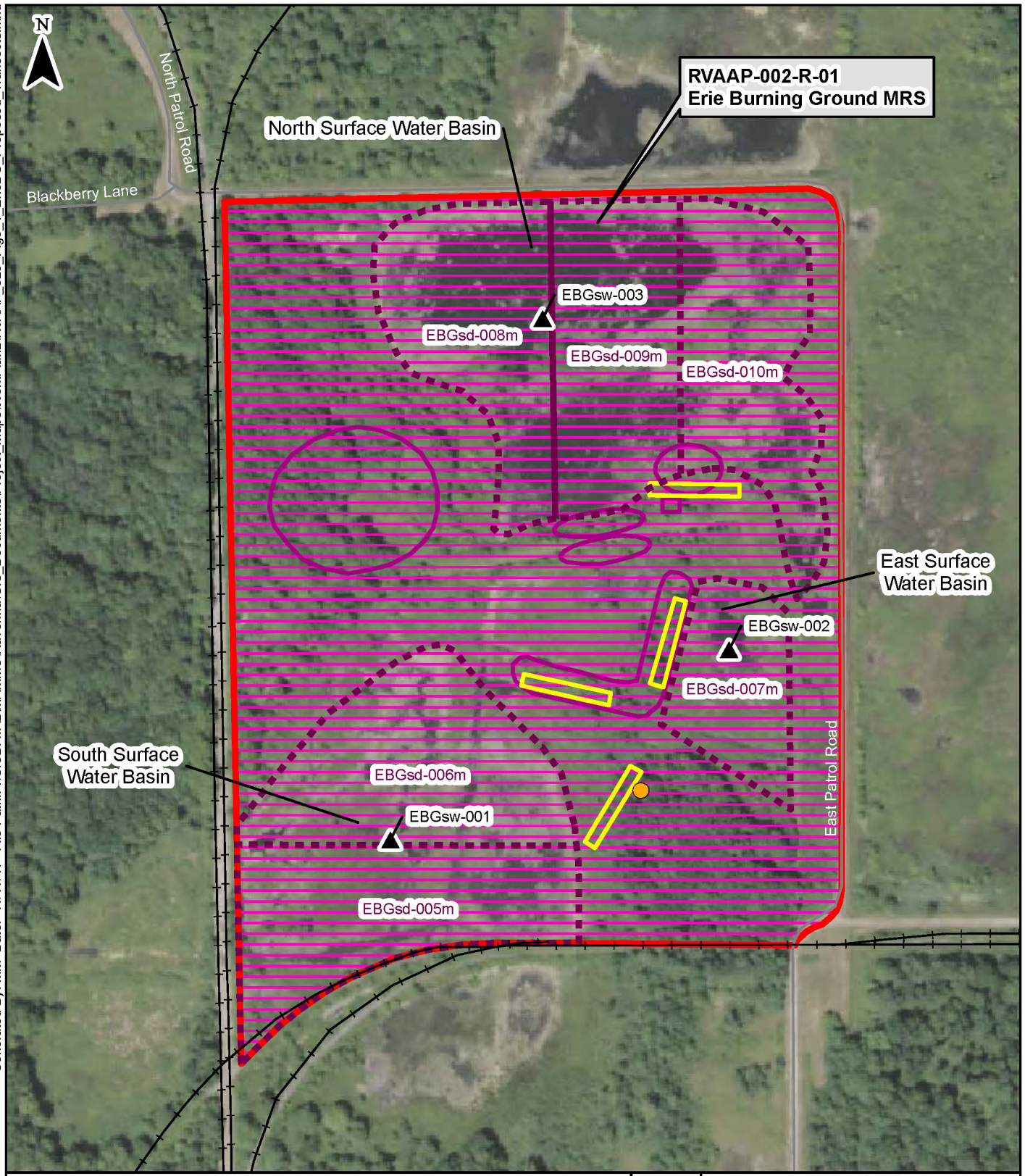
3.2.1 Erie Burning Grounds

The RI field work at the Erie Burning Grounds MRS will include a DGM survey and intrusive investigation in order to evaluate subsurface MEC/MD at the MRS. Complete DGM coverage (100 percent) is typically not warranted for sites where subsurface dense anomalies or burial areas are not anticipated which is the situation expected for the Erie Burning Grounds MRS. For sites such as this, the disposition of MEC/MD is expected to be on or just below the surface and well distributed across the site.

Each DGM transect is proposed as a straight line although the field team may deviate as needed to negotiate terrain conditions. The proposed transect spacing for the Erie Burning Grounds DGM transects is 20 feet. Each transect will consist of one line of DGM data corresponding to an effective width of 3 feet. The total distance of DGM transects is approximately 14.5 miles at the MRS. The total area of DGM coverage is 5.2 acres of the 33.93-acre MRS (15.4 percent). The final transect distance was determined using UXO Estimator© based on "95 percent confidence and 0.5 UXO/acre." The DGM transects for the Erie Burning Grounds are presented on **Figure 3-1**.

Following completion of DGM transects, Shaw will utilize the UXO Estimator© Analyze Field Data mode in order to assess the assumed UXO density (0.5 UXO per acre). At Erie Burning Grounds, 100 percent of the selected anomalies will be reacquired, excavated, and identified by UXO technicians to determine whether the item is MEC/MD.

Land-based DGM will be performed in the dry areas at Erie Burning Grounds. Due to the wetlands terrain at Erie Burning Grounds, float mounted DGM and former U.S. Navy explosives and ordnance disposal (EOD) divers may be utilized. At locations where water depth is less than 1 to 2 feet, float-mounted DGM will be performed. In areas with water depth greater than approximately 2 feet, a geophysical sensor (G882 magnetometer, horizontal gradiometer or



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Project Number: 136147

MRS Boundary
Potential OB/OD Area
Historic MD Locations
Proposed Incremental Wet Sediment Sample Decision Unit
Proposed Surface Water Sample Location
Proposed Transects
Former Railroad
MD Item (SI, 2007)

0 250 Feet

Projection : NAD_1983_UTM_Zone_17N

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-1

ERIE BURNING GROUNDS
DGM TRANSECTS AND MC SAMPLING LOCATIONS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

Shaw a world of Solutions

EM61 MK2 time domain electromagnetic induction metal detector) will be submerged and flown as close to the water bottom as possible. If excessive debris on the water bottom prevents the marine geophysical sensor from being deployed (e.g., tree stumps, etc.), the former U.S. Navy EOD divers will perform a magnetometer and dig survey in accordance with the Shaw *Dive Operations Plan* presented in the APP addendum. The divers will utilize a handheld underwater sensor such as a JW Fisher Pulse 8X TDEM or Diver Mag1 magnetometer system (or equivalent) in relatively deeper water, or a Schonstedt in very shallow water. The extent of float mounted and marine DGM surveys and magnetometer and dig surveys to be conducted by the former U.S. Navy EOD divers will be dependent on the site conditions at the time of the survey.

Although formal visual survey transects are not proposed at Erie Burning Grounds, the presence of surface MEC/MD will be investigated during the DGM survey. All MEC items visible on the ground surface or discovered via DGM survey will be identified and disposed of according to the procedures specified in Sections 3.6.9 and 3.6.12. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

In accordance with the recommendations in the SI Report (e^2M, 2008), MC sampling will be conducted for wet sediments and surface water at the MRS. A total of six IS wet sediment samples will be collected from the wetland areas; three IS sediment samples will be collected from the North Surface Water Basin (2.8 acres each), two IS sediment samples will be collected from the South Surface Water Basin (3.2 acres each) and one IS sediment sample will be collected from the East Surface Water Basin (1.5 acres). The rationale for the number of wet sediment samples is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). A total of three surface water samples will be collected, one from each of the water basin areas. The proposed wet sediment and surface water sample locations are shown on **Figure 3-1**.

The samples will be analyzed for MEC metals (aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, strontium, and mercury), explosives, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), nitrocellulose. The sediment and surface water samples will also be analyzed for geochemical metal parameters (calcium, magnesium and manganese). No additional soil or dry sediment sampling is recommended at the MRS based on the ROD for soils and sediment (SAIC, 2007) performed under the IRP; however, additional MC sampling may be warranted for these environmental media if source areas of MEC/MD is identified. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP in **Appendix A**.

Table 3-2 identifies the DQO process at Erie Burning Grounds.

Table 3-2
Data Quality Objective Process at the Erie Burning Grounds MRS

Step	Data Quality Objectives
1. State the problem.	Munitions were thermally treated at the Erie Burning Grounds MRS. In addition, open burning of bulk, off-spec propellants, conventional explosives, rags, and large explosive contaminated items was performed at the MRS. Based on the past activities, there is a potential for MEC/MD on the ground surface and subsurface. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	The goal of the investigation at Erie Burning Grounds is to identify the areas impacted with MEC/MD. In addition, MC sampling will be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • DGM survey • Intrusive Investigation • Surface water and incremental sediment sampling
4. Define the study boundaries.	The RI will be performed in the Erie Burning Grounds MRS boundaries as defined at the conclusion of the SI.
5. Develop a decision rule.	Although formal visual survey transects are not planned at Erie Burning Grounds, the presence of surface MEC/MD will be investigated during the DGM survey. A DGM survey and intrusive investigation will be performed at the Erie Burning Grounds MRS to assess the presence of buried MEC/MD. The DGM transects were placed using UXO Estimator©. Shaw and USACE agreed upon UXO Estimator© inputs of 95 percent confidence and 0.5 UXO/acre. 100 percent of the anomalies will be investigated to meet site-specific criteria. Land based DGM will be performed in the dry areas at Erie Burning Grounds. At locations where water depth is less than 2 feet, float mounted DGM will be performed. In areas with water depth greater than 2 feet, former U.S. Navy EOD divers will perform the DGM surveys in accordance with the Shaw Dive Plan. The extent of float mounted DGM survey and former U.S. Navy EOD diver DGM surveys will be dependent on the site conditions at the time of the survey. In accordance with the recommendations in the SI Report (e^2M, 2008), MC sampling will be conducted for wet sediments and surface water at the MRS. A total of six IS wet sediment samples will be collected from the wetland areas; three IS sediment samples will be collected from the North Surface Water Basin (2.8 acres each), two IS sediment samples will be collected from the South Surface Water Basin (3.2 acres each) and one IS sediment sample will be collected from the East Surface Water Basin (1.5 acres). The rationale for the number of wet sediment samples is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in

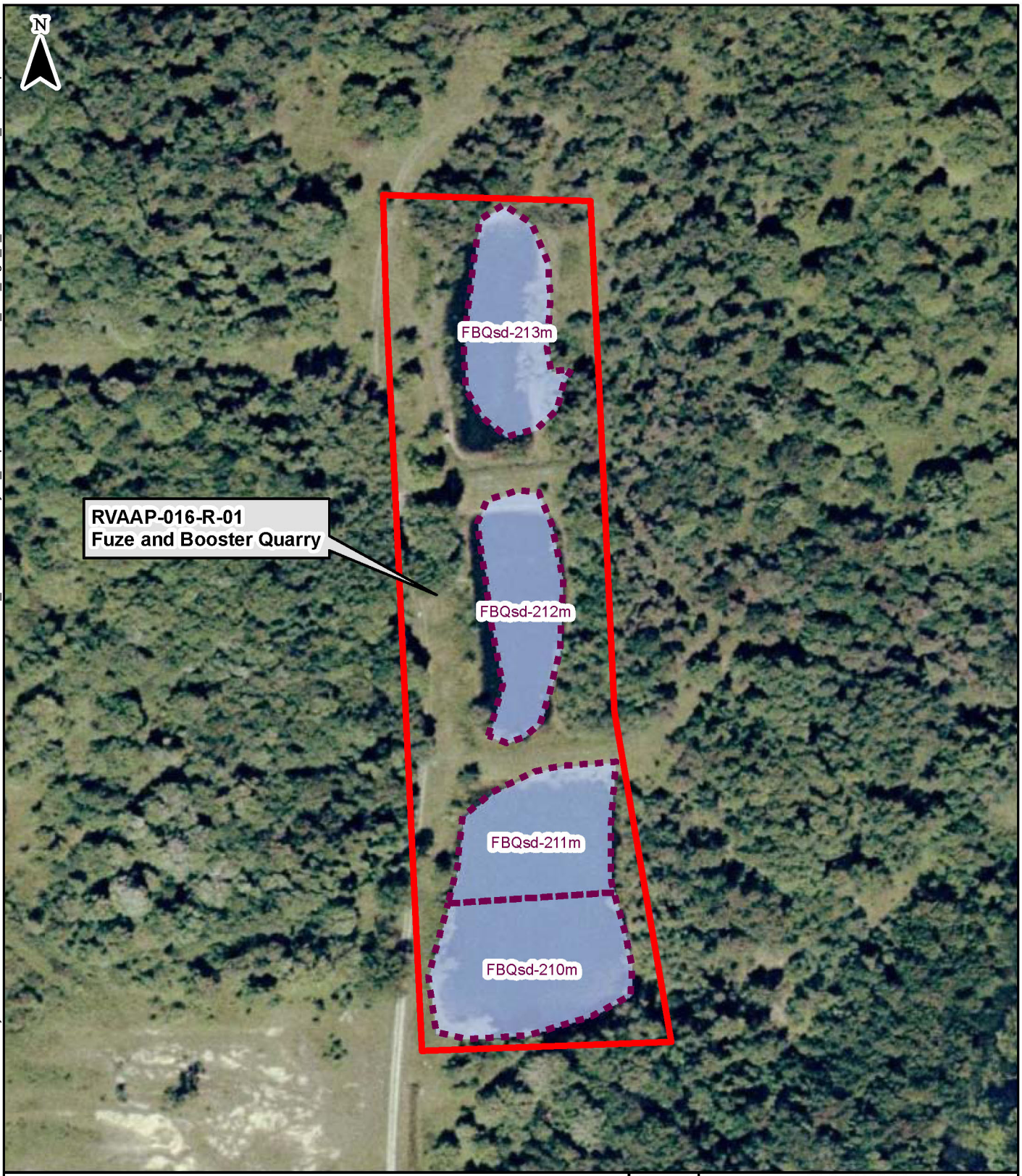
Step	Data Quality Objectives
	accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). A total of three surface water samples will be collected, one from each of the water basin areas. The proposed wet sediment and surface water sample locations are shown on **Figure 3-1**." The samples will be analyzed for MEC metals (aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, strontium, and mercury), explosives, SVOCs, PCBs, nitrocellulose. The sediment and surface water samples will also be analyzed for geochemical metal parameters (calcium, magnesium, and manganese). No additional soil or dry sediment sampling is warranted at the MRS based on the ROD for soils and sediment performed under the IRP; however, additional MC sampling may be performed for these environmental media if source areas of MEC/MD is identified. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at Erie Burning Grounds will be used to determine what risks or hazards, if any, are present. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
DGM = digital geophysical mapping
EOD = explosives and ordnance disposal
HHRA = human health risk assessment
IRP = Installation Restoration Program
IS = incremental sample
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
PCBs = polychlorinated biphenyls
QC = quality control
RI = remedial investigation
ROD = Record of Decision
RVAAP = Ravenna Army Ammunition Plant
SAP = Sampling and Analysis Plan
SI = Site Inspection
SLERA = screening level ecological risk assessment
SVOCs = semivolatile organic compounds
USACE = U.S. Army Corps of Engineers
UXO = unexploded ordnance

3.2.2 Fuze and Booster Quarry

A DGM survey and intrusive investigation will be performed at the Fuze and Booster Quarry MRS in order to evaluate subsurface MEC/MD. Due to the accessibility and manageable size of the MRS, 100 percent DGM coverage of the 4.92-acre site will be performed. The Fuze and Booster Quarry MRS boundaries and proposed investigation areas are shown on **Figure 3-2**.



MRS Boundary

Proposed Incremental Wet Sediment Sample Decision Unit

Surface Water

0 150 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-2

FUZE & BOOSTER QUARRY MRS
INVESTIGATION AREA AND MC SAMPLING LOCATIONS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

Shaw may utilize land based DGM, float mounted DGM, and former U.S. Navy EOD divers in order to perform the DGM survey. Land based DGM will be performed in all accessible areas surrounding the three ponds. At locations where water depth is less than 2 feet, float mounted DGM will be performed. In areas with water depth greater than 2 feet, DGM equipment may be submerged in the water to identify anomalies and/or former U.S. Navy EOD divers will perform the DGM surveys in accordance with the Shaw *Dive Operations Plan* in the APP Addendum (Shaw, 2011c). The extent of float mounted DGM survey and former U.S. Navy EOD diver DGM surveys will be dependent on the site conditions at the time of the survey.

Since 100 percent DGM coverage of the accessible areas will be performed at the Fuze and Booster Quarry MRS (4.92 acres), only a percentage of the anomalies identified during the survey will be investigated. The number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. The final dig list for the Fuze and Booster Quarry MRS will be sent to USACE and Ohio EPA for approval prior to reacquisition.

Although formal visual survey transects are not proposed at the Fuze and Booster Quarry MRS, the presence of surface MEC/MD will be investigated during the DGM survey. All MEC items visible on the ground surface or discovered via DGM survey will be identified and disposed of according to the procedures specified in Sections 3.6.7 and 3.6.10. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

The SI Report (e^2M, 2007) stated that MC at the Fuze and Booster Quarry MRS was being addressed under the IRP; however, Shaw will collect sediment samples from the ponds under the MMRP RI activities based on the detection of MC in the IRP sediment sample data sets. A total of 4 IS wet sediment samples will be collected from the three ponds. Two sediment samples will be collected from the most southern pond (0.6 acres each) and one sample each will be collected from the northern and central ponds (approximately 0.4 acres each) as shown on **Figure 3-2**. The need for additional MC sampling for other environmental media will be evaluated at this MRS if source areas of MEC/MD are identified around the pond areas. The rationale for MC sampling is presented in Section 3.7 and the SAP addendum in **Appendix A**.

Table 3-3 identifies the DQO process at the Fuze and Booster Quarry.

Table 3-3
Data Quality Objectives Process at Fuze and Booster Quarry MRS

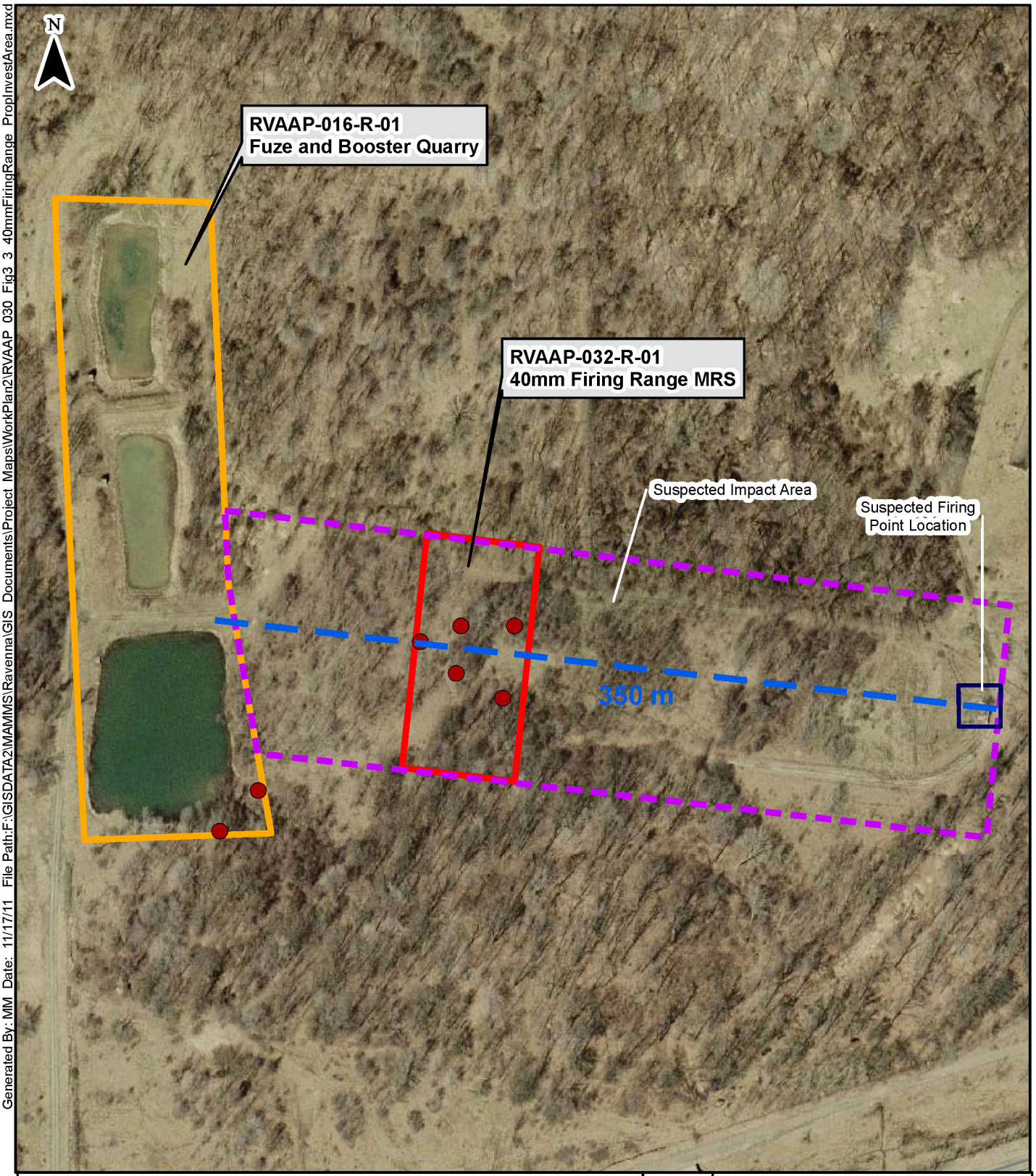
Step	Data Quality Objectives
1. State the problem.	The Fuze and Booster Quarry was used to treat sawdust waste using open burning. Following these activities, the MRS was reportedly used as a landfill that reportedly accepted fuze and booster assemblies, projectiles, residual ash, and sanitary waste. In 1976, the debris was reportedly moved to Ramsdell Quarry Landfill. However, MEC/MD associated with dumping activities may still exist at the MRS. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	The goal of the investigation at the Fuze and Booster Quarry MRS is to identify the areas impacted with MEC/MD. MC sampling may be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS based on the decision rules discussed in Step 5. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • DGM survey • Intrusive Investigation • Incremental and discrete environmental media sampling
4. Define the study boundaries.	The RI will be performed in the Fuze and Booster Quarry MRS boundaries as defined at the conclusion of the SI.
5. Develop a decision rule.	The presence of surface MEC/MD will be investigated during the DGM survey. 100 percent DGM coverage in all accessible areas will be performed within the MRS boundaries. Land based DGM will be performed in the areas surrounding the three ponds. At locations where water depth is less than 2 feet, float mounted DGM will be performed. In areas with water depth greater than 2 feet, DGM equipment may be submerged in the water to identify anomalies and/or former U.S. Navy EOD divers will perform the DGM surveys in accordance with the Shaw *Dive Operations Plan*. The extent of float mounted DGM survey and former U.S. Navy EOD diver DGM surveys will be dependent on the site conditions at the time of the survey. Since full coverage is proposed at the Fuze and Booster Quarry, the number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. A total of four wet sediment samples are proposed to be collected from the three ponds using IS. Two sediment samples will be collected from the most southern pond (0.6 acres each), and one sample each will be collected from the central and northern ponds (approximately 0.4 acres each). The wet sediment sample locations are shown on **Figure 3-2**. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4 of the work plan (Shaw, 2011b).

Step	Data Quality Objectives
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at the Fuze and Booster Quarry will be used to determine what risks or hazards, if any, are present at the MRS. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
DGM = digital geophysical mapping
EOD = explosives and ordnance disposal
HHRA = human health risk assessment
IRP = Installation Restoration Program
IS = incremental sampling
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SAP = Sampling and Analysis Plan
SI = Site Inspection
SLERA = screening level ecological risk assessment
USACE = U.S. Army Corps of Engineers

3.2.3 40mm Firing Range

Prior to developing the investigation strategy at the 40mm Firing Range MRS, historical aerial photographs from 1970 were reviewed to identify the firing point area and targets at the site and Field Manual 3-22.31, *40mm Grenade Launcher, M203* (Army, 2003) was used to determine the range dimensions. Although the suspected location of the firing point is located outside of the current 1.27-acre MRS boundary, Shaw proposes investigating this area in addition to the MRS due to the potential for MEC/MD associated with the historical activities conducted at the former firing range. The M406 and M407 grenades were used in the M203 grenade launcher and the original range shape was determined to be 30 meters wide. The furthest target was determined to be located 350 meters from the firing point. Based on the proposed firing point, the range extends into the Fuze and Booster Quarry MRS. Since the 40mm Firing Range operations were performed at the same time as the Fuze and Booster Quarry dump operations, it is unlikely that the furthest target extended into the Fuze and Booster Quarry MRS. During the RI at the Fuze and Booster Quarry MRS, Shaw will take note of 40mm grenades that may be attributed to the 40mm Firing Range. In the event that MEC/MD is found at the edge of the proposed range boundary or outside of the investigation area (i.e., Fuze and Booster Quarry MRS), Shaw may expand the investigation area. The investigations areas at the 40mm Firing Range that encompasses the suspected firing point, the current MRS boundary and the area beyond the MRS boundary that adjoins to the Fuze and Booster Quarry is presented on **Figure 3-3**.



Proposed Investigation Area
40mm Firing Range MRS Boundary
Fuze and Booster Quarry MRS Boundary
Suspected Firing Point Location
MD Items
Maximum Target Distance

0 200 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-3

40MM FIRING RANGE
INVESTIGATION AREA
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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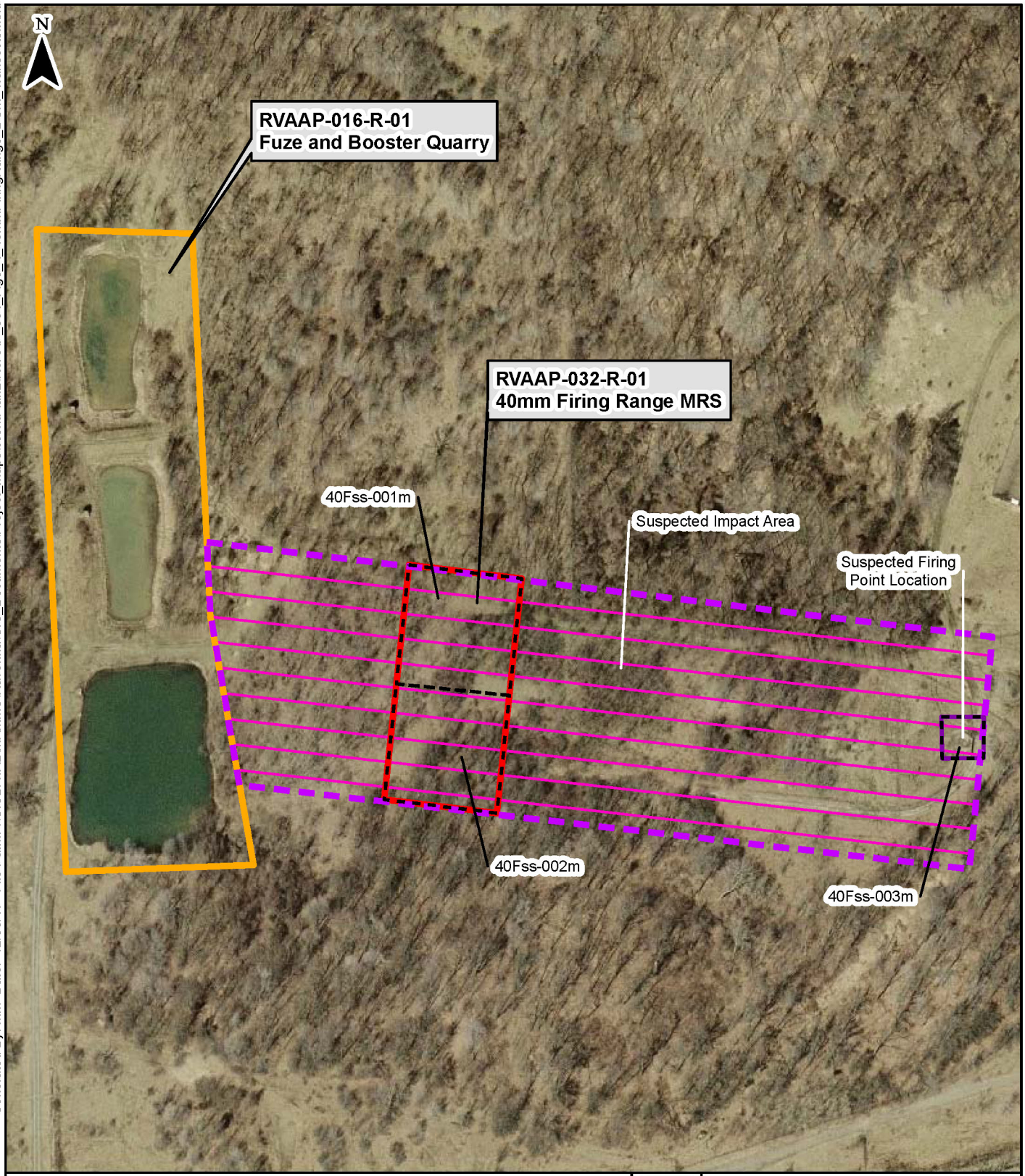
Project Number: 136147

The RI field work at the 40mm Firing Range MRS will include a DGM survey followed by intrusive investigation in order to evaluate potential detected subsurface MEC/MD at the MRS. Each transect will consist of one line of DGM data corresponding to an effective width of 3 feet. Each DGM transect is proposed as a straight line, although the field team may deviate as needed to negotiate terrain conditions. The final transect spacing was determined using the Visual Sample Plan© (VSP) program. The "Transect Sampling for UXO Target Traversal" module of VSP© suggests a transect spacing based on the anticipated target size for a typical 40mm Firing Range that ranges from 2 to 10 meters (Army, 2003). In order to ensure the footprint of the target area is traversed with 100 percent certainty, Shaw is proposing 10-meter transect spacing assuming that not every round hit its intended target when the range was in operation. The total distance of the transects at the 40mm Firing Range (within and outside of the MRS) is 1.88 miles. The area of DGM coverage within the entire 8.55-acre investigation area (within and outside of the MRS) is 0.75 acres (9 percent). The total distance of transects within the 1.27-acre MRS portion of the 40mm Firing Range itself is 0.1 acres (9 percent). The DGM transects proposed at the 40mm Firing Range MRS are presented on **Figure 3-3**.

Total DGM coverage (100 percent) is not proposed at the 40mm Firing Range MRS because the extent of any MEC/MD is expected to be located on or just beneath ground surface due to the previous use of the site as a firing range. No burial areas or concentrated areas of MEC/MD are anticipated. Reacquisition of 100 percent of the identified anomalies will be performed following the DGM investigation. The final dig list for the 40mm Firing Range will be sent to USACE and Ohio EPA for approval prior to reacquisition. The presence of surface MEC/MD will be investigated during the DGM survey. All MEC items visible on the ground surface or discovered via DGM survey and intrusive investigation will be identified and disposed of according to the procedures specified in Sections 3.6.7 and 3.6.10. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

The MRS boundaries consist of the impact target area portion of the 40mm Firing Range and 100 feet beyond that is approximately 1.27 acres in area. Sampling will consist of two IS soil samples from the MRS (approximately 0.63 acres each). The IS soil samples will be analyzed for aluminum and lead, explosives, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium and manganese and iron). In addition to the SI Report (e^2M, 2008) recommendations, an IS soil sample will be collected at the 0.05-acre former firing point of the range located outside of the MRS to evaluate for propellants only, the primary MC associated with mortar propellant M9. The investigation may be expanded if warranted by the identification of MEC/MD outside of the MRS boundary. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP in **Appendix A**. This proposed sampling locations are shown in **Figure 3-4**.



40mm Firing Range MRS Boundary
Suspected Firing Point Location
Fuze and Booster Quarry MRS Boundary
Proposed Investigation Area
Proposed Transects
Proposed Incremental Sample
Decision Unit Location

0 200
Feet
Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-4

40MM FIRING RANGE
DGM TRANSECTS AND MC SAMPLE LOCATIONS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

Table 3-4 identifies the DQO process at the 40mm Firing Range.

Table 3-4
Data Quality Objectives Process at the 40mm Firing Range MRS

Step	Data Quality Objectives
1. State the problem.	The 40mm Firing Range was used to test 40mm grenade cartridges from 1969 to 1971. Grenades were fired from a fixed position, located to the east of the current MRS boundary. The MRS includes the impact area and 100 feet beyond. The SI field work identified MD on ground surface; therefore, there is a potential for MEC/MD on the surface and shallow subsurface in the MRS and surrounding area. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	The goal of the investigation at the 40mm Firing Range is to identify the areas impacted with MEC/MD. In addition, MC sampling will be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information; • DGM survey; • Intrusive Investigation; and • Incremental environmental media sampling.
4. Define the study boundaries.	The RI will be performed in the MRS boundaries as defined at the conclusion of the SI Report (e^2M, 2008) as well as the proposed range boundaries that includes the firing point and area beyond the MRS.
5. Develop a decision rule.	Although no formal visual survey transects are planned at the MRS, the presence of surface MEC/MD will be investigated during the DGM survey. The DGM survey will be performed at the current MRS boundary as well as the assumed range boundary to assess the presence of MEC/MD on the ground surface and shallow subsurface. The DGM transects will be placed using the VSP© program. The "Transect Sampling for UXO Target Traversal" module of VSP© was used to identify the proposed transect spacing. Shaw will select anomalies based on the geostatistical mapping of anomalies. Following the MEC investigation at the 40mm Firing Range, MC soil sampling will be performed at the MRS for further characterization as recommended in the SI Report. One IS soil sample will be collected from the 0.05-acre former firing point at the eastern end of the range. The MRS boundaries include the target area and 100 feet beyond that is approximately 1.27 acres in area. Sampling will consist of two IS soil samples from the MRS (approximately 0.63 acres each) and one IS soil sample the former firing point as shown in **Figure 3-4**. The IS soil samples from within the MRS will be analyzed for aluminum and lead, explosives, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium and manganese and iron). The IS soil sample from the firing point will be analyzed for propellants only that are associated with the mortar propellant M9. The investigation may be expanded if warranted by the identification of MEC/MD outside of the MRS boundary. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.

Step	Data Quality Objectives
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at the 40mm Firing Range will be used to determine what risks or hazards, if any, are present at the MRS. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

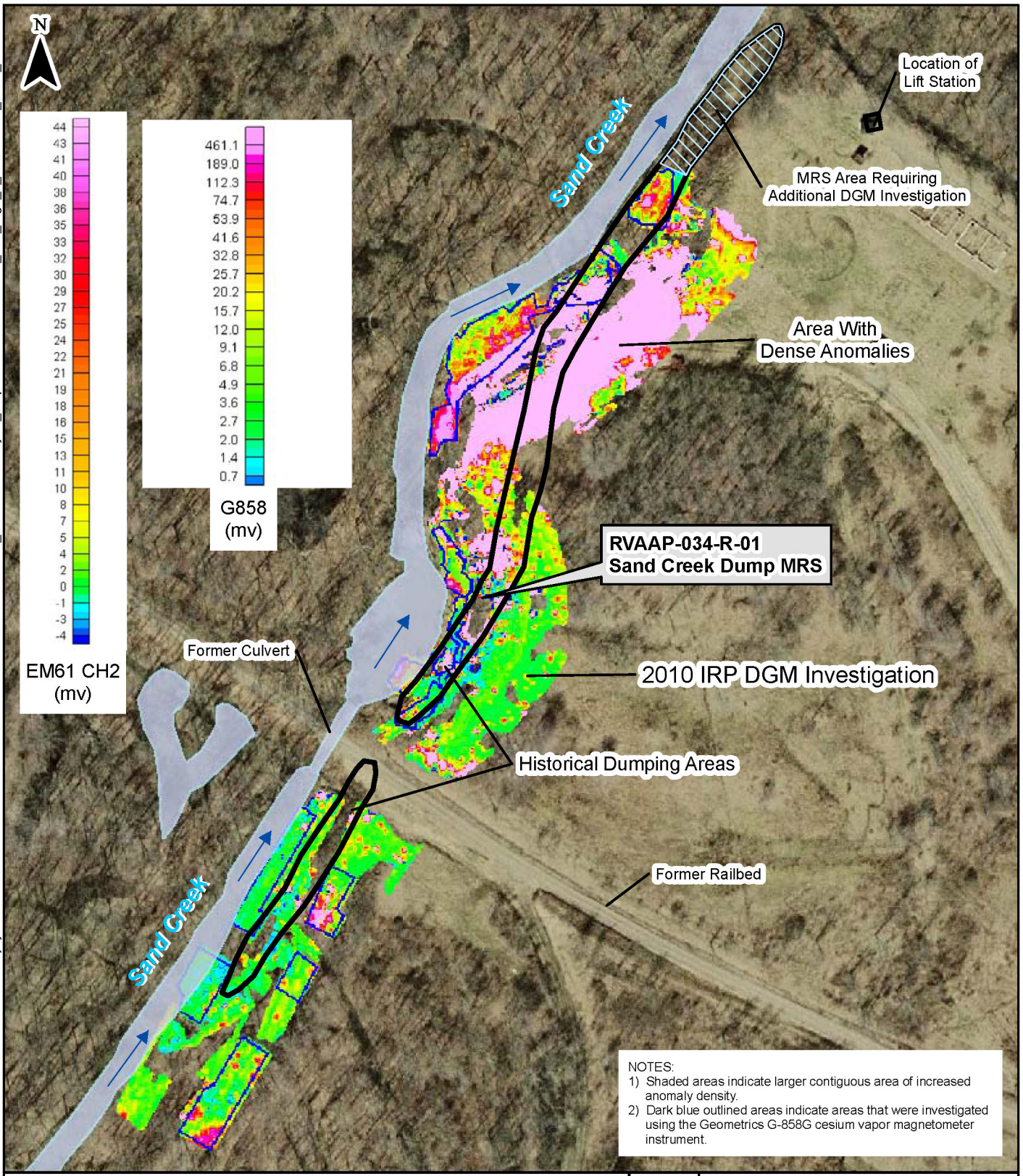
Notes:

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
DGM = digital geophysical mapping
HHRA = human health risk assessment
IS = incremental sampling
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SAP = Sampling and Analysis Plan
SI = Site Inspection
SLERA = screening level ecological risk assessment
USACE = U.S. Army Corps of Engineers

3.2.4 Sand Creek Dump

As part of the IRP, a full coverage DGM survey was performed in 2010 at the Sand Creek Dump AOC, which is collocated with much of the Sand Creek Dump MRS. However, additional DGM activities need to be performed for this investigation under the MMRP to the north of the MRS for approximately 150 feet. This is due to an inconsistency between the AOC and MRS boundaries. Since Shaw intends to complete 100 percent DGM survey coverage of the 0.85-acre MRS in all accessible areas, only a percentage of the anomalies identified during the survey will be investigated. Once Shaw completes DGM activities to the north of the MRS, the old data will be combined with the newly acquired data to develop a prioritized target list. Since full coverage is proposed, the number of anomalies will be biased on a prioritized ranking system and statistical sampling.

Based on the anomalous areas that have been previously detected at Sand Creek Dump that includes the majority of the MRS area, it is expected that test pit excavation will be utilized as the primary intrusive investigation technique at the MRS. Investigation of individual anomalies may be required at isolated locations based on the results of the additional survey. The final proposed investigation locations for the Sand Creek Dump MRS will be sent to USACE and Ohio EPA for approval prior to reacquisition. **Figure 3-5** identifies the DGM results at the Sand Creek Dump AOC and the areas at the MRS where additional DGM activities will be performed.



MRS Boundary

MRS Area Requiring Additional DGM Investigation

Stream

Direction of Flow

mv = millivolts

0 150 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-5

SAND CREEK DUMP EXISTING AND ADDITIONAL DGM SURVEY AREAS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

Although formal visual survey transects are not proposed at the Sand Creek Dump, the presence of surface MEC/MD will be investigated during the intrusive investigation. All MEC items visible on the ground surface or discovered during intrusive activities will be identified and disposed of according to the procedures specified in Sections 3.6.7 and 3.6.10. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

Based on the extensive data collected at the Sand Creek Dump MRS under the IRP, additional sampling for MC is not proposed. However, discrete samples may be collected if MEC/MD items are identified during the intrusive investigation based on the DGM results. The discrete samples will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, and mercury; explosives; and SVOCs, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium, and manganese). The number of samples required will be coordinated with USACE and the Ohio EPA prior to collection. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.

Table 3-5 identifies the DQO process at Sand Creek Dump.

Table 3-5
Data Quality Objectives Process at Sand Creek Dump MRS

Step	Data Quality Objectives
1. State the problem.	The Sand Creek Dump was used as a construction landfill from 1950 to 1960. Debris reportedly disposed within the landfill included concrete, wood, asbestos debris, lab bottles, 55-gallon drums, and fluorescent light tubes. During a 2003 IRP Removal Action, two 75mm projectile MD items were identified. During the SI, one MD item (105mm projectile) was identified in the creek, adjacent to the northern portion of the MRS. Based on this information, there is a potential for surface and subsurface MEC/MD at the MRS. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	The goal of the investigation at Sand Creek Dump is to identify the areas impacted by MEC/MD from potential dumping activities. MC sampling may be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS based on the decision rules discussed in Step 5. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • IRP Investigation Information • Intrusive Investigation • Discrete environmental media sampling (as needed)
4. Define the study boundaries.	The RI will be performed in the Sand Creek Dump MRS boundaries as defined at the conclusion of the SI.

Step	Data Quality Objectives
5. Develop a decision rule.	A full coverage DGM survey was performed in all accessible areas of the AOC boundaries as part of the IRP. The majority of the MRS is collocated with the AOC; however, an additional 0.13 acres of the 0.85-acre MRS requires investigation. Since anomalous areas have been detected at collocated portions of the MRS, test pit excavation is expected be utilized at the MRS for intrusive investigation purposes. The test pit locations will be based on the final DGM data and will be sent to USACE and Ohio EPA for approval prior to reacquisition. Although no formal visual survey transects are planned at the MRS, the presence of surface MEC/MD will be investigated during the intrusive survey. Based on the extensive data collected at the Sand Creek Dump MRS under the IRP, additional sampling for MC is not proposed. However, discrete samples may be collected if MEC/MD items are identified during the intrusive investigation based on the DGM results. If the MEC are intact and there is no obvious release of MC, a determination would be made in conjunction with the USACE and Ohio EPA as to whether sampling is required. If samples are collected, they will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, and mercury; explosives; and SVOCs, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium, strontium, and manganese). The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at the Sand Creek Dump will be used to determine what risks or hazards, if any, are present at the MRS. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:

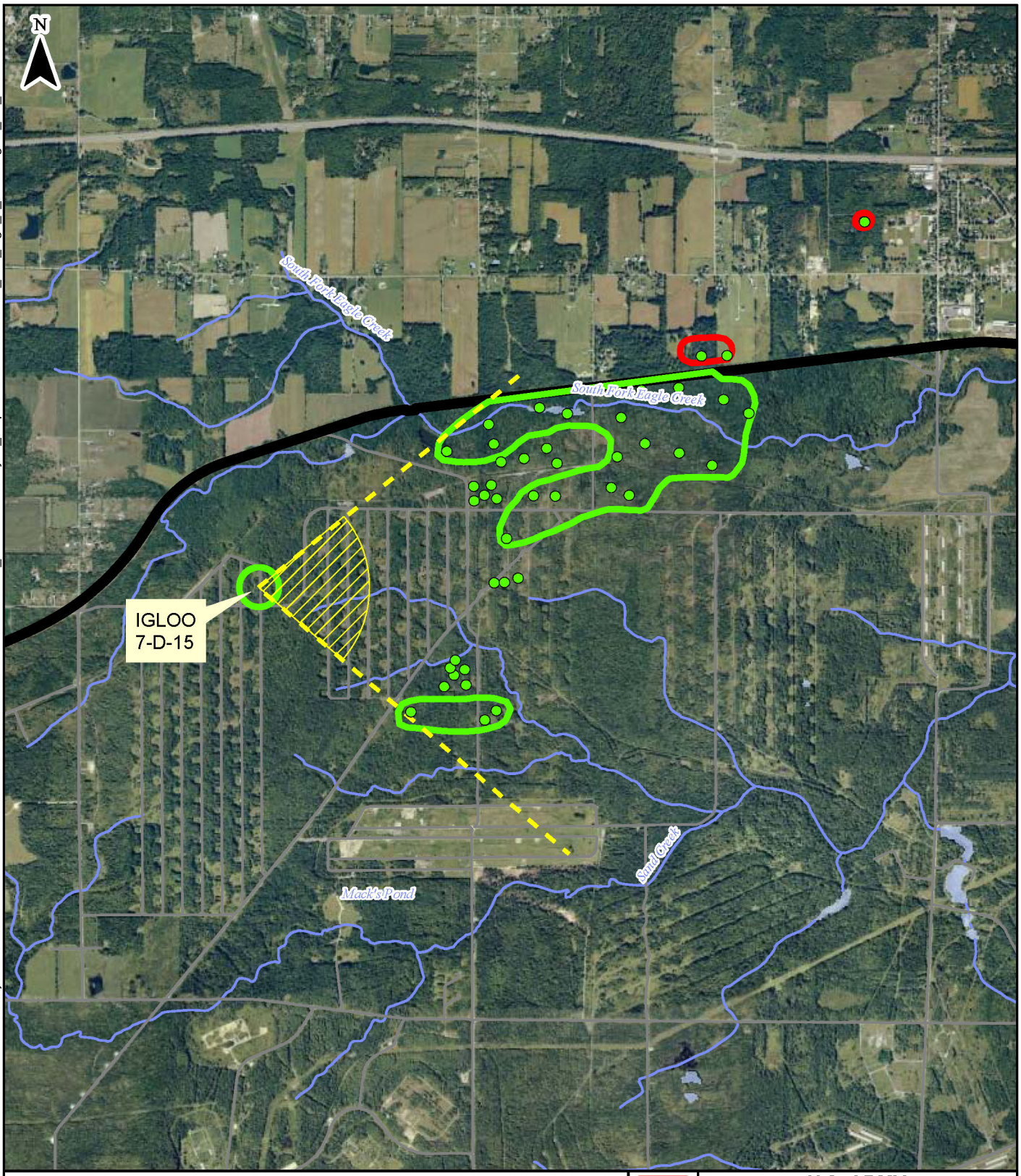
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
DGM = digital geophysical mapping
HHRA = human health risk assessment
IRP = Installation Restoration Program
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SAP = Sampling and Analysis Plan
SI = Site Inspection
SLERA = screening level ecological risk assessment
SVOCs = semivolatile organic compounds
USACE = U.S. Army Corps of Engineers

3.2.5 Block D Igloo-TD

The Block D Igloo–TD MRS represents the documented debris field locations that were not investigated during the SI field work. During the RI work plan planning phase for the Block D Igloo MRS (RVAAP-060-R-001), Shaw reviewed the available documentation on the 1943 explosion. During this review, it was determined that the documented debris field locations were in fact concrete, not MEC/MD. Based on this information, Shaw performed a boundary evaluation in order to determine areas where MEC/MD from the explosion may be observed. During the evaluation, Shaw UXO technical personnel recalculated the maximum fragmentation distance horizontal (MFD-H) for the type of munitions, the 20-lb M41 bomb that was being stored in the magazine. The MFD-H is the maximum horizontal distance that munitions fragments can be thrown as a result of detonation. This data was obtained from the DOD Explosives Safety Board (DDESB) Fragmentation Database, which is industry standard. The MFD-H for the 20-lb M41 bomb is based on inputs such as the explosive type, weight, maximum fragment velocity, etc. The MFD-H calculations were revised to incorporate sympathetic detonations, and were based on information contained in DOD Technical Paper (TP) No. 16, *Methodologies for Calculating Primary Fragment Characteristics* (DDESB, 2005), and discussions with USACE technical personnel at both the Huntsville (Dr. Michelle Crull) and Baltimore (Paul Greene) USACE offices. The revised MFD-H calculated by Shaw is approximately 2,389 feet, indicating that all MEC/MD from the 1943 explosion should be observed within 2,389 feet from Igloo 7-D-15. The basis for this calculation is as follows:

- The base MFD-H is 1,707 feet (fragmentation data review form in **Appendix B**). This represents the expected MFD-H for the detonation of one 20-lb fragmentation bomb.
- Based on discussions with Dr. Crull and additional research, the calculated MFD-H should be increased by 33 percent to account for sympathetic detonations of additional fragmentation bombs regardless of the number contained in the explosion. For this application, a 40 percent factor for sympathetic detonation was used and represents a conservative approach to calculating the impact of sympathetic bomb detonations. The resulting MFD-H with sympathetic detonations factored in is 2,389 feet.

Based on these calculations, an investigation arc was created that extends 2,389 feet from Igloo 7-D-15 (**Figure 3-6**). The investigation arc was directed to the east since the major force of the explosion was in that direction. Since the revised arc does not extend off-site, RI field efforts are not proposed at Block D Igloo–TD. If evidence of MEC/MD is identified beyond the Block D Igloo investigation area and indicates that properties outside of the RVAAP property boundaries may have been impacted, then off-site investigation will be warranted. The investigation strategy at the Block D Igloo–TD, if investigation is required, will be performed in the same manner as the Block D Igloo MRS. Shaw will obtain USACE and Ohio EPA approval prior to any field work, if necessary, at Block D Igloo–TD.



Ravenna Army Ammunition Plant
SI Block D Igloo-TD MRS Boundary
SI Block D Igloo MRS Boundary
Revised RI Investigation Area
Directional Angle of Explosives Debris Field
Stream
Historical Non-Munitions Related Debris Location

0 3,000 Feet

Projection : NAD_1983_UTM_Zone_17N

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MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-6

BLOCK D IGLOO
REVISED RI INVESTIGATION AREA
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

Table 3-6 identifies the DQO process at the Block D Igloo-TD.

Table 3-6
Data Quality Objectives Process at Block D Igloo-TD MRS

Step	Data Quality Objectives
1. State the problem.	There is a potential for MEC/MD dispersal as a result of the 1943 accidental explosion. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	As part of the RI at Block D Igloo, an investigation was performed in order to identify the areas impacted by MEC/MD from the 1943 explosion. In addition, MC sampling may be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • Results of the RI Investigation at the Block D Igloo MRS (RVAAP-060-R-01)
4. Define the study boundaries.	The SI Report (e^2M, 2008) concluded that the 19.25-acre area located north of the Installation boundary should be removed as the Block D Igloo-TD MRS and that two other areas be added. The total area of the current MRS is 14.131 acres and is based on areas where concrete fragments have historically been found; however, an investigation of these areas was never performed during the 2007 SI. Shaw determined that MEC/MD is not anticipated off RVAAP property based on the revised MFD-H for the Block D Igloo MRS. Therefore, no investigation is currently proposed at the Block D Igloo–TD MRS unless investigation at the Block D Igloo MRS determines otherwise.
5. Develop a decision rule.	If evidence of MEC/MD is identified beyond the Block D Igloo investigation area and indicates that properties outside of the RVAAP property boundaries may have been impacted, then off-site investigation will be warranted. The investigation strategy at the Block D Igloo–TD, if investigation is required, will be performed in the same manner as the Block D Igloo MRS.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.
7. Optimize the design for obtaining data.	Since no investigation is currently proposed at the Block D Igloo-TD, Shaw will use previous investigations and historical information to determine what risks or hazards, if any, are present. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results, if applicable. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
HHRA = human health risk assessment
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MFD-H = maximum fragmentation distance–horizontal
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SI = Site Inspection
SLERA = screening level ecological risk assessment
SVOCs = semivolatile organic compounds
USACE = U.S. Army Corps of Engineers

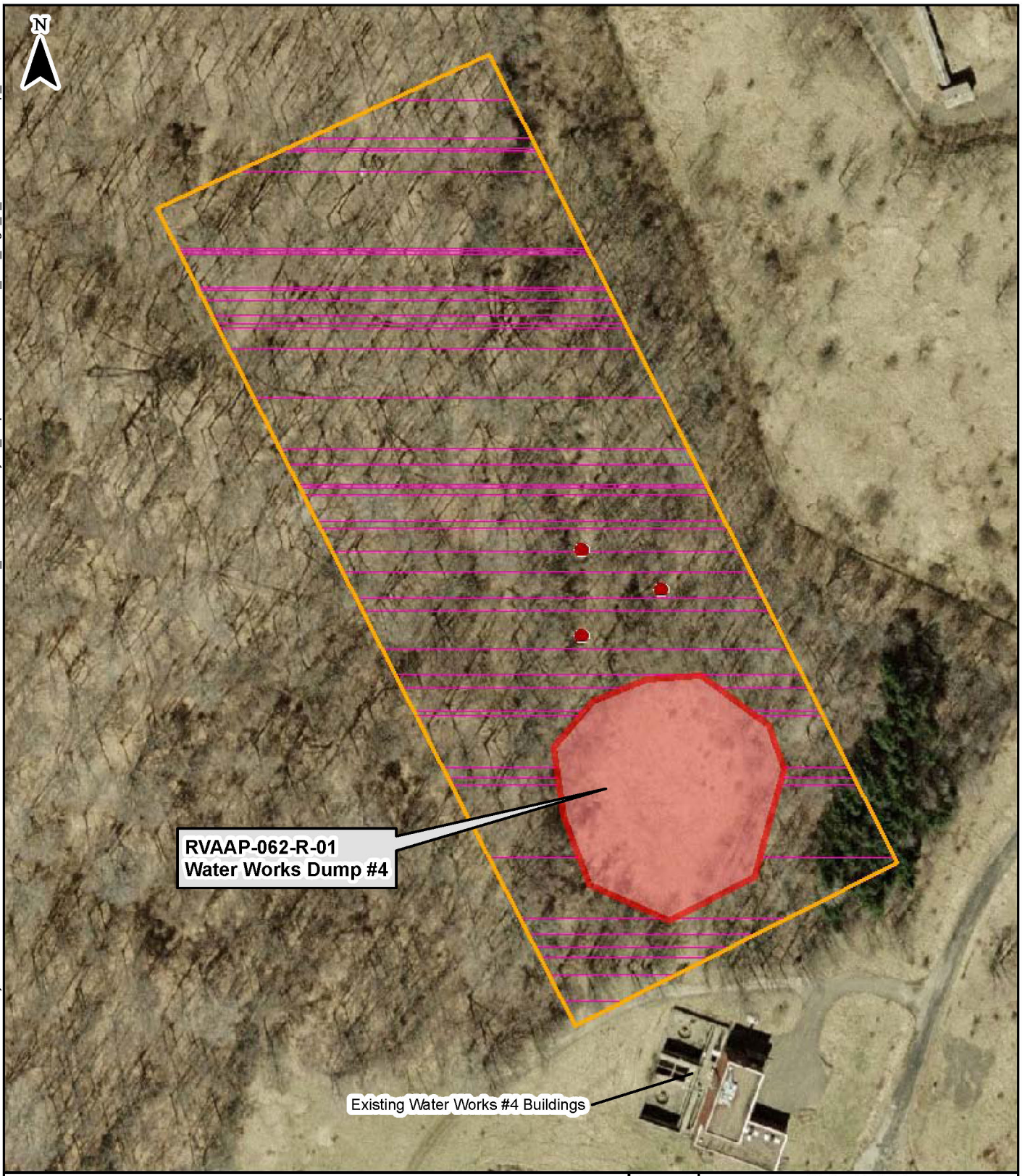
3.2.6 Water Works #4 Dump

Prior to developing the investigation strategy at the Water Works #4 Dump MRS, Shaw reviewed the current MRS boundaries. At the conclusion of the SI Report (e^2M, 2008), the Water Works #4 Dump MRS was reduced in size from 6.15 acres to 0.77 acres (**Figure 1-9**). The current MRS boundary includes the area where multiple subsurface anomalies were detected during the SI. The area removed from the MRS boundary had few subsurface anomalies but did contain the ogives from World War I 155mm projectiles. Since MD was identified in this area, Shaw proposes reinvestigating portions of the previous MRS boundary.

The RI strategy includes performing limited visual survey transects in the investigation area outside of the current MRS boundary to provide a more formal investigation than was performed during the SI in order to confirm that no MEC/MD is present at these locations. The visual survey transects were placed using the VSP© program with the assumption that "90 percent confidence that 95 percent of transects will not contain UXO." The VSP© program provides an unbiased random visual survey transect pattern based on the confidence percentage used, which is shown on **Figure 3-7**. In all, 42 transects with a total distance of 2.3 miles will be performed at the expanded investigation area.

Since subsurface MEC/MD is not anticipated in the expanded investigation area outside of the Water Works #4 Dump MRS boundaries, Shaw does not propose any DGM in this area. In the event that evidence of subsurface MEC/MD is observed, a DGM survey and intrusive investigation may be performed in this area.

Following the visual survey, a DGM survey and intrusive investigation will be performed in all accessible areas of the current MRS boundaries. Due to the MRS size and accessibility of the area, 100 percent DGM is proposed in the current 0.77-acre MRS boundaries; therefore, only a percentage of the anomalies identified during the survey will be investigated. The number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. The final dig list for the Water Works #4 Dump MRS will be sent to the USACE and the Ohio EPA for approval prior to reacquisition.



MRS Boundary - 100% DGM Coverage

Proposed Transect Area

Proposed Transects

MD Item (SI, 2007)

0 125 Feet

Projection : NAD_1983_UTM_Zone_17N

U.S. ARMY
CORPS OF ENGINEERS
LOUISVILLE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-7

WATER WORKS #4 DUMP
VISUAL SURVEY TRANSECTS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

All MEC items visible on the ground surface or discovered via DGM survey and intrusive investigation will be identified and disposed of according to the procedures specified in Sections 3.6.7 and 3.6.10. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

Additional sampling for MC was not recommended for the Water Works #4 Dump MRS in the SI Report (e^2M, 2008) since MC results were below screening criteria. However, IS or discrete samples may be collected if MEC/MD items are identified during the target anomaly investigation based on the DGM field activities. If sample collection is determined to be necessary, they will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, and mercury; explosives; and SVOCs, nitrocellulose, total organic carbon, strontium, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium and manganese). The number of samples required will be coordinated with USACE and the Ohio EPA prior to collection. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.

Table 3-7 identifies the DQO process at Water Works #4 Dump.

Table 3-7
Data Quality Objectives Process at the Water Works #4 Dump MRS

Step	Data Quality Objectives
1. State the problem.	The Water Works #4 Dump was reportedly used as a disposal site from approximately 1941 to 1949. Large caliber casings and ogives from 155mm projectiles have been found on the ground surface and partially buried. The type and origin of MEC potentially present remains unknown. At the conclusion of the SI Report (e^2M, 2008), the MRS was reduced in size. However, MD was observed outside of the current MRS boundary during the SI. Based on this information, there is a potential for MEC/MD on the surface and subsurface in the MRS and surrounding area. In addition, there is a potential for environmental impacts from MC associated with Water Works #4 Dump.
2. Identify the decision.	The goal of the investigation at Water Works #4 Dump is to identify the areas impacted with MEC/MD. MC sampling may be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS based on the decision rules discussed in Step 5. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • Magnetometer-assisted visual survey transects • DGM survey • Intrusive Investigation • Incremental and discrete environmental media sampling (as needed)

Step	Data Quality Objectives
4. Define the study boundaries.	The RI will be performed in the Water Works #4 Dump MRS boundaries as defined at the conclusion of the SI as well as the area removed from the MRS during the SI.
5. Develop a decision rule.	In order to confirm the absence of MEC/MD outside the MRS, a magnetometer assisted visual survey will be performed for the Water Works #4 Dump investigation area (with the exception of the current MRS boundary). Visual survey transects were placed using the VSP© program that "90 percent confidence that 95 percent of the transects do not contain UXO" module. 100 percent DGM coverage will be performed in all accessible areas within the MRS boundary. Since full coverage is proposed, the number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. Additional sampling for MC was not recommended for the Water Works #4 Dump MRS in the SI since MC results were below screening criteria. However, incremental or discrete samples may be collected if MEC/MD items are identified during the target anomaly investigation based on the DGM field activities. If sample collection is determined to be necessary, they will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, and mercury; explosives; and SVOCs, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium, strontium, and manganese). The number of samples required will be coordinated with USACE and the Ohio EPA prior to collection. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at Water Works #4 Dump will be used to determine what risks or hazards, if any, are present at the MRS. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

Notes:

CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
HHRA = human health risk assessment
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SI = Site Inspection
SLERA = screening level ecological risk assessment
SVOCs = semivolatile organic compounds
USACE = U.S. Army Corps of Engineers

3.2.7 Group 8 MRS

Prior to performing any field work at the Group 8 MRS, debris that may cause interference will be removed from the MRS. After the debris is removed, Shaw will perform a DGM survey in order to evaluate subsurface MEC/MD at the Group 8 MRS. Due to the relative minimal size of the MRS (2.65 acres) and accessibility to all areas, 100 percent DGM coverage will be performed; therefore, only a percentage of the anomalies identified during the survey will be investigated. The number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. The final dig list for the Group 8 MRS will be sent to USACE and Ohio EPA for approval prior to reacquisition. **Figure 3-8** depicts the Group 8 MRS where DGM activities will be performed.

Although formal visual survey transects are not proposed at the Group 8 MRS, the presence of surface MEC/MD will be investigated during the DGM survey and debris removal. All MEC items visible on the ground surface or discovered via DGM survey and intrusive investigation will be identified and disposed of according to the procedures specified in Sections 3.6.7 and 3.6.10. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3.

The SI Report recommended additional MC sampling at the Group 8 MRS based on previous surface soil results above screening criteria. Currently, a total of 4 IS surface soil samples are proposed at the site. Discrete soil samples may be collected based on the results of the DGM field activities and target anomaly investigation if MEC/MD is identified. The proposed sample locations at the Group 8 MRS are presented on **Figure 3-8**.

Collected samples will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc and mercury; explosives; SVOCs, nitrocellulose, total organic carbon and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium, strontium and manganese). The number of samples required will be coordinated with USACE and the Ohio EPA prior to collection. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP in **Appendix A**.

Table 3-8 identifies the DQO process at the Group 8 MRS. Details on the MC approach at the Group 8 MRS are provided in the SAP.

Table 3-8
Data Quality Objectives Process at the Group 8 MRS

Step	Data Quality Objectives
1. State the problem.	The Group 8 MRS was potentially used to burn construction debris and rubbish. In 1996, one anti-personnel fragmentation HE bomb was identified within the MRS. One 175mm projectile MD item was observed. During the SI, numerous MD items were found throughout the MRS. Therefore, there is a potential for MEC/MD associated with potential dumping activities on the ground surface and subsurface. In addition, there is a potential for environmental impacts from MC at the MRS.
2. Identify the decision.	The goal of the investigation at the Group 8 MRS is to identify the areas impacted with MEC/MD. In addition, MC sampling will be performed in order to further characterize the type and amount of contamination associated with munitions activities at the MRS. The information obtained during the RI will be used to assess the risk and hazards posed to human health and the environment.
3. Identify inputs to the decision.	• Historical Information • DGM survey • Intrusive Investigation • Incremental environmental media sampling
4. Define the study boundaries.	The RI will be performed in the Group 8 MRS boundaries as defined at the conclusion of the SI.
5. Develop a decision rule.	Prior to the MEC investigation at the Group 8 MRS, all construction debris will be removed. Although no formal visual survey transects are planned at the MRS, the presence of surface MEC/MD will be investigated during the DGM survey. 100 percent DGM coverage will be performed in all accessible areas within the MRS boundaries. Since full coverage is proposed at the Group 8 MRS, the number of anomalies investigated will be based on a prioritized ranking system and statistical sampling. The SI recommended additional MC sampling at the Group 8 MRS based on previous surface soil results above screening criteria. Currently, a total of 4 IS surface soil samples are proposed at the site as shown on **Figure 3-7**. Discrete soil samples may be collected based on the results of the DGM field activities and target anomaly investigation if MEC/MD is identified. Collected samples will be analyzed for aluminum, antimony, barium, cadmium, total and hexavalent chromium, copper, iron, lead, zinc, and mercury; explosives; and SVOCs, nitrocellulose, total organic carbon, and pH. The samples will also be analyzed for geochemical metal parameters (calcium, magnesium, strontium and manganese). If additional sampling is required, it will be coordinated with USACE and the Ohio EPA prior to collection. The rationale for any additional MC sampling, if necessary, is presented in Section 3.7 and the SAP addendum in **Appendix A**.
6. Specify limit of decision errors.	QC procedures are in place so that all field work is performed in accordance with all applicable standards. Further details on the QC process during the RI are located in Section 4.

Step	Data Quality Objectives
7. Optimize the design for obtaining data.	The information gathered as part of the field investigation at the Group 8 MRS will be used to determine what risks or hazards, if any, are present at the Group 8 MRS. Shaw will perform a MEC HA to identify the potential MEC hazards. In addition, a RVAAP site specific HHRA and SLERA will be performed on the analytical results. If unacceptable risks or hazards to human health and the environment are determined to exist at the MRS at the conclusion of the investigation, then the MRS will be identified for further evaluation under the CERCLA process.

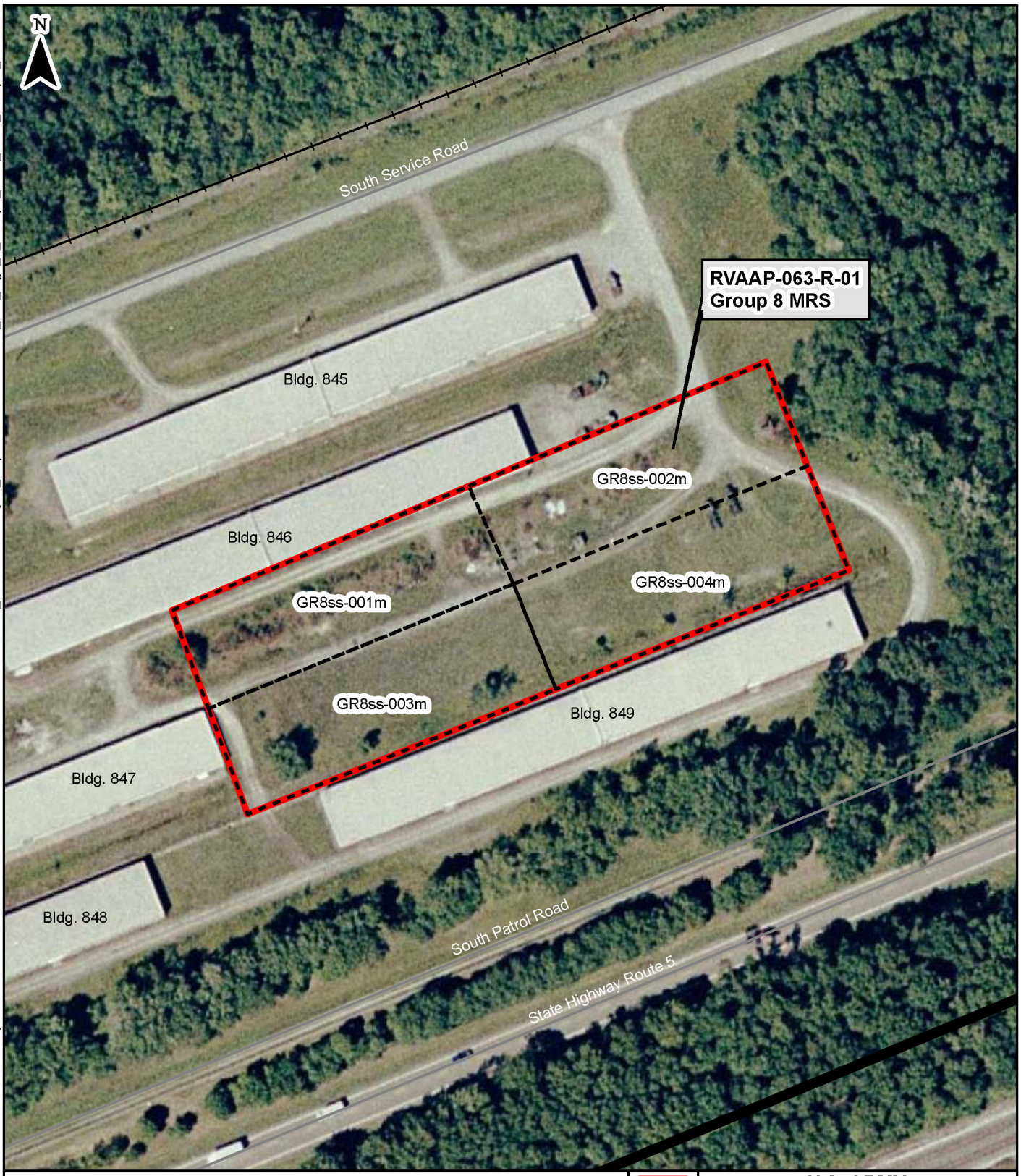
Notes:
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
HE = high explosives
HHRA = human health risk assessment
MC = munitions constituent
MD = munitions debris
MEC = munitions and explosives of concern
MEC HA = MEC Hazard Assessment
MRS = munitions response site
QC = quality control
RI = remedial investigation
RVAAP = Ravenna Army Ammunition Plant
SAP = Sampling and Analysis Plan
SI = Site Inspection
SLERA = screening level ecological risk assessment
SVOCs = semivolatile organic compounds
USACE = U.S. Army Corps of Engineers

3.3 Geophysical Investigations

This section was developed in accordance with the Data Item Description (DID) Munitions Regulations (MR)-09-004, *Geophysics* (USACE, 2009b), Engineering Manual (EM) 1110-1-4009, *Ordnance and Explosive Response* (USACE, 2000a), and the *Digital Geophysical Mapping Guidance Operational Procedures and Quality Control Manual* (DGM QC Guidance) (USACE, 2003h). It is anticipated that EM61 MK2 geophysical sensors will be used in conjunction with a real-time kinematic (RTK) global positioning system (GPS), robotic total station (RTS), or fiducial positioning systems for the DGM survey, which encompasses both one dimensional (1D) transects and two dimensional (2D) "full coverage" grid surveys. DGM surveys are currently proposed at the Erie Burning Grounds, Fuze and Booster Quarry, 40mm Firing Range, Sand Creek Dump, Water Works #4 Dump, and Group 8 MRSs.

3.3.1 Instrument Verification Strip (IVS) and Report

Shaw proposes to use an instrument verification strip (IVS) approach to validate the EM61 MK2 sensor, positioning methods, and data acquisition protocol for this survey effort. The decision not to use the Geophysical Prove-Out Plan (GPO), previously installed by Shaw at Load Line 7, in lieu of an IVS approach was suggested by Baltimore during the Army-only Technical Project Planning (TPP) meeting on October 7, 2010. The agreed upon reason being that using IVSs at each MRS would be more representative and easier to manage the testing of equipment rather than having to use a GPO located away from the MRSs. The IVS constructed for the first seven MRSs, as part of the work plan (Shaw,2011b), will be used at the start of this project to validate the equipment and personnel. A letter report will be issued to the USACE and the Ohio EPA that documents the results of the IVS.



MRS Boundary (100% DGM Coverage)

Proposed Incremental Sample Decision Unit Location

Former Railroad

0 125 Feet

Projection : NAD_1983_UTM_Zone_17N

U.S. ARMY CORPS OF ENGINEERS
LOUISVILLE DISTRICT

MILITARY MUNITIONS RESPONSE PROGRAM

FIGURE NUMBER 3-8

GROUP 8 MRS DGM SURVEY AREA AND MC SAMPLING LOCATIONS
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

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Project Number: 136147

The IVS at each MRS will consist of two small industry standard objects (ISOs) and up to several inert MEC items of interest, or adequate simulants that are representative of the MEC items of interest. The ISOs will be buried at approximately 0.33 to 1 foot depth at vertical and horizontal orientations approximately 10 to 15 feet apart at each IVS in a "background" area (i.e., area void of subsurface metal and electromagnetic interference), and the positions will be recorded by an Ohio Registered Land Surveyor to an accuracy of 3 centimeters (cm). The ISOs will consist of 1-inch by 4-inch pipe nipples made from Schedule 40 black carbon steel from McMaster Carr Hardware (or equivalent) as shown in **Table 3-9**. The IVS construction will follow the guidelines in Chapter 3 of the DGM QC Guidance (USACE, 2003h).

Table 3-9
Proposed IVS Design

Item	Burial Depth (feet)	Orientation	Number of Items	Easting (feet)	Northing (feet)
Small ISO	0.33-1	V or I	1	TBD	TBD
Inert MEC, site specific	various	various	various	TBD	TBD

Notes:
I = inclined
ISO = industry standard object
MEC = munitions and explosives of concern
TBD = to be determined
V = vertical

The ISO at each MRS will be used to confirm the sensitivity of the geophysical instrumentation and adequacy of the data acquisition parameters (line spacing, sampling frequency, positioning system accuracy and precision, and sensor height above the ground surface) by comparing the sensor responses from the ISOs to standardized, physics-based models of the ISOs created specifically for munitions response projects by the Naval Research Laboratory (NRL). The inert munitions will be used to assist the interpreter in defining the initial anomaly selection criteria for the project, and multiple acquisition lines will also be collected at offset distances from the IVS in order to determine the site-specific "noise," which is an important component in determining the anomaly selection criteria. If above ground power line interference is present near any of the geophysical survey areas, static geophysical sensor data will be acquired prior to the initiation of survey activities so that the information can be incorporated into the anomaly selection criteria.

At the commencement of the project prior to data acquisition activities, the following preproject, instrument-specific tests will be performed and the results documented:

- **Equipment Warm-Up**: Most instruments require a few minutes to warm up before data collection begins to minimize sensor drift due to thermal stabilization effects. All

instruments will be allowed to warm up for at least 5 minutes before data collection. This procedure will be followed each time the instrument is powered up (e.g., at the start of the day, after breaks).

- **Record Sensor Position**: At the beginning of the survey, and thereafter at any changes in form factor, or when a sensor is reattached to a pole or cart, the relative positions of the geophysical sensors with respect to the positioning system antenna or prism will be measured (tolerance ± 1 inch) and documented, as will the platform or sensor height above the ground surface.
- **Static Background Test**: The Static Background monitors the instrument background readings and electronic drift, and identifies potential interference. With the instrument held in a static position, measurements are recorded for a period of 30 seconds (the initial test at the start of the project may be recorded for a duration of 3 to 5 minutes). At a minimum the test is performed at the beginning and end of each day. Static background readings for the EM61 MK2 will remain within 2 millivolts (mV) of background determined as the standard deviation of the measurements for all data channels. The results of the Static Background Test are digitally documented using the ShawGeo software or a Microsoft® (MS) Excel spreadsheet.
- **Static Response (spike) Test**: The Static Spike Test monitors the impulse response and repeatability of measurements over a standard test item. The standard test item is a 1 inch by 2 inch or 1 inch by 4 in pipe nipple. For the EM61 MK2, the standard test item is placed at a predefined location on the man-portable unit on a rigid bracket or tube and measurements are recorded for a duration of 30 seconds. Measurements for the response of the standard test item will be within 10 percent after subtraction of the sensor baseline response, calculated as a running average of the first four project tests (two days). The test is performed at the beginning and end of each day. The results of the Static Spike Tests are digitally documented using the ShawGeo software or an MS Excel spreadsheet.
- **Personnel Test**: The Personnel Test is performed to check the influence of personnel-carried metallic items (e.g., keys, boots, belt buckles) on the man-portable geophysical sensor. With the instrument held in static position, the man-portable operator(s) move while adjacent to the sensor while measurements are being recorded for a period of 15 seconds. The measurements for all data channels of the EM61 MK2 will remain within 2 mV of background determined as the standard deviation of the measurements for all data channels. The test is performed at the beginning and end of each day. The results of the test are digitally documented using the ShawGeo software or an MS Excel spreadsheet.
- **Cable Shake Test**: The cable shake test is performed for each man-portable sensor at the beginning and end of each day to document any cable or connection problems. With the instrument motionless and recording data, each data cable is gently shaken and cable connector is wiggled to test for shorts or bad connections. Data collected during the Cable Shake Test will be free from spikes greater than 2 mV for all EM61 MK2 data channels. The results of the Cable Shake Tests are documented by the field geophysicist as part of the Static Background Test. The results of the test are digitally documented using the ShawGeo software or an MS Excel spreadsheet.

- **IVS Repeat Data**: The repeatability of geophysical mapping data is monitored by the collection of replicate data over an IVS at the beginning and end of each day. The amplitude of the items whose long axes are oriented perpendicular to the path of instrument travel or those that are vertical will be greater than 75 percent of the average determined during the first run of the IVS. The position of each item whose long axis is oriented perpendicular to the track path, or those that are vertical will be within 1.1 feet of the known position. The results of the test are digitally documented using the ShawGeo software or an MS Excel spreadsheet.

The IVS constructed at Load Line 7 for the first seven funded MRSs will be used to perform the initial equipment validation. As mentioned previously, the results of the initial IVS will be submitted in a letter report to USACE and Ohio EPA for review and approval and will include, at a minimum, the following information:

- As-built map of the IVS
- Digital photographs of the inert and ISO seed items as used and in the open hole
- Graphical plots of the EM61 MK2 DGM system responses for the ISOs superimposed on the NRL standardized curves
- Color-coded maps of the geophysical data with track path superimposed
- Geophysical interpretation, including initial anomaly selection criteria
- Proposed geophysical equipment, techniques, and methodologies
- Recommended QC performance metrics

Shaw assumes that a USACE representative will be on site during the initial IVS to discuss results and provide real-time concurrence. Concurrence of the IVS results will be based on meeting the following metrics in the work plan (Shaw, 2011b) for the DGM system:

- Static background test
- IVS results
  - ISO response
  - interpreted position of known buried items
  - dynamic noise
- Known location check

As part of the IVS effort all instrument functional and quality tests will be digitally documented and stored in the project database for review by the client and stakeholders.

3.3.2 Personnel

For the geophysical survey at RVAAP, the field team will be comprised of the Site Geophysicist and an assistant. The field DGM team will report to the Senior Geophysicist, who is responsible

for the execution of the fieldwork and the entire DGM survey. The Senior Geophysicist, Tim Deignan, PGP, has more than the required 5 years of experience directly related to geophysics and reports directly to the PM.

The Site Geophysicist has overall responsibility for design, implementation, and management of the on-site DGM activities required for the work effort. The Site Geophysicist has a degree in geology, geological engineering, or a closely related field and a minimum of 2 years of directly related geophysical experience. Additional supervising geophysicists may be required to oversee the day-to-day operations of the site geophysical investigations. The supervising geophysicist shall have the same education requirements as the Site Geophysicist, except the 2 years minimum experience requirement is waived, if the supervisor is working under the general supervision of the Site Geophysicist. The Site Geophysicist will report to the Senior Geophysicist.

The QC Geophysicist is responsible for planning and executing QC oversight of geophysical activities and ensuring compliance with geophysical QC requirements. Specifically, the QC Geophysicist is responsible for the following:

- Reviewing and approving the qualifications of proposed geophysical staff and subcontractors
- Ensuring the performance of preparatory, initial, follow-up, and completion inspections for the definable geophysical features of work
- Planning and ensuring the acceptable performance and completion of all geophysical QC activities as specified in this work plan addendum
- Reviewing the DGM and instrument quality control test data in concert with the Senior Geophysicist
- Identifying nonconformance and verifying that appropriate root cause analysis and corrective actions are implemented for geophysical activities
- Ensuring that the requisite documentation, including submittals, is generated and retained as prescribed

The QC Geophysicist will have daily access to all geophysical QC and DGM data. It is expected that the QC Geophysicist will provide more detailed review at the onset of the project. The QC Geophysicist will report to the Senior Geophysicist and the Shaw PM.

3.3.3 Production Rates

DGM production rates are highly variable and depend on several factors including topography, vegetation, presence of water, site access, proximity of survey area to the mobilization area, and weather conditions. For full coverage surveys, it is anticipated that approximately 2 acres per day of EM61 MK2 data can be acquired over contiguous grids in "open" areas at a 2.5-foot lane

spacing. For transects it is estimated that 3 to 4 miles of data acquisition will occur per day in "open" areas void of thick vegetation.

A factor that may impact production rates is OHARNG training activities that may affect work at the various MRSs. Although these MRSs are not currently utilized by the OHARNG, activities in the vicinity may affect access and ability to work at them. In order to effectively coordinate with the OHARNG and avoid impacting any training exercises, Shaw will provide a weekly schedule to the OHARNG that includes the proposed work locations for the upcoming week. Shaw will work with the OHARNG to resolve any scheduling conflicts in a timely manner in order to avoid impacting work.

3.3.4 Site Conditions

3.3.4.1 Geology/Soils

The soils identified at RVAAP are generally derived from the Wisconsin-age silty clay glacial till, ranging in permeability from 6.0×10^{-7} to 1.4×10^{-3} centimeter per second (cm/s). In Portage County, sand and gravel aquifers are present in the buried valley and outwash deposits. No magnetic soils that would significantly alter the results of the time domain electromagnetic or magnetic techniques proposed are anticipated.

3.3.4.2 Topography and Vegetation

RVAAP contains rolling topography with incised streams and dendric drainage. The majority of the MRSs to be assessed are undeveloped and forested, although there are larger contiguous areas void of thick vegetation at some of the MRSs where geophysical surveys will be performed.

3.3.4.3 Manmade Features

Most of the MRSs where geophysics will be performed are located within undeveloped areas and there are no major buildings and roads. Man-made features existing within or in close proximity to the DGM survey areas have the potential to negatively impact geophysical investigations. These features include, but are not limited to, utility corridors; buried pipes, cables, and radio transmitters; above and below ground power lines; fences; trash dumpsters; monitoring wells; benches; metal signs; buildings; vehicles; firing targets; bunkers; berms, and slag-covered roads or railroad beds. All of these features may introduce noise in the DGM data. Therefore, the position of these features will be accurately documented with the proposed positioning system(s) so that they can be accounted for during the interpretation.

In areas where power lines or radio transmitters are present, static noise tests may be performed prior to large-scale mapping efforts in order to assess the impact of these features on the DGM data. Modifications to the existing DGM system (e.g., data acquisition platform, data processing parameters, and interpretation criteria) may be performed in areas where the source of the noise

can be mitigated by changes to existing protocol. Any changes to the DGM system during the project will be documented in the digital project files (e.g., Oasis Montaj™ processing log).

3.3.4.4 Site-Specific Dynamic Events

Dynamic events (e.g., rain, lightning, solar flares) may temporarily impact geophysical data collection and/or data quality. Procedures for these anticipated events are as follows:

- **Rain**: Depending on its intensity, rain may be an impediment to survey operations. The Site Geophysicist will assess the intensity of rainfall and its effects on survey instrumentation and safety (slip, trip, and fall) considerations to determine when or how to proceed. General guidance for common conditions is as follows:
  - **Drizzle or Intermittent Light Rain**: Check electrical tape around electronic connections and continue.
  - **Continuous Medium or Heavy Rain**: As necessary, take cover and cease operations until conditions improve.
- **Lightning**: Because most geophysical instruments contain sufficient metal and geometry to pose a preferred pathway for electrical discharge (lightning rod effect), observed lightning in the area will be deemed a safety hazard and will be cause for the cessation of survey activities until the lightning activity has ceased. Shaw will utilize a lightning detector as an adjunct to visual and auditory observations. Site personnel and equipment will shelter in a safe area. The Site Geophysicist will make the determination that lightning is present and will log the times when MRS survey activities are shut down and resumed. Lightning safety is discussed further in Section 9.21.2 of the APP addendum (Shaw, 2011c).

3.3.4.5 Potential Worker Hazards

All site personnel will adhere to the practices, procedures, and training and monitoring requirements mandated by the APP and SSHP addendums provided under separate cover. Because of the potential MEC hazard, UXO-qualified personnel may perform a surface sweep of the areas of interest prior to DGM activities such that instrument operators may proceed with survey activities without requiring active UXO escort. Alternatively, a UXO-qualified technician may accompany the DGM teams and provide real-time escort if the location of the transects is uncertain. A UXO-qualified Technician III or higher will be onsite for the duration of all geophysical investigation activities.

3.3.4.6 Access Issues

Site conditions pose challenges in terms of MRS accessibility. The following general site conditions and remedies are expected at most remote MRSs:

- **Remote Access**: Approximately 60 percent of RVAAP is covered by forest or tree dominated vegetations. The sites will be accessed by vehicles daily. All vehicles will stay on hardened roads, trails, or former railroad beds.

- **Poisonous Plants**: To the maximum extent possible, these plants will be avoided during the surveys. If possible, they will be removed prior to surveying by brush cutting.
- **Sensitive Habitats:** Shaw will coordinate with the RVAAP, OHARNG Camp Ravenna environmental office, and Ohio EPA prior to conducting activities that may impact sensitive habitats (i.e., forested areas, wetlands, streams, ponds, grasslands, areas with threatened and/or endangered species, etc).
- **Thick Vegetation**: The removal of any thick vegetation from forested areas or grasses will be coordinated with the OHARNG prior to activities. Areas with high grass may only be mowed prior to April or after August due to the potential for disturbing grassland nesting species.
- **Wooded Areas**: Approximately 60 percent of the facility is forested. Investigative activities will occur in forested areas on several MRSs. No forested areas will be disturbed without the approval of RVAAP and/or Camp Ravenna staff.
- **Surface Water Features (i.e., ponds, wetlands, and streams)**: Surface water features such as ponds, wetlands and streams may cause access issues within MRSs. Portions of surface water features within Erie Burning Grounds and the Fuze and Booster Quarry will be specifically investigated as part of the RI activities. Access to surface water features within other MRSs will be limited and mainly include transient access. No vehicles or heavy equipment will access surface water features on the facility.

3.3.5 Survey Control

A preexisting survey monument established by a licensed Ohio surveyor of third order horizontal accuracy (residual error less than or equal to 1 part in 10,000) will be used to provide position information for the DGM survey either directly or by using the monument as a source to generate additional control points near the DGM survey areas. If control points are generated during the DGM activity, they will be validated by occupying at least one other independent control point within RVAAP. The tolerance for this procedure is ± 0.5 foot.

A system of 1D transects (less than 100 percent MRS coverage) or 2D (full coverage of an MRS) grids will be generated over the survey areas prior to DGM activities. The location of each transect endpoint or grid corner will be predefined using the project geographic information system (GIS), and the coordinate data will be uploaded to a survey-grade RTK GPS or RTS system for stakeout in the field by the field crew. A metal nail (e.g., 16 penny) or 6 to 8-inch rebar section will be placed at some transect endpoints or "full coverage" grid corner and a unique grid identifier written on a section of survey lathe or a small tag. The actual survey coordinates as staked in the field will be digitally recorded and uploaded to the project database.

The metal nails at each grid corner or some of the transect endpoints will be used as control point locations for the RTS (if used) as well as a quality control check for the positioning accuracy and repeatability of the DGM surveys. All mapping will be developed in the North American Datum (NAD) 1983 Universal Transverse Mercator (UTM) Zone 17N Coordinate System.

3.3.6 DGM System

3.3.6.1 EM61 MK2 Geophysical Sensor

The Geonics EM61 MK2 is a 4-channel high-sensitivity Time-Domain Electromagnetics (TDEM) sensor designed to detect ferrous and nonferrous metal objects with good spatial resolution and minimal interference from adjacent anomalies and above ground metallic features. TDEM sensors work by utilizing a transmitter that generates a pulsed primary magnetic field in the earth, which induces eddy currents in nearby metallic objects. The eddy current decay produces a secondary magnetic field measured by the receiver coil of the EM61 MK2. Measurements are recorded a relatively long time after the primary pulse at specified time gates. This allows the current induced in the ground to have dissipated, leaving only the current in the metal to still produce a measureable secondary field.

The EM61 MK2 consists of two air-cored, 1-meter by 0.5-meter rectangular coils. Secondary voltages induced in both coils are measured in mV. The coils are stacked 40 centimeters (cm) apart, with the source/receiver coil located below a second receiver coil. The EM61 MK2 records a voltage output from both coils, as well as a differential that is the calculated voltage difference between the two coils. The EM61 MK2 data will be collected at a rate of approximately 15 hertz (Hz) and the positioning data will be acquired at a rate of 1 Hz. Both sensor and position data will be simultaneously logged and time stamped using a Juniper Allegro or CX data logger using the EM61 MK2 software.

The EM61 MK2 was designed to detect individual small items at shallow depths and relatively larger items (e.g., 155mm projectile) at depths approaching 5 to 7 feet. The resulting data can be used to differentiate, in simplistic fashion, the relative size and distance (or depth) of metal items when the anomaly density is relatively low. In cluttered areas where the anomaly density is relatively high (e.g., burial pits, trenches, etc.) and the anomaly signatures overlap, the determination of size and depth is much more difficult.

3.3.6.2 Positioning Methods

In open areas void of tall vegetation and canopy, RTK GPS will be used to provide position information for the geophysical measurements. In areas where there is interference from tree canopy an RTS or the fiducial method may be used to provide positioning data for the geophysical measurements.

A Leica RTK GPS System 500 or 1200 will be used for spatial positioning over a high percentage of the open areas at the MRS. The proposed RTK global positioning system utilizes a base station that is set-up on a known position. Once the base station is set-up, it determines its location using satellites and then applies a correction based on the offset from the known coordinates at the location. This correction is then used by a rover that is in direct communication with the base station through a radio link. The rover should be within 6 to 10 miles of the base station and have line of sight for optimum operation. The Leica System 500

and 1200 RTK GPS units are capable of recording survey-grade measurements in real time and providing immediate accuracy to within approximately five cm.

The Leica TPS1200 is a motorized RTS that uses automatic target recognition to track the location of the prism and has a highly accurate distance/azimuth measurement system to produce ± 2mm accuracy. The RTS system hardware consists of three integrated components: (1) the Leica TPS1200 dual-laser RTS, (2) the RTS rover remote link control panel, and (3) a survey prism that is tracked by the RTS base station. The position data are recorded onto a data storage card on the RTS. The data storage card can be used to transfer position data between the RTS and field computers. For DGM, RTS navigation data can also be output as a real-time data stream via a serial adapter from the remote link to the geophysical sensor's data logger.

The fiducial method relies on data collection in a straight line between two known (geo referenced) locations and the sensor measurements are translated from relative distance traveled from the origination location into actual geo referenced coordinates using the state planar or UTM locations of the known locations. In order to provide accurate position data, the terrain between the two known locations should be relatively flat and smooth.

The wheel counter technique uses an internal counter attached to the lower EM61 MK2 coil to collect data measurements every 10 cm (4 inches) of distance traveled. The EM61 MK2 system is pulled in a straight line between two known (geo referenced) locations and the sensor measurements are translated from relative distance traveled from the origination location into actual geo referenced coordinates using the state planar or UTM locations of the known locations. In order to provide accurate position data, the terrain between the two known locations should be relatively flat and smooth.

The determination of the specific positioning method used in areas of canopy (RTS, fiducial, or wheel counter) will be addressed during reconnaissance activities during the initial stages of the field program. In addition to providing position data for the geophysical sensor measurements, the RTS or GPS will be used for other location tasks including:

- **Feature Identification**: The RTS or GPS will be used to augment geophysical data and improve geophysical mapping through capture of visual observations made during MRS walk-overs. During this process, RTS or GPS will be used to record the positions of cultural features (e.g., fences, vehicles, wells, structures, manhole covers, above-ground utilities, sign posts) so that these features can be accounted for during the interpretation of the geophysical data.
- **Anomaly Relocation**: RTS or GPS will be used for anomaly relocation (if necessary) in order to optimize the placement of any sample locations. The "Waypoint-Mode" feature for these units facilitates quick and reliable relocation for each anomaly.

Position data for the project will be reported in NAD 83 UTM Zone 17N coordinate system in units of US Survey meters in order to be compatible with existing MRS information and data.

3.3.6.3 Data Acquisition and Survey Methodology

Based on the existing historical information at the Erie Burning Grounds, Fuze and Booster Quarry, 40mm Firing Range, Sand Creek Dump, Water Works #4 Dump, and Group 8 MRSs, Shaw anticipates that: (1) MEC will not be found in large-scale burial trenches or pits, (2) munitions related features of interest (e.g., range fans, bomb targets, etc.) are not present, and (3) small and large MEC items are homogeneously distributed throughout the MRS and may be present at variable depths. Based on this information, the EM61 MK2 is the best instrument for detecting both small and large MEC items at variable depths and is proposed for use at Erie Burning Grounds (1D transects) and 40mm Firing Range (1D transects), as shown in **Figures 3-1** and **3-3**, respectively. In addition, 2D full coverage will be performed at all accessible areas at the Fuze and Booster Quarry, Sand Creek Dump, and Water Works #4 Dump, and Group 8 MRSs.

DGM data will be collected using the performance metrics specified in Section 3.3.12 to ensure the information is of sufficient quantity and quality to meet the project objectives. **Table 3-10** presents the DGM equipment and methods, MRS acreage and the percent acreage that will be covered for the four MRSs where full-coverage DGM activities will be performed.

Table 3-10
Summary of the Digital/Analog Geophysical Mapping Effort

MRS Name	DGM Sensor Equipment	Positioning	DGM Method	Size of MRS (acres)	DGM Area Covered (acres)	DGM Percent Coverage
Erie Burning Grounds	EM61 MK2	RTK GPS/RTS/ Fiducial	1D Transects	33.93	5.2	15.4
Fuze & Booster Quarry	EM61 MK2 or digital magnetometer (as necessary in water)	RTK GPS/RTS/ Fiducial	2D Full Coverage	4.92	4.92	100
40mm Firing Range	EM61 MK2	RTK GPS/RTS/ Fiducial	1D Transects	1.27	0.1[1]	9.0
Sand Creek Dump	EM61 MK2	RTK GPS/RTS/ Fiducial	2D Full Coverage	0.85	0.85	100

MRS Name	DGM Sensor Equipment	Positioning	DGM Method	Size of MRS (acres)	DGM Area Covered (acres)	DGM Percent Coverage
Water Works Dump #4	EM61 MK2	RTK GPS/RTS/ Fiducial	2D Full Coverage	0.77	0.77	100
Group 8 MRS	EM61 MK2	RTK GPS/RTS/ Fiducial	2D Full Coverage	2.65	2.65	100

Notes:

1D = one dimensional

2D = two dimensional

DGM = digital geophysical mapping

GPS = global positioning system

MRS = Munitions Response Site

NA = not applicable

RTK = real-time kinematic

RTS = robotic total station

[1]*The percent DGM coverage at the 40mm Firing Range MRS is based on coverage within the actual 1.27-acre MRS only. DGM coverage is being expanded to investigate an additional 7.28 acres outside of the MRS that includes the boundaries of the former firing range and is not included in this table.*

The general DGM procedures at each MRS will consist of the following:

- Review the DGM survey area by performing a MRS walk-over. Pay special attention to difficult terrain and the presence of obstacles, which create potential safety issues.
- Set up the applicable positioning system at a documented control point of known location or determine location by using a minimum of two known control points (e.g., RTS). Confirm location control via at least one "check shot" to a different control point of known location.
- Perform DGM system instrument functional and quality checks and document results.
- For 2D full coverage surveys systematically survey the MRS in the most effective pattern based on the terrain, vegetation, and obstacles present. The survey pattern will consist of consecutive sensor passes at the designated lane spacing, using the navigation techniques proven at the IVS.
- For 1D transect surveying, use physical (e.g., survey lathe or pin flags, traffic cones) or virtual (lateral offset designated on RTK GPS or RTS screen) waypoints and follow specified transect paths while avoiding obstacles and unsafe terrain.
- Use digital field logs to document MRS conditions during data collection. The field logs will include information and observations regarding the data collection process, weather, field conditions, data acquisition parameters, and quality checks performed.

At the end of each day's activities, the DGM data will be uploaded to a laptop at the MRS for initial quality control checks and data processing. These data will be backed up on the Shaw network and transferred to the Shaw processing center where they will be analyzed and interpreted. Raw and final processed data will be transferred to USACE at intervals specified in DID MR-09-004, *Geophysics* (USACE, 2009b).

Erie Burning Grounds and 40mm Firing Range

The UXO Estimator© software was used to determine the sampling strategy for Erie Burning Grounds MRS based on the homogeneous distribution of MEC anticipated and the size of the MRS. The transects at Erie Burning Grounds MRS are randomly spaced per the UXO Estimator© output. The VSP© program was used to determine the sampling strategy for the 40mm Firing Range MRS based on the minimum transect spacing required for target traversal. A 10-meter transect spacing was used for the 40mm Firing Range MRS based on the typical target diameter of 2 to 10 meters for a firing range and the assumption that not every round hit its target when the range was in operation.

For the DGM surveys at the Erie Burning Ground and the 40mm Firing Range MRSs, Shaw anticipates using a single EM61 MK2 sensor on wheels (or two person tethered or stretcher carry) that is transported across the area to detect metal items. The positioning system sensor (RTK GPS antenna or RTS prism) will be mounted directly over the center of the EM61 MK2 coils. 1D transect DGM survey methodology will be used to collect geophysical data at a uniform spacing across these MRSs. Data collection lines will be approximately parallel and spaced at specific locations across the MRS. Along each 1D transect positioning system, data will be recorded at a minimum rate of 1 Hz and the EM61 MK2 measurements will be recorded at a rate of approximately 15 Hz, which translates to a measurement sample density along the ground surface of approximately 4 to 6 inches. The DGM data will be digitally recorded using Geonics® software that resides on a Juniper Allegro or CX data logger.

The EM61 MK2 test protocol specified in the Section 3.3.12 will be followed during survey activities. In densely wooded areas it may be necessary to utilize fiducial or "wheel mode" positioning to locate the geophysical sensor measurements. The distance between successive waypoints will not exceed 150 to 200 feet, and each waypoint coordinate will be location-surveyed with the RTS (or RTK GPS, if possible) to an accuracy of less than 20 percent of the average distance between transects. The instrument operator will walk a constant pace between each survey lathe and the EM61 MK2 measurements will be interpolated between the known coordinates.

If real-time excavation of the geophysical anomalies occurs in the densely wooded areas, the DGM and positioning data will still be recorded along the transects to develop anomaly density estimates. However, the positioning of the sensor measurements will not be compared to the performance metrics for DGM.

At locations in the Erie Burning Grounds MRS where water depth is less than 2 feet, float mounted DGM will be performed. In areas with water depth greater than 2 feet, former U.S. Navy EOD divers will perform the geophysical investigations in accordance with the Shaw *Dive Operations Plan* in the APP addendum (Shaw, 2011c). The extent of float mounted geophysical investigation and former U.S. Navy EOD diver geophysical investigations will be dependent on site conditions at the time of the survey; however, the majority of the wetland areas at the Erie Burning Grounds MRS are less than 2 feet deep and the expected percent coverage is approximately 15 percent.

Fuze and Booster Quarry

For the DGM survey at the Fuze and Booster Quarry, land based DGM will be used in the areas surrounding the three ponds. The equipment used will consist of a single EM61 MK2 sensor on wheels (or two person tethered or stretcher carry) that is transported across the area to detect metal items. The positioning system sensor (RTK GPS antenna or RTS prism) will be mounted directly over the center of the EM61 MK2 coils. Full coverage (i.e., 2D grid) DGM survey methodology will be used to collect the geophysical data. Data collection lines will be parallel and spaced at 2.5 to 3-foot intervals over the survey area, with no lines separated by more than 3.5 feet except around existing obstacles. Along each acquisition line positioning system data will be recorded at a minimum rate of 1 Hz and the EM61 MK2 measurements will be recorded at a rate of approximately 15 Hz, which translates to a measurement sample density along the ground surface of approximately 4 to 6 inches. The DGM data will be digitally recorded using Geonics software that resides on a Juniper Allegro or CX data logger.

The EM61 MK2 test protocol specified in the Section 3.3.12 will be followed during survey activities. Navigation will be performed using a system of nonmetallic measuring tapes and traffic cones (or spray paint marks on the surface) spaced at regular intervals that are utilized as "waypoints" during data acquisition activities to ensure the line spacing is maintained.

At locations in the existing ponds where water depth is less than 2 feet, float mounted DGM will be performed. In areas with water depth greater than 2 feet, DGM equipment may be submerged in the water to identify anomalies, and/or former U.S. Navy EOD divers will perform the geophysical investigations in accordance with the Shaw *Dive Operations Plan* in the APP addendum (Shaw, 2011c). The extent of float mounted geophysical investigation and former U.S. Navy EOD diver geophysical investigations will be dependent on site conditions at the time of the survey; however, 100 percent investigation coverage of the pond areas is expected.

Sand Creek Dump, Water Works #4 Dump, and Group 8 MRS

For the DGM survey at the remainder of the areas at the Sand Creek Dump MRS that were not covered as part of the 2010 DGM investigation and the 100 percent surveys at the Water Works #4 Dump and Group 8 MRSs, a single EM61 MK2 sensor on wheels (or two person tethered or stretcher carry) that is transported across the area to detect metal items will be used. The

positioning system sensor (RTK GPS antenna or RTS prism) will be mounted directly over the center of the EM61 MK2 coils. Full coverage (i.e., 2D grid) DGM survey methodology will be used to collect the geophysical data. Data collection lines will be parallel and spaced at 2.5 to 3-foot intervals over the survey area, with no lines separated by more than 3.5 feet except around existing obstacles. Along each acquisition line positioning system, data will be recorded at a minimum rate of 1 Hz and the EM61 MK2 measurements will be recorded at a rate of approximately 15 Hz. This translates to a measurement sample density along the ground surface of approximately 4 to 6 inches. The DGM data will be digitally recorded using Geonics software that resides on a Juniper Allegro or CX data logger.

The EM61 MK2 test protocol specified in the Section 3.3.12 will be followed during survey activities. Navigation will be performed using a system of nonmetallic measuring tapes and traffic cones (or spray paint marks on the surface) spaced at regular intervals that are utilized as "waypoints" during data acquisition activities to ensure the line spacing is maintained.

3.3.7 Data Processing

Data processing includes verifying the validity of the data using the performance metrics, assessment of the track path and spatial sample density, latency correction, data leveling, and color-coded image generation. Shaw will use software from the equipment manufacturers, in-house software (ShawGeo), and Geosoft Oasis Montaj™ to complete data processing tasks. Subsequent to the processing and review of the data, color-coded images of the geophysical sensor data will be transferred into the project GIS.

Vendor-supplied software will be used during the initial review of the data. This step validates that the data are generally representative of the MRS conditions. The final step during the initial review is the output of a digital file is correctly formatted for transfer into Geosoft Oasis Montaj™.

The processing steps in Oasis Montaj™ begin with assessing the data in terms of the performance metrics. After it has been ascertained that the sensor and position equipment are functioning properly, the spatial sample density and position accuracy of the data set is evaluated by ensuring that the survey area matches the dimensions and accurately fits within the predefined survey area. The final steps of data processing include a latency correction, leveling of the data to a common background, and generation of color-coded images for interpretation.

The DGM sensor and position data will be recorded in the field using Geonics software that resides on the Juniper Allegro or CX ruggedized data logger. At the end of each field day the field geophysicist will upload the DGM data to the MRS computer where the data will be archived, backed-up, and transferred to the Shaw processing center for final processing and analysis.

Shaw will utilize the following software to process the data:

- Geonics DAT61MK2 for review of data ranges and output of a sensor and position file in ASCII format
- Geosoft Oasis Montaj™ for latency correction, data leveling, interpolation (gridding) and generation of color-coded images, and statistical analysis of the data in terms of the performance metrics such as spatial sample density, static, static spike, and IVS tests
- ShawGeo (or Excel spreadsheet) to digitally document all data collection and processing parameters, as well as conformance with the performance metrics for the project
- Leica GeoOffice may be utilized for location survey and cultural feature mapping tasks, as well as for statistical review of position data

Geosoft Oasis Montaj™ will be the primary software utilized for most data processing tasks. The Oasis processing log file (process.log) will be recorded by the software and serve as the digital documentation, along with ShawGeo (or Excel spreadsheet), for the processing parameters used for each data acquisition session. The performance metrics included in the Excel output are presented in an example worksheet in **Appendix E** in the work plan (Shaw, 2011b).

3.3.7.1 Data Organization, Initial Processing, and Data Tracking

The data processing begins by organizing the data on the Shaw server using the following structure:

RVAAP
    Geodata
        041610 (April 16, 2010)
            Raw
            Proc

The raw data for the EM61 MK2 are stored in the "raw" folder and will be copied to the "proc" directory for further processing and are never compromised so the sequence of events can be reconstructed in the future, if necessary. The raw binary data are converted to an ASCII format using the DAT61MK2 software and concurrently reviewed to ensure the sensor and positioning equipment are functioning properly, that the data are accurately positioned along survey lines and corrected for acquisition geometry and that they match the MRS dimensions and properly fit within the predefined survey MRS.

The final step of the process includes output of an ASCII "XYZ" file that includes the coordinates (NAD 83 UTM Zone 17 N, feet or m), four data channels for the EM61 MK2, a time stamp, and a quality indicator for the RTK GPS positioning device when used. The format of the "XYZ" file will be consistent for the project and compatible with Oasis Montaj™.

The daily quality control tests and other events pertinent to the DGM survey (e.g., areas surveyed, weather, acquisition file names, operators, data processing sequence, and parameters) are tracked using the ShawGeo software or an MS Excel spreadsheet/Access database.

3.3.8 Review of Quality Control Data

The ASCII data from the initial processing are imported into Oasis Montaj™ using a predefined processing script. The QC data for each data acquisition session are reviewed by the data processor to document compliance with the project performance metrics. The general steps performed include the following:

- **Review of Geophysical Sensor Quality Data**: Sensor test results (static and dynamic background, static spike tests, cable shake test, personnel test, and IVS repeat data) for the EM61 MK2 will be reviewed to ensure proper system function. This step validates the repeatability and sensitivity of the EM61 MK2 in terms of the standard response to known items in both static and dynamic modes of operation, as well as provides information on the background noise in the survey area for the EM61 MK2. Conformance with the performance metrics specified in the Section 3.3.12 is digitally documented for each data acquisition session.
- **Review of Position and Spatial Sampling Quality Data**: Positioning system and spatial sample density test results (static position, comparison with a known control point, and along and across track measurement spacing for full coverage surveys) will be reviewed to ensure proper system function and determine any spatial data gaps. This step validates the repeatability and accuracy of the positioning system as well as the overall data acquisition protocol in terms of the navigation procedures used during field execution. Conformance with the performance metrics specified in the Section 3.3.12 is digitally documented for each data acquisition session.

For each data acquisition file a unique line code will be entered into the Oasis Montaj™ database that documents the date of acquisition, responsible crew, and the DGM system used.

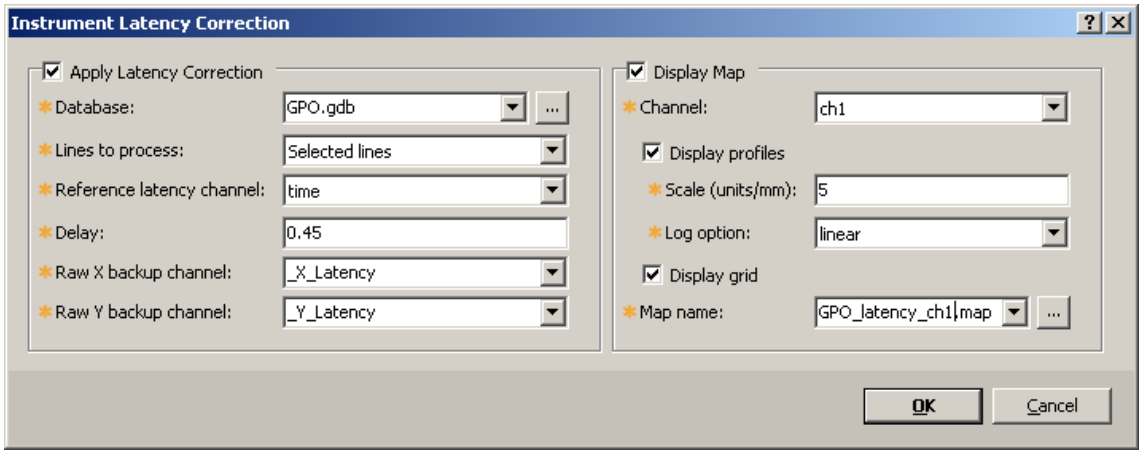
3.3.9 Final Data Processing

The data processor will utilize a predefined Oasis Montaj™ script for each data acquisition file to (1) correct the data for latency, (2) level the EM61 MK2 data to a common background (drift removal) using a median filter or the UX Process drift correction tool, and (3) interpolate the EM61 MK2 data channels to generate color-coded images used for analysis and interpretation. It is anticipated that the minimum curvature gridding routine (or nearest neighbor) will be used to interpolate the data. The color-coded images will be transcribed onto the plan map of the MRS created and maintained by the Shaw GIS department for analysis and interpretation. For the 1D transect data the profile viewer in Oasis Montaj™ will be used to analyze the data.

The specific processing parameters selected by the data processor are based on a review of each dataset and may differ based on the response of the instrumentation in specific areas of the MRS (e.g., high density anomaly area versus low anomaly density area, influence of anthropogenic noise sources from utilities or power lines). The Oasis Montaj™ processing log file contains the data processing parameters used and will be recorded during the processing of each data acquisition session. The Oasis Montaj™ processing logs will be maintained throughout the

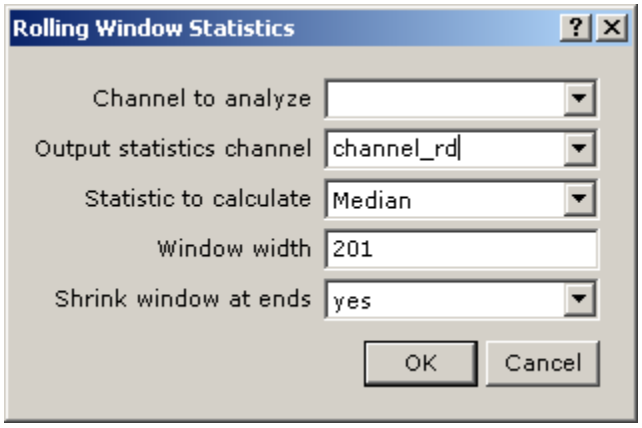
duration of the project on the Shaw server. Examples of data processing parameters are included below in Figures **3-9** through **3-12**.

Figure 3-9
Latency Correction (EM61 MK2 channels 1 through 4)



The actual value for the EM61 MK2 latency correction is based on the IVS repeat line. A value of 0.35 to 0.45 seconds is common.

Figure 3-10
Drift Correction (EM61 MK2 channels 1 through 4)



The median-filtered data from the process above are subtracted from the original channel data to generate the drift-corrected data. The length of the EM61 MK2 median filter in this example is for a low anomaly density area (<50 anomalies per acre). The UX process drift correction method (ucedrift.gx) may be substituted for the median filter based on the IVS results. If used, Shaw anticipates the following parameters will be utilized:

Figure 3-11
UX Process Drift Correction Method Parameters

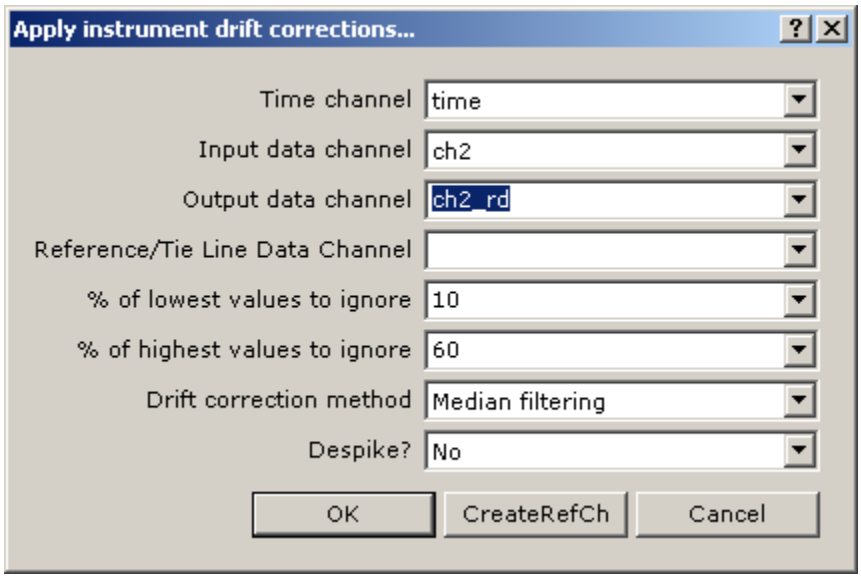
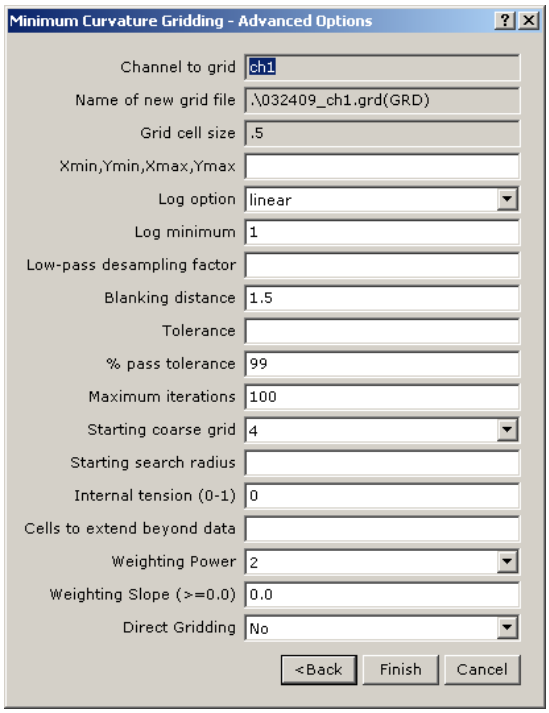


Figure 3-12
Data Interpolation (EM61 MK2 channels 1 through 4)



Value of 0.5 assumes units are feet. Blanking distance selected will show "white" on color-coded image for areas where lane spacing exceeds 3 feet for the EM61 MK2.

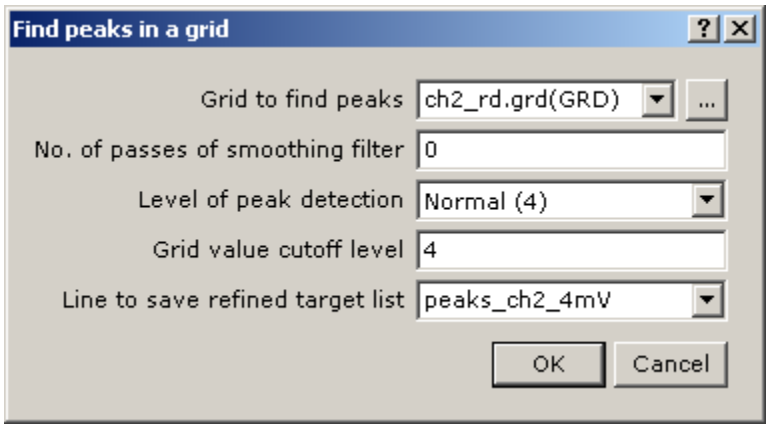
Additional tasks during the final data processing include deletion of turnarounds and overlapping data past the edge of the defined data acquisition area (i.e., 2D grid edges) and examination of the data with respect to the location of cultural or natural features (e.g., wells, trees, utilities) observed on MRS base map. If any data gaps are present at an MRS requiring full coverage EM61 MK2 survey (i.e., Fuze and Booster Quarry, Sand Creek Dump, Water Works #4 Dump, and Group 8 MRSs) the data processor will digitize the area and transfer the coordinates to the Site Geophysicist for subsequent data acquisition. The location of data gaps will be recorded in an Oasis Montaj™ database and the project database within the GIS. The final processed data will be copied to a "master" Oasis Montaj™ database for the project to track the data acquisition process on a daily basis and to allow continual review of the data by the QC and Senior Geophysicist in an efficient manner.

The raw and final processed data for each data acquisition session will be provided to the USACE for independent interpretation/evaluation at intervals specified in DID MR-09-004 (USACE, 2009b) and at the end of the geophysical phase of the project. A secure Shaw ftp site for the RVAAP project will be used to transfer the DGM data.

3.3.10 Anomaly Selection

For all MRSs where an EM61 MK2 is used, a dig sheet will be generated that contains, at a minimum, the required information specified in DID MR-09-004 (USACE, 2009b). For the EM61 MK2 data acquired over 2D full coverage grids, anomalies are selected via a two-step process: (1) initial automated selection and (2) manual selection by a qualified geophysicist. The first step is automated anomaly selection based on a predefined signal intensity threshold. The Oasis/Montaj™ program "gridpeak.gx" (or the Blakely method in UX Process) is an industry standard application that Shaw will use for threshold selection using interpolated data for EM61 MK2 channel 2. Based on the RVAAP IVS results, the MEC potentially present in the survey areas, and our previous MMRP experience, it is anticipated that a signal intensity of approximately 4 to 5 mV will be used for the Channel 2 data. The NRL detection curves will also be used to exhibit the depth of detection for specific MEC items at a selected signal intensity. Automatic selection of anomalies using a computer algorithm, as shown in **Figure 3-13**, is implemented as a quality control tool to minimize the occurrence of human error in the decision process.

Figure 3-13
Automatic Selection of Anomalies



Along transects, 100 percent of the anomalies are anticipated to be excavated and the classification of anomalies will be "dig" or "no dig" based on a signal intensity of approximately 4-5 mV for Channel 2. Where there is evidence of an elongated object at horizontal orientation parallel to the acquisition path (characteristic "double peak" response) the comment "elong" will be entered by the data interpreter, and the excavation results for these anomalies will be tracked so that the information, if shown useful, can be utilized to prioritize anomalies in areas where only a portion of the anomalies are specified for investigation. Prioritization of anomalies for transects will be "dig-elong," "dig," and "no dig," with a respective prioritized ranking of 1, 2, and 3, respectively.

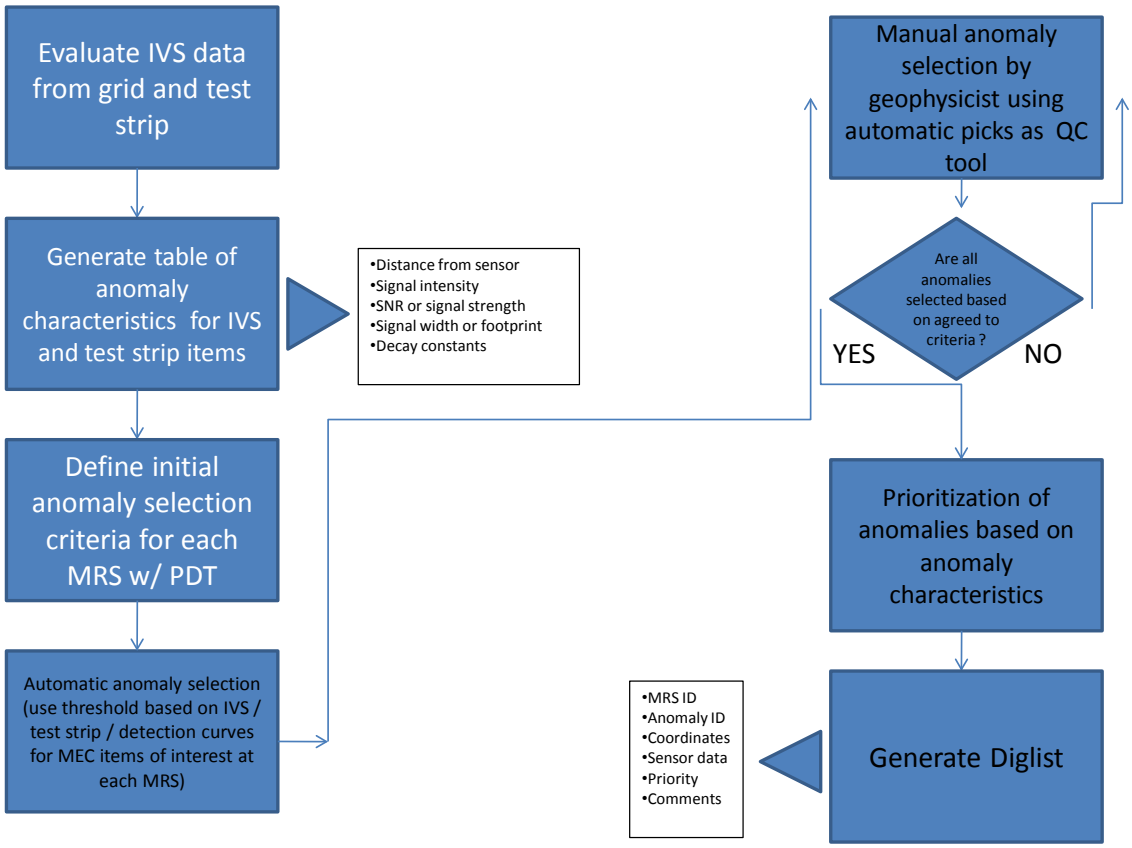
For "full coverage" DGM data collected in areas of low to medium anomaly density where anomaly signatures do not overlap, anomalies will be classified based on four primary attributes; signal intensity, anomaly footprint, signal shape (e.g., "elong"), and time constant. The attributes for the MEC of interest will be determined from the site-specific IVS as well as the Shaw database of IVS results from MMRP investigations at the first seven MRSs.

Prioritization of the classified anomalies will depend on the total number of anomalies present and the specific types of MEC that are native to the MRS. In full coverage survey areas with extremely high anomaly density, random selection of a percentage of the anomalies is anticipated. Hypergeometric statistics are proposed to determine the number of anomalies to sample from the total anomaly population above the signal threshold. This population will be prioritized using a ranking system of 1, 2, 3, or 4 with 1 being the most MEC-like and 4 being the least MEC-like based on the attributes. It is likely that the classification and prioritization scheme will be modified during project execution based on the feedback process at each MRS and input from the Project Delivery Team.

The manual selection process uses the information from the automatic selection process as well as other significant anomaly characteristics such as the anomaly size (footprint) and shape, signal

to noise ratio (SNR), time constants, IVS results, and presence of surrounding anomalies. Using the automatically selected anomalies as a guide, the interpreter will digitize the optimum excavation location for each anomaly; a "target" GDB (Oasis Montaj™ database) is automatically updated with the anomaly selections during this process. The signal strength, SNR, and size (footprint) of each anomaly for the 2D full coverage data will be determined using the "uceanalysetarget.gx." Based on Shaw's past experience with "uceanalysetarget.gx," the interactive mode for determining the background will be used. If the anomaly density is relatively high and a large percentage of the anomaly signatures interfere with one another, then "uceanalyse.gx" will not be used. A flow chart depicting the manual selection process is presented in **Figure 3-14**.

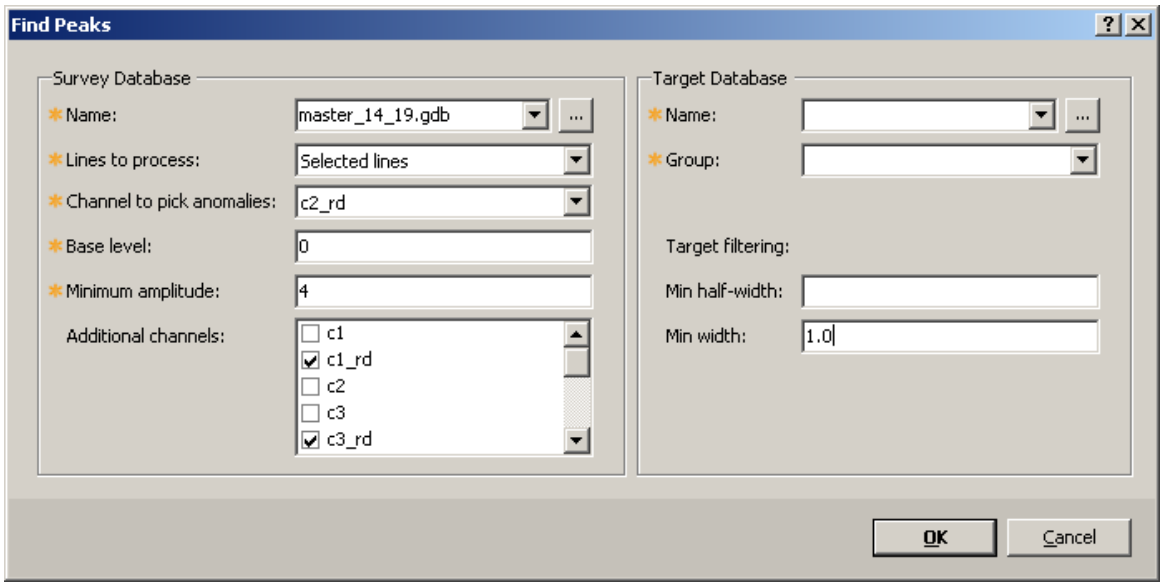
Figure 3-14
EM61 MK2 Anomaly Selection and Prioritization Process



Notes:
IVS = instrument verification strip
MEC = munitions and explosives of concern
MRS = munitions response site
PDT = project delivery team
QC = quality control

1D transect data will be analyzed using the "uceanompick.gx." The interpreter will interactively analyze the data and results using the profile window in Oasis Montaj™ as is shown on **Figure 3-15**.

Figure 3-15
Profile Window in Oasis Montaj™



The final product for the 2D full coverage and 1D transect surveys is a dig sheet for each grid or area that includes at a minimum the grid and MRS designator, a unique identifier for each anomaly location, easting and northing coordinates, sensor data for channels 1 through 4 of the EM61 MK2, and a prioritized ranking. Each anomaly on the dig sheet will have a unique anomaly identifier.

Important factors that are considered during the interpretation process include the following:

- Data Acquisition methodology (1D or 2D)
- Types of MEC most likely present based on historical data
- 1D and/or 2D anomaly shape and signal intensity in relation to the spatial sample density (along track and across track)
- Anomaly time constants
- Local background conditions
- Presence of surrounding anomalies (anomaly density)
- Presence of cultural features and sources of interference
- Anomaly characteristics from the IVS items

3.3.11 Anomaly Reacquisition

Reacquisition consists of relocating the interpreted coordinates for each anomaly on the dig sheet. To locate the ground position of the interpreted anomaly coordinates, the navigational system "Waypoint Location" mode will be used for the RTK GPS or RTS positioning system. A nonmetallic pin flag, labeled with the unique anomaly identification, will be placed in the ground at the interpreted location.

Reacquisition of any sampling or dig sheet locations (i.e., interpreted location) will be performed to ± 0.5 foot of the coordinates specified on the dig sheet. This location will be the initial origin for the further evaluation of the anomaly using an EM61 MK2 or handheld sensor. For anomalies detected in full coverage surveys, a 3-foot radius around the origin will be searched and the location of the peak instrument response will be marked with a pin flag and unique identifier. This location will be within 2 feet of the interpreted location as specified on the dig sheet. For transect surveys, a rectangular area approximately 5 to 6 feet wide by 3 to 4 feet long that is perpendicular to the direction of travel during DGM will be searched and a pin flag positioned at the peak instrument response.

The reacquisition team will be provided with a color-coded image of the area and a dig sheet with the proposed sampling or intrusive locations transcribed onto the map to facilitate the efficient reacquisition of each anomaly. The color-coded image will also assist the reacquire team with their specific reacquire protocol in areas of medium and high anomaly density.

3.3.12 DGM Quality Control

The geophysical QC system consists of a battery of preproject tests (Section 3.3.1), as well as tests performed on a daily basis to ensure the data are of sufficient quantity and quality to meet the project objectives. The performance metrics proposed for the EM61 MK2 sensor are derived from a combination of DID MR-09-004 (USACE, 2009b) and the USACE *Table Performance Requirements for RI/FS using DGM Methods*. These performance metrics are included in the Excel output as shown in the example worksheet in **Appendix E** in the work plan (Shaw, 2011b).

Instrument standardization procedures are implemented to ensure accuracy and repeatability of all collected field data. ShawGeo software (or an Excel spreadsheet) will be used to digitally document the activities associated with the DGM process for the entire project duration. The information will be updated on a daily basis and delivered daily to the QC Geophysicist for inclusion into the project report.

3.3.12.1 Test Site Establishment

An instrument functional check area and IVS will be established at convenient location within each MRS in an area determined to have "background" characteristics (e.g. free of large sources

of metal or man-made interference). The test area will be near the IVS and consist of a reference area where instrument function checks and quality tests may be performed.

3.3.13 Daily Tests

Instrument functional checks for the DGM system that occur on a daily basis during field operations include the following:

- Instrument warm up
- Instrument operator(s) metal check (visual and frisk as necessary—ensure no metal present on data acquisition personnel)
- Static background test
- Cable shake test
- Personnel test
- Static response (spike) test
- IVS repeat line
- Known location check (occupation of survey monument, control point, grid corner, or transect endpoint)

Some of the field tests discussed above is quantitatively evaluated during the initial data processing that occurs each day. Based on the preproject tests and Shaw's experience in using the EM61 MK2, the following initial performance metrics will be used that are in accordance with the DID MR-09-004, *Geophysics* (USACE, 2009b) and the more recent *USACE Performance Requirements Tables* in **Appendix E** of the work plan (Shaw, 2011b):

- **Background static position check**. The standard deviation for static measurements for the positioning system will not exceed 0.5 foot.
- **Static background test**. Static background readings for the EM61 MK2 will remain within 2.0 mV of background for all data channels.
- **Cable shake test.** With the instrument motionless and recording data, each data cable is gently shaken and cable connector is wiggled to test for shorts or bad connections. Data collected during the Cable Shake Test will be free from spikes greater than 2 mV for all EM61 MK2 data channels.
- **Personnel test.** With the instrument held in static position, the man-portable operator(s) move while adjacent to the sensor while measurements are being recorded for a period of 15 seconds. The measurements for all data channels of the EM61 MK2 will remain within 2 mV of background determined as the standard deviation of the measurements for all data channels.
- **Static response (spike) test**. The standard test item is a 1- by 2-inch or 1-by 4-inch pipe nipple. For the EM61 MK2, the standard test item is placed at a predefined location on the man-portable unit on a rigid bracket or tube and measurements are recorded for a duration of 30 seconds. Measurements for the response of the standard test item will be

within 10 percent after subtraction of the sensor baseline response, calculated as a running average of the first four project tests (2 days).

- **IVS repeat data collection**. The amplitude of the items whose long axes are oriented perpendicular to the path of instrument travel or those that are vertical will be greater than 75 percent of the average determined during the first run of the IVS. The position of each item whose long axis is oriented perpendicular to the track path, or those that are vertical will be within 1.1 feet of the known position.
- **Background dynamic geophysical sensor check**. The standard deviation for dynamic noise in the survey area (i.e., areas where no metal is present) for the EM61 MK2 will remain within 2.0 mV of background for all data channels.
- **Sensor velocity checks (Speed)**. Ninety-five (95) percent of the EM61 MK2 sensor measurements will be acquired at a speed of less than or equal to 3.4 miles per hour (5 feet per second).
- **Known location check**. The acceptable difference in location measurement at a grid corner, transect endpoint, or survey monument is less than or equal to 0.5 foot when the DGM system positioning unit is static and coincident with the known location.

In addition to the analysis of the field tests during data processing, quantitative criteria are proposed for the following spatial sampling components of the DGM system:

- **Along Track Sampling**. Ninety-eight (98) percent of the EM61 MK2 sensor measurements will be less than or equal to 0.8 foot. The UX Process utility "ucedatasep.gx" will be used to evaluate this metric.
- **Across Track Sampling**. The line spacing for the EM61 MK2 2D full coverage survey methodology is 2.5 to 3 feet. Ninety (90) percent of the area will be covered at a 3.5-foot line spacing or less excluding data gaps from trees or other obstacles that preclude the survey platform from providing complete coverage. The not-to-exceed line spacing is 4.0 feet. Areas that exceed the metric may be identified by the data processor as potential "fill-in" areas where full coverage will be performed. Data gaps will be not be specified by the processor where the collection of additional data will not provide useable information (e.g., high density anomaly areas, buildings, adjacent to cultural features). This metric is intended to control data gaps due to inconsistent navigation that are not associated with trees or other obstructions. The UX Process utility "ucefootprintcov.gx" will be used to evaluate this metric.
- **Known Location Dynamic Positioning Check**. The interpreted location of the grid corner nails will be $\leq$ 2.5 feet for the EM61 MK2 2D full coverage surveys. For the EM61 MK2 1D transect surveys that use the RTK GPS or RTS to determine position the interpreted location of the nails at the transect endpoints will be $\leq$ 1.5 feet (projected perpendicular to the instrument direction). For the 1D transects that use fiducial positioning the interpreted location of the nails at the transect endpoints will be $\leq$ 2.0 feet for approval (projected perpendicular to the instrument direction).

The color-coded images generated from the final processed data need to be representative of the MRS conditions. During the interpretation phase, checks performed to ensure the representativeness of the data include the following:

- **Latency Correction**. The EM61 MK2 sensor data will be aligned to one sample increment (approximately 0.5 foot).
- **Data Consistency**. Consistent channel naming conventions, processing parameters and methods will be used for all datasets and channels within each dataset by utilizing Oasis Montaj™ scripts.

After the geophysical data are interpreted, specific anomalies may be reacquired for use in the sampling program. In order to ensure these processes meet the project objectives, the following checks related to the DGM system are performed:

- **Anomaly Reacquisition**. Reacquisition of any sampling or dig sheet locations (i.e., interpreted location) will be performed to ± 0.5 foot of the coordinates specified on the dig sheet. The dig location marked in the field after reacquiring will be within 2 feet of the interpreted dig sheet location for full coverage surveys.
- **Feed Back Process**. For anomalies that are intrusively investigated during the project, the Site Geophysicist or designee will review the excavation results with respect to the geophysical anomaly characteristics and selection criteria. If there are potential discrepancies they will be documented in the project database.
- **Anomaly Selection**. All anomalies included on the dig sheet will meet the anomaly selection criteria as established at the beginning of the project. If the anomaly selection criteria are modified during project execution based on the intrusive findings the USACE and Ohio EPA will be notified in advance via a field change order.

3.3.14 Intrusive Anomaly Verification

After anomaly locations have been reacquired, the following procedures will be used for the intrusive verification and reporting of the target anomalies. The Site Geophysicist will report the anomalies to the SUXOS as ready for excavation and identification. The SUXOS will assign a UXO team to excavate and identify the anomaly and record the required information as per DID MR-09-004, *Geophysics* (USACE, 2009b). The ShawGeo and/or ShawMEC software will be used to record any discrepancies between the dig sheet location and the actual reacquired location, and to note any anomalies that could not be excavated.

After the UXO team has completed the excavation and recording process, a DGM reacquire team will return to selected excavation locations with a man-portable EM61 MK2 and record the postexcavation anomaly peak values using ShawGeo (or MS Excel) to ensure that the source of the anomaly has been removed. The acceptable tolerance for the instrument readings for postexcavation analysis will be determined from the IVS results. This procedure will only be used for isolated anomalies or when the intention of the intrusive excavation is to remove the

entire anomaly source (i.e., the procedure is not applicable for sample locations placed within a large-scale anomaly) where only a portion of the anomalous area is intrusively investigated.

If the EM61 MK2 sensor data are determined to be within the background range (as determined from the IVS) the QC test is complete and the excavation can be backfilled. If the sensor data are determined to be above the background range, the excavation will continue to a depth agreed upon by the USACE and the Ohio EPA.

The USACE Table *Performance Requirements for RI/FS using DGM Methods* will be used to ensure that that there is a 90 percent confidence that less than 5 percent of the anomalies are unresolved. This table is presented in **Appendix E** in the work plan (Shaw, 2011b).

3.3.15 DGM Reporting

Finalized DGM data will be transmitted to the USACE and Ohio EPA 30 days after completion of survey activities, along with a letter of transmittal conveying explanations and pertinent information. The data submittal will include maps, QC reports, summaries, and supporting data.

The data will be presented in delineated fields as X, Y, Z1, Z2, Z3…, where X and Y are UTM Zone 17N coordinates and Z1, Z2, Z3… are the instrument readings. Each of the fields will be separated by a space or comma. A "readme" file will accompany the transmittal that specifies the data channels and measurement units. Final versions of DGM-related field logs and the digital documentation for the QC tests will also be provided.

Data delivered to the client during the DGM field program will adhere to the formats and timelines specified in Sections 4.0 and 5.0 in DID MR-009-04 (USACE, 2009b). Digital maps of the DGM data collected for the project will be prepared as part of the final deliverable. These maps will reflect the current MRS conditions when the DGM survey was performed. ArcView format GIS maps will be provided including the locations of all anomalies and any sampling results superimposed on a color-coded image of the DGM data.

3.4 Nonintrusive Visual Surveys

Nonintrusive visual surveys using handheld Schonstedt Model 52CX flux-gate magnetometers are intended at areas where the lateral boundaries of the MRS have not been conclusively determined. The only area that this will be performed at for the seven MRSs included in this work plan addendum is the expanded investigation area outside of the Water Works #4 Dump MRS (**Figure 3-7**). Visual surveys are warranted at this area since surface MD has been previously identified and subsurface MEC/MD is not anticipated. If the munitions response features at this location consisted of bombing targets or range fans, the depth distribution of the MEC would likely be deeper and DGM would be necessary to determine the nature and extent with a higher degree of certainty. The visual survey will be performed concurrently with the DGM survey at the actual 0.77-acre Water Works #4 Dump MRS.

The visual survey will not require formal transects but will include observations of surface MEC/MD that may be present and any other features relevant to the conceptual site model (CSM) for the MRS and the expanded investigation area. Because it is not feasible to survey every square foot of the investigation area, a representative number of reconnaissance transects are planned to characterize the area and support decision-making. MEC avoidance procedures will be performed during visual surveys.

As is discussed in Section 3.2.6 for the Water Works #4 Dump, the proposed visual survey areas, transect spacing, and the anticipated total length of the transects is 2.3 total miles with spacing ranging from 3 to 70 feet. The placement and spacing of transects is derived from VSP© assuming a "90 percent confidence that 95 percent of transects will not contain UXO." The transect spacing and visual survey area may vary and will be adjusted based on site conditions (e.g., manmade features, terrain). The transects will be used as a general guide for the field teams during the visual surveys. For areas where physical barriers or manmade features are present (e.g., building, equipment, land feature), the teams will divert around the barrier and reacquire the transect once the barrier is bypassed.

The field team will divide into a minimum of two groups consisting of one UXO technician and one field support person (e.g., field lead, geologist) to conduct the visual survey. To the extent practical (depending on vegetation, accessibility, and land features), the field team will walk along a preplanned transect that represents a percentage of the overall area.

The planned transects will be uploaded to the GPS and the visual sweep team will navigate along each planned transect using the GPS in waypoint mode. The GPS system will be configured to record position data at maximum intervals of 1 minute along each transect to create a permanent record of where each team actually walked. If MEC or MD are identified along the transect the location will be stored in the GPS along with a brief description of the findings. The GPS track path and findings along each transect will be uploaded to the project GIS in order to create a permanent record of the actual path followed. The spatial distribution of MEC or MD will be analyzed at the MRS and will be used to refine the extents of the MRS, as applicable.

3.5 Geospatial Information and Electronic Submittals

A Geospatial Information and Electronic Submittals Plan is used to describe the methods, equipment, and accuracy for conducting location surveys and mapping during the RI field activities, and the subsequent development of the project GIS databases to support the mapping and document production process. Survey and/or DGM activities will be performed as part of the these RIs. All geospatial data generated during the course of this project will be incorporated into the project GIS. This section was drafted using the general instructions outlined in DID MR-005-07.01, *Geospatial Information and Electronic Submittals* (USACE, 2007b).

3.5.1 MEC Tracking

Personal Digital Assistants (PDAs) equipped with the ShawMEC data management system will be used to record and track MEC, MD, and other metallic items identified during the course of the investigation. ShawMEC will be populated with the DGM anomalies selected for reacquisition. UXO Teams will be able to link the DGM anomaly with the dig results electronically and in real-time while in the removal grid. In addition, ShawMEC has the capability of recording the type, weight, size, and other characteristics of MEC, MD, and other metallic items observed during the surface clearance. The northing and easting location of all MEC will be recorded and tracked in ShawMEC.

3.5.2 Accuracy

Semi-permanent and permanent control monuments established by a licensed Ohio surveyor will be of Class I, Third Order accuracy.

3.5.3 GIS Incorporation

Geo-referenced information generated during the course of the project will be incorporated into the project GIS. The project GIS will be used for map development and progress tracking. The project GIS will be used to quickly plot MEC locations and determine the most appropriate MSDs for MEC disposal/demolition activities.

3.5.4 Mapping

Maps will be developed in the NAD 1983 UTM Zone 17N Coordinate System.

3.5.5 Computer Files and Digital Data Sets

All GIS files will be compatible with ArcGIS. Data will be available electronically on CD or DVD upon request.

3.6 Intrusive Investigation

This project involves using geophysical data to identify metallic anomalies to be excavated by Shaw UXO personnel. This section presents the procedures to be followed for such intrusive investigations.

Shaw will provide all necessary qualified personnel and equipment to perform intrusive target anomaly investigation. Intrusive investigation will follow all applicable USACE and DOD guidance.

Media sampling and analysis will be performed during the RI activities to determine levels of MC contamination as described in detail in the SAP addendum provided in **Appendix A**. The analytes to be evaluated will be based on evidence of MEC observed at the MRS during the visual surveys and DGM intrusive investigation primarily, with consideration of historical

records of MEC use, as well. Investigated media will primarily be soil, but some limited sediment and surface water sampling may be performed as well.

The types of media to be sampled, locations and number of samples, methods of sampling, and analyses to be performed will be determined in conjunction with the USACE and the Ohio EPA based on the results of the visual survey, geophysical investigation and historical data. The analytical methods selected to address chemical contaminants will be based on the types of items known or suspected to exist at each MRS. Other analyses may be added based on the visual survey and geophysical investigation findings and input from the USACE and Ohio EPA.

3.6.1 Accountability and Records Management for MEC

Shaw will maintain a detailed accounting of all MEC items encountered. Data from intrusive investigations and surface clearance will be entered in the GIS database and included in each of the RI reports. The database will track all anomalies excavated and all surface and subsurface MEC recovered.

Data collected regarding MEC found will include the standard official nomenclature, condition of the item, depth located, and orientation of item, location coordinates, and final disposition. A digital photograph of each type of MEC item and significant/unusual items recovered during the intrusive investigation will be taken and entered into the GIS database.

MD will be tracked in the database as well as the number and type of intact, inert munitions if any are discovered. The items shall be documented from the munitions and range debris turn-in procedure and documented in the final report.

3.6.2 Personnel Qualifications

All intrusive investigations will be performed by UXO qualified personnel as outlined in TP 18, *Minimum Qualifications for Unexploded Ordnance (UXO) Technicians and Personnel* (DDESB, 2004).

3.6.3 MEC Sampling Locations

The areas selected for excavation will be selected based on the results of the geophysical surveys. Select anomalies will be identified for sampling jointly with the USACE Geophysicist.

3.6.4 MEC Sampling Procedures

The UXO team will locate target anomalies for excavation using coordinates identified in the geophysical survey and RTK GPS or RTS positioning units. UXO-qualified Technicians will investigate each target anomaly by using small hand tools such as shovels, spades, and trowels to access targets. The following procedure and basic techniques will be used for excavation:

1. The UXO Technician will locate the anomaly with a Schonstedt magnetometer.
2. Until the anomaly is otherwise identified, it will be assumed that the anomaly is MEC. Excavation will be initiated adjacent to the anomaly. The excavation will continue until 1) the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with a metal detector, 2) native material has been identified (i.e., a clear delineation between native and fill materials is evident), 3) or the water table is reached.
3. Using progressively smaller and more delicate tools to carefully remove the soil, the excavation team will expand the sidewall to expose the metallic item in the wall of the excavation for inspection and identification without moving or disturbing the item.
4. Once the item is exposed for inspection, the excavation team will determine whether it is MEC or MD. If the item is determined to be MD, it will be removed and the area will be rechecked with the metal detector to ensure that a hazardous item is not hidden beneath it. If the anomaly is determined to be a MEC item, it will be removed, stored and disposed as discussed in the following sections. The excavation team will then annotate the results of the excavation on the geophysical anomaly tracking sheet and move on to the next marked subsurface anomaly.

3.6.5 Munitions with Greatest Fragmentation Distance

Table 3-11 provides a list of MGFD and the calculated fragmentation distances for each MRS. The fragmentation distances were calculated using the fragmentation data review forms prepared for each of the MRSs and included in **Appendix B**.

Table 3-11
RVAAP MRS Munitions with Greatest Fragmentation Distance

MRS Location	Munitions with the Greatest Fragmentation Distance	Unintentional Detonations		Intentional Detonations	
		Hazardous Fragment Distance (HFD) (feet)	K 40 Team Separation Distance (feet)	Without Engineering Controls (MFR) (feet)	Using Engineering Controls (feet)
Erie Burning Grounds	155mm M107, HE Projo (Composition B)	450	105	2,630	220
	155mm M107, HE Projo (TNT)	389	98	2,894	200
Fuze and Booster Quarry	M557 Fuze with M125A1 Booster Cup	56	15	310	200
40mm Firing Range	40mm M406 Grenade	124	17	339	200
Sand Creek Dump	105mm M1, HE Projo	335	72	1,886	200
Block D Igloo-TD	20-lb Frag Bomb M41	67	59	1,707	200
Water Works #4 Dump	155mm MK I Shrapnel	215	33	558	200

MRS Location	Munitions with the Greatest Fragmentation Distance	Unintentional Detonations		Intentional Detonations	
		Hazardous Fragment Distance (HFD) (feet)	K 40 Team Separation Distance (feet)	Without Engineering Controls (MFR) (feet)	Using Engineering Controls (feet)
Group 8 MRS	M557 Fuze with M125A1 Booster Cup	56	15	310	200

Notes:
HE = high explosives
TNT = trinitrotoluene

3.6.6 Minimum Separation Distances

3.6.6.1 Unintentional Detonations

The MSD for unintentional detonations is the distance nonproject personnel must maintain from intrusive operations. The MSD will be the hazard fragment distance (HFD) for each MGFD. All UXO Teams will be separated by the K40 distance of the MGFD indicated in **Table 3-11**.

3.6.6.2 Intentional Detonations

The MSD for intentional detonations is the distance all personnel must maintain from the blown-in-place (BIP) detonation or consolidated detonation site, and will be based on the greatest of the fragmentation and blast overpressure distances as follows:

- The maximum fragmentation distance of the specific munitions being detonated
- The blast overpressure distance of the munitions according to the following formula:

$$K\ (NEW)^{1/3}$$

Where:
K = the K-factor (328 for intentional detonations)
NEW = the net explosive weight in pounds (including the donor charge)

- 1,250-foot minimum unless maximum debris throw distance is known (per DOD 6055.9-STD, paragraph C9.8.4.2.1) (DOD, 2008)

The MSD for intentional detonations when conducting munitions disposal operations is identified in **Table 3-11**.

3.6.7 MEC Identification

The UXO technicians will make every effort to identify MEC through visual examination of items for markings and other identifying features such as shape, size, and external fittings. Items will not be moved during the inspection/identification until the nature and condition of the item can be ascertained. If the condition is questionable, the ordnance item will be considered to be armed. The fuze in the spotting charge is considered the most hazardous component of MEC,

regardless of type or condition. The SUXOS and the USACE OE Safety Specialist (OESS) will agree on the positive identification and disposition of the item prior to implementing any disposal operations.

The following general ordnance safety guidelines will be followed:

- In general, ordnance containing a spotting charge will be considered armed.
- Arming wires and pop-out pins on unarmed fuzes in spotting charges will be secured by taping in place prior to movement.
- Color-coding will NOT be used for positive identification of contents. Munitions having incomplete or improper color-coding have been encountered.
- Prior to conducting any demolition activities Shaw will coordinate with RVAAP, USACE, Ohio EPA, and the OHARNG. Shaw will notify Ohio EPA of any demolition activities in accordance with the RVAAP *MEC Notification Procedures* in **Appendix H** of the work plan (Shaw, 2011b).
- Personnel will avoid the area forward of the nose of a munitions item and backward from the tail fins, if present, until it can be ascertained that the item does not contain a spotting charge. The explosive jet can be fatal at great distances forward of the longitudinal axis of the item. Any munitions equipped with a spotting charge will be assumed to contain black powder or phosphorus until the contents are positively identified. Black powder and phosphorus can be extremely sensitive and may remain hazardous for an indefinite period of time.
- Practice munitions will be assumed to contain a live charge until it can be determined otherwise. Expended pyrotechnic/practice devices may contain red phosphorus/white phosphorus residue. Due to incomplete combustion, phosphorous may be present and reignite spontaneously if subjected to friction or if the crust is broken and the contents are exposed to air.
- Personnel will not approach smoking white phosphorus ordnance. Burning white phosphorus may detonate the burster or dispersal explosive charge at any time.
- The UXO team will visually, positively identify MEC (if any are observed) and MEC as having originated from a munitions item that was used for training exercises.

Chemical warfare materiel is not expected to be encountered at any of the sites. If CWM is encountered, normal MRS activities will immediately stop until the CWM has been recovered and removed from the MRS. Field teams will immediately notify the SUXOS and evacuate the MRS along cleared paths at least 450 meters upwind. The SUXOS will account for all field personnel and notify the PM, USACE OESS or other USACE representative, RVAAP, and the Ohio EPA. The USACE will initiate notification of the nearest EOD unit. Before work can resume, the site plans will be reviewed for adequacy by the USACE, RVAAP, and Ohio EPA in consideration of this newly discovered hazard.

3.6.8 MEC Removal

All MEC and MPPEH will be subjected to demolition procedures. If necessary, demolition of the item will be conducted using a 32-gram jet perforator or other suitable explosive, as determined by the SUXOS. This will result in one of the following operations:

- BIP detonation for a live item
- Venting of an inert item that possesses a hidden cavity potentially filled with high explosives, black powder, white phosphorous, or other energetic materiel

If there is a need to relocate an unfuzed item for disposal due to safety concerns or to consolidate shots, this will be done in coordination with the USACE OESS.

3.6.9 MEC Storage

All recovered MEC and MPPEH encountered during field investigations that is identified as safe to move will be transferred to an on-site magazine for temporary storage in accordance with Section 5.4. Donor explosives charges to be used for MEC demolition will be delivered to the site on an ”On-Call” basis. Donor explosives will either be consumed on the same day they are delivered or picked up at the end of the day by the vendor/supplier.

3.6.10 MEC Disposal

Shaw will be responsible for destroying MEC and MPPEH encountered. Explosives will be delivered to the project location on an “On-Call” basis.

3.6.10.1 Area Notification/Evacuation Procedures.

Prior to any detonation, a preestablished notification procedure will be initiated. As soon as it is determined that a detonation will be required, the SUXOS will initiate this procedure. The SUXOS will schedule the demolition to allow sufficient time to complete all notifications, approvals, and evacuations as required.

3.6.10.2 Demolition Procedures.

During demolition activities, the SUXOS will maintain overall control of the MRS. An exclusion zone (EZ) will be established around the demolition area according to the MSD for intentional detonations stated in Section 3.6.6.2. Evacuation, if necessary, will be coordinated with RVAAP and OHARNG personnel. Only the SUXOS, the OESS, the UXO team, and UXO-qualified safety personnel will be allowed within the EZ once the demolition operations have begun. The UXOSO and UXO safety personnel will ensure safe work practices are observed, and the UXO Technician III will perform the necessary steps to safely dispose of the MEC. The following general procedures will be followed for all disposals by detonation:

- Prior to conducting any demolition activities Shaw will coordinate with RVAAP, USACE, and the OHARNG.
- The Ohio EPA will be notified in accordance with the *MEC Notification Procedures* in **Appendix H** of the work plan (Shaw, 2011b).
- As part of the Ohio EPA *MEC Notification Procedures*, Shaw will submit a technical memorandum for approval that will outline the proposal sampling rationale and MC analysis for the pre- and postdemolition sampling requirements.
- The MEC Disposal Checklist will be completed for each disposal operation. See **Appendix E** in the work plan (Shaw, 2011b).
- Installation utility maps will be checked for utilities within the vicinity of the demolition area.
- Donor explosives will be delivered to the project location on an "On-Call" basis.
- The UXO Team comprised of the UXO Team Leader and a UXO Technician will inspect the location, condition, and NEW of the MEC to be treated.
- The UXO Team Leader will ensure that permission to detonate explosives has been obtained from the SUXOS and approved by a USACE government representative and the Ohio EPA.
- The SUXOS will be responsible for scheduling the detonations and ensuring that all project personnel are accounted for before disposal operations begin.
- All necessary safety briefs will be conducted.
- Shaw will ensure that a red demolition notification flag is flying to notify that the range is live and that demolition activities are occuring.
- As necessary, engineering controls in accordance with HNC-ED-CS-S-98-7, *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, Amendment 1* (USACE, 1998), and the specification presented in TP-16 rev 2, *Methodologies for Calculating Primary Fragment Characteristics* (DDESB, 2005), will be used if necessary to reduce the fragmentation distance for the MEC item requiring disposal.
- The UXO Team Leader will observe the UXO technicians as they position the explosive charge against the MEC item. However, care will be taken to never bury the initiators (caps).
- The UXO Team Leader will then inspect the disposal shot and return to the safe firing point.
- Prior to initiation, the UXO Team Leader will ensure that authorized Shaw personnel are stationed at the roadblocks, will scan the exclusion zone for personnel, and will sound three distinct blasts on an air or vehicle horn. He or she will then scan the area again and initiate the demolition charge if all is clear. All roadblocks will be coordinated with RVAAP and OHARNG prior to implementation.

- Techniques described in Technical Manual (TM) 60A-1-1-31, *EOD Disposal Procedures* (Army, 1994), will be used during all demolition operations.
- In the event of a misfire, a 60-minute wait time will be observed. A Misfire Checklist will be completed by the UXO Technician III and filed with the daily logs. This checklist is presented in **Appendix E** in the work plan (Shaw, 2011b).

3.6.10.3 Postdemolition Operations.

After successful initiation of the explosive charge, the UXO team will conduct an inspection of the shot to ensure complete destruction of the MPPEH or MEC. After verification that no more detonations will be required, an "all clear" notification will be sent out to all parties on the notification list. Shaw will then collect postdemolition samples per the Ohio EPA approved Technical Memorandum that was issued with the *MEC Notification Form*. Following postdemolition sampling, Shaw MEC personnel will then backfill all holes and restore the area to prior condition.

3.6.10.4 Engineering Controls.

Engineering controls such as sandbags may be used on a case-by-case basis to reduce the fragmentation distance. If required, engineering controls outlined in HNC-ED-CS-S-98-7, *Use of Sandbags for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonations of Munitions, Amendment 1* (USACE, 1998) and HNC-ED-CS-S-00-3, *Use of Water for Mitigation of Fragmentation and Blast Effects Due to Intentional Detonation of Munitions* (USACE, 2000b) for demolition operations will be used. Sandbags will be positioned at the MRS and used to assist in performing demolition operations as required.

3.6.11 Disposal Alternatives

No specific disposal alternatives are considered for this project. If situations arise that are beyond the capabilities of the contractor, Shaw will coordinate with USACE, RVAAP and Ohio EPA to request disposal assistance from military EOD.

3.7 Munitions Constituents Sampling

Media sampling and analysis will be performed during the RI activities to determine levels of MC contamination as described in detail in the SAP addendum provided in **Appendix A**. The analytes to be evaluated will be based on evidence of MEC/MD observed at the MRSs during the visual surveys and DGM intrusive investigation primarily, with consideration of historical records of MEC use, as well. The proposed investigated media for the MRSs is currently surface soil, wet sediment, and surface water; however, MC investigation may also include sampling and analysis of subsurface soil and dry sediment depending on the results for the investigation of MEC/MD.

The types of sampling methods of surface soil and dry sediment (0 to 1 foot) will consist of IS and/or discrete sampling at 6-inch intervals. Surface soil sampling using IS will be performed to evaluate the potential for wide spread contamination associated with MEC/MD (i.e., spread over the ground surface). Discrete surface soil samples will be collected to evaluate the potential for a release from an individual MEC/MD item if a release is suspected. Subsurface soil sampling (greater than one foot beneath MEC/MD) will consist of discrete sampling at six inch intervals if a release is suspected. Discrete subsurface samples may also be collocated with an IS decision unit to evaluate subsurface conditions associated with MEC/MD spread over the ground surface. Shaw is not proposing to sample beneath every MEC/MD item identified and will evaluate these items in the field when found as to the depth and condition of the MEC/MD item and the surrounding soils that may have been impacted. If the MEC are intact and there is no obvious MC release, a determination would be made as to whether sampling is required as discussed below.

Wet sediment samples will be collected similarly to IS surface soil samples. The sample aliquots for the IS wet sediment samples will be collected from 0 to 6 inches and will be representative of submerged conditions in the surface water areas.

The types of media to be sampled, locations and number of samples, method of sampling, and analyses to be performed will be determined in conjunction with the Army and the Ohio EPA based on the results of the visual survey, geophysical investigation, and historical data. The analytical methods selected to address chemical contaminants will be based on the types of items known or suspected to exist at each MRS. Other analyses may be added based on the visual survey and geophysical investigation findings and input from the USACE, RVAAP and the Ohio EPA.

3.8 Investigative-Derived Waste

The section describes the handling of investigation-derived waste (IDW) that is expected to be generated during the RI activities planned at the RVAAP MRSs. The handling of IDW will follow the methods outlined in the *Facility-Wide Sampling and Analysis Plan for Environmental Investigations* (FSAP) (SAIC, 2011) and the DID MR-005-13, *IDW Plan* (USACE, 2003d). Minimal to no hazardous waste is anticipated for this project. Any MEC encountered will be demilitarized, classified as MD and disposed of accordingly. In this work plan addendum, IDW includes all materials generated during performance of an investigation that could potentially pose a risk to human health and the environment. The following types of IDW are anticipated to be generated at the RVAAP MRSs during RI and RIP activities:

- **Environmental Media**: (soil and dry sediment) residual soil samples; soil and buried waste materials from trenching, residual sediment samples.

- **Solid Waste**: (decontamination fluids) derived from the decontamination of sampling equipment.
- **Solid Waste**: (expendable waste debris) including scrap metal, personal protective equipment (PPE), disposable sampling equipment and miscellaneous trash.

The IDW expected to be generated during the MC sampling activities will be described in the SAP addendum (**Appendix A**), which also addresses sampling and analysis of IDW. The data results for the IDW will determine the proper procedures for handling, packaging, storage, transportation, and disposal of the waste.

3.8.1 Munitions Debris

The management and disposition of MPPEH, including MD, will be performed in accordance with DOD Instructions (DODI) 4140.62, *Management and Disposition of Materiel Potentially Presenting and Explosive Hazard* (DOD, 2004). For MD, Shaw shall use the closed-circuit process discussed in this section that maintains a chain of custody from collection through release from the DOD as material documented as safe (MDAS). Because recovered MDAS, including MD, will ultimately be disposed off-site, it is imperative that procedures be established to preclude MPPEH from being commingled with materiel documented as an explosive hazard (MDEH) or MDAS or misidentified once the explosive hazards, if present, are determined. The approach is designed to ensure that all MPPEH is 100 percent independently inspected and then 100 percent reinspected as part of the certification and verification process. The process will include the following:

- The UXO-qualified technicians will perform a 100 percent inspection of any MPPEH and determine if the item is a MDEH or MDAS (i.e., DMM, MD range related debris or cultural artifact).
- The UXO-qualified Team Leader will perform a 100 percent independent inspection (reinspection) of any MPPEH to determine if free of explosives hazards or other dangerous fillers.
- All MDAS identified as MD will be segregated and securely stored in lockable containers until it can be shipped to a scrap yard for recycling. All MD will be collected in a centralized, secured area pending reinspection and will be segregated from other metallic debris.
- MPPEH identified as MDEH will be managed in accordance with Section 3.6.10 for MEC Disposal.
- The UXOQC Specialist will conduct daily audits of the procedures performed by UXO teams.
- The UXOSO will ensure the specific procedures are being performed safely and consistent with applicable regulations.

- At the conclusion of the investigation, all MDAS identified as MD will be released for off-site disposal.
- The demilitarized and inspected MD will be placed into a sealed container with completed DD Form 1348-A1, Issue Release/Receipt Document or equivalent, attached. The following statement will be included on the form:

  "This certifies and verifies that the material listed has been 100% inspected and 100% reinspected and to the best of our knowledge and belief, are inert and/or free from explosives or related materials."

- The SUXOS will sign the form as the certifier that the debris is free of explosive hazards and USACE OESS will sign the form as the verifier that the MPPEH inspection process has been followed. If an OESS is not on-site, the UXOQCS, or similarly trained individual, can be delegated to verify the MPPEH process.
- This DD Form 1348-1A will be maintained as a chain of custody until the MD reaches final disposition. The DD Form 1348-1A will be signed by the recycling vendor upon receiving the MD. The recycling vendor will provide documentation on company letterhead stating that the contents of these sealed containers will not be sold, traded, or otherwise given to another party until the contents have been smelted, shredded, or treated in a furnace and are only identifiable by their basic content. Once the munitions related scrap is smelted, shredded, or treated in a furnace, the recycling vendor is required to send follow-on documentation indicating the material is now only identifiable by their basic content.

Using these procedures, Shaw will ensure that the collected MD will be properly inspected and classified. The method includes three distinct inspections, which will be performed by persons of increasing levels of responsibility. The UXO Team Leader will perform the first inspection at the operating grid; the supervisor responsible for the operating grid will perform the second; and the final inspection will be performed by the SUXOS who will be vested with overall responsibility.

3.8.2 Environmental Media and Solid Waste

Environmental media and solid waste will be contained separately. For the environmental media, unsaturated soils will be segregated from saturated soils. For solid waste, decontamination fluids will be containerized separately from expendable solid waste debris. Non-ordnance-related scrap could be generated during intrusive investigations. If sufficient quantities are removed from the MRS, they will be stored separately from MD and the metal will be recycled. Characterization and classification of the different types of IDW will be based on the specific protocols described below.

- **Soils and Dry Sediment**: Excess surface soils and dry sediment will be placed in 55-gallon steel drums, plastic lined and sealed with gasketed ring-topped lids. Disposition of the drummed soil will be based on analytical results from the environmental samples or from direct results of composite IDW samples.

- **Decontamination Fluids**: Decontamination fluids will be placed in steel or polyethylene drums. Disposition of decontamination liquid will be based on the analytical results of composite grab samples from the containers.
- **Expendable Waste Debris**: Expendable waste debris, including non-ordnance-related scrap metal, will be segregated as noncontaminated and potentially contaminated material based on visual inspection, use of the waste material and field screening using field screening instruments. Scrap metal will be placed in 55-gallon steel drums or roll-off containers for off-site recycling or disposal. Expendable waste debris considered to be noncontaminated (PPE, disposable sampling equipment and miscellaneous trash) will be placed in trash bags and stored in 55-gallon drums or sanitary waste containers whereas potentially contaminated expendable waste will be containerized in 55-gallon steel drums, plastic lined and sealed with gasketed ring-topped lids. Disposition of expendable waste debris will be based on correlative results of the environmental samples submitted for laboratory analyses.

All containerized environmental media and solid waste will be labeled as specified in Section 8.2 of the FSAP (SAIC, 2011). Label information on each container will be written in indelible ink and will include at a minimum: container number, contents, source of the waste, source location, project name and MRS identification, physical characteristics of the waste, and generation dates. Each label will be placed on the side of each container at a location that will be protected from damage or degradation.

3.8.3 IDW Field Staging

Shaw will coordinate central field staging areas (FSAs) with the RVAAP Facility Manager, OHARNG/Camp Ravenna environmental office and Ohio EPA prior to generating waste. All waste shall remain on the FSAs until it has been characterized for disposal. The FSAs will be visibly identified with signage and the drums/containers will be covered with poly sheeting or tarps if the FSAs are in an open location. Drummed soil will be transported to the FSAs where it will be staged on wooden pallets. Decontamination fluids will also be staged at the identification location within secondary containment structures. To avoid potential drum rupture due to freezing conditions, drums containing liquid IDW will be filled only to 75 percent capacity.

Excavated soil from trenching activities will be placed, in one foot lifts, on 6 mil plastic with erosion and sediment controls as needed. Excavation investigation activities shall be terminated upon reaching groundwater. The soil may be replaced back into the investigation area in reverse order from which it was excavated. However, no solid or hazardous waste will be placed back into the excavation and, when initially excavated, will be segregated from visually clean soil and placed in drums/roll-offs for testing and disposal. Visibly stained soil will be segregated and drummed for testing and disposal. No MEC/MD will be replaced back into the excavation.

Off-site soils required for backfilling will be obtained from a source approved by the USACE, RVAAP and Ohio EPA. All off-site soils will be analyzed for the RVAAP full suite to include VOCs, SVOCs, PCBs, pesticides, metals, explosives and propellants.

If any corrective measures are required after the completion of the filling in of the excavation, immediate action will be taken by Shaw to abate the problem.

3.8.4 IDW Disposal

All disposal of IDW will be conducted in accordance with Section 8.5 of the FSAP (SAIC, 2011). All waste determined to be 'nonhazardous, contaminated' or 'hazardous, contaminated' will be disposed off-site at a permitted waste facility. Noncontaminated expendable waste debris will be disposed as sanitary trash. Nonordnance scrap metal will be sent off-site for recycling. Potentially contaminated expendable waste debris will be disposed similar to the associated waste under which it was generated. Any on-site disposal of the generated waste (soils and dry sediments) that have been identified with concentrations below the RVAAP acceptable criteria and background concentrations will require approval from the RVAAP Facility Manager, OHARNG/Camp Ravenna environmental office, and the Ohio EPA prior to on-site disposal.

3.9 Vegetation Clearing

Many areas where Shaw is proposing to conduct visual survey and DGM activities are overgrown with high grasses, thick vegetation, debris and low tree limbs (less than 6 feet above the ground). Depending on the time of year, minimal clearing/trimming of this vegetation may be required to allow for the performance of the geophysical survey, sampling activities, and magnetometer and dig activities. Any vegetation clearing/trimming activities at these locations will be minimized to the extent possible to allow for the execution of work. Shaw will coordinate with the OHARNG/Camp Ravenna environmental office prior to performing work and any vegetation disturbance at Camp Ravenna property. Areas with high grass may only be mowed prior to April or after August due to the potential for disturbing grassland nesting species, and mowing must be approved by the OHARNG. Shaw will only clear vegetation that impedes or interferes with the safe and effective implementation of the project.

With the exception of excavation test pits at the Sand Creek Dump MRS, significant ground disturbance is not expected as part of the proposed activities. Minor ground disturbance is expected due to foot traffic related with the DGM, MC sampling, and magnetometer and dig activities associated with shallow anomalies. Shaw will use mechanical brush cutting equipment for most of the tall grass removal activities, when approved by the OHARNG, and hand tools (loppers) and/or chain saws for any larger tree limb removal (< 3 inches in diameter). Shaw will coordinate with the OHARNG/Camp Ravenna environmental office as to the extent of vegetation that will require clearing and whether the removed vegetation can be placed in piles at

the MRSs or will require off disposal or chipping at a central location designated by the OHARNG.

3.10 Rights-of-Entry

In the event that a field investigation is required at the Block D Igloo–TD, the USACE will be responsible for obtaining the rights-of-entry (ROEs) for access to private properties as necessary, which will apply to all representatives, agents, and contractors of the government. This will enable project personnel access to private property in order to accomplish the project's objectives. The USACE will notify property owners of the field investigation schedule prior to entering the investigation areas. If an ROE cannot be obtained, work will be prevented from occurring on the property and Shaw will make best efforts to complete the investigation without entering the property.

3.11 Risk Characterization and Hazard Analysis

Evaluation of risk will be necessary to complete the RI and for use in the FS to estimate risk reduction for various response actions. The planned method for risk evaluation is the MEC Hazard Assessment (EPA, 2008). The MEC Hazard Assessment (HA) allows a project team to evaluate the potential explosive hazard associated with an MRS, given current conditions and under various cleanup, land use activities, and land use control alternatives. As the approach is standardized, it provides a method of risk assessment that is more easily understood by, and communicated to, stakeholders. The MEC HA provides a qualitative hazard assessment for MRSs by using direct analysis of MRS conditions and human issues that create MEC risk. The MEC HA will allow the alternatives to be qualitatively compared for the level of protectiveness.

In addition to the risk assessment for MEC, screening level risk assessments for environmental media will be completed for MC for both human health and ecological risks. Validated analytical data collected as part of MC analysis will be used for the screening level risk assessments to determine the potential risk to human health and the environment. In addition, data collected at an MRS under the IRP may also be included in the screening level human health and ecological risk assessments if deemed applicable.

Discrete samples will be used to evaluate the potential for MEC releases at individual MD items or consolidated areas of MEC/MD, and IS samples will be used to evaluate wide spread areas of MEC/MD as a whole. Both discrete and IS samples will be used in the RI to evaluate the nature and extent of contamination, fate and transport, and human health and ecological risk. Although these sample types cannot be compared directly to each other, they can be evaluated separately to provide valuable input with regards to site-related contamination and potential effects on human health and ecological receptors at the MRSs.

3.11.1 Geochemical Evaluation

The geochemical approach is an effective strategy for distinguishing anthropogenic from naturally occurring metal concentrations, particularly when it is used with traditional quantitative statistical evaluations. The approach often identifies naturally occurring metal concentrations that are erroneously identified as site-related by traditional evaluations (i.e., comparisons of study area metal concentrations to established background values) (USACE, 2008).

Munitions constituents samples where metals will be evaluated will also be analyzed for the following three additional metals for geochemical evaluation purposes only: calcium, magnesium, and manganese. Aluminum and iron would typically also be analyzed for geochemical evaluation purposes in certain MRSs where they are not considered MC; however, aluminum and iron are considered MC at seven and six MRSs, respectively. Therefore, aluminum will not be analyzed for geochemical purposes at any of the MRSs in this work plan and iron will only be analyzed for geochemical purposes at one MRS (40mm Firing Range).

Proposed geochemical evaluation will be used to compare MRS metals data to existing background data. Statistical MRS-to-background comparisons for trace elements in environmental media commonly have high false-positive error rates. A large number of background samples, which exist for RVAAP, are required to adequately characterize the upper tails of most trace element distributions, which are typically right-skewed and span a wide range of concentrations. There are also concerns regarding the statistical validity of comparing MRS data from a small parcel with facility-wide background data that typically display higher variance than the site data. The presence of estimated concentrations and nondetects with differing reporting limits can also cause statistical comparison tests to fail.

Statistical tests consider only the absolute concentrations of individual elements, and they disregard the interdependence of element concentrations and the geochemical mechanisms controlling element behavior. However, it is well established that trace elements naturally associate with specific soil-forming minerals, and the preferential enrichment of a sample with these minerals will result in elevated trace element concentrations. It is thus important to be able to identify these naturally high concentrations and distinguish them from potential contamination. This is achieved by performing a geochemical evaluation.

The Ohio EPA does not object to Shaw performing the geochemical evaluation as described in this section. However, it is noted that the Ohio EPA has not approved or disapproved the proposed geophysical evaluation process or the rationale for conducting the evaluation at this time. Consequently, the Ohio EPA may determine at a later date whether the results of the geochemical study may or may not be able to be used in the project decision making process.

3.11.2 Human Health Screening Risk Assessment

Following the visual survey and DGM activities at each of the MRSs, Shaw will develop the DQOs for MC sampling in accordance with the SAP addendum in **Appendix A**. The DQOs will be developed utilizing the investigative facility-wide DQO approach presented in the FSAP (SAIC, 2001) and the *Ravenna Army Ammunition Plant Facility-Wide Human Health Risk Assessor Manual, Amendment 1* (HHRAM) (USACE, 2005) to evaluate the data results (analytical and geophysical) collected during previous actions conducted at each of the MRSs. The DQO process is a tool to guide investigations at CERLCA sites, under which the MMRP operates, and will be implemented for each of the MRSs to identify the presence of contamination and data gaps, if any.

The RVAAP has worked closely with the Ohio EPA and other stakeholders such as the OHARNG to develop an acceptable approach to the completion of human health risk assessments. Because of the initial successes of the human health risk assessment program at the RVAAP, there was mutual agreement to streamline the process. Streamlining the Human Health Risk Assessment process resulted in the establishment of Facility-Wide Cleanup Goals (FWCUGs) as presented in the *Final Facility-Wide Human Health Cleanup Goals for the RVAAP* (SAIC, 2010), herein referred to as the Final FWCUG document. The original intent of developing the Final FWCUGs was to eliminate the need for baseline risk assessments. Because the development of the Final FWCUGs, they also have been recognized as appropriate tools to be used in screening-level assessments.

The FWCUGs were developed to reduce the level of effort and to limit the amount of time required to make informed risk management decisions regarding sampling locations, delineations of contamination, data gaps, and remediation of contaminants without needing to complete a baseline risk assessment. The selection of chemicals requiring a FWCUG is based upon the screening process outlined in the HHRAM (USACE, 2005). The guidance for the application of the FWCUGs to MC data to be collected is presented in the *USACE RVAAP Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals* (USACE, 2009a); herein, referred to as the Position Paper.

3.11.2.1 Sampling and Analysis Plan Decision Rules

Each of the MRSs will proceed through the RI process. The Sand Creek Dump and Water Works #4 Dump MRSs will proceed through the FS, PP, and ROD stages until RIP is attained. For MRSs where MC samples are collected, the general decision rules as identified in the Position Paper (USACE, 2009a) will be applied to the data collected.

Determination of the Chemicals of Potential Concern

It is anticipated that MC sampling will be conducted at each of the MRSs during the RI phase to determine the presence or absence of contamination, nature and extent of contamination,

characterization of contamination, and need for additional sample locations (if any) associated with munitions historically used or disposed at the MRSs. It should be noted at this point that only explosive or unexplosive material associated with munitions used at a particular MRS will be evaluated unless additional sampling and analysis is agreed upon by the Ohio EPA. These data will be evaluated in accordance with the initial evaluation step presented in the Position Paper (USACE, 2009a) to further establish chemicals of potential concern (COPCs) and characterize source areas of contamination with the exceptions noted below due to differences between the IRP and MMRP. This evaluation process consists of the following guidance:

1. The concentrations of inorganics shall be compared to the soil background values in the Final FWCUG document (SAIC, 2010) and the results of the geochemical evaluation. Exceedance of an inorganic above its respective background value will require it to be retained as a COPC for further evaluation. Comparison of results to the geochemical evaluation is considered an exception to the procedures presented in the Position Paper (USACE, 2009a), which provides for a comparison of all data to available background values.
2. MMRP-related metals that are considered essential nutrients will be screened out with the exception of iron, which is considered an MC at six of seven MRSs. The EPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at low concentrations (i.e., only slightly above naturally occurring levels), and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at the MRS).
3. Chemicals meeting the less than 5 percent detected rule (i.e., frequency of detection) may be screened out. However, in order for this to occur, the chemical must have a statistically valid data set with a sample size of at least 20. The frequency of detection screening does not apply to MRS-related contaminants such as propellants and explosives, which will be retained as COPCs through the evaluation process.
4. To establish COPCs, all chemicals that have not been eliminated to this point will be evaluated using the following process:
   - The FWCUGs developed for the Residential Farmer Adult and Child and the National Guard Trainee human health receptors for each chemical will be used. If there are no FWCUGs developed for a particular chemical, then the EPA Regional Screening Levels (RSLs) for the Residential Receptor will be used. If neither the FWCUG nor the RSL is available, then a cleanup goal will be developed or another approach will be developed in concurrence with USACE and the Ohio EPA. The FWCUGs presented in the FWCUG document (SAIC, 2010) are; hereafter, referred to as the Final FWCUGs.
   - The Final FWCUGs at the $1x10^{-6}$ cancer risk level and noncarcinogenic risk Hazard Quotient (HQ) using the 0.1 risk value for each of the receptors will be selected.
   - All carcinogenic and noncarcinogenic risk values for each chemical for each receptor will be reported.

- A comparison of the selected Final FWCUG to the Exposure Point Concentration (EPC) will be completed. The EPC will be either the 95 percent Upper Confidence Limit (UCL) of the mean for each chemical concentration or the maximum value detected, depending upon whichever value is the lowest. In comparisons where the 95 percent UCL cannot be determined, the maximum concentration of the chemical will be compared to the appropriate Final FWCUGs.
- The chemical will be retained as a COPC if the EPC exceeds the most stringent risk value for the Residential Farmer Adult and Child, the intended National Guard land user and/or any of the National Guard receptors for either one of the $1x10^{-6}$ carcinogenic value and the noncarcinogenic HQ using the 0.1 risk value.

Determination of the Chemicals of Concern

Once the COPCs have been thoroughly evaluated and all sampling has been completed so that the nature and extent of contamination is known, the second step as identified in the Position Paper (USACE, 2009a) will be implemented to determine which COPCs are chemicals of concern (COCs). It is expected that the determination of COCs will occur at the conclusion of field activities during the RI stage and will consist of screening of the chemical concentrations to specific Final FWCUGs similar as for COPCs. However, the COCs are determined by comparing the chemical concentration to the most restrictive Final FWCUG value for the Residential Farmer Adult and Child, the representative OHARNG receptor as well as provide a comparison to the other OHARNG receptors to evaluate if the Final FWCUG values are more stringent.

The representative receptor(s) for each of the MRSs is as follows:

- ***Erie Burning Grounds (RVAAP-002-R-01)***—Security Guard/Maintenance Worker and the National Guard Trainee
- ***Fuze and Booster Quarry (RVAAP-016-R-01)***—National Guard Trainee
- ***40mm Firing Range (RVAAP-032-R-001)***—National Guard Trainee
- ***Sand Creek Dump (RVAAP-034-R-01)***—Security Guard/Maintenance Worker, and the Range Maintenance Soldier
- ***Block D Igloo-TD (RVAAP-061-R-01)***—Adult Residential Farmer and Child Residential Farmer
- ***Water Works #4 Dump (RVAAP-062-R-01)***—National Guard Trainee and the Engineering School Instructor
- ***Group 8 MRS (RVAAP-063-R-01)***—Security Guard/Maintenance Worker and the National Guard Trainee

The determination of COCs for each of the MRSs will proceed as follows:

1. The Final FWCUG values for the Residential Farmer Adult and Child receptors, the representative OHARNG user, as well as the other OHARNG receptors, will be selected using the $1x10^{-5}$ carcinogenic value and noncarcinogenic risk value termed HQ using the 1.0 risk value.
2. All carcinogenic and noncarcinogenic risk values for all receptors and all critical effect and target organ for each of the noncarcinogenic risk values will be reported.
3. A comparison of the Final FWCUG to the EPC will be completed similarly to that discussed for COPC evaluation.
4. For carcinogens and noncarcinogens, the chemical-specific concentrations will be compared to the target risk Final FWCUG using the Sum or Ratios method presented in the Position Paper (USACE, 2009a).
5. The chemical will be retained as a COC if (1) the EPC exceeds the most stringent risk value for either the Adult Residential Farmer, Child Residential Farmer, the representative OHARNG receptor, and/or other OHARNG receptors if the values for these other receptors are more stringent than the other receptors, for either one of the $1x10^{-5}$ carcinogenic value and the noncarcinogenic risk value termed HQ using the 1.0 risk value; and/or (2) the Sum of Ratios for all carcinogens and all noncarcinogens that may affect the same organ are greater than 1 and the chemical contributes at least 10 percent to the sum.

The Final FWCUGs for each of the COCs identified through the aforementioned process are the actual remediation levels unless there are additive effects. These levels will be applicable for achieving RIP at the Sand Creek Dump and Water Works #4 Dump MRSs only. In some instances, there may be a risk management analysis such as a "Weight of Evidence" approach that may allow for a COC to be reassessed. However, any reevaluation of a COC and the proposed approach will require concurrence from the Ohio EPA. The use of the Sum of Ratios approach is intended to account for additive effects from exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ. The Sum of Ratios approach compares the chemical concentration (e.g., mean concentration or concentration in confirmation samples, the EPC) of the COC to the individual Final FWCUG to determine a ratio of acceptable risk (USACE, 2009a).

3.11.3 Ecological Risk Assessment

3.11.3.1 Screening Level Ecological Risk Assessment

The potential for ecological risks from exposures to contaminants detected at the MRSs will be assessed through the completion of a screening level ecological risk assessment (SLERA). The SLERA will be conducted in accordance with the guidelines set forth in *Ohio EPA Guidance for Conducting Ecological Risk Assessments* (Ohio EPA, 2008).

The SLERA will consist of the following components:

- Description of the environmental setting at the MRS
- Discussion of the constituents detected in MRS media
- General discussion of the constituent fate and transport
- Discussion of the potential ecological receptors at the MRS
- Description of the complete exposure pathways at the MRS
- Discussion of the screening level assessment and measurement endpoints
- Discussion of the ecological screening values for the various environmental media at the MRS to be used to select preliminary constituents of potential ecological concern (COPECs) to carry through the SLERA
- Description of the EPCs of the selected COPECs in each of the environmental media at the MRS
- Calculation of screening level HQs for COPECs selected in each environmental medium
- Consideration of additional lines of evidence that may be important to refine the screening level HQ estimates, such as more realistic estimates of chemical bioaccumulation, bioavailability, exposure, and/or toxicity, typically referred to as Step 3 of the EPA (1997) 8-step ecological risk assessment (ERA) process
- Identification of final COPEC in each environmental medium
- Uncertainty analysis
- SLERA summary and conclusions

During preparation of the RI reports, sites may be combined into a single document whenever possible; however, an individual SLERA will be required for each MRS. The results of the SLERAs will provide sufficient information for risk managers to make a decision of either negligible ecological risk at the each of the MRS (no further ERA is necessary) or further baseline ERA (BERA) is warranted.

3.11.3.2 Baseline Ecological Risk Assessment

A BERA will only be recommended for MRSs where the following three conditions are met:

- Ample habitat exists wherein ecological receptors can occur.
- Contaminants are present in environmental media at levels that could pose risk.
- A complete exposure pathway exists whereby the ecological receptors could be exposed to the chemical contaminants.

If any one of these conditions is not met, then the potential for ecological receptors to be exposed to contaminants at levels that may pose a risk does not exist, and NFA is necessary to address

ecological concerns. Determining whether contaminants are present at levels that could pose risk will be accomplished through the SLERA. For MRSs where these conditions are met, a BERA might be recommended.

The objective of a BERA is to evaluate the potential for adverse effects to ecological receptors from MRS contaminants. The potential for adverse effects to ecological receptors is dependent on the ecological receptor species, the contaminants present, and the pathways by which ecological receptors could be exposed to the contaminants. Because the nature and extent of contamination is unknown, it would be premature to develop a plan to evaluate a BERA for the RVAAP MRSs. If the ecological risk managers consider that the SLERA for an MRS identifies enough ecological risk to warrant a BERA, a BERA work plan will be prepared that will include a modified ecological CSM, identification of endpoint measurements and assessments, and the hypothesis being tested.

3.12 Analysis of Institutional Controls

An institutional controls analysis will be conducted in accordance with Engineer Pamphlet (EP) 1110-1-24, *Establishing and Maintaining Institutional Controls for Ordnance and Explosives (OE) Projects* (USACE, 2000c). Institutional controls are substantially the same as land use controls (LUCs) as defined in the DOD's *Policy of Land Use Controls Associated with Environmental Restoration Activities* (DOD, 2001). For the RVAAP project, an FS will be performed to evaluate response actions at MRSs with evidence of MEC or MC impacts. In support of the FS, an institutional controls analysis will be conducted in accordance with EP 1110-1-24 (USACE, 2000c). The analysis will highlight existing opportunities to implement institutional controls at the MRS, identify government agencies that have jurisdiction, and assess the appropriateness, capability, and willingness to exert their control. Institutions selected for evaluation will include USACE, RVAAP, OHARNG, and the Ohio EPA. For each institution selected for review, the following information will be provided:

- Name of Agency
- Origin of Institution
- Basis of Authority
- Sunset Provisions
- Geographic Jurisdiction
- Public Safety Function
- Land Use Control Function
- General Financial Capability
- Desire to participate

- Constraints on effectiveness

An Institutional Analysis Report will be included as an appendix to the RI report. The report will be prepared in accordance with the Army's *Munitions Response Remedial Investigation/Feasibility Study Guidance* (Army, 2009). Information from the Institutional Analysis will be used to prepare alternatives for the FS.

4.0 Quality Control Plan

Section 4.0 of the work plan (Shaw, 2011b) presents the QCP that addresses the specific operating needs of the project and establishes the necessary levels of management and control to ensure all work performed meets the technical requirements of the applicable project plans and conforms in all respects to the requirements of the contract and applicable regulations. The QCP also identifies the approach and operational procedures to be employed to perform QC during activities associated with the project. The QCP was developed in accordance with DID MR-005-11.01, *Quality Control Plan* (USACE, 2003e).

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5.0 Explosives Management Plan

This Explosives Management Plan provides details for the management of explosives during the RI. This work plan addendum was developed in accordance with DID MR-005-03, *Explosives Management Plan* (USACE, 2003f), *Federal Acquisition Regulations, Subpart 45.5, Government Property Management* (DOD et al, 2000), Bureau of Alcohol, Tobacco, and Firearms (ATF) P 5400.7, *Federal Explosives Law and Regulations* (ATF, 2007), 27 CFR 555, DOD 6055.09-STD, *Ammunition and Explosive Safety Standards* (DOD, 2008), and Army Regulation 190-11, *Military Police, Physical Security of Arms, Munitions and Explosives* (Army, 1998).

Shaw anticipates that any identified MEC/MPPEH requiring destruction will be transported to the Operational Open Demolition Range at the Open Demolition Area #2 if it has been deemed as safe to move by the Shaw SUXOS. However, any MEC/MPPEH verified by the Shaw SUXOS as unsafe to move will be BIP at the location where it was identified.

5.1 Licenses/Permits

Shaw maintains a valid Explosive Permittee License (1-VA-510-33-9B-00374) issued by the ATF and complies with the appropriate portions of ATF P 5400.7 (ATF, 2007). The Shaw demolition team will consist of at least two UXO technicians qualified in accordance with DDESB TP 18 (DDESB, 2004) for demolition services, if required. Copies of most recent permitted Shaw ATF licenses will be maintained on site during field activities. All demolition team members have been cleared by the ATF as Employee Possessors.

5.2 Acquisition

Shaw will acquire commercial explosives from a local ATF-licensed vendor or vendors who will deliver the materials to the MRS. A copy of the Shaw user permit will be maintained at the MRS, and upon request, will be made available to any local, state, or federal authority.

The types of explosives anticipated during this project and their intended use are specified as follows. Typically, the following explosives will be used for disposal of MEC or venting of inert munitions:

- Jet Perforators (shaped charges)
- Detonating cord (Det Cord/Prima Cord)
- Electric or nonelectric initiators (Blasting Caps or NONEL)

Maximum anticipated quantities of explosives that will be ordered and delivered to the MRS will depend on the number of items encountered.

5.3 Initial Receipt

The licensed explosives vendor will deliver the explosives to Shaw at the MRS, at a designated location. The actual type and quantity of explosives received will be noted on the shipping documentation with the signatures of both the delivery driver and the individual authorized to receive such explosives. When required to perform demolition procedures, required explosives will be ordered and delivered to the Shaw SUXOS. Only the SUXOS and UXOSO will be authorized to receive the explosives.

5.4 Storage

MEC requiring demolition will be temporarily stored at the RVAAP in accordance with the requirements of the ATF (27 CFR 555, Subpart K). If the MEC item is determined that it can be moved, it will be stored in a temporary Type 2 explosives storage magazine at the Open Demolition Area #2 MRS. In the event a white phosphorus item is identified, it will be placed in a water bath to shield it from exposed air and placed in a separate magazine from other explosives identified.

The ESP for this project states that the maximum NEW allowable for on-site storage is 100 lbs. Shaw will limit the amount of MEC/MPPEH stored on-site and proposes to perform demolition activities as the explosives storage approaches 25 lbs NEW, the maximum NEW of explosive allowed for destruction at the Open Demolition Area #2 Operation Area per a single charge. Donor explosives will be delivered as needed but will not be stored at the facility during the project. If possible, all demolition activities will be scheduled for a single day, with all of the required explosives being delivered and consumed on the same day. If not consumed, any donor explosives remaining will returned to the vendor or supplier at the end of the day that it was delivered.

5.4.1 Inspection of Magazines

Each explosives storage magazine will be inspected daily in order to determine whether there has been an unauthorized entry or attempted entry into the magazine(s), or unauthorized removal of the contents of the magazine.

5.4.2 Location of the Magazines

The explosive storage magazine(s) will be stored at a secured location agreed upon by the Army and the RVAAP in accordance with DOD 6055.09-STD (DOD, 2008) and 27 CFR 555, Subpart K. The magazine(s) will not be placed closer to inhabited buildings, passenger railways, public highways, or other magazines in which high explosives are stored than the minimum separation distances presented in 27 CFR 555.218 for the quantity of explosives that are stored in the

magazine(s). Shaw will also coordinate with the OHARNG to assess if there is a potential for impact to the safety of personnel that are training or performing other activities within the MSDs for the quantity of explosives that are to be stored in the magazine(s).

5.4.3 Smoking and Open Flames

Smoking, matches, open flames, and spark producing devices are only permitted at areas designated by the RVAAP Facility Manager and not within 50 feet of the magazine(s).

5.4.4 Quantity and Storage Restrictions

As discussed in this section, donor explosives will not be stored on-site and will be delivered to the RVAAP on an ”On-Call” basis. Shaw will attempt to limit the number of deliveries of donor explosives by consolidating demolition activities when possible.

5.4.5 Explosives Storage within a Magazine

Any MEC items identified and placed in the magazine(s) will be stored within their assigned group numbers and may be stored with other assigned group numbers if they can be stored together without significantly increasing either the probability of an accident, or for a given quantity, the magnitude of the effects of such an accident. MEC items will not be stored with dissimilar substances or articles (e.g., flammable or combustible materials, acids, or corrosives) that may present additional hazards to the MEC unless they have been assessed to be compatible (DOD, 2008).

Any explosive materials placed within the magazine(s) will not be placed against the interior walls and must be stored as not to interfere with ventilation. A nonsparking lattice work or other nonsparking material may be used to prevent contact of stored MEC with walls. Any MEC item shall be stored so that it can be easily counted and checked upon inspection. MEC items are not to be packed and/or repacked inside a magazine or within 50 feet of a magazine and must not be unpacked or repacked close to other explosive materials. All containers with explosives must be closed while being stored. Tools used to open or close containers with explosive materials must be nonsparking.

5.4.6 Housekeeping

The explosive storage magazine(s) will be kept clean, dry, and free of grit, paper, empty packages, and containers and rubbish. The area surrounding the magazine(s) is to be kept clear of rubbish, brush, dry grass, or trees (except live trees more than 10 feet tall, for not less than 25 feet in all directions). Volatile materials are to be kept a distance of not less than 50 feet from the magazine(s).

5.5 Transportation

This section presents the vehicle requirements and on-site transportation procedures for explosives during the RVAAP RI activities.

5.5.1 On-Site Transportation Procedures

On-site delivery of donor explosive materials for demolition activities will occur on an "On-Call" basis by licensed-commercial carrier(s) to be determined. When explosives are required at the work site, vendor personnel will transport the explosives to an area designated by Shaw UXOSO.

Identified MEC/MPPEH requiring destruction will be transported to the Operational Open Demolition Range at the Open Demolition Area #2 if it has been deemed as safe to move by Shaw UXO personnel. Authorized Shaw personnel will be responsible for the transport of the MEC/MPPEH to the demolition range along RVAAP roadways.

The driver of any explosive-laden vehicle will ensure that the load is properly braced and that the initiators are carried separately from main-charge explosives. The SUXOS or authorized individual of moving explosives will ensure that the driver and any passengers are not carrying any smoking products or flame-producing devices. Smoking will be strictly forbidden among all personnel involved in the handling or transportation of explosives.

5.5.2 Vehicle Requirements

As required, Shaw UXO personnel will schedule a demolition operation and the required explosives will be delivered directly to the Open Demolition Range at Open Demolition Area #2 (or the MRS if BIP is required) by an authorized and licensed explosives vendor. Access through the RVAAP gate will be coordinated with the RVAAP and OHARNG in advance.

After issue at the general demolition area, Shaw will transport the explosives to the actual demolition area on foot. If transporting explosives by road, Shaw will comply with the following requirements:

- Vehicles transporting explosives will be placarded when carrying any Class 1 explosives.
- All vehicles transporting explosives will be equipped with reliable communications, a first-aid kit, and two 10-lb "BC"-type fire extinguishers. One extinguisher will be located in the driver's compartment and the other will be located in the cargo compartment.
- Vehicles transporting explosives will be inspected using DD Form 626, and the inspections will be documented on an explosives transportation vehicle safety checklist, which will be kept in the vehicle during transport.

- The vehicle used to transport the explosives will have a nonsparking bed liner, and all explosive loads will be covered prior to departure.
- Vehicles used for the transportation of explosive materials shall not be loaded beyond their rated capacity and the explosive materials shall be secured to prevent shifting of load or dislodgement from the vehicle.
- When explosive materials are transported by a vehicle with an open body, a magazine or closed container shall be securely mounted on the bed to contain the cargo.
- The driver of any explosive-laden vehicle will ensure that the load is properly braced and that the initiators are carried separately in an authorized portable container.
- Smoking, matches, open flames, and spark producing devices are only permitted at areas designated by the RVAAP Facility Manager and not within 50 feet of the magazine(s).
- Electromagnetic radiation hazards (e.g., radios and mobile phones) will be minimized when carrying electric detonators.

5.6 Receipt Procedures

This section describes the procedures that Shaw will use to maintain records of explosives received.

5.6.1 Inventory Control and Records Management

Explosives will be inventoried upon delivery to the magazine(s) storage area. Shaw will maintain records for all explosive materials received. Donor explosives for detonation of MEC will not be stored at the RVAAP; therefore, all explosives will be expended or returned to the supplier the same day it was delivered.

5.6.2 Authorized Individuals

Only the SUXOS and UXOSO will be authorized to receive the explosives. The SUXOS will be responsible for the proper issue of explosives to the authorized Shaw UXO personnel for detonation purposes.

5.6.3 End User Certification

The SUXOS or UXO Technician III, as the end user of explosives, will certify in writing that the explosives were used for their intended purpose. This information is tracked on the Explosive Usage Form and is presented in **Appendix E** in the work plan (Shaw, 2011b).

5.6.4 Reconciling Discrepancies

In the event that there is a discrepancy with any aspect of the management of explosives, the SUXOS will be immediately notified. The SUXOS, together with the UXOSO and UXOQCS, will review documentation to determine whether the discrepancy is a paperwork error or whether

explosives have been lost or stolen. If it is concluded that explosives have been lost or stolen, the incident will be immediately reported as discussed in Section 5.8.

5.7 Inventory of Stored MEC

An accurate running inventory of all identified MEC stored at in the magazines will be maintained. A minimum of two copies of the inventory shall be retained at the facility. One copy will be at the location of the magazine and the other will be maintained by the SUXOS in the field office. Shaw will provide a weekly update of the inventory to the RVAAP Facility Manager at Building 1037.

5.8 Lost, Stolen, or Unauthorized Use of Explosives

If explosives are discovered to be lost, stolen, or used without authorization, the incident will be immediately reported to the SUXOS and the Shaw PM, who in turn, will inform the USACE, RVAAP Facility Manager, and the Ohio EPA.

As the federal licensee, Shaw is required by law (27 CFR 55.30) to report the theft or loss of explosives to the ATF within 24 hours. In the event of such an occurrence, the following procedures will be followed:

- Shaw will make the appropriate notifications in accordance with 27 CFR 55.30. These will include calling the ATF (800-461-8841 or 888-283-2662) and the local law enforcement authorities.
- Shaw will be responsible for completing and forwarding ATF Form 5400.5. This form will be completed by the SUXOS, and a copy will be provided to USACE OESS.
- Shaw will notify the USACE OESS, USACE PM, RVAAP Facility Manager and Ohio EPA.

6.0 Explosives Site Plan

An ESP (USACE, 2009c) was developed by USACE for the RVAAP MMRP in accordance with DID MR-005-04, (DOD et al., 2000), ATF P 5400.7 (ATF, 2000), DOD 6055.09-STD (DOD, 2004), and Army Regulation 190-11 (Army, 1998). The ESP is included in Appendix I of the work plan (Shaw, 2011b).

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7.0 Environmental Protection Plan

Section 7.0 of the work plan presents the EPP that describes the approach, methods, and procedures to be employed by Shaw to protect the natural, cultural, and archaeological environments during performance of tasks associated with the RI. Specifically, the EPP describes the procedures and methods that will be implemented during MRS activities to minimize pollution, protect and conserve natural resources, provide notification of activities, restore damaged areas, and control noise and dust within reasonable limits. The EPP was prepared in accordance with DID MR-005-12, *Environmental Protection Plan* (USACE, 2003g).

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8.0 Property Management Plan

Section 8.0 of the work plan presents the Property Management Plan that describes how government property will be managed for this project.

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9.0 Interim Holding Facility Siting Plan for Recovered Chemical Warfare Materiel Projects

An Interim Holding Facility Siting Plan for recovered CWM is not applicable to the RVAAP Project.

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10.0 Physical Security Plan for Recovered Chemical Warfare Materiel Project Sites

A Physical Security Plan for recovered CWM is not applicable to the RVAAP Project.

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APPENDIX A
SITE SPECIFIC MUNITIONS CONSTITUENTS SAMPLING AND ANALYSIS PLAN/QUALITY ASSURANCE PROJECT PLAN ADDENDUM

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Final Sampling and Analysis Plan and Quality Assurance Project Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services Version 1.0

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912DR-09-D-0005
Delivery Order 0002

Prepared for:

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December 7, 2011

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Executive Summary

Preface

Shaw Environmental & Infrastructure, Inc. (Shaw) has been tasked by the U.S. Army Corps of Engineers (USACE) under the United States Army firm fixed-price remediation services Performance-Based Acquisition (PBA) Contract No. W912DR-09-D-0005, Delivery Order (DO) 0002, to perform a Remedial Investigation (RI) at 14 Munitions Response Sites (MRSs) for the Ravenna Army Ammunition Plant (RVAAP) located in Ravenna, Ohio. The Department of Defense (DoD) has established the Military Munitions Response Program (MMRP) to address DoD sites suspected of containing Munitions and Explosives of Concern (MEC) or Munitions Constituents (MC). This *Final Sampling and Analysis Plan and Quality Assurance Project Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services* is inclusive of a Field Sampling and Analysis Plan (SAP) and a Quality Assurance Project Plan (QAPP). This document; hereafter, referred to as the "SAP addendum," will apply to all site and laboratory activities performed under the aforementioned contract in accordance with the *Work Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services* at the RVAAP (hereafter, referred to as the "work plan addendum," which this SAP/QAPP addendum supports).

This SAP addendum provides the guidelines for the systematic data collection and analysis associated with the project. In accordance with the *Uniform Federal Policy for Quality Assurance Project Plans* (UFP-QAPP) (USEPA, 2005), this SAP addendum includes 37 worksheets that detail various aspects of the environmental investigation process and establishes protocols to allow for comparability and defensibility of sampling and analytical data. This SAP addendum (also referred to herein as UFP-QAPP) adheres to the program requirements of the *Department of Defense Quality Systems Manual for Environmental Laboratories* (DoD QSM), Version 4.2 (DoD, 2010).

Background

This SAP/QAPP addendum is intended to encompass sampling and analysis at the remaining seven MRSs under this DO where an RI will be conducted, including remedy-in-place (RIP) actions at two sites. This SAP/QAPP addendum will guide RIs at the following MRSs included in the work plan addendum:

- Erie Burning Grounds (RVAAP-02-R-01);
- Fuze and Booster Quarry (RVAAP-016-R-1);
- 40mm Firing Range (RVAAP-032-R-01);
- Sand Creek Dump MRS (RVAAP-034-R-01);
- Block D Igloo–TD MRS (RVAAP-061-R-01);
- Water Works #4 Dump (RVAAP-062-R-01); and
- Group 8 MRS (RVAAP-063-R-01).

In addition, RIP will be required to be achieved for two of the MRSs:

- Sand Creek Dump MRS (RVAAP-034-R-01); and
- Water Works #4 Dump (RVAAP-062-R-01)

The primary goal of the RIs is to gather sufficient data to characterize the nature and extent of MEC and MC relevant to the MMRP activities at each MRS addressed under this contract. The primary project objectives for MC sampling during the RIs are as follows:

- Determine the nature and extent of MC;
- Determine the fate and transport of MC;
- Determine the risk posed to human health and the environment by MC; and
- Collect or develop additional data to support the preparation of a Feasibility Study (FS) for the 2 RIP MRSs to determine remediation alternatives, including evaluation for no further action.

A site inspection (SI) was completed by engineering-environmental Management, Inc. (e^2M) in 2007 at each of the seven MRSs covered in this work plan addendum. During the SI, both a MEC and MC investigation were conducted to determine if there has been an impact at a given MRS. Analytical results for samples collected during the SI field activities indicate that explosive residues were either not detected in the samples or concentrations detected were significantly below the United States Environmental Protection Agency (USEPA) Residential Soil Preliminary Remediation Goals (PRGs). Concentrations of metals in soil were all below the USEPA Residential Soil PRGs with the exception of antimony, arsenic, lead, cadmium, iron, and manganese at the Group 8 MRS. Although metals concentrations were only detected above the PRGs at the Group 8 MRS the existing data is deemed to be incomplete. Thus, an RI is planned at each of the seven MRSs to characterize the nature and extent of MEC and MC; subsequent actions to achieve RIP (i.e., FS, Proposed Plan, Record of Decision, and remedy implementation) will be taken at the Sand Creek Dump and Water Works #4 Dump MRSs. Existing data will be fleshed out with new MMRP-related MC sampling and analysis. MEC investigations will be combined with the data to identify the true extent of MEC and MC related-conditions at the RVAAP MRSs under the MMRP.

For MC characterization, an evaluation of the MC associated with the MEC used at the MRS will first be performed. Following this, an evaluation of the data collected from various media under the Installation Restoration Program (IRP) will be performed and data gaps and data quality objectives (DQOs) identified. Data gaps will be filled during the RI. The analytes to be evaluated will be based on evidence of MEC observed at the site during the visual surveys and DGM intrusive investigation primarily, with consideration of historical records of MEC use, as well. Investigated media will primarily be soil, but some sediment and surface water sampling may be performed as well. The rationale and basis for MC sampling at the seven MRSs included in this work plan addendum is presented in Attachment F of this SAP addendum.

SAP Worksheet #1 - Title and Approval Page

Final Sampling and Analysis Plan and Quality Assurance Project Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services
Document Title

U.S. Army Corps of Engineers, North Atlantic Baltimore District
Lead Organization

Maqsud Rahman, Shaw Environmental & Infrastructure, Inc.
Preparer's Name and Organizational Affiliation

100 Technology Center Drive, Stoughton, MA 02072 (617-589-1043)
Preparer's Address, Telephone Number

06 December 2011
Preparation Date (Day/Month/Year)

Investigative Organization's Project Manager: 
Signature

David Cobb, Shaw Environmental & Infrastructure, Inc., 06 December 2011
Printed Name/Organization/Date

Investigative Organization's Project Chemist: 
Signature

Maqsud Rahman, Shaw Environmental & Infrastructure, Inc., 06 December 2011
Printed Name/Organization/Date

SAP Worksheet #2 - SAP Identifying Information

Site Number/Code: 7 Munitions Response Sites at the Ravenna Army Ammunition Plant
Operable Unit: RVAAP MRS
Contractor Name: Shaw Environmental & Infrastructure, Inc. (Shaw)
Contract Number: W912DR-09-D-0005
Contract Title: Multiple Award Military Munitions Services, Environmental Remediation Services, Ravenna Army Ammunition Plant, Ravenna, Ohio
Work Assignment Number: Contract Delivery Order No. 0002

1. This SAP addendum was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (USEPA, 2005).

2. Identify regulatory program: The RVAAP RI is being performed under the Military Munitions Response Program (MMRP) and, per Department of Defense (DoD) policy, is being conducted in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The Ohio Environmental Protection Agency (Ohio EPA) is the regulatory lead with support from the USEPA (not actively involved).

3. This SAP addendum is a *project-specific* SAP addendum.

4. List dates of scoping sessions that were held:

Scoping Session Date	Reference Document
07 October 2010	Technical Meeting w/Baltimore District Meeting Minutes

5. List dates and titles of SAP addendum documents written for previous site work, that are relevant to current investigation:

Title	Received Date
Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunitions Plant, Ravenna, Ohio dated February 24, 2011	
Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2 dated October 25, 2011.	
Louisville Chemistry Guideline, Louisville District United States Army Corps of Engineers, Revision No.5 dated June 2002	

6. List organizational partners (stakeholders) and connection with lead organization:
The Army inclusive of USACE–Louisville District, RVAAP, Installation Management Command (IMCOM), Department of Defense Explosives Safety Board (DDESB) U.S. Army Technical Center for Explosive Safety (USATCES), U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM), and U.S. Army Environmental Command (AEC); regulators, Ohio Environmental Protection Agency (Ohio EPA) and USEPA (not actively involved); current land user (non Base Realignment and Closure Division [BRACD] parcels), Ohio Army National Guard (OHARNG); current land owner (non BRAC parcels), Headquarters National Guard Bureau (NGB); and, Restoration Advisory Board (RAB) private landowners; interested parties.

7. Lead organization:
USACE, Baltimore District (contract management, technical support), USACE, Louisville (project management lead)

8. If any required SAP addendum elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below. All worksheets completed for this QAPP.

SAP Worksheet #2 - SAP Identifying Information (continued)

UFP-SAP Worksheet #	Required Information	Crosswalk to Related Information
A. Project Management		
Documentation		
1	Title and Approval Page	Included
2	Table of Contents SAP Identifying Information	Included
3	Distribution List	Included
4	Project Personnel Sign-Off Sheet	Included
Project Organization		
5	Project Organizational Chart	Included
6	Communication Pathways	Included
7	Personnel Responsibilities and Qualifications	Included
8	Special Training Requirements Table	Included
Project Planning / Project Definition		
9	Project Planning/Problem Definition (including Data Needs tables) Project Scoping session Participants Sheet	Included
10	Problem Definition, Site History, and Background Site Maps (historical and present)	Included
11	Site-Specific Project Quality Objectives	Included
12	Measurement Performance Criteria	Included
13	Sources of Secondary Data and Information Secondary Data Criteria and Limitations Table	Included
14	Summary of Project Tasks	Included
15	Reference Limits and Evaluation Table	Included
16	Project Schedule / Timeline Table	Included
B. Measurement Data Acquisition		
Sampling Tasks		
17	Sampling Design and Rationale	Included
18	Sampling Locations and Methods/SOP Requirements Table Sample Location Map(s)	Included
19	Analytical Methods/SOP Requirements Table	Included
20	Field Quality Control Sample Summary Table	Included
21	Project Sampling SOP References Table Sampling SOPs	Included
22	Field Equipment Calibration, Maintenance, Testing, and Inspection Table	Included
Analytical Tasks		
23	Analytical SOPs Analytical SOP References Table	Included
24	Analytical Instrument Calibration Table	Included
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures	Included

SAP Worksheet #2 - SAP Identifying Information (continued)

UFP-SAP Worksheet #	Required Information	Crosswalk to Related Information
Sample Collection		
26	Sample Handling System, Documentation Collection, Tracking, Archiving and Disposal Sample Handling Flow Diagram	Included
27	Sample Custody Requirements, Procedures/SOPs Sample Container Identification Example Chain of Custody Form and Seal	Included
Quality Control Samples		
28	QC Samples Table Screening / Confirmatory Analysis Decision Tree	Included
Data Management Tasks		
29	Project Documents and Records Table	Included
30	Analytical Services Table Analytical and Data Management SOPs	Included
C. Assessment Oversight		
31	Planned Assessments Table Audit Checklists	Included
32	Assessment Findings and Corrective Action Responses Tables	Included
33	QA Management Reports Table	Included
D. Data Review		
34	Verification (Step I) Process Table	Included
35	Validation (Steps IIa and IIb) Process Table	Included
36	Validation (Steps IIa and IIb) Summary Table	Included
37	Usability Assessment	Included

SAP Worksheet #3 - Distribution List

Name of SAP Recipients	Title / Role	Organization	Telephone Number	E-mail Address
Dave Cobb	Project Manager	Shaw	T : (617) 589-5561 F : (617)589-2160 C : (508) 667-3608	dave.cobb@shawgrp.com
Travis McCoun	Contracting Officer's Representative	Baltimore District Corps of Engineers	T : (410) 962-6728 F: (410) 962-4266	Travis.Mccoun@usace.army.mil
Glen Beckham	MMRP Project Manager	Louisville District Corps of Engineers	T: (502) 315-6799 F: (502) 315-6793	Glen.Beckham@usace.army.mil
Mark Patterson	Facility Manager	Base Realignment and Closure Division (BRACD) Ravenna Army Ammunition Plant	T: (330) 358-7312 F: (330) 358-7314	mark.c.patterson@us.army.mil
Katie Tait	Environmental Specialist	Ohio Army National Guard	T: (614)336-6136	kathryn.s.tait@us.army.mil
Eileen Mohr	Project Manager	Ohio EPA–NE District, DERR	T: (330) 963-1221	eileen.mohr@epa.state.oh.us
William O'Donnell	Program Manager	BRACD	T: (702) 601-1570	william.odonnell@us.army.mil
Mark Eldridge	Program Manager	Army Environmental Command	T: (410) 436-0542	mark.eldridge@us.army.mil
Kim Harriz	Cleanup Program Manager	National Guard Bureau	T: (703) 607-7991	kim.harriz@us.army.mil
Administrative Copy		Shaw		

SAP Worksheet #4 - Project Personnel Sign-Off Sheet

Organization: Shaw

Project Personnel	Title / Role	Telephone Number	Signature / Email Receipt	SAP Section(s) Reviewed	Date SAP Read
Dave Cobb	Shaw Project Manager	T: (617) 589-5561 F: (617) 589-2160 C: (508) 667-3608			
Timothy Deignan, PG	Shaw Senior Geophysicist	T: (720) 554-8273 F: (720) 554-8298 C: (303) 319-1196			
David Crispo, PE	Shaw Senior Environmental Engineer	T: (617) 589-8146 F: (617) 589-2160 C: (617) 834-5230			
Braden Livingstone	Shaw Quality Control	T: (330) 358-0058 C: (303) 888-5017			
Robert Harrison	Shaw Sr. UXO Supervisor	T: (330) 358-0058 C: (253) 486-2687			
Maqsud Rahman	Project Chemist	T: (513) 782-4859 C: (513) 919-8422			
Ken Morgan	Shaw UXO Safety Officer	T: (330) 358-0058 C: (303) 995-8760			

SAP Worksheet #4 - Project Personnel Sign-Off Sheet (continued)

Organization: USACE / Ohio EPA

Project Personnel	Title / Role	Telephone Number	Signature / Email Receipt	SAP Section(s) Reviewed	Date SAP Read
Travis McCoun	USACE TM	T: (410) 962-6728			
Glen Beckham	USACE PM	T: (502) 315-6799			
Alan Warminski	USACE Baltimore Chemist	T: (410) 962-7677			
Eileen Mohr	Ohio EPA PM	T: (330) 963-1221			

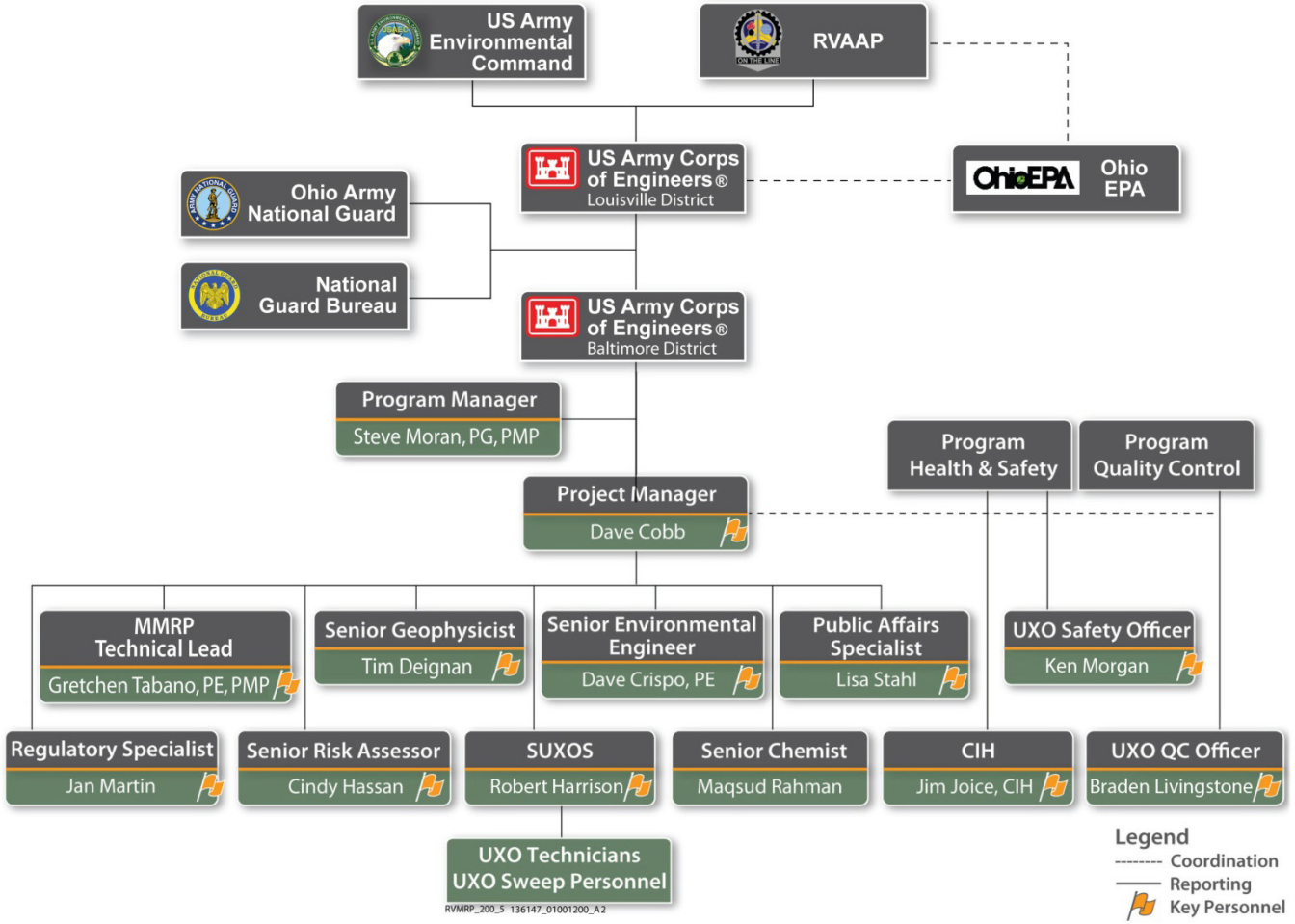
Organization: CT Laboratories, Inc.

Project Personnel	Title / Role	Telephone Number	Signature / Email Receipt	SAP Section(s) Reviewed	Date SAP Read
David Berwanger	Laboratory Director	T: (608) 356-2760 F: (608) 356-2766			
Dan Elwood	Laboratory QA Officer	T: (608) 356-2760 F: (608) 356-2766			
Eric Korthals	Laboratory PM	T: (608) 356-2760 F: (608) 356-2766			

Organization: ALS Laboratory Group. (Subcontract Lab for CT Labs)

Project Personnel	Title / Role	Telephone Number	Signature / Email Receipt	SAP Section(s) Reviewed	Date SAP Read
Kevin Griffiths	Laboratory PM	T: (800) 356-9135 F: (801) 268-9992			

SAP Worksheet #5 - Project Organizational Chart



SAP Worksheet #6 - Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or email	Procedure (timing, pathways, etc.)
Point of Contact with USACE COR	Shaw Project Manager	Dave Cobb	T : (617) 589-5561 F : (617)589-2160 C : (508) 667-3608 E : dave.cobb@shawgrp.com	Issues are to be reported to the USACE PM immediately and followed up in writing within 2 business days.
Manage All Project Phases	Shaw Project Manager	Dave Cobb	T : (617) 589-5561 F : (617) 589-2160 C : (508) 667-3608 E : dave.cobb@shawgrp.com	Issues are to be reported to the USACE PM immediately and followed up in writing within 2 business days.
SAP Changes in the Field Reporting Laboratory data quality issues and corrective actions	Shaw Project Chemist, Program Chemist or Sampling Technician	Maqsud Rahman	T: (513) 782-4859 C: (513) 919-8422 E: maqsud.rahman@shawgrp.com	Point of contact for all field related sampling activities will notify the Project Chemist or Program Chemist of any necessary field sampling changes. Point of contact for laboratory Project Manager or QC Manager if any laboratory QA/QC issues arise with field samples
Daily Field Progress Reports	Shaw Sr. UXO Supervisor	Robert Harrison	T: (330) 358-0058 C: (253) 486-2687 E: robert.harrison@shawgrp.com	The Sr. UXO Supervisor will provide daily reports to the Shaw PM via phone, fax, or e-mail and the daily reports will be forwarded to the USACE PM via e-mail.
Reporting Laboratory Data Quality Issues	Laboratory QA Officer	Dan Elwood	T : (608) 356-2760 F : (608) 356-2766 E : delwood@ctlaboratories.com	All QA/QC issues with laboratory analyses will be reported to the Shaw Project Chemist immediately and corrective actions implemented. The corrective actions follow-on report will be provided to the Shaw PM within 2 business days.

SAP Worksheet #6 - Communication Pathways (Continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or email	Procedure (timing, pathways, etc.)
Field Corrective Actions	Shaw UXO QC Specialist	Braden Livingston	T: (330) 358-0058 C: (303) 888-5017 E: braden.livingstone@shawgrp.com	Based on QA oversight of field work the need for corrective actions will be determined by Shaw QA Manager and documented in the daily log.
Lab Analytical Corrective Actions	Shaw Project Chemist	Maqsud Rahman	T: (513) 782-4859 C: (513) 919-8422 E: maqsud.rahman@shawgrp.com	The Shaw Project Chemist will be notified immediately by the lab of the need for any item requiring immediate corrective actions for laboratory analytical issues. The corrective actions follow-on report will be provided to the Shaw PM within 2 business days.
Release of Analytical Data	Shaw Project Chemist	Maqsud Rahman	T: (513) 782-4859 C: (513) 919-8422 E: maqsud.rahman@shawgrp.com	No analytical data will be released until verification and data validation is completed. Data will be verified by the Shaw Project Chemist within 1 business day of receipt from the laboratory.
SAP Amendments	Shaw Project Chemist	Maqsud Rahman	T: (513) 782-4859 C: (513) 919-8422 E: maqsud.rahman@shawgrp.com	Any major changes to the SAP addendum must be approved by the Shaw PM and the USACE PM before the changes can be forwarded to the RVAAP Project Delivery Team for approval. The proposed changes will be forwarded to the Project Delivery Team within 5 days of proposal. Changes to the SAP addendum will not be implemented unless approved by the USACE and the Ohio EPA

SAP Worksheet #7 - Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Dave Cobb	Shaw Project Manager	Shaw	• Manages oversight of the project for Shaw • Ensures that all requirements of project contract are attained in a manner consistent with project plans • Manages project budgets and schedules	• Masters of Science in Environmental Engineering • Massachusetts Licensed Engineer in Training, 20 years experience
David Crispo, PE	Sr. Environmental Engineer	Shaw	• Manages technical quality of contract • Directs the development and implementation of the Quality Assurance /Quality Control (QA/QC) Program • Ensures the Health and Safety Program is adequately implemented	• B.S. Civil Engineering • Professional Engineer (PE), Environmental Engineering discipline in the State of Ohio • Over 18 years experience in the environmental construction and remediation field
Ernie Duke	Contractor QC System Manager	Shaw	• Develops the project QC objectives and prepares the QC Plan • Administers the QC Plan • Manages QC documentation and QC deliverables • Lists definable features of work	• B.S. Geology, PA • Licensed Professional Geologist • U.S. Army Corps of Engineers (USACE) Construction Quality Manager • 36 years experience

SAP Worksheet #7 - Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Ken Morgan	Unexploded Ordnance (UXO) Safety Officer (UXOSO)	Shaw	• Conducts training of project personnel and accompany them during investigation activities • Responsible for munitions and explosives of concern (MEC) safety and will have "stop work" authority	• 29 Years EOD/UXO experience • More than 15 years of Explosives Ordnance Disposal (EOD)/UXO field health and safety experience
Robert Harrison	Sr. UXO Supervisor (SUXOS)	Shaw	• Responsible for managing all field sampling activities.	• B.S. Business Management • US Naval EOD School • 24 years EOD/UXO experience • 11 years EOD/UXO supervisory experience
Braden Livingstone	UXO QC Specialist (UXOQCS)	Shaw	• Field QA oversight on the project	• 11 years EOD/UXO experience • 7 years of EOD/UXO QC experience
Maqsud Rahman	Project Chemist	Shaw	• Selects qualified subcontract laboratories • Implements chemical data QC procedures and audits field performance • Reviews laboratory data prior to use • Performs validation of laboratory data • Reviews data validation report • Prepares appropriate sections of the report summarizing the project activities	• PhD, Chemistry • Knowledgeable of the Department of Defense Quality Systems Manual (DoD QSM), Version 4.2 and Louisville Chemistry Guidelines (LCG) • 34 years experience in the analytical chemistry field

SAP Worksheet #7 - Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Jim Joice, CIH	Health & Safety (H&S) Manager, Certified Industrial Hygienist (CIH)	Shaw	• Conducts inspections (preparatory, initial, follow-up, completions) • Develops and administers the Site Health and Safety Plan • Manages personnel and environmental monitoring • Coordinates preparation of Job Safety Analyses • Selects appropriate Personal Protective Equipment (PPE) • Reviews essential health and safety requirements with on-site personnel • Facilitates daily safety meetings	• BS Zoology • 18 years CIH experience • 30 years of H&S experience with more than 20 years as a Certified Hazardous Materials Manager (CHMM), managing H&S programs
David Berwanger	Laboratory Director	CT Laboratories, Inc.	• Manages the generation of analytical data	• B.S. Chemistry • Over 30 years experience in technical and managerial positions in the laboratory arena, 11 years as CT Laboratory's Lab Director
Dan Elwood	Laboratory QA Officer	CT Laboratories, Inc.	• Performs laboratory QA oversight.	• B.S. Biochemistry • Over 30 years experience in analytical chemistry, 19 years as CT Laboratory's QA Officer

SAP Worksheet #7 - Personnel Responsibilities and Qualifications Table (Continued)

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications
Eric Korthals	Laboratory PM	CT Laboratories, Inc.	• Serves as Laboratory PM and laboratory liaison with Shaw	• M.S. Biology and B.S. Biology/Chemistry Minor • Over 20 years experience in microbiology and inorganic chemistry, 12 years as CT Laboratory's PM
Kevin Griffiths	Laboratory Project Manager	ALS Group, Inc.	• Serves as Laboratory PM for secondary subcontract laboratory and laboratory liaison with CT Labs	• B.S. Chemistry • Over 30 years experience in the environmental industry and 19 years as ALS Group's PM

SAP Worksheet #8 - Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
MC Sampling	• 40-Hour Hazardous Waste Site Worker • 8-Hour Hazardous Waste Site Worker Annual Refresher • 8-Hour Hazardous Waste Site Supervisor Training • 10-Hour Occupational, Safety and Health Administration (OSHA) Construction Site Worker Safety Training	Varies[2]	Varies[2]	All	Munitions Constituents (MC) Sampling Lead - Shaw	Certification files are maintained on site during field activities and will be provided to U.S. Army Corps of Engineers (USACE) and Vista (RVAAP Operating Contractor) prior to deployment in the field.
Unexploded Ordnance (UXO) Team	• 40-Hour Hazardous Waste Site Worker • 8-Hour Hazardous Waste Site Worker Annual Refresher • Specialized training per the U.S. Department of Defense Explosives Safety Board (DDESB) Technical Paper (TP) 18 (DDESB, 2004)	Varies[2]	Varies[2]	All	• Sr. UXO Supervisor • UXO Quality Control Specialist • UXO Safety Officer • UXO technicians—all levels	Certification files are maintained on site during field activities and will be provided to USACE and Vista (RVAAP Operating Contractor) prior to deployment in the field.

SAP Worksheet #8 - Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates[1]
Any personnel working in the exclusion zone or areas of contamination on the project site	• 40-Hour Hazardous Waste Site Worker • 8-Hour Hazardous Waste Site Worker Annual Refresher	Varies[2]	Varies[2]	All	Varies	Certification files are maintained on site during field activities and will be provided to USACE and Vista (RVAAP Operating Contractor) prior to deployment in the field.

[1] Training records and/or certificates will be available on site at RVAAP.
[2] The training provider and date of the training may/will vary from person to person but is indicated on the individual's certificate.

SAP Worksheet #9 - Project Scoping Session Participants Sheet

Project Name: *Military Munitions Response Program Remedial Investigation Environmental Services at RVAAP* ***Projected Date(s) of Sampling:*** *November - January 2011* ***Project Manager:*** *Dave Cobb*	***Site Name:*** *Ravenna Army Ammunition Plant* ***Site Location:*** *Ravenna, Ohio*

Date of Session: 07 October 2010
Scoping Session Purpose: Technical Meeting with Baltimore Corps

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
David Cobb	Project Manager	Shaw	(617) 589-5561	dave.cobb@shawgrp.com	PM
David Crispo	Senior Environmental Engineer	Shaw	(617) 589-8146	david.crispo@shawgrp.com	Senior Environmental Engineer
Tim Deignan	Senior Geophysicist	Shaw	(720) 554-8273	timothy.deignan@shawgrp.com	Senior Geophysicist
Laura O'Donnell	Engineer	Shaw	(410) 612-6313	laura.odonnell@shawgrp.com	Project Engineer
Tom Colozza	Geophysicist	USACE	(410) 962-6647	thomas.s.colozza@usace.army.mil	Lead Geophysicist
Maria Orosz	Geophysicist	USACE	(410) 962-2700	maria.t.orosz@usace.army.mil	Project Geophysicist
Travis McCoun	Corps Officer's Representative	USACE	(410) 962-6728	travis.mccoun@usace.army.mil	COR
Deborah McKinley	Project Engineer	USACE	(410) 962-6730	deborah.k.mckinley@usace.army.mil	Project Engineer

Meeting minutes for the Technical Meeting with the Baltimore Corps (full reference follows) are provided in Appendix G of the RVAAP RI Work Plan (USACE, 2010):

U.S. Army Corps of Engineers (USACE). 2010. Ravenna TPP Meeting Minutes for Military Munitions Response Program, Ravenna, Ohio. Final Document. Prepared by Shaw Environmental & Infrastructure, Inc. January 2010.

SAP Worksheet #10 - Problem Definition

The Data Quality Objectives (DQO) process, as defined in *Data Quality Objectives Process for Hazardous Waste Site Investigations*, EPA QA/G-4HW (USEPA, 2000), consists of the following 7 steps:

- State the problem;
- Identify the decision;
- Identify inputs to the decision;
- Define the study boundaries;
- Develop a decision rule;
- Specify limits of decision errors; and
- Optimize the design for obtaining data.

This 7-step process provides the objective basis for quantitative definition of project requirements. DQOs will be developed and used to ensure that the amount, type, and quality of data obtained during a field sampling project are adequate to support project decisions with a known level of confidence.

The problem to be addressed by the project:

Purpose and Scope

The overall objective of this task order is to conduct a remedial investigation (RI) for 14 munitions response sites (MRSs) at the Ravenna Army Ammunition Plant (RVAAP). This SAP/QAPP addendum addresses the remaining seven MRSs addressed in this addendum. The purpose of the RI is to determine whether the MRSs warrants further response action pursuant to the Comprehensive Environmental, Response, Compensation and Liability Act (CERCLA) and the National Contingency Plan (NCP). The RI will accomplish the following objectives:

- Determine nature and extent of munitions and explosives of concern (MEC);
- Determine nature and extent of munitions constituents (MC);
- Determine the risk posed to human health and the environment by MEC and MC; and
- Collect or develop additional data for the Feasibility Study (FS), as appropriate, to determine remediation alternatives, including evaluation of no action.

Project Location and Description

RVAAP is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 km (3 miles) east–northeast of the town of Ravenna and approximately 1.6 km (1 mile) northwest of the town of Newton Falls. The installation consists of 8668.3 ha (21,683 acres) contained in a 17.7-km (11-mile)-long, 5.6-km (3.5-mile)-wide tract bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; State Route 534 on the east; Garrettsville and Berry Roads on the west; and the CONRAIL Railroad on the north. The land use surrounding the installation is primarily farmland with occasional private residences. The installation is surrounded by several local communities: Windham, which borders the installation to the north; Garrettsville, located 9.6 km (6 miles) to the northwest; Newton Falls, 1.6 km (1 mile) to the east; Charleston, bordering the southwest; and Wayland, 4.8 km (3 miles) to the southeast. RVAAP was established on August 26, 1940 for the primary purpose of loading conventional medium- and large-caliber artillery ammunition; bombs; mines; fuzes and boosters; primers and percussion elements; and for the storage of finished ammunition components. Originally, the installation was divided into two separate units; one was designated the Portage Ordnance Depot with the primary mission of the depot's storage activity, and the other was designated as the Ravenna Ordnance Plant with the primary mission of the ammunition-loading activities.

SAP Worksheet #10 – Problem Definition (continued)

Site History

Over the years, RVAAP handled and stored strategic and critical materials for various government agencies and received, stored, maintained, transported, and demilitarized military ammunition and explosive items. RVAAP maintained the capabilities to load, assemble, and pack military ammunition. However, these operations are inactive. As part of the RVAAP mission, the inactive facilities were maintained in a standby status by keeping equipment in a condition to permit resumption of production within the prescribed time limitations.

As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP have been transferred to the National Guard Bureau (NGB) from the U.S. Army and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site. Currently, RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the Camp Ravenna Joint Military Training Center (Camp Ravenna). These 1,280 acres consist of former industrial facilities that are being remediated and managed by the Base, Realignment and Closure Division (BRACD) that have, among other responsibilities, the task of overseeing inactive status installations. Military Munitions Response Program (MMRP) work will be performed on both NGB and BRAC parcels at RVAAP.

Currently, the Installation is known as Camp Ravenna. During the operational years, prior to Camp Ravenna, the entire 21,683- acre property was a government-owned, contractor-operated (GOCO) industrial facility. The RVAAP MMRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP; therefore, references to the RVAAP are considered to be inclusive of the historical extent of the RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

It is important to note that RVAAP is bound to the Director's Final Findings and Orders (DFFOs) issued June 10, 2004 by the Ohio EPA pursuant to the authority vested under Chapters 3734, 3745, and 6111 of the Ohio Revised Code (ORC). The objective of the Orders is to ensure that the public health, safety, and welfare, as well as the environment, is protected from the disposal, discharge, or release of MC (including MEC which includes unexploded ordnance [UXO], discarded military munitions [DMM], or MC at explosive concentrations) and MC at or from the Installation, through the implementation of a CERCLA based environmental remediation program. It should be noted that the Ohio EPA is the lead regulator at RVAAP. As a new program, some elements of the MMRP are still under development.

Summary of Previous Site Investigation Findings

Site Inspections (SIs) have been completed by engineering-environmental Management, Inc. (e^2M) in 2007 at each of the seven MRSs addressed in this SAP/QAPP addendum. During the SI, both a MEC and MC investigation were conducted to determine if there has been an impact at a given MRS. Analytical results for samples collected during the SI field activities indicate that explosive residues were either not detected in the samples or concentrations detected were significantly below USEPA Residential Soil Preliminary Remediation Goals (PRGs). Concentrations of metals in soil were all below the USEPA PRGs with the exception of antimony, arsenic, lead, cadmium, iron, and manganese at the Group 8 MRS. Although metals concentrations were only detected above the PRGs at the Group 8 MRS, existing data is deemed to be incomplete. Thus, an RI is planned at each of the seven RVAAP MRSs to characterize the nature and extent of MEC and MC; subsequent remedy-in-place (RIP) actions will be taken at two of the MRSs; the Sand Creek Dump MRS (RVAAP-034-R-01) and the Water Works #4 Dump MRS (RVAAP-062-R-01). Existing data will be fleshed out with new MMRP-related MC sampling and analysis and MEC investigations will be combined to identify the true extent of MEC and MC related-conditions at the RVAAP MRSs under the MMRP.

Areas of Concern and Investigation Strategy

This SAP/QAPP addendum is intended to encompass sampling and analysis at the seven MRSs included in the work plan where an RI will be conducted, as well as RIP actions (i.e., FS, proposed plan [PP], record of decision [ROD], and remedy implementation) at the two aforementioned MRSs. Site-specific worksheet addendums will be submitted for the 7 remaining MRSs as each of these subsequent sites move through the Technical Planning Process (TPP) and the

SAP Worksheet #10 – Problem Definition (continued)

development of site details with all stakeholders. This SAP/QAPP addendum will guide RIs at the following MRSs under this Delivery Order: Erie Burning Grounds (RVAAP-002-R-01), Fuze and Booster Quarry (RVAAP-016-R-01), 40mm Firing Range (RVAAP-032-R-01), Sand Creek Dump (RVAAP-034-R-01), Block D Igloo-TD (RVAAP-061-R-01), Water Works #4 Dump (RVAAP-062-R-01) and Group 8 (RVAAP-063-R-01).

MEC Investigation

For MEC characterization, the MEC investigation approach will involve a surface survey. The objectives of the surface survey are as follows:

- Determine nature and extent of MEC/MD on the ground surface;
- Determine whether explosive hazards exist;
- Obtain additional military munitions response information/data on the installation;
- Better define the Conceptual Site Model (CSM) that has been developed for the MRSs; and
- Confirm the historical information regarding types of MEC used at the installation.

The entire MRS boundary as well as areas outside of the MRS boundary, as necessary to delineate the extent of MEC, will be investigated. The area will be surveyed visually on the surface and concurrently screened with a Schonstedt metal detector by a UXO Technician using avoidance techniques. Items found will be identified by UXO technicians to determine whether they are MEC/MD.

Following the visual survey, digital geophysical mapping (DGM) with anomaly reacquisition, will be performed in either focused areas where there is evidence of subsurface MEC or statistically placed using UXO Estimator. The anomalies identified during the surveys will be reacquired as part of the RI, and the data will be used to determine the potential for MEC to be present in the subsurface and scope future remedial action, if warranted.

MC Investigation

For MC characterization, an evaluation of the MC associated with the MEC used at the MRS will first be performed. Following this, an evaluation of the usability of the data collected from various media under the Installation Restoration Program (IRP) will be performed and data gaps and data quality objectives (DQOs) identified. Data gaps will be filled during the RI. The analytes to be evaluated will be based on evidence of MEC observed at the site during the visual surveys and DGM intrusive investigation primarily, with consideration of historical records of MEC use, as well. Investigated media will primarily be soil, but some limited sediment and surface water sampling may be performed as well.

The environmental questions being asked:

- Has the nature and extent of MEC/MD been determined?
- Has the nature and extent of MC been determined?
- Has the risk posed to human health and the environment by MEC and MC been determined?
- Has the information required to develop and FS and to determine remediation alternatives, including no action been collected?

Observations from any site reconnaissance reports:
Detailed investigations of the source and nature and extent of MEC/MD present at the RVAAP MRSs were not completed during the SI field investigation (e2M, 2008). The reader is referred to this document for additional information on the field program and results obtained during this investigation. Visual surveys were the primary source of data for this delineation effort. Data collected during this investigation indicates that potential MEC/MD and/or MC impacts are present on the seven MRSs evaluated in this RI effort. Suspected MEC materials ranged from training items (flares) to 500-pound bombs (e2M, 2008).

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The possible classes of MC and the affected matrices: The MRSs evaluated in this RI include two areas where burning potentially took place (Erie Burning Grounds and Group 8 MRS), one disposal area, two dumps, one 40mm firing range, and the off-site portion of the 1943 explosion. Based on historical information or physical evidence of MD or MEC identified during past investigations, MEC known to have been used at the RVAAP MRSs include the following:

- Flares;
- Projectiles, 40mm, 40mm fragmentation, 105mm, and 155mm;
- Bombs (20-lb fragmentation and 500-lb);
- Triple-based propellant; and
- Bulk explosives.

MC samples where metals will be evaluated will also be analyzed for the following three additional metals for geochemical evaluation purposes only: calcium (Ca); magnesium (Mg); and manganese (Mn). Aluminum (Al) and iron (Fe) would typically also be analyzed for geochemical evaluation purposes in certain MRSs where they are not considered MC; however, Al and Fe are considered MC at seven and six MRSs, respectively. Therefore, Al will not be analyzed for geochemical purposes at any of the MRSs in this SAP addendum and Fe will only be analyzed for geochemical purposes at one MRS (40mm Firing Range). Proposed geochemical evaluation will be used to compare site metals data to background data. Statistical site-to-background comparisons for trace elements in environmental media commonly have high false-positive error rates. A large number of background samples, as exists at RVAAP, are required to adequately characterize the upper tails of most trace element distributions, which are typically right-skewed and span a wide range of concentrations. There are also concerns regarding the statistical validity of comparing site data from a small parcel with facility-wide background data that typically display higher variance than the site data. The presence of estimated concentrations and nondetects with differing reporting limits can also cause statistical comparison tests to fail.

Statistical tests consider only the absolute concentrations of individual elements, and they disregard the interdependence of element concentrations and the geochemical mechanisms controlling element behavior. However, it is well established that trace elements naturally associate with specific soil-forming minerals, and the preferential enrichment of a sample with these minerals will result in elevated trace element concentrations. It is thus important to be able to identify these naturally high concentrations and distinguish them from elevated MC. This is achieved by performing a geochemical evaluation.

Recent publications indicate that environmental investigations are increasingly considering these elemental associations (e.g., U.S. Environmental Protection Agency, 1995; Barclift et al., 2000; U.S. Navy, 2002 and 2003; Myers and Thorbjornsen, 2004; Thorbjornsen and Myers, 2007). A properly executed geochemical evaluation can distinguish between naturally high element concentrations versus contamination, and it can identify the specific samples that may contain some component of site-related contamination. If an analyte fails either of the statistical tests, then a geochemical evaluation is performed to determine if the elevated concentrations are caused by natural processes.

The Ohio EPA does not object to Shaw performing the geochemical evaluation as described in this section. However, it is noted that the Ohio EPA has not approved or disapproved the proposed geochemical evaluation process or the rationale for conducting the evaluation at this time. Consequently, the Ohio EPA may determine at a later date whether the results of the geochemical study may or may not be able to be used in the project decision making process.

Geochemical Evaluation Methodology. Trace elements naturally associate with specific minerals in soil, and geochemical evaluations are predicated on these known associations. For example, in most uncontaminated oxic soils, arsenic exhibits an almost exclusive association with iron oxide minerals (Bowell, 1994; Schiff and Weisberg, 1997). Arsenic exists in oxic soil pore fluid as oxyanions such as $HAsO_4^{-2}$ and $H_2AsO_4^{-}$ (Brookins, 1988), and these negatively charged species have a strong affinity to adsorb on iron oxides, which tend to maintain a net positive surface charge (Electric Power Research Institute, 1986). (In this report, the term “iron oxide” encompasses oxides, hydroxides, oxyhydroxides, and hydrous oxides of iron.) This association is expressed as a positive correlation

SAP Worksheet #10 – Problem Definition (continued)

between arsenic concentrations and iron concentrations for uncontaminated samples: samples with a low percentage of iron oxides will contain proportionally lower arsenic concentrations, and samples that are enriched in iron oxides will contain proportionally higher arsenic concentrations. Although there is variability in the absolute concentrations of arsenic and iron in soil at a site, the arsenic (As) to iron (Fe) ratios of the samples will be relatively constant if no contamination is present (Daskalakis and O'Connor, 1995). Samples that contain excess arsenic from a MC source (e.g., arsenical pesticides) will exhibit anomalously high As/Fe ratios compared to the uncontaminated samples. Although this is only an example to show the geochemical methodology, it should be noted that Fe is considered an MC at six of the seven MRSs discussed in this SAP addendum and will only be analyzed as a geochemical chemical at one MRS (40mm Firing Range).

It is important to note that there is natural variability, as well as analytical uncertainty, in the elemental ratios of uncontaminated soil and sediment samples. Trace/major element ratios are calculated from two uncertain analytical results, so the resulting uncertainties in the ratios can produce some scatter in the points on a ratio plot. This is especially true when estimated ("J"-qualified) analytical results are used. This can be seen on many of the plots that show more scatter of the points at the lower end of the concentration range, where analytical uncertainties are higher and analytical results are reported with fewer significant figures. On ratio plots, vertical trends should be expected only in those cases where the trace element adsorption is a linear process, where the trace element concentrations are controlled exclusively by adsorption on a given mineral type, and where the variances of the reference and trace element concentrations are similar (Thorbjornsen and Myers, 2007). Nonvertical trends are much more common in ratio plots. However, because adsorption processes often are not linear, trace elements often have affinities for more than one type of sorptive surface, and the reference and trace element concentrations usually possess different variances. Nonlinear adsorption of a trace element on mineral surfaces will manifest itself as a curve rather than a straight line on a correlation plot and as a nonvertical trend on a ratio plot. In addition, the presence of competing ions in soil (or sediment) and differences in pH and redox conditions among the sample locations can add to the natural variability of elemental ratios.

Ratio plots may also be prepared for the major elements (e.g., aluminum versus Al/Fe ratios). However, adsorption is not the dominant process controlling major element concentrations. For example, aluminum and iron concentrations co-vary largely because they are controlled by the abundance of fine-grained minerals in the samples. The plots thus reflect physical effects rather than chemical effects such as adsorption. Constant ratios are not typically observed for major versus major elements.

Because some of the screening levels that will be used for the screening level Ecological Risk Assessment (SLERA) are dependent upon total organic carbon (TOC) and/or pH, soil samples will also be analyzed for TOC and pH, and sediment samples will also be analyzed for TOC.

The overall analytical groups and overall target lists (as noted in Worksheets 18 and 19) to be evaluated based on the types of munitions used at the RVAAP MRSs as well as the MC and geochemical analytes to be evaluated for each MRS include:

- Erie Burning Grounds (RVAAP-02-R-01):
    - MEC Metals, Method USEPA SW846 6010C and 7196A: aluminum (Al), barium (Ba), cadmium (Cd), chromium (Cr) III and VI (hexavalent), copper (Cu), iron (Fe), lead (Pb), zinc (Zn), antimony (Sb), strontium (Sr), barium (Ba), and mercury (Hg).
    - Explosives, Method USEPA SW846 8330B: 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX), cyclotrimethylenetrinitramine (RDX), 1,3,5-Trinitrobenzene (1,3,5-TNB), 1,3-Dinitrobenzene (1,3-DNB), tetryl, nitrobenzene (NB), 2,4,6-trinitrotoluene (2,4,6-TNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT), 2-amino-4,6-dinitrotoluene (2-Am-DNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4/2,6-Dinitrotoluene Mix (2,4/,2,6-DNT Mix), 2-nitrotoluene (2-NT), 3-nitrotoluene (3-NT), 4-nitrotoluene (4-NT), nitroglycerin (NG), pentaerythritol tetranitrate (PETN), 3,5-Dinitroaniline (3,5-DNA), and nitroguanidine (NQ).
    - Semivolatile Organic Chemicals (SVOCs), Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene,

SAP Worksheet #10 – Problem Definition (continued)

1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

- Polychlorinated Biphenyls (PCBs), Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260 (sediment only).
- Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: calcium (Ca), magnesium (Mg), and manganese (Mn).
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

- <u>Fuze and Booster Quarry (RVAAP-016-R-1):</u>
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX), RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
  - PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.

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- 40mm Firing Range (RVAAP-032-R-01)*:
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al and Pb.
  - Explosives, Method USEPA SW846 8330B: HMX), RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, Mn and Fe.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

  **Note: the IS soil sample from the firing point will be analyzed for propellants (nitrocellulose, nitroguanidine and nitroglycerine) only.*
- Sand Creek Dump MRS (RVAAP-034-R-01):
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX), RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.

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- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

- Block D Igloo–TD MRS (RVAAP-061-R-01):
  - MEC Metals, Method USEPA SW846 6010C: Al, Fe, Pb, and Sb.
  - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
- Water Works #4 Dump (RVAAP-062-R-01)
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX), RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
- Group 8 MRS (RVAAP-063-R-01)
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX), RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.

SAP Worksheet #10 – Problem Definition (continued)

- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
- PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.
- Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

- Investigative Derived Waste (IDW)
  - TCLP Metals, Method USEPA SW846 1311/6010C/7470A;
  - TCLP SVOCs, Method USEPA SW846 1311/8270C;
  - Explosives, Method USEPA SW846 8330B: (Full list);
  - Ignitability, Method USEPA SW846 1010A/1030;
  - Corrosivity as pH, Method USEPA SW846 9040C/9045D;
  - Total Cyanide, Method USEPA SW846 9012/9013; and
  - Total Sulfide, Method USEPA SW846 9030B.

The affected matrix is primarily soil. However, at some MRSs, impacts to wetland sediment, stream sediment, surface water, and potentially groundwater may also have occurred. Impacts to groundwater are considered very unlikely. As such, evaluation of groundwater will only be performed if the results from the previous investigations or soil sampling indicate that migration of MC through that media to groundwater may have occurred.

Other analyses may be added based on the MEC/MD findings if the items found were not identified to date as having been used at the RVAAP MRSs.

The rationale for inclusion of chemical and nonchemical analyses:
The rationale for inclusion of chemical and nonchemical analyses is based on a detailed evaluation of the MCs in the fillers and bodies/casings of the munitions used or potentially used at the RVAAP MRSs that may be found during the RI field effort. A summary of the MEC used and the associated MC is presented in **Table 1**. The overall site-wide MC by MRS is identified above. Further discussion for the rationale for inclusion of chemical and nonchemical analyses by MRS and the proposed lists of MCs to be analyzed for the samples may be found in **Attachment F**.

SAP Worksheet #10 – Problem Definition (continued)

Project decision conditions (If..., then...@ statements):
Chemicals of Potential Concern

The following Decision Rules for the screening level risk assessment for human health will be applied to the MC data collected during the RI in accordance with the *USACE RVAAP Position Paper for the Application and Use of Facility-Wide Human Health Cleanup Goals* (USACE, 2009a), hereafter referred to as the "Position Paper":

1. The concentrations of inorganics shall be compared to the soil background values in the *Final Facility-Wide Human Health Cleanup Goals for the RVAAP* (SAIC, 2010); hereafter; referred to as the "FWCUG report," and the results of the geochemical evaluation. Exceedance of an inorganic above its respective background value will require it to be retained as a chemical of potential concern (COPC) for further evaluation. Comparison of results to the geochemical evaluation is considered an exception to the procedures presented in the Position Paper (USACE, 2009a) which provides for a comparison of all data to available background values.
2. MMRP-related metals that are considered essential nutrients will be screened out with the exception of iron which is considered an MC at six of seven MRSs. The USEPA recommends that these chemicals not be evaluated as COPCs as long as they are: (1) present at low concentrations (i.e., only slightly above naturally occurring levels), and (2) toxic at very high doses (i.e., much higher than those that could be associated with contact at the MRS).
3. Chemicals meeting the less than 5 percent detection rule may be screened out in accordance with the Position Paper (SAIC, 2009a). However, this step is based on having a statistically valid data set (sample size of at least 20) but may not apply if the MQOs for sensitivity are not met. Frequency of detection does not apply to explosives or propellants, which will be retained as COPCs throughout the evaluation process.
4. The steps below will be followed for the comparison process to be acceptable and complete when establishing MMRP-related COPCs or characterizing elevated MC in an area:
   a. The FWCUGs developed for the Residential Farmer Adult and Child and the National Guard Trainee human health receptors for each chemical will be used. If there are no FWCUGs developed for a particular chemical, then the USEPA Regional Screening Levels (RSLs) for the Residential Receptor will be used. If neither the FWCUG nor the RSL is available, then a cleanup goal will be developed or another approach will be developed in concurrence with USACE and the Ohio EPA. The FWCUGs presented in the FWCUG document (SAIC, 2010) are hereafter referred to as the Final FWCUGs.
   b. The Final FWCUGs at the $1x10^{-6}$ cancer risk level and noncarcinogenic risk Hazard Quotient (HQ) using the 0.1 risk value for each of the receptors will be selected.
   c. Report all carcinogenic and noncarcinogenic risk values for each chemical for the Adult and Child Residential Farmer and National Guard Trainee.
   d. Complete a comparison of the selected Final FWCUG to the Exposure Point Concentration (EPC). The EPC will be either the 95 percent Upper Confidence Limit (UCL) of the mean for each chemical concentration or the maximum value detected, depending on whichever value is the lowest. In comparisons where the 95 percent UCL cannot be determined, the maximum concentration of the chemical should be compared to the appropriate CUGs.

IF the EPC exceeds the most stringent FWCUG for the Residential Farmer Adult and Child, the intended National Guard land user and/or any of the National Guard receptors for either one of the $1x10^{-6}$ carcinogenic value and the noncarcinogenic HQ using the 0.1 risk value, **THEN** the chemical will be retained as a COPC. **IF** organic, explosives, and/or propellant MC are identified in samples, **THEN** the analytes will be evaluated as COPCs/COC following the risk assessment in the RI regardless of the carcinogenic value or hazard quotient. **IF** the metals MC concentrations are determined to be below background and the risk-based

SAP Worksheet #10 – Problem Definition (continued)

human health, **THEN** no further evaluation for metals MC is required. **IF** the metals MC concentrations exceed their background values and/or the risk-based human health, **THEN** the metals MC will be retained as COPCs. **IF** metals MC concentrations are detected above RVAAP background values and below the risk based human health and ecological screening values, **THEN** a statistical and geochemical analysis will be conducted to determine if the MC metal concentrations are associated with munitions activities or attributed to native sources. **IF** the metals MC concentrations are determined to be associated with native sources following the geochemical analysis, **THEN** no further evaluation is required. **IF** metals MC are determined to be attributable to munitions activities, **THEN** the metals MC will be retained as COPC. **IF** metals MC are identified as COPCs or, **THEN** they will be evaluated as chemicals of concern (COCs).

Chemicals of Concern

The following Decision Rules will be applied to the MC data identified as COCs in accordance with the Position Paper (USACE, 2009a):

Once the COPCs have been thoroughly evaluated and all sampling has been completed so that the nature and extent of MC is known, the second step will be implemented to determine which COPCs are COCs. An evaluation of the risks and associated risk assessment will be conducted in the RI. Any COCs will be evaluated in the beginning of the FS as part of the Risk Management Evaluation Process. It is expected that the determination of COCs will consist of screening of the chemical concentrations to specific Final FWCUGs similar as for COPCs. However, the COCs are determined by comparing the chemical concentration to different risk levels and the Residential Farmer Adult and Child, the representative OHARNG human health receptor(s) identified for each the MRSs or other OHARNG receptor if the FWCUG is more stringent than for the representative OHARNG receptor. The determination of COCs will proceed as follows:

1. The Final FWCUG values for the Residential Farmer Adult and Child receptors, the representative OHARNG user as wells as the other OHARNG receptors will be selected using the $1x10^{-5}$ carcinogenic value and noncarcinogenic risk value termed HQ using the 1.0 risk value.
2. All carcinogenic and noncarcinogenic risk values for all receptors and all critical effect and target organ for each of the noncarcinogenic risk values will be reported.
3. A comparison of the Final FWCUG to the EPC will be completed similarly as discussed for COPC evaluation.
4. For carcinogens and noncarcinogens, the chemical-specific concentrations will be compared to the target risk Final FWCUG using the Sum or Ratios method presented in the Position Paper (USACE, 2009a).

IF the EPC exceeds the most stringent risk value for the Adult Residential Farmer, Child Residential Farmer, the intended OHARNG receptor and/or other OHARNG receptors for either one of the $1x10^{-5}$ carcinogenic value and the noncarcinogenic risk value termed HQ using the 1.0 risk value, **THEN** the MC will be retained as a COC. **IF** the Sum of Ratios for all carcinogens and all noncarcinogens that may affect the same organ are greater than 1 and the chemical contributes at least 10 percent to the sum, **THEN** the MC will be retained as a COC for the MRSs requiring RIP. **IF** unacceptable human health or ecological risks are determined for metal MC and they are above background, **THEN** an evaluation of remedial alternatives will be required.

A site-specific cleanup goal will be developed for any new chemical at an MRS this is identified as a COC requiring remediation in accordance with RVAAP's *Facility-Wide Human Health Risk Assessor Manual* (USACE, 2005); herein referred to as the HHRAM. The Final FWCUGs for each of the COCs identified through the aforementioned process are the actual remediation levels unless there are additive effects. These levels will be used to determine the nature and extent, fate and transport of MC, and risk to human health and the environment at all MRSs. In addition, the Final FWCUGs will be used to help achieve RIP at the Sand Creek Dump and Water Works #4 Dump MRSs. In some instances, there may be a risk management analysis such as "Weight of Evidence" approach that may allow for a COC to be reassessed. However, any reevaluation of a COC and the proposed approach will require concurrence from the USACE and Ohio EPA. The use of the Sum of Ratios approach is intended to account for additive effects from exposure to multiple chemicals that can cause the same effect (e.g., cancer) or affect the same target organ. The Sum of Ratios approach compares the chemical concentration (e.g., mean concentration or concentration in confirmation

SAP Worksheet #10 – Problem Definition (continued)

samples, the EPC) of the COC to the individual Final FWCUG to determine a ratio of acceptable risk.

Ecological Risk Assessment

The potential for ecological risks from exposures to contaminants detected at the MRSs will be assessed through the completion of a screening level ecological risk assessment (SLERA). The following Decision Rules for ecological assessment will be conducted in accordance with the guidelines set forth in *Ohio EPA Guidance for Conducting Ecological Risk Assessments* (Ohio EPA, 2008).

The SLERA will consist of the following components:

- Description of the environmental setting at the MRS;
- Discussion of the constituents detected at the MRS media;
- General discussion of the constituents fate and transport;
- Discussion of the potential ecological receptors at the MRS;
- Description of the complete exposure pathways at the MRS;
- Discussion of the screening level assessment and measurement endpoints;
- Discussion of the ecological screening values for the various environmental media at the MRS to be used to select preliminary constituents of potential ecological concern (COPECs) to carry through the SLERA;
- Description of the EPCs of the selected COPECs in each environmental media at the MRS;
- Calculation of screening level hazard quotients for COPECs selected in each environmental medium;
- Consideration of additional lines of evidence that may be important to refine the screening level hazard quotient estimates, such as more realistic estimates of chemical bioaccumulation, bioavailability, exposure, and/or toxicity, typically referred to as Step 3 of the USEPA (1997) 8-step ecological risk assessment (ERA) process;
- Identification of final COPECs in each environmental medium;
- Uncertainty analysis; and
- SLERA summary and conclusions.

Depending on the constituents detected at the RVAAP MRSs and the ecological habitat available at each MRS, it may be appropriate to conduct more than one SLERA. Individual MRSs may be grouped together for the purposes of conducting SLERAs based on similar constituents and similar ecological habitats. The results of the SLERA(s) will provide sufficient information for risk managers to make a decision of either negligible ecological risk at the MRS (no further ERA is necessary) or further baseline ERA (BERA) is warranted. The following screening value ecological hierarchy will be used for the media types anticipated and integrates the Ohio EPA, USEPA and USACE ERA processes:

Hierarchy used to select the soil screening values:

1. USEPA EcoSSL (plants, invertebrates, wildlife;
2. ORNL PRGs (1997) (plants, invertebrates, wildlife);
3. USEPA Region 5 ESLs (2003d);
4. LANL (2010) (various endpoints); and
5. Talmage et el (1999);

SAP Worksheet #10 – Problem Definition (continued)

Hierarchy used to select the sediment screening values:

1. MacDonald et al (2000);
2. USEPA Region 5 ESLs (2003d);
3. ORNL PRGs (1997) (plants, invertebrates, wildlife);
4. LANL (2010) (various endpoints); and
5. Talmage et el (1999).

Hierarchy used to select the surface water screening values:

1. Ohio water quality criteria (2010) (aquatic life, OMZA);
2. USEPA Region 5 ESLs (2003d);
3. ORNL PRGs (1997) (plants, invertebrates, wildlife);
4. LANL (2010) (various endpoints); and
5. Talmage et el (1999).

IF the following three conditions are met, **THEN** a BERA will be recommended:

1. Ample habitat exists wherein ecological receptors can occur.
2. Contaminants are present in environmental media at levels that could pose risk.
3. A complete exposure pathway exists whereby the ecological receptors could be exposed to the chemical contaminants.

IF any of these conditions is not met, **THEN** the potential for ecological receptors to be exposed to contaminants at levels that may pose a risk does not exist, and NFA is necessary to address ecological concerns.

The objective of a BERA is to evaluate the potential for adverse effects to ecologic al receptors from MRS contaminants. The potential for adverse effects to ecological receptors is dependent on the ecological receptor species, the contaminants present, and the pathways by which ecological receptors could be exposed to the contaminants. Because the nature and extent of contamination is unknown, it would be premature to develop a plan to evaluate a BERA for the RVAAP MRSs. If the ecological risk managers consider that the SLERA for an MRS identifies enough ecological risk to warrant a BERA, Shaw will prepare a BERA work plan that will include a modified ecological CSM, identification of endpoint measurements and assessments, and the hypothesis being tested.

SAP Worksheet #11 - Project Quality Objectives/Systematic Planning Process Statements

Who will use the data?
The data will be used by the USACE (and its contractors), Ohio EPA, and other stakeholders to determine the nature and extent, fate and transport and potential risk to human health and the environment by munitions constituents (MC) associated with former military munitions activities that occurred on the RVAAP MRSs. MC collected during the RI will be used during the human health and ecological risk assessment to evaluate risk from MC exposure.

What will the data be used for?
Shaw will perform an screening level risk human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA) utilizing the sample results from the RI and previous investigations, where appropriate, to determine whether unacceptable risks are associated with the MC detected at the site. Shaw will also perform a background assessment (statistical and geochemical, as needed) to determine whether metals detected in the site samples are attributable to background or site activities.

What types of data are needed (matrix, target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?
The sampling at this site will include the following guidance:

- Shaw Standard Operating Procedures (SOPs) for sample collection, handling, sample preparation, and analytical methods.
- *Facility-Wide Sampling and Analysis Plan for RVAAP* (FSAP) (SAIC, 2011).

For sample collection and handling, refer to Worksheet 21 for field sampling SOPs.

All sample analysis will be performed by the off-site laboratory (CT Laboratories, Inc.). Refer to Worksheet 19 for sample types, matrices, analytical groups and methods, and laboratory SOPs.

How "good" does the data need to be in order to support the environmental decision?
The data will be of the quantity and quality necessary to provide technically sound and defensible assessments of potential risks to human health and ecological receptors posed by the MC identified. For high level decisions, the laboratory methods will meet the *EPA Test Methods for Evaluation Solid Waste* (SW846), Update 4 (2007) and the *DoD Quality Systems Manual (QSM) for Environmental Laboratories, Version 4.2* (DoD, 2010). The analytical data will be reported to the reporting limit (RL) defined as the sample level of quantitation (LOQ) or the low calibration standard; and adjusted for sample characteristics, such as dilutions, sample volumes, and moisture effects (where applicable). Any detection between the LOQ and the limits of detection (LODs) will be noted as estimated values "J." Nondetects will be reported to the LOQ. The condition of LOQs and/or the LODs exceeding the screening criteria occurs occasionally in the realm of chemical analysis with the given current USEPA methodology, especially for ecological assessments. When this occurs, Sections 5.3.3 and 5.3.5 of *EPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual* (Part A) provide guidance for the risk assessor. In some cases ½ of the LOD or LOQ is used as proxy concentrations (detected in some samples), and in some cases the chemical is removed all together (nondetect for all samples). For toxicity characteristic leaching procedure (TCLP) and other investigative-derived waste (IDW) sample analysis, the laboratory has not established QSM LODs and LOQs, but will report utilizing the laboratory's MDL and RL. The data will be validated as described in Worksheet #35 in accordance with the data validation and verification guidance provided in the Louisville Chemistry Guideline (LCG), Revision 5 (2002). The data collected is necessary to support a HHRA in accordance with the procedures presented I the RVAAP's HHRAM (USACE, 2005). The HHRAM provides a framework for the facility-wide cleanup goals (FWCUGs) included in the Final FWCUG report (SAIC, 2010).

SAP Worksheet #11 - Project Quality Objectives/Systematic Planning Process Statements (continued)

How much data are needed (number of samples for each analytical group, matrix, and concentration)?
Sample locations and numbers in surface soil/dry sediment, subsurface soil, wet sediment and surface water will be selected based on the type and quantity of munitions and explosives of concern/munitions debris (MEC/MD) encountered during the remedial investigation (RI) visual surveys and geophysical activities. Samples should be biased to areas of maximum concentrations where evidence of MEC/MD is observed. If no evidence of MEC/MD is observed, sampling may not be required.

Where, when, and how should the data be collected/generated?
Samples should be biased to areas of maximum concentrations, which would be heavily used and potential source areas. This can be identified through the visual surveys and geophysical investigation as areas of highest metallic concentration (i.e., areas of high fragmentation or MEC). To assess central tendency exposure (CTE), both discrete and Incremental Sampling (IS) techniques will be performed. Discrete samples will be collected from hot spot or from individual source areas or for worst case analysis of MC concentrations, as warranted. Based on results from sampling at MEC sites nationwide, it is not anticipated that MC will be detected at levels associated with unacceptable risks to human health or the environment. As such, the results obtained are anticipated to demonstrate that no further action (NFA) is warranted for MC. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required. Samples will be collected using the IS method to characterize the overall exposure risk across the MRSs. The IS method will be performed for all analytes designated as potential MC from select decision units distributed across the target areas. The potential exists for metals that are ground with the puck mill to become cross contaminated due heat generated in the grinding process, in particular iron and chromium are elements in the puck mill equipment. A determination as to whether metals will be ground or unground will be made by Ohio EPA following MC investigation for the first seven MRSs presented in the work plan (Shaw, 2011). There are no temporal concerns, so samples can be collected at any time of the day or year. Sampling procedures must provide representative samples that provide exposure point concentrations for the risk assessment.

Who will collect and generate the data?
On-site Shaw personnel will collect the proposed environmental samples (soil, sediment, and/or surface water) and ship them to the off-site laboratory (CT Laboratories, Inc.). The laboratory will analyze the environmental samples for the parameters from the following as appropriate based on the MEC used at the MRS from which the samples were collected. The actual target lists for the analytical groups vary per MRS depending upon the possible analyte of concern. The overall analytical groups and target lists (as noted in Worksheet 18) are noted above. The specific analytical criteria are noted in Worksheets 12, 15, and 28.

How will the data be reported?
To ensure the integrity of sample analytical data from the time of collection in the field to the tabulation of results, data documentation protocols will be implemented as outlined in the Shaw field collection SOPs and CT Laboratories, Inc. SOPs. This will include providing sample labels, chains-of-custody (COC) records, and field information forms to document field data; and for comparing laboratory analysis reports with tabular displays and graphic displays to evaluate the accuracy of the data transfer.

The laboratory will provide sample results, final complete Contract Laboratory Program (CLP)-like data packages, and electronic data deliverables (EDDs). Any detection between the LOQ and the LODs will be noted as estimated values “J.” Nondetects will be reported to the LOQ. The laboratory will provide data results (emailed or faxed) within the specified turnaround time (TAT). The faxed data includes batch QC results, including laboratory control sample (LCS)/ laboratory control sample duplicates (LCSD), matrix spike/matrix spike duplicates (MS/MSD), matrix spike/sample duplicates (MS/SD) for metals in some cases, surrogate spikes, and method blanks unless otherwise stipulated by the Shaw Project Chemist. The TAT begins at the time the samples are received by the laboratory to the

SAP Worksheet #11 - Project Quality Objectives/Systematic Planning Process Statements (continued)

time the laboratory faxes the final results to the Shaw Project Chemist (as designated in this document) with the following exceptions:

- Holidays do not count as calendar days
- TAT for samples received by a laboratory representative after 1500 hours begins at 0800 hours of the next business day

The final complete analytical data package will be sent to Shaw also within the specified TAT of sample receipt. A complete data package consists of the analytical reports, required quality assurance/quality control (QA/QC) reports, and the EDD disks. A copy of the data package will be included with the EDD. The laboratory will provide one original electronic copy and one PDF-formatted copy (on a CD) of hardcopy data packages. All electronic data shall match the hardcopy reports provided. Shaw requires the submission of the reporting levels for the data packages be in accordance with the DoD QSM, version 4.2 (2010) for samples submitted to the laboratory. Any reporting levels that are required other than specified in the DoD QSM, version 4.2 (2010) will be designated on the chain-of-custody forms. Data qualifiers and data qualifying conventions provided in Section I and Attachment A of the DoD QSM, version 4.2 (2010) must be used for reporting of electronic and hard-copy data packages.

All data packages are unbound and systematically organized. All pages within the data package are stamped legibly with consecutive page numbers. The completed, original COC, with records of sample transfers, acknowledgments, receipt conditions and any discrepancies, must be submitted with the data package. Any out-of-control event or changes in the analytical program shall be clearly indicated on the COC and stated in the case narrative.

To limit transcription errors, electronic data transfer should be performed through the laboratory's Laboratory Information Management System (LIMS). The EDD format, as required by the Ravenna Environmental Information Management System (REIMS), is used to transfer information from sample analyses. It is meant to capture as much information as possible. However, it is recognized that not all fields may be relevant or available. Therefore, only a limited number of the fields are required. It is recognized that files in this format may be significantly empty. The format specification has been broken into subsections relating to the basic types of information. The file should not contain laboratory QC samples (e.g., method blanks, surrogates). It may contain field QC data such as field duplicates, results from split samples, trip blanks, and equipment rinsates. The EDDs are provided either on CD/DVD with the data package or via e-mail.

An RI Report will be prepared summarizing the data collection and the analytical results for each sample. All of the data generated by the laboratory will be validated suitable for risk assessment by Shaw for each parameter group as noted in Worksheets 34 and 35.

How will the data be archived?
Upon completion of all field, laboratory, and validation activities, Shaw will prepare an RI Report documenting site activities and reporting all data. The analytical reports will be included in the RI Report. All analytical reports, electronic deliverables, and the RI Report will be stored on the Shaw server in PDF format. The server is backed up automatically and archived on tape daily in accordance with federal regulations. Hardcopy and all electronic data will also be stored by Shaw through the final report deliverables. Following final approval of the each RI report, Shaw will provide the REIMS administrator with electronic copies of all EDD for inclusion into the REIMS data base. All electronic files will be submitted to the REIMS administrator on CD/DVD.

SAP Worksheet #12.1 - Measurement Performance Criteria Table

Matrix	Surface water, Sediment, Soil, & Aqueous and Solid IDW
Analytical Group	Explosives (Nitroaromatics and Nitramines)
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Aqueous Sampling Water Level Meas., 9/11/06, SOP EI-FS-108; Bailer, 9/21/06, SOP EI-FS-109; Depth Water Samplers, 9/21/06, SOP EI-FS-112; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113; Water Quality Meas., 9/22/06, SOP EI-FS-204 Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids and Aqueous: SW-846 8330B / SOP 8330B Rev 5	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ reporting limit (RL) for IDW only and <½ level of quantitation (LOQ) for surface water sediment and soil. Project QLs for all target compounds are specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous Not Applicable for IDW aqueous and solids	Field Blank / Equipment Blank	S + A
		Field Precision	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous Not Applicable for IDW aqueous and solids	Field Duplicate	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous	Method Blank / Grinding Blank (for soil IS samples only)	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.1 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Surrogate Spike	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.2 - Measurement Performance Criteria Table

Matrix	Surface water, Sediment, & Soil
Analytical Group	ICP Metals
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; <u>Aqueous Sampling</u> Water Level Meas., 9/11/06, SOP EI-FS-108; Bailer, 9/21/06, SOP EI-FS-109; Depth Water Samplers, 9/21/06, SOP EI-FS-112; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113; Water Quality Meas., 9/22/06, SOP EI-FS-204 <u>Solids Sampling</u> Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids: SW-846 6010C / SOPs 6230B Rev 4 & 6105B-6000 Rev 2 Aqueous: SW-846 6010C / SOPs 6225B Rev 8 & 6105B-6000 Rev 2	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ level of quantitation (LOQ). Project QLs for all target compounds are specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous	Field Blank / Equipment Blank	S + A
		Field Precision	QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous	Field Duplicate	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous	Method Blank / Grinding Blank[3]	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.2 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Accuracy	ICS-A: Absolute value of concentration for all nonspiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Interference check solutions (ICS)	A
		Precision (field samples)	Five-fold dilution must agree within ± 10% of the original measurement. Only applicable for samples with concentrations >50x LOQ for ICP.	Serial Dilution Test	S + A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.
[3]Currently, no grinding of metals is anticipated for IS soils/sediment samples per the *Implementation of IS of Soil for the MMRP Interim Guid*ance (USACE, 2009). The determination of whether or not grinding is needed will be coordinated with the Army based on the grinding versus nongrinding comparison of metals in soil samples from the initial seven MRSs in the work plan. The Ohio EPA will make the final determination as whether grinding is required. The laboratory shall confirm with Shaw if grinding of IS soil/sediment samples is necessary prior to processing.

SAP Worksheet #12.3 - Measurement Performance Criteria Table

Matrix	Sediment & Soil
Analytical Group	Total Organic Carbon (TOC)
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids: Lloyd Kahn Method / SOP SOP CC-TOC solid Rev 3	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ level of quantitation (LOQ). Project QLs for all target compounds are specified in: Worksheet 15.5 for TOC solids	Field Blank / Equipment Blank	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.5 for TOC solids	Method Blank	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A

SAP Worksheet #12.3 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.4 - Measurement Performance Criteria Table

Matrix	Soil
Analytical Group	pH
Concentration Level	Not Applicable

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103;	Solids: SW-846 9045D / SOP CC-24b Rev 3	Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ level of quantitation (LOQ) and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.6 for pH solids	Method Blank	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.6 for pH solids %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Precision (field samples)	For cyanide and sulfide: QC acceptance criteria for all target compounds as specified in: For pH: % QC acceptance criteria for sample duplicate for all target compounds as: %RPD≤10% Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Sample Duplicate	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.5 - Measurement Performance Criteria Table

Matrix	Aqueous and Solid IDW
Analytical Group	Total Cyanide, Total Sulfide, Ignitability, Corrosivity as pH, TCLP Metals, & TCLP SVOCs (See Worksheet 12.1 for explosives)
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Aqueous Sampling Bailer, 9/21/06, SOP EI-FS-109; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113 Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	Aqueous and Solids: Cyanide SW-846 9012/9013 & Sulfide SW-846 9030B, CC-1 Rev 8 & CC-Reactive Sulfide Dist Rev 0; Ignitability SW-846 1010A/1030, CC-37 Rev 2, Corrosivity as pH SW-846 9040C/9045D, CC-24b Rev 3; TCLP Metals SW-846 1311/6010C/7470A, CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2 and TCLP SVOCs SW-846 1311/3510C/8270C, CL-8b Rev 4	Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ reporting limit (RL) and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.7 for Total Cyanide, Total Sulfide, Ignitability, Corrosivity as pH, TCLP Metals, and TCLP SVOCs (aqueous and solids).	Method Blank	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for Total Cyanide, Total Sulfide, Ignitability, Corrosivity as pH, TCLP Metals, and TCLP SVOCs (aqueous and solids). %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	For cyanide and sulfide: QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for Total Cyanide and Total Sulfide (aqueous and solids). For pH, ignitability, TCLP Metals, and TCLP SVOCs: Not Applicable (aqueous and solids) Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.5 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	For cyanide and sulfide: QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for Total Cyanide, Total Sulfide (aqueous and solids). For pH: % QC acceptance criteria for sample duplicate for all target compounds as: %RPD≤10% For ignitability, TCLP Metals, and TCLP SVOCs: Not Applicable Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.6 - Measurement Performance Criteria Table

Matrix	Surface water, Sediment, & Soil
Analytical Group	Nitrocellulose
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids : SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ level of quantitation (LOQ). Project QLs for all target compounds are specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	Field Blank / Equipment Blank	S + A
		Field Precision	QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	Field Duplicate	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	Method Blank / Grinding Blank (for soil IS samples only)	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.6 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.8for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.7 - Measurement Performance Criteria Table

Matrix	Surface water, Sediment, & Soil
Analytical Group	Semivolatile Organic Compounds (SVOCs)
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; <u>Aqueous Sampling</u> Water Level Meas., 9/11/06, SOP EI-FS-108; Bailer, 9/21/06, SOP EI-FS-109; Depth Water Samplers, 9/21/06, SOP EI-FS-112; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113; Water Quality Meas., 9/22/06, SOP EI-FS-204 <u>Solids Sampling</u> Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids: SW 846 3546/8270C / SOP No: 8270C Rev 9 Aqueous: SW 846 3510C/8270C / SOP No: 8270C Rev 9	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ level of quantitation (LOQ). Project QLs for all target compounds are specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous	Field Blank / Equipment Blank	S + A
		Field Precision	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous	Field Duplicate	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous	Method Blank / Grinding Blank (for soil IS samples only)	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value - Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.7 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Surrogate Spike	A
		Accuracy (Instrument sensitivity control)	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL EICP area within -50% to +100% of ICAL midpoint standard	Internal Standards	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #12.8 - Measurement Performance Criteria Table

Matrix	Sediment & Soil
Analytical Group	Polychlorinated Biphenyls (PCBs)
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014; Solids Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	Solids: SW 846 3546/8082A/ SOP No: 8082A Rev 11	Field Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. All Target Compounds <½ level of quantitation (LOQ). Project QLs for all target compounds are specified in: Worksheet 15.12 for PCB solids	Field Blank / Equipment Blank	S + A
		Field Precision	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids	Field Duplicate	S + A
		Laboratory Representativeness (Absence of interference / contamination)	The blank results are evaluated for the analytes of concern to ascertain the efficiency of decontamination and assess the potential for cross-contamination. No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.12 for PCB solids	Method Blank / Grinding Blank (for soil IS samples only)	A
		Laboratory Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids %Recovery = (Calculated Value / True Value) *100%	Laboratory Control Sample	A
		Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. DoD QSM uses LCS criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100%	Matrix Spike	A

SAP Worksheet #12.8 - Measurement Performance Criteria Table (continued)

Sampling Procedure[1]	Analytical Method/SOP[2]	Data Quality Indicators	Measurement Performance Criteria	QC Sample and / or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision and Accuracy (field samples)	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD (%) = [(XA-XB)/ XM] * 100 Where: XA and XB are the concentration in the MS and MSD, and XM is the average value of the concentrations in the MS and MSD, (XA + XB)/2	Matrix Spike Duplicate or Sample Duplicate	A
		Accuracy	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Surrogate Spike	A
		Accuracy (Instrument sensitivity control)	Retention time ±30 seconds from retention time of the midpoint standard in the ICAL EICP area within -50% to +100% of ICAL midpoint standard	Internal Standards	A
		Completeness	% Analytical Completeness = 100 * (Number of Useable Data) / (Total Number of Requested Analyses) % Sampling Completeness = 100 * (Number of Proposed Samples) / (Total Number of Samples Collected)	Analytical Sample Completeness (Usability)	S + A

Notes:
[1] Reference number from SAP/QAPP Worksheet #21. Field SOPs are subject to revision and updates during the duration of the project. Any changes to the SOPs must be approved by USACE and the Ohio EPA and documented in an approved Field Change Order prior to implementation in the field.
[2] Reference number from SAP/QAPP Worksheet #23. Laboratory SOPs are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #13 - Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (if known)	How Data Will Be Used	Limitations on Data Use
Site Inspections at each of the 7 MRSs—MEC Survey and MC sampling	Final Site Inspection for the Military Munitions Response Program, May 2008 (e^2M)	MEC surveys, Digital Geophysical Mapping (DGM) transects, MC sampling	The results of the SI will be used to determine where to focus remedial investigations (RIs) in order to fully characterize the nature and extent of MEC and MC.	Heterogeneity between sample methodologies in the SI and as proposed for the MMRP RI will limit the certainty of the comparison of results between the two investigations.
Existing MC data collected under the Installation Response Program (IRP)	IRP data collected at each MRS will be evaluated for usability and will be incorporated into RI activities when feasible.	Records research	Existing MC data collected during IRP investigations will be incorporated into the RI to the extent practical in order to prevent overlap of data and to better characterize the nature and extent of MC at the MRSs.	Limitations on IRP data use at a minimum may include variations in method detection limits (MDLs) /reporting limits (RLs) and limits of detection (LODs)/limits of quantitation (LOQs), sampling procedures, field and laboratory quality assurance/quality control (QA/QC) parameters, applicability in meeting the RI data quality objectives (DQOs) and QA/QC parameters.

SAP Worksheet 14 - Summary of Project Tasks

Sampling Tasks:

1. Delineate target areas by finding areas of high metallic concentrations (fragmentation) using visual surveys and geophysics in accordance with the work plan.
2. Collect discrete soil and/or sediment and surface water samples adjacent to and immediately topographically downgradient of areas where evidence of munitions and explosives of concern/munitions debris (MEC/MD) is observed. Discrete samples will be collected from "hot spots" or from individual source areas for worst case analysis of munitions constituents (MC) concentrations, as warranted.
3. Collect Incremental Sampling (IS) soil samples from areas where evidence of explosives or propellants is identified through visual or geophysical surveys. IS samples will be collected to characterize the overall exposure risk across the munitions response sites (MRSs) in accordance with the work plan SAP for the first seven MRSs. The analysis will be run for the MC metals of concern for that MRS only..
4. Soil samples will be collected using a core-type sampler (for IS), a stainless steel trowel, a Shelby tube sampler, hand auger, or disposable sampling equipment. Sediment samples will be collected using grab techniques as specified in the *Facility-Wide Sampling and Analysis Plan* (FSAP) (SAIC, 2011) or an Eckman dredge if water levels are greater than 4 feet. Surface water samples will be collected using grab or depth water sampler as specified in the FSAP (SAIC, 2011). See Worksheets 18 and 21 for field standard operating procedures (SOPs) and sampling techniques.
5. All sampling equipment that may come into contact with samples or sampling surfaces will be constructed of stainless steel, borosilicate glass, or Teflon™.
6. All equipment used for collection, transfer, and homogenization will be properly decontaminated before collecting samples and between sampling locations. See Worksheet 17 for sampling decontamination procedures.
7. Collect (as needed) aqueous and solid investigative-derived waste (IDW) samples generated from sampling activities for waste disposal characterization analysis.
8. Samples collected for chemical analysis will be placed in the appropriate sample containers, labeled with proper identification, and packed in a cooler with ice pending shipment to the laboratory. See Worksheet 19 for sample containers requirements.
9. To maintain integrity, samples collected in the field must be placed in a dedicated sample ice chest, on ice, and chilled to 4ºC ± 2ºC from the time of collection until receipt by the laboratory for analysis.
10. All samples will be visually classified and documented on a sample collection log. The MC Sampling Lead will choose the method for sampling, such as disposable equipment, Shelby tube sampler, or hand auger.
11. All sample documentation and chain of custody (COC) procedures outlined in Worksheet 27 should then be followed. After proper documentation has been performed, sample packaging and shipping as outlined in Worksheet 27 of this document should be completed.

SAP Worksheet #14 - Summary of Project Tasks (continued)

Analysis Tasks:

CT Laboratories, Inc. will process, prepare, and analyze the MC samples in accordance the requirements stated in this sampling analysis plan/quality assurance project plan (SAP/QAPP) addendum, the Department of Defense Quality Systems Manual (QSM), Version 4.2 (DoD, 2010) and noted USEPA SW-846 or other cited methodology. The overall analytical groups and overall target lists (as noted in Worksheets 18 and 19) based on the types of munitions used at the RVAAP MRSs as well as the MC and geochemical analytes to be evaluated for each MRS are presented in this worksheet. Sampling is not proposed for all MRSs based on the rationale provided in the work plan. If the investigation activities identify the need to collect samples at an MRS not initially proposed for sampling then the samples will be analyzed for the MC presented in this worksheet.

- Erie Burning Grounds (RVAAP-02-R-01):
    - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
    - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
    - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
    - PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260 (sediment only).
    - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
    - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
    - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

SAP Worksheet #14 - Summary of Project Tasks (continued)

- Fuze and Booster Quarry (RVAAP-016-R-1):
    - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
    - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
    - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
    - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
    - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
    - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
    - PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.
- 40mm Firing Range (RVAAP-032-R-01)*:
    - MEC Metals, Method USEPA SW846 6010C and 7196A: Al and Pb.
    - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
    - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl

SAP Worksheet #14 - Summary of Project Tasks (continued)

alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

- Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, Mn and Fe.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

**Note: the IS soil sample from the firing point will be analyzed for propellants (nitrocellulose, nitroguanidine and nitroglycerine) only.*

- Sand Creek Dump MRS (RVAAP-034-R-01):
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
  - PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.

SAP Worksheet #14 - Summary of Project Tasks (continued)

- Block D Igloo–TD MRS (RVAAP-061-R-01):
  - MEC Metals, Method USEPA SW846 6010C: Al, Fe, Pb, and Sb.
  - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
- Water Works #4 Dump (RVAAP-062-R-01)
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
  - SVOCs Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
  - Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
  - Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
  - Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).
- Group 8 MRS (RVAAP-063-R-01)
  - MEC Metals, Method USEPA SW846 6010C and 7196A: Al, Ba, Cd, Cr III and VI (hexavalent), Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
  - Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-

SAP Worksheet #14 - Summary of Project Tasks (continued)

DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.

- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
- PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.
- Nitrocellulose, USEPA Method SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB: nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

- Investigative Derived Waste (IDW)
  - TCLP Metals, Method USEPA SW846 1311/6010C/7470A;
  - TCLP SVOCs, Method USEPA SW846 1311/8270C;
  - Explosives, Method USEPA SW846 8330B: (Full list);
  - Ignitability, Method USEPA SW846 1010A/1030;
  - Corrosivity as pH, Method USEPA SW846 9040C/9045D;
  - Total Cyanide, Method USEPA SW846 9012/9013; and
  - Total Sulfide, Method USEPA SW846 9030B.

See Worksheet 19 for analytical method requirements.

SAP Worksheet #14 - Summary of Project Tasks (continued)

Quality Control Tasks:

1. Implement SOPs as defined in Worksheet 18 for field sampling procedures, follow guidelines as described in Worksheet 26 and 27 for sample custody procedures, packaging, and transporting of samples.
2. Laboratory to follow preparation and analysis methods as described in Worksheets 15 and 19. Laboratory to follow quality control samples and procedures as defined in Worksheet 28.
3. Field duplicate samples will be collected at a rate of one per ten field samples per matrix. Equipment blank samples will be collected 1 per 20 field samples per matrix per sampling technique. One matrix/matrix spike duplicate (MS/MSD) will be collected at a rate of 1 per 20 samples per matrix. TOC and pH are indicator analytes and IDW is for disposal characterization; therefore, do not require field duplicates or equipment blanks.

Secondary Data:

1. See Worksheet 13.

Data Management Tasks:

Analytical data will be placed in an excel spreadsheet with risk-based screening values, analytical reports will be received in PDF format. The laboratory will provide sample results, final complete Contract Laboratory Program (CLP)-like data packages, and electronic data deliverables (EDDs), as required per the Ravenna Environmental Information Management System (REIMS) format, via email or fax within the specified turnaround times (TAT) of sample receipt. A complete data package consists of the analytical reports, required QA/QC reports, and the EDD disks. A copy of the data package will be included with the EDD. To limit transcription errors, electronic data transfer should be performed through the laboratory's LIMS system. The laboratory will provide one original electronic copy and one PDF-formatted copy (on a CD) of hardcopy data packages. All electronic data shall match the hardcopy reports provided and will be cross checked by CT Laboratories for accuracy. Shaw requires the submission of the reporting levels for the data packages be in accordance with the DoD QSM, version 4.2 (2010) for samples submitted to the laboratory. Any reporting levels that are required other than specified in the DoD QSM, version 4.2 (2010) will be designated on the chain-of-custody forms. Data qualifiers and data qualifying conventions provided in Section I and Attachment A of the DoD QSM, version 4.2 (2010) must be used for reporting of electronic and hard-copy data packages.

Documentation and Records:

1. All samples collected will have sample locations documented in field logbooks. COC records, air bills and laboratory sample logs will be retained for each sample and will become a part of the analytical PDF data report.
2. Analytical laboratory and validation reports and electronic deliverables will be stored on the Shaw server. Hardcopy data, validation reports, and electronic data will be stored by Shaw through the RI Report as well.
3. Copy of the finalized SAP addendum will be retained in the Shaw and subcontract laboratories central file area and at the site (during site activity) for review.
4. Shaw will provide the REIMS administrator with electronic copies of all EDD for inclusion into REIMS data base. All electronic files will be submitted to the REIMS administrator in CD/DVD.

SAP Worksheet #14 - Summary of Project Tasks (continued)

Assessment / Audit Tasks:

1. Sampling SOPs and Safety will be reviewed prior to start up of sampling.
2. QC Meetings will be conducted throughout the project at a minimum monthly and if necessary more frequently.

Data Review Tasks:

1. The Shaw Project Chemist will verify that data has been received for all samples submitted to the laboratory. An evaluation of these data will be performed to determine whether the laboratory met the QC requirements for the analytical as stated in the analytical methods and laboratory SOPs.
2. Analytical results will be evaluated by the Shaw technical staff to evaluate nature and extent of MC and in a screening level human health risk assessment and screening level ecological risk assessment.
3. Data verification will be performed on all samples by qualified Shaw personnel. Data verification that sample analysis was performed as stated in the FSAP (SAIC, 2001a) and per the laboratory SOPs.
4. The Shaw Project Chemist will verify the EDDs have been issued by the laboratory in the format required by REIMS.

SAP Worksheet #15.1 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils, Sediments, and Solid IDW
Analytical Group: Explosives—SW-846 8330B

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]				Precision and Accuracy Method Performance Criteria[3]				
						LOD (µg/kg)	LOQ (µg/kg)	MDLs[4] (µg/kg)	QLs[4] (µg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
2,4,6-Trinitrotoluene	118-96-7	3,650	3,650	400	See Table 11 of Attachment F	150	400	90	400	69-129	69-129	30	NA	50
4-Amino-2,6-Dinitrotoluene	19406-51-0	1,540	1,540	250		150	250	70	250	75-122	75-122	30	NA	50
2-Amino-4,6-Dinitrotoluene	35572-78-2	1,540	1,540	250		150	250	50	250	75-118	75-118	30	NA	50
2,4/2,6-Dinitrotoluene Mix	25321-14-6	710	710	250		TBD	TBD	80	270	50-150	50-150	20	NA	50
2,4-Dinitrotoluene	121-14-2	753	753	500		150	500	80	500	80-118	80-118	30	NA	50
2,6-Dinitrotoluene	606-20-2	769	TBC	250		150	250	70	250	74-122	74-122	30	NA	50
HMX	2691-41-0	359,000	3,594	400		150	400	120	400	71-120	71-120	30	NA	50
Nitroguanidine	556-88-7	611,000	611,000	140		120	250	60	250	50-150	50-150	30	NA	50
RDX	121-82-4	8,030	8,030	500		150	500	140	500	63-125	63-125	30	NA	50
Tetryl	479-45-8	24,400	24,400	400		250	400	90	400	10-165	10-165	30	NA	50
Nitroglycerin	55-63-0	610	52,500	200		600	2,000	500	2,000	77-123	77-123	30	NA	50
PETN	78-11-5	TBC	TBC	200		1,000	2,000	500	2,000	74-123	74-123	30	NA	50
1,3,5-Trinitrobenzene	99-35-4	225,000	TBC	500		150	500	130	500	78-121	78-121	30	NA	50
1,3-Dinitrobenzene	99-65-0	765	TBC	400		150	400	80	400	83-115	83-115	30	NA	50
Nitrobenzene	98-95-3	TBC	TBC	250		150	250	40	250	82-116	82-116	30	NA	50
2-Nitrotoluene	88-72-2	3,880	TBC	500		150	500	90	500	77-118	77-118	30	NA	50
3-Nitrotoluene	99-08-1	TBC	TBC	250		150	250	70	250	75-118	75-118	30	NA	50
4-Nitrotoluene	99-99-0	52,500	TBC	400		250	400	70	400	76-118	76-118	30	NA	50
3,5-Dinitroaniline	610-41-3	TBC	TBC	400		150	400	90	400	10-165	10-165	30	NA	50

Notes:

μg/kg = micrograms per kilogram
LCS = laboratory control sample
LOD = level of detection
LOQ = limit of quantitation
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QL = quantitation limit
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent
TBD = to be determined

[1]Only the minimum criteria action limits are shown here for comparison. For example, the minimum sediment project action limit for 2,4,6-TNT is 3,650 μg/kg. The intent of these worksheets is to provide a comparison of the LOD and LOQ to show these parameters are below the lowest action level. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon on a dry weight basis. CT Laboratories, Inc. does not report an isomer mix for the DNT's. The project quantitation limit goals are based upon a wet weight basis. Project Action Limits presented in **bold** represent values below project quantitation limits. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs have been determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM) version 4.2 (2010).*

[3]The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM

[4]MDLs and QLs for solid investigative-derived waste (IDW) only

SAP Worksheet #15.2 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Surface Water and Aqueous IDW
Analytical Group: Explosives—SW-846 3535A/8330B

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]				Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	MDLs[4] (µg/L)	QLs[4] (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
2,4,6-Trinitrotoluene	118-96-7	7.82	1.0	See Table 11 of Attachment F	0.80	1.00	0.22	1.0	50-145	50-145	30	NA	50
4-Amino-2,6-Dinitrotoluene	19406-51-0	3.13	1.0		0.60	1.00	0.28	1.0	55-155	55-155	30	NA	50
2-Amino-4,6-Dinitrotoluene	35572-78-2	3.13	1.0		0.60	1.00	0.24	1.0	50-155	50-155	30	NA	50
2,4/2,6-Dinitrotoluene Mix	25321-14-6	TBC	1.0		TBD	TBD	0.25	1.0	50-150	50-150	20	NA	50
2,4-Dinitrotoluene	121-14-2	1.99	2.0		0.80	2.00	0.30	2.0	60-135	60-135	30	NA	50
2,6-Dinitrotoluene	606-20-2	2.13	1.0		0.80	1.00	0.24	1.0	60-135	60-135	30	NA	50
HMX	2691-41-0	782	1.0		0.60	1.00	0.25	1.0	80-115	80-115	30	NA	50
Nitroguanidine	556-88-7	TBC	84		60	80	28	80	50-150	50-150	30	NA	50
RDX	121-82-4	15.5	0.80		0.60	0.8	0.18	0.80	50-160	50-160	30	NA	50
Tetryl	479-45-8	TBC	2.00		1.00	2.00	0.21	2.0	20-175	20-175	30	NA	50
Nitroglycerin	55-63-0	TBC	8.0		3.2	8.0	2.2	8.0	50-150	50-150	30	NA	50
PETN	78-11-5	TBC	12		8.0	12	3	12	50-150	50-150	30	NA	50
1,3,5-Trinitrobenzene	99-35-4	TBC	2.0		0.80	2.00	0.23	2.00	65-140	65-140	30	NA	50
1,3-Dinitrobenzene	99-65-0	TBC	0.80		0.60	0.80	0.20	0.80	45-160	45-160	30	NA	50
Nitrobenzene	98-95-3	TBC	0.8		0.60	0.80	0.22	0.80	50-140	50-140	30	NA	50
2-Nitrotoluene	88-72-2	7,410	2.0		0.80	2.0	0.40	2.0	45-135	45-135	30	NA	50
3-Nitrotoluene	99-08-1	TBC	0.8		0.60	0.80	0.23	0.80	50-130	50-130	30	NA	50
4-Nitrotoluene	99-99-0	100,000	1.0		0.80	1.00	0.22	1.00	50-130	50-130	30	NA	50
3,5-Dinitroaniline	610-41-3	TBC	0.8		0.60	0.80	0.23	0.80	20-175	20-175	30	NA	50

Notes:

µg/L = micrograms per liter
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MDL = method detection limit
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QL = quantitation limit
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent
TBD = to be determined

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. CT Laboratories, Inc. does not report an isomer mix for the DNT's. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010).*

[3]The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

[4]MDLs and QLs for aqueous investigative-derived waste (IDW) only.

SAP Worksheet #15.3 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils and Sediment
Analytical Group: Metals—SW-846 3050B/6010C

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LODs (mg/kg)	LOQs (mg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Aluminum	7429-90-5	3496	3496	10	See Table 11 of Attachment F	0.12	0.24	80-120	80-120	20	NA	35
Cadmium	7440-43-9	6.41	6.41	0.20		0.018	0.042	80-120	80-120	20	NA	35
Chromium (as Cr-3)	7440-47-3	8,147	8,147	6.4		2.0	6.4	NA	NA	NA	NA	35
Chromium, hexavalent	7440-47-3	1.64	1.64	6.4		2.0	6.4	83-115	75-125	30	NA	35
Calcium	7440-70-2	NA	NA	250		0.45	0.90	80-120	80-120	20	NA	35
Copper	7440-50-8	311	311	1.3		0.18	0.38	80-120	80-120	20	NA	35
Iron	7439-89-6	2313	2313	5.0		0.9	1.8	80-120	80-120	20	NA	35
Lead	7439-92-1	40	40	5.0		0.12	0.24	80-120	80-120	20	NA	35
Magnesium	7439-95-4	NA	NA	250		0.36	0.72	80-120	80-120	20	NA	35
Manganese	7439-96-5	NA	NA	0.75		0.06	0.12	80-120	80-120	20	NA	35
Zinc	7440-66-6	2321	2321	1.08		0.12	0.48	80-120	80-120	20	NA	35
Antimony	7440-36-0	2.82	2.82	0.54		0.24	0.54	80-120	80-120	20	NA	35
Strontium	7440-24-6	TBC	TBC	0.076		0.018	0.076	80-120	80-120	20	NA	35
Barium	7440-39-3	351	351	0.048		0.024	0.048	80-120	80-120	20	NA	35
Mercury*	7439-97-6	2.27	2.27	0.0079		0.0050	0.0079	80-120	80-120	20	NA	35

Notes:

mg/kg = milligrams per kilogram
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate NA = Not Applicable.
QLs = quantitation limits
%R = percent recovery
RPD = relative percent difference

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2009).*

[3] The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM

SAP Worksheet #15.4 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Surface Water
Analytical Group: Metals—SW-846 3010A/6010C

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Aluminum	7429-90-5	14827	208	See Table 11 of Attachment F	12	208	80-120	80-120	20	NA	25
Cadmium	7440-43-9	4.08	5.0		0.33	1.60	80-120	80-120	20	NA	25
Calcium	7440-70-2	NA	1000		45	100	80-120	80-120	20	NA	25
Chromium (as Cr-3)	7440-47-3	6,165	25		8	25	NA	NA	NA	NA	25
Chromium, hexavalent	7440-47-3	24.5	25		8	25	87-115	85-115	20	NA	25
Copper	7440-50-8	614	25		3.6	3.6	80-120	80-120	20	NA	25
Iron	7439-89-6	4527	300		27	54	80-120	80-120	20	NA	25
Lead	7439-92-1	TBC	9.8		4.5	9.8	80-120	80-120	20	NA	25
Magnesium	7439-95-4	NA	5000		9	88	80-120	80-120	20	NA	25
Manganese	7439-96-5	NA	15		2.1	4.2	80-120	80-120	20	NA	25
Zinc	7440-66-6	4617	23.6		5.4	23.6	80-120	80-120	20	NA	25
Antimony	7440-36-0	4.91	32		12	32	80-120	80-120	20	NA	25
Strontium	7440-24-6	TBC	6.0		0.018	6	80-120	80-120	20	NA	25
Barium	7440-39-3	2,901	1.80		0.78	1.80	80-120	80-120	20	NA	25
Mercury	7439-97-6	4.35	0,14		0.08	0.14	80-120	80-120	20	NA	25

Notes:

µg//L = micrograms per liter
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate

NA = Not Applicable.
%R = percent recovery
RPD = relative percent difference

TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010).*

[3]The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.5 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soil and Sediment
Analytical Group: Total Organic Carbon by Lloyd Kahn Method

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LOD (mg/kg)	LOQ (mg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Total Organic Carbon	TOC	NA	NA	2000	NA	600	2000	84-113	NA	20	NA	NA

Notes:

mg/kg = milligrams per kilogram
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
%R = percent recovery
RPD = relative percent difference

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010)*.

[3] The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per the DoD QSM.

SAP Worksheet #15.6 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils
Analytical Group: pH SW-846 9045D

Analyte	CAS Number	Minimum Soils Project Action Limit[1] (units) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (units)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (units)	LOQ (units)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	S/SD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
pH	pH	NA	NA	NA	±0.01 pH units	±0.01 pH units	NA	NA	Within 1 pH unit	NA	NA

Notes:

LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
%R = percent recovery
RPD = relative percent difference

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Project Action Limits presented in **bold** represent values below project quantitation limits and those presented in ***bold italic*** represent values below achievable method detection limits. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010)*.

[3] The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.7 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Aqueous and Solids IDW
Analytical Group: Cyanide SW-846 9012/9013, Sulfide SW-846 9030B, Ignitability (Flashpoint) SW-846 1010A/1030, Corrosivity as pH SW-846 9040C/9045D, TCLP SVOCs (1311/8270C), and TCLP Metals (1311/6010C/7470A)

Analyte	CAS Number	Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					MDLs (mg/kg)	QLs (mg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Total Cyanide, ASTM D5049	57-12-5	TBD	50	TBD	20	20	70-130	70-130	20	NA	NA
Total Sulfide	7783-06-4	TBD	50		40	40	70-130	70-130	20	NA	NA
Ignitability (Flashpoint)	Ignit.	<200 Deg. F	NA		NA	NA	70-130	NA	5°F	NA	NA
Corrosivity as pH	pH	≥12.5 and <2.0 pH units	±0.01 pH units		±0.01 pH units	±0.01 pH units	±0.05	NA	NA	NA	NA

SAP Worksheet #15.7 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Regulatory Limit (mg/L) *Equal to or Less Than*	Project Quantitation Limit Goal (mg/L)	Regulatory Limit Reference	MDLs[1] (mg/L)	QLs[1] (mg/L)	LCS Control Limit[2] (%R)	MS/MSD Control Limit[2] (%R)	MS/MSD Precision Limit[2] (RPD)	Surrogate Control[2] Limit (%R)	Project Field Precision[2] Limit (RPD)
TCLP 2-Methylphenol	95-48-7	200	0.004	USEPA TCLP Maximum Concentration of Contaminants 40CFR 261 (June, 1996)	0.00086	0.004	40-110	40-110	30	NA	50
TCLP 3&4-Methylphenol	NA	200	0.005		0.0014	0.005	30-110	30-110	30	NA	50
TCLP Pentachlorophenol	87-86-5	100	0.005		0.0011	0.005	40-115	40-115	30	NA	50
TCLP 2,4,5-Trichlorophenol	95-95-4	400	0.005		0.00011	0.005	50-110	50-110	30	NA	50
TCLP 2,4,6-Trichlorophenol	88-06-2	2.0	0.004		0.0001	0.004	50-115	50-115	30	NA	50
TCLP 1,4-Dichlorobenzene	106-46-7	7.5	0.004		0.00019	0.004	30-100	30-100	30	NA	50
TCLP 2,4-Dinitrotoluene	121-14-2	0.13	0.004		0.00021	0.004	50-120	50-120	30	NA	50
TCLP Hexachlorobenzene	118-74-1	0.13	0.004		0.00027	0.004	50-110	50-110	30	NA	50
TCLP Hexachlorobutadiene	87-68-3	0.50	0.004		0.00018	0.004	25-105	25-105	30	NA	50
TCLP Hexachloroethane	67-72-1	3.0	0.0004		0.00022	0.004	35-95	35-95	30	NA	50
TCLP Nitrobenzene	98-95-3	2.0	0.0004		0.00016	0.004	45-110	45-110	30	NA	50
TCLP Pyridine	110-86-1	5.0	0.02		0.00062	0.02	1-78	1-78	30	NA	50
2-Fluorophenol	367-12-4	NA	NA	NA	NA	NA	NA	NA	NA	20-110	50
Phenol-d5	4165-62-2	NA	NA	NA	NA	NA	NA	NA	NA	10-115	50
2,4,6-Tribromophenol	118-79-6	NA	NA	NA	NA	NA	NA	NA	NA	40-125	50
Nitrobenzene-d5	4165-60-0	NA	NA	NA	NA	NA	NA	NA	NA	40-110	50
2-Fluorobiphenyl	321-60-8	NA	NA	NA	NA	NA	NA	NA	NA	50-110	50
Terphenyl-d14	1718-51-0	NA	NA	NA	NA	NA	NA	NA	NA	50-135	50

SAP Worksheet #15.7 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Regulatory Limit[1] (mg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/L)	Regulatory Limit Reference	MDLs[1] (mg/L)	QLs[1] (mg/L)	LCS Control Limit[2] (%R)	MS/MSD Control Limit[2] (%R)	MS/MSD Precision Limit[2] (RPD)	Surrogate Control Limit[2] (%R)	Project Field Precision Limit[2] (RPD)
TCLP Arsenic	7440-38-2	5.0	0.024	USEPA TCLP Maximum Concentration of Contaminants 40CFR 261 (June, 1996)	0.0040	0.024	80-120	80-120	20	NA	25
TCLP Barium	7440-39-3	100	0.0018		0.00026	0.0018	80-120	80-120	20	NA	25
TCLP Cadmium	7440-43-9	1.0	0.0016		0.00011	0.0016	80-120	80-120	20	NA	25
TCLP Chromium	7440-47-3	5.0	0.0042		0.0007	0.0042	80-120	80-120	20	NA	25
TCLP Lead	7439-92-1	5.0	0.0098		0.0015	0.0098	80-120	80-120	20	NA	25
TCLP Mercury	7439-97-6	0.20	0.00014		0.00004	0.00014	80-120	80-120	20	NA	25
TCLP Selenium	7782-49-2	1.0	0.014		0.0023	0.014	80-120	80-120	20	NA	25
TCLP Silver	7440-22-4	5.0	0.008		0.0007	0.008	80-120	80-120	20	NA	25

Notes:

mg/kg = milligrams per kilogram
µg//L = micrograms per liter
LCS = laboratory control sample
MDLs = method detection limits
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QLs = quantitation limits
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1] Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.*

[2] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories* (DoD QSM), Version 4.2, (2010). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM. No field duplicate or MS/MSD is required for waste profile analysis.

SAP Worksheet #15.8 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils and Sediment
Analytical Group: Nitrocellulose—USEPA SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						MDLs (mg/kg)	QLs (mg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Nitrocellulose	9004-70-0	TBC	TBC	20	See Table 11 of Attachment F	5.0	20	80-120	80-120	15	NA	50

Notes:

mg/kg = milligrams per kilogram
LCS = laboratory control sample
MDLs = method detection limits
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QLs = quantitation limits
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed MDLs and QLs are based upon a wet weight basis.

[3] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories* (DoD QSM), Version 4.2, (2010). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.9 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Surface Water
Analytical Group: Nitrocellulose—USEPA SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Nitrocellulose	9004-70-0	TBC	3.0	See Table 11 of Attachment	1.0	3.0	70-130	70-130	20	NA	50

Notes:

µg//L = micrograms per liter
LCS = laboratory control sample
MDLs = method detection limits
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QLs = quantitation limits
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]Achievable MDLs and QLs are limits that an individual laboratory can achieve when performing a specific analytical method. *Laboratory Generated Limits are subject to change, the laboratory will use the most current limits at the time of analysis.* The listed MDLs and QLs are based upon a wet weight basis.

[3] The laboratory precision and accuracy method performance criteria are based upon the *DoD Quality Systems Manual for Environmental Laboratories* (DoD QSM), Version 4.2, (2010). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.10 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils and Sediments
Analytical Group: SVOCs—SW-846 8270C

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LOD (µg/kg)	LOQ (µg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
1,2,4-Trichlorobenzene	120-82-1	6,200	6,200	400	See Table 11 of Attachment F	100	400	45-110	45-110	30	N/A	50
1,2-Dichlorobenzene	95-50-1	190,000	190,000	400		100	400	45-95	45-95	30	N/A	50
1,3-Dichlorobenzene	541-73-1	2,400	2,400	400		100	400	40-100	40-100	30	N/A	50
1,4-Dichlorobenzene	106-46-7	TBC	TBC	400		100	400	35-105	35-105	30	N/A	50
2,4,5-Trichlorophenol	95-95-4	610,000	610,000	500		400	500	50-110	50-110	30	N/A	50
2,4,6-Trichlorophenol	88-06-2	6,100	6,100	500		400	500	45-110	45-110	30	N/A	50
2,4-Dichlorophenol	120-83-2	18,000	18,000	500		400	500	45-110	45-110	30	N/A	50
2,4-Dimethylphenol	105-67-9	120,000	120,000	400		100	400	30-105	30-105	30	N/A	50
2,4-Dinitrophenol	51-28-5	12,000	12,000	2000		1000	2000	15-130	15-130	30	N/A	50
2-Chloronaphthalene	91-58-7	630,000	630,000	400		100	400	45-105	45-105	30	N/A	50
2-Chlorophenol	95-57-8	39,000	39,000	500		400	500	45-105	45-105	30	N/A	50
2-Methylphenol	95-48-7	310,000	310,000	1000		500	1000	40-105	40-105	30	N/A	50
2-Nitroaniline	88-74-4	61,000	61,000	400		100	400	45-120	45-120	30	N/A	50
2-Nitrophenol	88-75-5	TBC	TBC	500		400	500	40-110	40-110	30	N/A	50
3&4-Methylphenol	30030	TBC	TBC	2000		1000	2000	40-105	40-105	30	N/A	50
3,3'-Dichlorobenzidine	91-94-1	1,100	1,100	500		400	500	10-130	10-130	30	N/A	50
3-Nitroaniline	99-09-2	TBC	TBC	1000		400	1000	25-110	25-110	30	N/A	50
4,6-Dinitro-2-methylphenol	534-52-1	490	490	1000		400	1000	30-135	30-136	30	N/A	50
4-Bromophenyl-phenyl ether	101-55-3	TBC	TBC	400		100	400	45-115	45-115	30	N/A	50
4-Chloro-3-methylphenol	59-50-7	610,000	610,000	500		400	500	45-115	45-115	30	N/A	50
4-Chloroaniline	106-47-8	2.4	2.4	400		100	400	10-95	10-95	30	N/A	50
4-Chlorophenyl-phenyl ether	7005-72-3	TBC	TBC	400		100	400	45-110	45-110	30	N/A	50

SAP Worksheet #15.10 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LOD (µg/kg)	LOQ (µg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
4-Nitroaniline	100-01-6	24,000	24,000	1000	See Table 11 of Attachment F	400	1000	35-115	35-115	30	N/A	50
4-Nitrophenol	100-02-7	61,200	TBC	1000		400	1000	15-140	15-140	30	N/A	50
Acenaphthene	83-32-9	340,000	340,000	400		100	400	45-110	45-110	30	NA	50
Acenaphthylene	208-96-8	TBC	TBC	400		100	400	45-105	45-105	30	NA	50
Anthracene	120-12-7	1,700,000	1,700,000	400		100	400	55-105	55-105	30	NA	50
Benzo(a)anthracene	56-55-3	221	221	400		100	400	50-110	50-110	30	NA	50
Benzo(a)pyrene	50-32-8	22	22	400		100	400	50-110	50-110	30	NA	50
Benzo(b)fluoranthene	205-99-2	221	221	400		100	400	45-115	45-115	30	NA	50
Benzo(g,h,i)perylene	191-24-2	TBC	TBC	400		100	400	40-125	40-125	30	NA	50
Benzo(k)fluoranthene	207-08-9	2,210	2,210	400		100	400	45-125	45-125	30	NA	50
Chrysene	218-01-9	22,100	15,000	400		100	400	55-110	55-110	30	NA	50
Dibenzo(a,h)anthracene	53-70-3	22	22	400		100	400	40-125	40-125	30	NA	50
Fluoranthene	206-44-0	163,000	230,000	400		100	400	55-115	55-115	30	NA	50
Fluorene	86-73-7	243,000	230,000	400		100	400	50-110	50-110	30	NA	50
Indeno(1,2,3-cd)pyrene	193-39-5	221	221	400		100	400	40-120	40-120	30	NA	50
2-Methylnaphthalene	91-57-6	30,600	31,000	400		100	400	45-105	45-105	30	NA	50
Naphthalene	91-20-3	122,000	3,600	400		100	400	40-105	40-105	30	NA	50
Phenanthrene	85-01-8	TBC	TBC	400		100	400	50-110	50-110	30	NA	50
Pyrene	129-00-0	122,000	170,000	400		100	400	45-125	45-125	30	NA	50
Benzoic acid	65-85-0	24,000,000	24,000,000	2000		500	2000	0-110	0-110	30	NA	50
Benzyl alcohol	100-51-6	TBC	TBC	1000		500	1000	20-125	20-125	30	N/A	50
Bis(2-chloroethoxy)methane	111-91-1	23.000	18,000	400		100	400	45-110	45-110	30	N/A	50
Bis(2-chloroethyl)ether	111-44-4	210	210	400		100	400	40-105	40-105	30	N/A	50

SAP Worksheet #15.10 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (µg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LOD (µg/kg)	LOQ (µg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Bis(2-chloroisopropyl)ether	39638-32-9	4,600	4,600	400	See Table 11 of Attachment F	100	400	20-115	20-115	30	N/A	50
Bis(2-ethylhexyl)phthalate	117-81-7	35,000	35,000	1000		100	400	45-125	45-125	30	N/A	50
Butylbenzylphthalate	85-68-7	260,000	260,000	400		100	400	50-125	50-125	30	N/A	50
Carbazole	86-74-8	44,600	TBC	400		100	400	45-115	45-115	30	N/A	50
Di-n-butylphthalate	84-74-2	610,000	610,000	400		100	400	55-110	55-110	30	N/A	50
Di-n-octylphthalate	117-84-0	TBC	TBC	400		100	400	40-130	40--130	30	N/A	50
Dibenzofuran	132-64-9	15,300	7,800	400		100	400	50-105	50-105	30	N/A	50
Diethylphthalate	84-66-2	4,900,000	4,900,000	400		100	400	50-115	50-115	30	N/A	50
Dimethylphthalate	131-11-3	TBC	TBC	400		100	400	50-110	50-110	30	N/A	50
Hexachlorobenzene	118-74-1	300	300	400		100	400	45-120	45-120	30	N/A	50
Hexachlorobutadiene	87-68-3	6,100	6,100	400		100	400	40-115	40-115	30	N/A	50
Hexachlorocyclopentadiene	77-47-4	37,000	37,000	400		100	400	30-137	30-137	30	N/A	50
Hexachloroethane	67-72-1	6,100	6,100	400		100	400	35-110	35-110	30	N/A	50
Isophorone	78-59-1	510,000	510,000	400		100	400	45-110	45-110	30	N/A	50
N-Nitroso-di-n-propylamine	621-64-7	120	TBC	400		100	400	40-115	40-115	30	N/A	50
N-Nitrosodiphenylamine & Diphn	86-30-6	99,000	99,000	800		200	800	50-115	50-115	30	N/A	50
Pentachlorophenol	87-86-5	2,120	890	1000		400	1000	25-120	25-120	30	N/A	50
Phenol	108-95-2	1,800,000	1,800,000	500		400	500	40-100	40-100	30	N/A	50

Notes:

µg/kg = micrograms per kilogram
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon on a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Project Action Limits presented in **bold** represent values below project quantitation limits. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010).*

[3]The laboratory precision and accuracy method performance criteria are based upon the DoD QSM, Version 4.2, (2010). If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.11 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Surface Water
Analytical Group: SVOCs—SW-846 8270C

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
1,2,4-Trichlorobenzene	120-82-1	TBC	4	See Table 11 of Attachment F	1	4	35-105	35-105	30	N/A	50
1,2-Dichlorobenzene	95-50-1	TBC	4		1	4	35-100	35-100	30	N/A	50
1,3-Dichlorobenzene	541-73-1	TBC	4		1	4	30-100	30-100	30	N/A	50
1,4-Dichlorobenzene	106-46-7	18.7	4		1	4	30-100	30-100	30	N/A	50
2,4,5-Trichlorophenol	95-95-4	TBC	5		4	5	50-110	50-110	30	N/A	50
2,4,6-Trichlorophenol	88-06-2	TBC	4		1	4	50-115	50-115	30	N/A	50
2,4-Dichlorophenol	120-83-2	TBC	4		1	4	50-105	50-105	30	N/A	50
2,4-Dimethylphenol	105-67-9	899	4		1	4	30-110	30-110	30	N/A	50
2,4-Dinitrophenol	51-28-5	TBC	10		5	10	15-140	15-140	30	N/A	50
2-Chloronaphthalene	91-58-7	TBC	4		1	4	50-105	50-105	30	N/A	50
2-Chlorophenol	95-57-8	TBC	4		1	4	35-105	35-105	30	N/A	50
2-Methylphenol	95-48-7	TBC	4		1	4	40-110	40-110	30	N/A	50
2-Nitroaniline	88-74-4	TBC	4		1	4	50-115	50-115	30	N/A	50
2-Nitrophenol	88-75-5	TBC	4		1	4	40-115	40-115	30	N/A	50
3 & 4-Methylphenol	30030	TBC	5		4	5	30-110	30-110	30	N/A	50
3,3'-Dichlorobenzidine	91-94-1	TBC	4		1	4	20-110	20-110	30	N/A	50
3-Nitroaniline	99-09-2	TBC	4		1	4	20-125	20-125	30	N/A	50
4,6-Dinitro-2-methylphenol	534-52-1	TBC	5		4	5	40-130	40-130	30	N/A	50
4-Bromophenyl-phenyl ether	101-55-3	TBC	4		1	4	50-115	50-115	30	N/A	50
4-Chloro-3-methylphenol	59-50-7	TBC	4		1	4	45-110	45-110	30	N/A	50
4-Chloroaniline	106-47-8	TBC	4		1	4	15-110	15-110	30	N/A	50

SAP Worksheet #15.11 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
4-Chlorophenyl-phenyl ether	7005-72-3	TBC	4	See Table 11 of Attachment F	1	4	50-110	50-110	30	N/A	50
4-Nitroaniline	100-01-6	TBC	4		1	4	35-120	35-120	30	N/A	50
4-Nitrophenol	100-02-7	TBC	5		4	5	1-125	1-125	30	N/A	50
Acenaphthene	83-32-9	TBC	4		1	4	45-110	45-110	30	NA	50
Acenaphthylene	208-96-8	TBC	4		1	4	50-105	50-105	30	NA	50
Anthracene	120-12-7	TBC	4		1	4	55-110	55-110	30	NA	50
Benzo(a)anthracene	56-55-3	0.014	4		1	4	55-110	55-110	30	NA	50
Benzo(a)pyrene	50-32-8	0.0008	4		1	4	55-110	55-110	30	NA	50
Benzo(b)fluoranthene	205-99-2	0.008	4		1	4	45-120	45-120	30	NA	50
Benzo(g,h,i)perylene	191-24-2	TBC	4		1	4	40-125	40-125	30	NA	50
Benzo(k)fluoranthene	207-08-9	23.3	4		1	4	45-125	45-125	30	NA	50
Chrysene	218-01-9	1.36	4		1	4	55-110	55-110	30	NA	50
Dibenzo(a,h)anthracene	53-70-3	0.00052	4		1	4	40-125	40-125	30	NA	50
Fluoranthene	206-44-0	TBC	4		1	4	55-115	55-115	30	NA	50
Fluorene	86-73-7	TBC	4		1	4	50-110	50-110	30	NA	50
Indeno(1,2,3-cd)pyrene	193-39-5	0.008	4		1	4	45-125	45-125	30	NA	50
2-Methylnaphthalene	91-57-6	TBC	4		1	4	45-105	45-105	30	NA	50
Naphthalene	91-20-3	TBC	4		1	4	40-100	40-100	30	NA	50
Phenanthrene	85-01-8	TBC	4		1	4	50-115	50-115	30	NA	50
Pyrene	129-00-0	469	4		1	4	50-130	50-130	30	NA	50
Benzoic acid	65-85-0	TBC	80		50	80	0-125	0-125	30	NA	50
Benzyl alcohol	100-51-6	TBC	5		4	5	30-110	30-110	30	NA	

SAP Worksheet #15.11 - Reference Limits and Evaluation Table
MC Sampling (continued)

Analyte	CAS Number	Minimum Surface Water Project Action Limit[1] (µg/L) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (µg/L)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
					LOD (µg/L)	LOQ (µg/L)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Bis(2-chloroethoxy)methane	111-91-1	TBC	4	See Table 11 of Attachment F	1	4	45-105	45-105	30	NA	50
Bis(2-chloroethyl)ether	111-44-4	TBC	4		1	4	35-110	35-110	30	NA	50
Bis(2-chloroisopropyl)ether	39638-32-9	TBC	4		1	4	25-130	25-130	30	NA	50
Bis(2-ethylhexyl)phthalate	117-81-7	3.49	4		1	4	40-125	40-125	30	NA	50
Butylbenzylphthalate	85-68-7	TBC	4		1	4	45-115	45-115	30	NA	50
Carbazole	86-74-8	TBC	4		1	4	50-115	50-115	30	NA	50
Di-n-butylphthalate	84-74-2	TBC	4		1	4	55-115	55-115	30	NA	50
Di-n-octylphthalate	117-84-0	TBC	4		1	4	35-115	35-115	30	NA	50
Dibenzofuran	132-64-9	TBC	4		1	4	55-105	55-105	30	NA	50
Diethylphthalate	84-66-2	TBC	4		1	4	40-120	40-120	30	NA	50
Dimethylphthalate	131-11-3	TBC	4		1	4	25-125	25-125	30	NA	50
Hexachlorobenzene	118-74-1	TBC	4		1	4	50-110	50-110	30	NA	50
Hexachlorobutadiene	87-68-3	TBC	4		1	4	25-105	25-105	30	NA	50
Hexachlorocyclopentadiene	77-47-4	TBC	4		1	4	36-106	36-106	30	NA	50
Hexachloroethane	67-72-1	TBC	4		1	4	30-95	30-95	30	NA	50
Isophorone	78-59-1	TBC	4		1	4	50-110	50-110	30	NA	50
N-Nitroso-di-n-propylamine	621-64-7	TBC	4		1	4	35-130	35-130	30	NA	50
N-Nitrosodiphenylamine & Diphn	86-30-6	TBC	8		2	8	50-110	50-110	30	NA	
Nitrobenzene-d5	4165-60-0	NA	NA	NA	NA	NA	NA	NA	NA	40-110	NA
2-Fluorobiphenyl	321-60-8	NA	NA	NA	NA	NA	NA	NA	NA	20-110	NA
Terphenyl-d14	1718-51-0	NA	NA	NA	NA	NA	NA	NA	NA	50-135	NA

Notes:

µg/L = micrograms per liter
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantification
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
%R = percent recovery
RPD = relative percent difference
TBC = To be calculated; no available screening level or RSL (USEPA, 2010) is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010).*

[3]The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #15.12 - Reference Limits and Evaluation Table
MC Sampling

Matrix: Soils and Sediment
Analytical Group: Polychlorinated biphenyls (PCBs)

Analyte	CAS Number	Minimum Soil Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Minimum Sediment Project Action Limit[1] (mg/kg) *Equal to or Less Than*	Project Quantitation Limit Goal[1] (mg/kg)	Project Action Limit Reference	Achievable Laboratory Limits[2]		Precision and Accuracy Method Performance Criteria[3]				
						LODs (mg/kg)	LOQs (mg/kg)	LCS Control Limit (%R)	MS/MSD Control Limit (%R)	MS/MSD Precision Limit (RPD)	Surrogate Control Limit (%R)	Project Field Precision Limit (RPD)
Aroclor 1016	12674-11-2	0.203	0.203	0.1	See Table 11 of Attachment F	0.030	0.1	40-140	40-140	30	NA	50
Aroclor 1221	11104-28-2	0.14	0.14	0.1		0.030	0.1	40-140	40-140	30	NA	50
Aroclor 1232	11141-16-5	0.14	0.14	0.1		0.030	0.1	40-140	40-140	30	NA	50
Aroclor 1242	53469-21-9	0.22	0.22	0.1		0.030	0.1	40-140	40-140	30	NA	50
Aroclor 1248	12672-29-6	0.203	TBC	0.1		0.03	0.1	40-140	40-140	30	NA	50
Aroclor 1254	11097-69-1	0.12	0.12	0.1		0.030	0.1	40-140	40-140	30	NA	50
Aroclor 1260	11096-82-5	0.203	0.203	0.1		0.030	0.1	60-130	60-130	30	NA	50

Notes:

mg/kg = milligrams per kilogram
LCS = laboratory control sample
LOD = limit of detection
LOQ = level of quantitation
MS = matrix spike
MSD = matrix spike duplicate
NA = Not Applicable.
QLs = quantitation limits
%R = percent recovery
RPD = relative percent difference

[1]Only the minimum criteria action limits are shown here for comparison. Further information regarding the criteria and basis for the project action limits and the associated sources is provided in Table 15 of the Attachment F Munitions Constituent Sampling Rationale. Project action limits are based upon a dry weight basis. The project quantitation limit goals are based upon a wet weight basis. Following the receipt of the analytical results, the project team will review the data to ensure that the sampling and data meets the DQOs. Please see Worksheet #37 - Usability Assessment for further discussion.

[2]LODs and LOQs were determined in accordance with *DoD Quality Systems Manual for Environmental Laboratories (DoD QSM), Version 4.2 (2010).*

[3] The laboratory precision and accuracy method performance criteria are based upon the DoD QSM. If a compound/analyte is not listed, then the established laboratory in-house limits are used per DoD QSM.

SAP Worksheet #16 - (UFP-SAP Manual Section 2.8.2) - Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Overview of Project Schedule is provided in the Project Management Plan (PMP) for this Delivery Order	Shaw	November 29, 2011*	December 2011	Field Activities	NA
Data Review	Shaw (Automated Data Review System)	After hardcopy data received from laboratory	15–21 Days after receipt of hardcopy data	Final Report	None
Data Validation	Shaw (Automated Data Review System and Manual validation)	After hardcopy data received from laboratory	15–21 Days after receipt of hardcopy data	Final Report	See PMP

* Anticipated start date is dependent on final approval of the Work Plan Addendum for MMRP Remedial Investigation Environmental Services at RVAAP by Ohio EPA.

SAP Worksheet #17 - Sampling Design and Rationale

Visual Survey, Geophysical Surveying and Intrusive Excavation:

Visual surveys and geophysical transect surveys will be performed per the work plan addendum to identify the location of burial areas, OB/OD areas, or target areas based on high amounts of metallic debris. After the surveys, anomalies will be intrusively investigated per the work plan addendum to assess the nature, horizontal density and vertical distribution of MEC and MD.

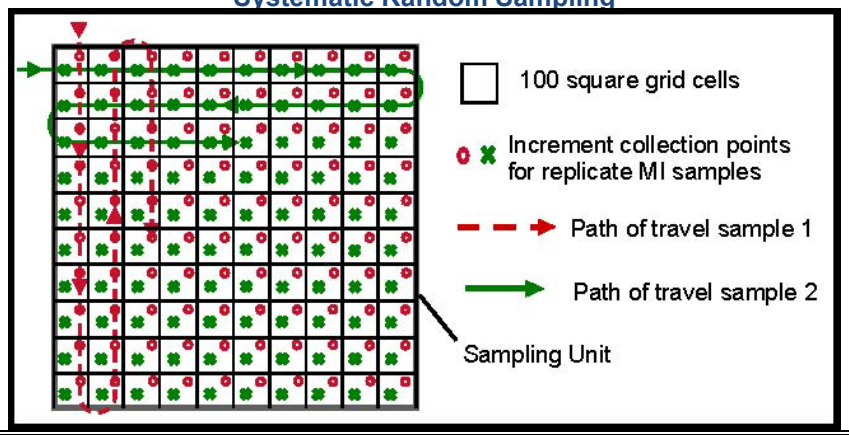
Soil Sampling

Soil sampling will be performed per the Munitions Constituents Sampling Rationale (**Attachment F**) to identify the nature and extent of MC at the RVAAP MRSs.

Surface Soil Sampling

Incremental Sampling (IS): Surface soil (herein inclusive of soils and dry sediment samples) will be collected at a depth between 0 to 6 inches below the MEC/MD item using IS and/or discrete sampling on a per site basis. The sample will consist of material collected from the entire depth interval. Each IS surface soil sample will consist of 30 random samples collected from locations selected in a systematic random pattern throughout each designated area (i.e., sampling unit or decision unit). The determination of 30 increments per IS sample is based on the historical collection process for IS samples at RVAAP. Increment samples will be collected in accordance with the USACE Interim Guidance 09-02, *Implementation of Incremental Sampling of Soil for the Military Munitions Response Program* (USACE, 2009b). The key steps for collection of a systematic random sample are as follows: (1) sub-divide the decision unit into a uniform grid (e.g., pace out the area and divide into at least 30 grids for a 30-aliquot sample), (2) randomly select a single increment location in the first grid, and (3) collect increments from the same relative location within each of the other grids. An example of systematic random sampling is shown below although this pattern shows a 100 cell grid as opposed to the 30 cell grid utilized at RVAAP.

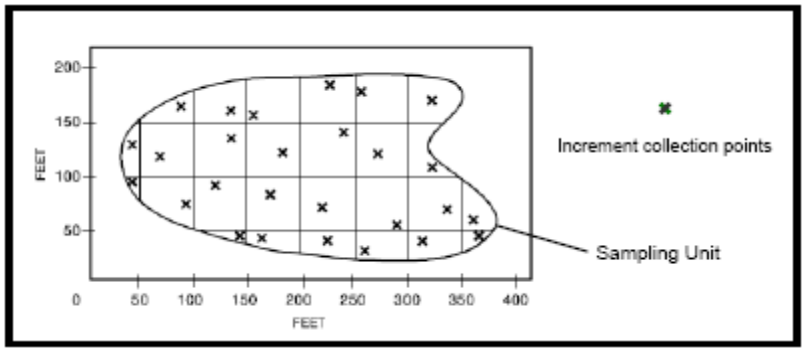
Systematic Random Sampling



SAP Worksheet #17 - Sampling Design and Rationale (continued)

In the event that field conditions (i.e., uneven terrain and heavy vegetation) do not permit increments to be collected in a systematic random pattern, stratified random pattern sampling may be performed. In stratified random sampling, the decision unit is sub-divided into a uniform grid and one increment is collected from a location chosen randomly in each grid cell. An example of stratified random sampling is provided below:

Stratified Random Sampling



As in all field sampling, sufficient prefield work should be done to select an array of possible tools. The selection and use of the tools should be customized to the actual field conditions. For instance, one type of surface soil sample may be more effective with sandy soils than with clay soils. Most commonly, increments will be collected using a 7/8-inch stainless steel step probe (or approved equal) sample collection device. All increments will be of equal size and volume to ensure an accurate sampling has been taken. The increments will be placed into a plastic lined bucket or plastic zip lock bag and combined to make a single sample. If feasible, disposable tools may be utilized; otherwise, decontamination of tools will be performed between decision units, but not during collection of the increments within a decision unit. The increments collected from a decision unit will be placed in a container, such as a large baggie, large enough to transport them back to the sample processing location.

Approximately 1 to 2 kilograms of soil or dry sediment will be collected for each IS decision unit and submitted to the laboratory for processing and analysis. Processing consists of drying out the sample and then sieving the sample through a #10 sieve. Any material larger than the #10 sieve is discarded. The remaining air-dried, sieved material will be ground for the analytes that require grinding (see Work Sheet #19) in order to reduce particle size to control the Fundamental Error (FE). Shaw has successfully used off-site laboratories for IS sample processing and analysis in the past for work conducted at the RVAAP and intends to do the same for this program.

Currently, no grinding of metals is anticipated for IS soils/sediment samples; however, final determination as to whether grinding of metals will be required will be made by the Ohio EPA based on the grinding versus nongrinding comparison of metals in soil samples from the initial seven MRSs in the work plan (Shaw, 2011). The laboratory shall confirm with Shaw if grinding of IS soil/sediment samples is necessary prior to processing.

Field duplicate samples will be collected from the IS decision units at the frequency listed in Work Sheet 28.1. The collection of the field duplicate samples requires two similar portions of soil or dry sediment. Therefore, at an IS decision unit where a field duplicate is to be collected, two IS samples will be collected from within the same decision unit consisting of at least 30 increment aliquots each. The two samples

SAP Worksheet #17 - Sampling Design and Rationale (continued)

will be labeled with different sample numbers and submitted to the laboratory for processing as a blind field duplicate.

Discrete Surface Soil Sampling: The trowel/spoon method may be used in situations where the desired depth is less than 6 inches and where conditions dictate that the IS sample technique is not applicable. Disposable equipment may be used to reduce further decontamination efforts. The trowel/spoon collection method will be accomplished using a stainless steel trowel or spoon. This instrument will be used to manually dig into the subsurface material to the required depth designated for the sampling location. The trowel may also be necessary to collect composite samples. The trowel (if nondisposable) will be decontaminated after completion of digging at each sample location. Alternatively, the bucket hand auger method may be used for the collection of surface soil / dry sediments and where deeper intervals are required. The bucket hand auger collection method will be accomplished using a stainless steel bucket auger head attached to an extension rod and T-shaped bar. The auger will be advanced continuously over 4.0- to 6.0-inch intervals into the soil to the required depth designated for the sampling location. Material collected in the bucket cylinder in each interval will be removed to the greatest extent possible using a stainless steel spoon or disposable sample collection equipment. The bucket auger will be decontaminated after completion of augering at each sampling location. However, the auger will not be decontaminated after removal of material from each interval augered at a location unless multiple discrete samples are collected from a single location at different depth intervals.

Rationale for IS Soil Sampling

The selection of the decision units for IS samples is site-specific. The two primary rationales for a decision unit size are (1) the contaminant release area and (2) the area for potential receptor exposure. In general, a decision unit will only encompass areas where surface contamination (0 to 1 foot) is suspected since the sampling objective is to characterize a known or suspected release. In addition, since the sample results will be used to determine exposure risk and will be compared to the risk-based facility-wide cleanup goals FWCUGs or USEPA Regional Screening Levels (RSLs) for soil, the decision unit will include areas of equally probably anticipated use by the future receptor. The MRSs with known IS soil decision units based on this rationale include the 40mm Firing Range and the Group 8 MRSs.

MEC/MD was identified at the 40mm Firing Range MRS during the SI (e^2M, 2008) and no MC samples were collected. The size of the MRS was reduced from approximately 6 acres to 1.27 acres (the suspected target area) based on the recommendations in the SI Report (e^2M, 2008). It is proposed that two IS samples be collected from the 1.27-acre MRS (approximately 0.63 acres per sample) to characterize where MEC/MD was previously identified; however, the sample areas may be modified (scaled down or broken into smaller IS samples) based on the location of the MEC/MD in order to provide a representative sample of potential source areas. An IS soil sample will be collected from the 0.05-acre firing point located outside of the MRS. This area is being investigated since no MC samples have been previously collected at this location. The sample will be analyzed for propellants (nitrocellulose, nitroguanidine and nitroglycerine) only since these are the primary MC associated with the 40mm grenade igniter.

A total of five IS samples were collected from the Group 8 MRS during the SI (e^2M, 2008) and identified potential MC metals above the screening criteria and low concentrations of explosives that warrant further investigation for additional analyses. The MRS is approximately 2.65 acres and may have been used for debris and rubbish burning. It is not known if open burning of MEC/MD was conducted at the MRS; however, MEC and concentrated areas of MD have been found at the site. Based on the accessibility to potential receptors, unknown areas where debris burning or MEC/MD storage occurred and previous data that identifies MC, a total of 4 IS samples (approximately 0.66 acres per sample) are recommended to further characterize the MRS.

The need to collect IS soil samples at the remaining MRSs (Erie Burning Grounds, Fuze and Booster Quarry, Sand Creek Dump, Water Works

SAP Worksheet #17 - Sampling Design and Rationale (continued)

#4 Dump, and Block D Igloo-TD) will be evaluated if a potential release from MEC/MD is identified. If an IS sample is required, the decision unit size will be evaluated on a site-specific basis and require approval from both the USACE and Ohio EPA.

Determination of IS Soil Decision Units

For the MRSs where IS sampling is proposed, the determination of appropriate decision units depends on many factors including the ultimate use of the average value, the constituent's toxicity and mobility, physical/chemical characteristics of a given site, and the reasonably anticipated future land use. For instance, in the ecological realm, if a fish population study is to be conducted over a specified reach of a creek or river; then the appropriate IS decision unit is the entire same specified reach of that creek or river. If a vegetation analysis is to be made at a burning pad grounds, than the appropriate decision unit is the pad area. In the human health realm, if the future land use is known, then the appropriate decision unit is the smallest exposure area associated with that land use. Similar site by site selection is required when discrete biased sampling is performed, so there is nothing new or additional in determining appropriate IS decision units.

Currently, the Group 8 MRS (RVAAP-063-R-01) and the 40mm Firing Range (RVAAP-032-R-01) are the only MRSs with proposed predetermined IS decision units for soil based on the recommendations in the SI Report (e^2M, 2008). The proposed IS decision units were based on the entire areas of the MRSs that were considered representative of the location where MEC/MD may have impacted surface soils and are within the decision unit size criteria presented in the *MMRP IS Sampling Guidance* (USACE, 2009b).

Subsurface Soil Sampling and Solid IDW

Subsurface samples may be collected using discrete sampling at depths ranging from 1 to a maximum depth of 7 feet bgs. Methods for subsurface soil sample collection may include drilling, test pitting, and bucket augering in accordance with the requirements of the *Facility-Wide Field Sampling and Analysis Plan* (FSAP) (SAIC, 2011). It must be determined, to the extent practical, prior to drilling or trenching that no potential exists for unexploded ordnance and that adequate provisions are in place for worker health and safety. The solid IDW samples will be collected using the trowel/spoon method.

Test Pit Excavation. The test pit excavation method is anticipated to be used to collect subsurface samples and examine potentially buried MEC identified from the geophysical investigations, in particular at the Sand Creek Dump MRS (RVAAP-034-R-01). As stated in the FSAP, authorization must be granted by Ohio EPA prior to commencement of any trenching activities.

Prior to commencing excavation activities, erosion control measures such as silt fence will be placed to prevent soil erosion on roadways edges and roadside ditches. Dust suppression will consist of water application from an Ohio EPA approved water source to exposed surface soils. Water will be applied so as to prevent soil and water migration to nearby drainage pathways. Diversion channels and berms will be constructed to direct runoff to control structures. For stockpiled excavated soil or fill material brought to the RVAAP, berms will be constructed around the pile and covered with 6-mil poly sheeting to prevent sediment migration. Water that accumulates in open excavation(s) will be completely removed by pumping and stored in 55-gallon drums or a temporary water tight storage tank.

The depth interval of which material will be collected will be determined based on the results of the geophysical investigation at the various MRSs. However, test pits will not be excavated below the groundwater table to avoid the potential for contaminating groundwater and the hazard of collapse caused by digging into the saturated material. Excavation will be stopped at the first indication of groundwater, and the test pit will be backfilled with at least two feet of material. In the event that subsurface soil samples are required to be collected at depths below the groundwater table, these samples will be obtained using the hydraulic direct push method.

Test pits will be excavated using a backhoe or other type of excavation equipment (i.e., clam shell, trench excavator, etc.). Soil material in each excavation will be removed in layers measuring approximately one foot in thickness. At the areas identified as having subsurface anomalies, the

SAP Worksheet #17 - Sampling Design and Rationale (continued)

Shaw UXO Team will work directly with the excavation crew to identify suspected MEC or MD that may be uncovered. One UXO Technician will stand in a safe area at the front and upwind of the operation and will be responsible for examining the area to be advanced into, to visually observe for the presence of MEC or MD before the site is disturbed. Once the soils are excavated, they will be spread on 6-mil poly in an adjacent area where the UXO Team member will visually examine it for MEC and/or MD materials. The UXO Team will remove the MEC/MD when they are observed.

Soil will be removed in a fashion until the test pit has been excavated to the required depth designated for the sampling or anomaly inspection location. The total depth of each test pit will be dictated by the target depth(s) for anomalies and associated sampling and will be contingent upon the depth of groundwater constraints as the maximum depth of excavation. Under no circumstances will project personnel enter excavations deeper than 4 feet unless sloping and/or benching is provided in accordance with the Shaw *Site Safety and Health Plan* (SSHP) *Addendum* and the *Facility-Wide Health and Safety Plan* (FSHP) (SAIC, 2001).

All soil and solid waste removed from test pits will be placed on 6-mil poly sheeting beside the excavation at a minimum of 2 feet from the edge of the excavation. The soil and solid waste will be placed on plastic sheeting and segregated by layers in which it was excavated, if necessary, so that potentially hazardous materials are not commingled with hazardous materials. Segregation of the material by layers will also allow for placement of material back in the excavation in the position that it was excavated. Any buried debris will be removed for off-site disposal and only soils that are not visibly contaminated will be returned back to the excavation. Any hazardous material encountered will not be placed back into the excavation, but will be containerized for storage and off-site disposal. If as a result of excavation operations a release occurs, corrective measures will be initiated immediately to abate the release.

Subsurface soil samples collected using the test pit method would be classified as disturbed sample types. Therefore, physical and geotechnical analyses of samples collected using these methods would be limited to those analyses for disturbed samples (i.e., grain size, Atterberg limits, moisture content, etc.). Samples collected using these methods would not be utilized for the determination of in-situ permeability values. A sample will be collected from the required depth using either excavation equipment or a bucket hand auger as described in this and following sections of the SAP addendum. When excavation equipment is used, the sample will be placed onto polyethylene sheeting located at least 4 feet from the edge of the collection trench. When a bucket hand auger is used, the sample will be place into a decontaminated stainless steel bowl at the sampling location. The quantity of the sample required for physical and geotechnical analyses will be collected from the soil stockpile or stainless steel bowl using a stainless steel spoon and placed into sample containers.

Bucket Auger. The bucket hand auger method is another method that may be used for the collection of subsurface samples (greater than one foot bgs). The method may be used in place of the hydraulic push method where sample depths are considered relatively shallow (less than 5 feet) or where sample areas are inaccessible due to rough terrain. This method will be implemented in the same manner as described for discrete surface soil samples.

Hydraulic Direct Push Method. Sampling of soils associated with MEC/MD using hydraulic direct push is the mostly unlikely method to be used since any soil sampling will most likely be associated with source areas and not require extensive sampling to depth. Any soil samples collected at depth will most likely be conducted as part of test pitting or acquired using a bucket auger. In addition drilling in areas of potential MEC presents safety concerns. However, if hydraulic direct push is utilized, a thin-walled (Shelby) tube sampler device will be used. Samples will be collected using this device as part of hollow stem auger drilling of boreholes. The size (both diameter and length) of the Shelby tube sampler to be used, and the intervals over which soil samples will be collected will be coordinated with the USACE and the Ohio EPA prior to implementing any subsurface sampling activities.

During the drilling of investigation boreholes, the lead hollow stem auger will be advanced to the top of the soil interval to be sampled. The Shelby tube sampler will then be inserted into the auger string and hydraulically pushed to the bottom of the soil interval to be sampled. Upon retrieval of the sampler, the percentage of recovery will be recorded and the ends of the sampler will be sealed with wax or rubber packers to

SAP Worksheet #17 - Sampling Design and Rationale (continued)

preserve moisture content. The preparation of Shelby tube samplers for shipment will be conducted in accordance with the American Society for Testing and Materials (ASTM) Method K1587-83.

Underwater Sediment

A predetermined number of sediment samples will be collected at Erie Burning Grounds MRS (6) and the Fuze and Booster Quarry MRS (4). Sediment samples at the Erie Burning Grounds MRS were recommended in the SI Report (e^2M, 2008) since MEC/MD items have reportedly been seen in the water bodies. The SI Report (e^2M, 2008) did not suggest that additional wet sediment samples were necessary at the Fuze and Booster Quarry MRS based on the available IRP data; however, additional wet sediment samples to be collected using IS are proposed based on detections of MC explosives and metals in the IRP sediment data.

Rationale for IS Sediment Sampling

The rationale for the number of wet sediment samples at each of the MRSs is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern.

Determination of IS Sediment Decision Units

The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). The final number and location of samples at these MRSs will be based on the findings during the MEC investigation.

Sediment Sampling Collection Methods

The trowel/spoon, hand core, and Eckman dredge methods are anticipated to be used during the MRS-specific investigation for the collection of sediment samples located underwater. A general discussion of the sampling methodologies for underwater sediment is discussed below.

Trowel/Spoon Method. The trowel/spoon method will be used in situations where the water depth is less than 6 inches and for solid IDW samples. Sediment samples will be collected from the sediment-water interface to a depth of 6 inches, unless otherwise specified in the project-specific addenda. The trowel/spoon collection method will be accomplished using a stainless steel trowel or spoon. This instrument will be used to manually dig into the subsurface material to the required depth designated for the sampling location. The trowel may be necessary to collect composite samples. The trowel will be decontaminated after completion of digging at each sample location.

Hand Core Sampler Method. The hand core sampler method is anticipated to be a second method used for collection of sediment samples located underwater during the MRS-specific investigations. This method will be used in situations where the water depth is greater than 6 inches but less than 10 feet in depth. In the event that a particular MRS investigation requires sediment sampling to be conducted where water depths are greater than 10 feet, the method to be implemented to accomplish this sampling will be presented in the addendum to the FSAP for that investigation.

Hand core sediment samples will consist of a stainless steel sample barrel with either an auger bit or core tip mounted on the leading end of the device. In either configuration, a self-closing value and/or core catcher will be installed to retain the sample obtained with the device. Extension rods will be attached to the core sampler and used to lower the device through the body of water to the sample point. Upon reaching the sediment, the core sampler will be pushed or augered into the sediment to the required depth designated for the sampling location. The core sampler and extension roads will be decontaminated after completion of coring at each sampling location.

The diameter of the core sampler to be used for the investigations will depend on the quantity of sediment sample required to be collected from each sampling location to fulfill chemical analyses requirements. Therefore, the specifications for the core sampler to be used for sediment sampling may vary will be coordinated with the USACE and Ohio EPA prior to implementing sediment sampling activities.

SAP Worksheet #17 - Sampling Design and Rationale (continued)

Eckman Sampler Method. The Eckman sampler method is anticipated to be a third method used for collection of sediment samples located underwater during the MRS-specific investigations. This method will be used in situations where the water depth is greater than 6 inches but less than 10 feet in depth. In the event that a particular MRS investigation requires sediment sampling to be conducted where water depths are greater than 10 feet, the method to be implemented to accomplish this sampling will be presented in the addendum to the FSAP for that investigation.

Eckman sediment samples will consist of a stainless steel clamshell device designed for use in soft bottoms. The Ekman sampler rests on the bottom and uses a messenger system to activate the closure spring system. The sampler scoops up the material caught between the jaws upon closure. A metal weight messenger, usually lead, with a hole through its core that is used to activate the spring closure on clamshell devices. The messenger is dropped onto the closure activation mechanism by sliding it down a line. It activates the closure by the force of its weight upon impact. Upon reaching the sediment, the core sampler messenger will be dropped for the sampling location.

Surface Water and Aqueous IDW

A predetermined number of surface water samples (3) will be collected at the Erie Burning Grounds MRS based on the recommendations made in the SI Report (e^2M, 2008). The final number and location of samples will be based on the findings during the MEC investigation. The surface water samples will be taken in the same general location as the sediment samples to be collected at this MRS.

Surface Water Sample Collection Methods

Surface water samples will be collected in a variety of ways. These methods include: the hand-held bottle, dipper and pond, bailer, and Kemmerer sampler methods. The aqueous IDW will be collected using a bailer or hand-held bottle. The method will be chosen depending on site-specific conditions, and will be specified in site-specific addendums to this SAP/QAPP addendum. A general discussion of the sampling methodologies follows.

Hand-Held Bottle and Bailer Methods. Collection of surface water samples using the hand-held bottle method or bailer method will be accomplished by submerging the appropriate sample container with the cap in place or bailer into the body of water. The container will then be slowly and continuously filled using the cap to regulate the rate of sample entry into the container and the bailer will be allowed to fill as well. The sample container or bailer should be filled such that a minimum of bubbling (and volatilization) occurs. The sample container will be retrieved from the water body with minimal disturbance to the sample. Immediately after collection of the sample and completion of the bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

Dipper and Pond Sampler Method. Dipper and pond samplers perform similar functions and vary only in the length of the handle attached to the sampling vessel (usually a beaker). Before beginning sampling, a handle of appropriate length is attached to a dipper or pond sampler. Collection of surface water samples using the dipper or pond sampler method will then be accomplished by slowly submerging the device into the water so that the open end of the device is facing upstream. The sample container will be retrieved from the water body with minimal disturbance to the sample. Immediately after collection of the sample and completion of the bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

Kemmerer Sampler Method. The Kemmerer sampler is a messenger-activated water sampling device that is used to sample water from a specific depth. Collection of surface water samples using the Kemmerer sampler method will be accomplished by removing the upper and lower stoppers and lowering the sampler to the designated sample depth. Upon reaching the depth, the messenger will be used to close the lower stopper and the sampler will be retrieved. Upon recovery of the sampler, the water sample will be transferred into the appropriate sample containers using the lower stopper drain. Immediately after collection of the sample and completion of the bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

SAP Worksheet #17 - Sampling Design and Rationale (continued)

Field Measurements. Surface water field measurements to be collected as part of Shaw's surface water sampling activities will include determination of static water level, pH, conductivity, dissolved oxygen concentrations and temperature in accordance with Section 4.3.3 in the FSAP (SAIC, 2001). Shaw shall utilize a combination meter designed to measure the aforementioned parameters. The collection of field measurements will comply with the performance requirements as specified in Table 4-3 of the FSAP (SAIC, 2001a).

Wastewater. Any wastewater generated by investigation activities or encountered during activities will be handled in accordance with the methods outlined in the FSAP (USACE, 2011) and as discussed in the IDW section of the work plan.

Decontamination Procedures

Decontamination of nondedicated sampling equipment used during the MRS specific investigations will be conducted within a temporary decontamination pad to be constructed at each MRS where sampling will be performed. Equipment requiring decontamination may also be brought to Building 1036 where the decontamination procedures may be performed to minimize the movement of liquids. The decontamination pad will be designed so that all decontamination liquids are contained from the surrounding environment and can be recovered for disposal as IDW. The procedure for decontamination of nondedicated sampling equipment will be as follows:

Wash with approved water and phosphate-free detergent using various types of brushes to:

1. Remove particulate matter and surface films;
2. Rinse thoroughly with American Society of Testing and Materials (ASTM) Type I or equivalent water;
3. Rinse thoroughly with methanol;
4. Rinse thoroughly with ASTM Type I or equivalent water;
5. Rinse thoroughly with hydrochloric acid (2 percent solution);
6. Rinse thoroughly with ASTM Type I or equivalent water;
7. Allow equipment to air dry as long as possible; and
8. Place equipment on clean plastic if immediate use is anticipated or wrap in aluminum foil to prevent contamination if longer-term storage is required.

Decontamination of small tools and equipment shall be performed at each controlled area. Larger pieces of equipment (i.e.; drilling equipment) will be thoroughly decontaminated to remove all loose soil from tire, tracks, and undercarriage prior to leaving the controlled area. Decontamination methods to be implemented may range from wet brush washing to steam cleaning depending on the extent of residual soils on the equipment. Temporary decontamination pads capable of collecting wash water, including overspray, and loose soil shall be constructed to avoid potential cross contamination of clean areas during decontamination procedures.

Shaw will provide all water for construction use, including decontamination of large equipment. Suitable analytical data will be provided for each water source and approval to utilize the water source must be received from the Ohio EPA prior to transporting the water on-site in accordance with 5.4.2.2.4 of the FSAP (SAIC, 2011). Water to be used for nondedicated sampling equipment decontamination purposes is separate from the water for construction and decontamination use and must be ASTM Type I per the requirements of Section 5.5.2.8 the FSAP (SAIC, 2011).

All IDW will be handled according to the FSAP (SAIC, 2011) and as discussed in the IDW section of the work plan.

SAP Worksheet #17 - Sampling Design and Rationale (continued)

Field Equipment Calibration Procedures.
Field equipment (if any) will be calibrated according to manufactures directions. Field meters are received at the site with calibration records from the rental company. Field meter calibrations will be checked daily prior use.

SAP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Erie Burning Grounds (RVAAP-02-R-01)						
MC Sampling EBGss-NNN(m)	Incremental Sampling Soil/Dry Sediment	Surface[3]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC and pH	Surface Soil/Dry Sediment: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Incremental Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	In accordance with the *Final Record of Decision Soil and Dry Sediment at the Erie Burning Grounds*, no further action is proposed for soil and dry sediment. Therefore, soil and dry sediment sampling is not proposed at the MRS unless source areas of MEC/MD are identified during the RI field activities. A minimum of 6 IS wet sediment and 3 surface water samples are proposed adjacent to and immediately topographically down-gradient of areas where evidence of MEC/MD is observed for worst case analysis of MC concentrations, as warranted. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
MC Sampling EBGss-NNN(d) or EBGsb-NNN(d)	Discrete Sampling Soil/Dry Sediment	Surface[3] and Subsurface[4]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC and pH	Surface and Subsurface Soil/Dry Sediment: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	
MC Sampling EBGsd-NNN(d)	Incremental Sampling Wet Sediment	Surface[3]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC	Wet Sediment: 6 Rinse Blank: 1 Field Duplicate: 1 (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Sediment Sampling: Discrete Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	
MC Sampling EBGsw-NNN(d)	Discrete Sampling Surface Water	Surface[3]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • Nitrocellulose	Surface Water: 3 Rinse Blank:1 Field Duplicate: 1 (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Surface Water Sampling: Discrete Bailer, 9/21/06, SOP EI-FS-109; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113	

SAP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Fuze and Booster Quarry (RVAAP-016-R-01)						
MC Sampling FBQss-NNN(m)	Incremental Sampling Soil/Dry Sediment	Surface[3]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC & pH	Surface Soil/Dry Sediment: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Incremental Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	The SI Report did not recommend additional MC sampling since it is being performed under the IRP; however, based on the previous detections of MC explosives and metals in the wet sediment under the IRP, further delineation of wet sediment will be performed under the MMRP using IS. A minimum of 4 wet sediment samples will be collected from the ponds. The rationale for the number of wet sediment samples is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). The need for additional MC sampling will be evaluated for the environmental media at this MRS if source areas of MEC/MD are identified. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
MC Sampling FBQss-NNN(d) or FBQsb-NNN(d)	Discrete Sampling Soil/Dry Sediment	Surface[3] and Subsurface[4]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC & pH	Surface and Subsurface Soil/Dry Sediment: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	
MC Sampling FBQsd-NNN(d)	Incremental Sampling Wet Sediment	Surface[3]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC	Wet Sediment: 4 Rinse Blank: 1 Field Duplicate: 1 (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Sediment Sampling: Discrete Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103; Sediment Corer, 9/21/06, SOP EI-FS-123; Sediment Ponar/Ekman, 9/21/06, SOP EI-FS-124	
MC Sampling FBQsw-NNN(d)	Discrete Sampling Surface Water	Surface[3]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • Nitrocellulose	Surface Water: TBD Sediment: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Surface Water Sampling: Discrete Bailer, 9/21/06, SOP EI-FS-109; Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113	

SAP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
40mm Firing Range (RVAAP-032-R-01)						
MC Sampling 40Fss-NNN(m)	Incremental Sampling Soil	Surface[3]	• Aluminum & Lead • Geochemical metals (Ca, Mg, Mn and Fe) • Explosives[6] • Nitrocellulose • Nitrocellulose, Nitroguanidine and Nitrocellulose[9] • TOC & pH	Surface Soil: 3 Rinse Blank: 1 Field Duplicate: 1 (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Incremental Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	Minimal IRP data exists for this MRS; therefore, MC sampling will be performed at the MRS for further characterization of surface soil as recommended in the SI Report. The MRS boundaries consist of the target area portion of the MRS that is approximately 1.27 acres in area. Sampling will be for two IS sample from the MRS (approximately 0.63 acres each). In addition, the potential for propellants exist at the 60' x 60' firing point area since propellants are associated with the ignition charge for the 40mm round. Therefore, an IS soil sample will be collected at the firing point of the range and analyze for propellants only. The rationale for the number of IS samples at the MRS is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
MC Sampling 40Fss-NNN(d) or 40Fsb-NNN(d)	Discrete Sampling Soil	Surface[3] and Subsurface[4]	• Aluminum & Lead • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • Nitrocellulose • TOC & pH	Surface Soil: TBD Subsurface Soil: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	

SAP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Sand Creek Dump MRS (RVAAP-034-R-01)						
MC Sampling SCDsb-NNN(d)	Discrete Sampling Soil	Subsurface[4]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • Nitrocellulose • TOC & pH	Subsurface Soil : TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	Based on the extensive data collected at this MRS under the IRP, additional sampling for MC is not proposed. However, discrete samples may be collected if MEC/MD items are identified during the intrusive investigation based on the DGM results. If the MEC are intact and there is no obvious release of MD, a determination would be made in conjunction with the USACE and Ohio EPA as to whether sampling is required. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
Block D Igloo–TD MRS (RVAAP-061-R-01)						
MC Sampling BDTss-NNN(d) or BDT4sb-NNN(d)	Discrete Sampling Soil	Surface[3] and Subsurface[4]	• Metals (Al, Fe, Pb and Sb) • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • Nitrocellulose • TOC & pH	Surface Soil: TBD Subsurface Soil: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	No MC sampling is proposed at this MRS based on recalculation of the MFD-H for the 20-lb bomb that was stored at the Block D Igloo. If evidence of MEC/MD is identified during the RI at the Block D Igloo, Shaw may extend its investigation boundaries. If an off-site investigation is warranted, the investigation strategy at the Block D Igloo–TD will be performed in the same manner as the Block D Igloo MRS. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.

SAP Worksheet #18 - Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Water Works #4 Dump (RVAAP-062-R-01)						
MC Sampling WW4ss-NNN(m)	Incremental Sampling Soil	Surface[3]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • Nitrocellulose • TOC & pH	Surface Soil: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Incremental Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	Additional sampling for MC was not recommended for this MRS in the SI Report since MC results were below screening criteria. However, incremental or discrete samples may be collected if MEC/MD items are identified during the target anomaly investigation based on the DGM field activities. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
MC Sampling WW4ss-NNN(d) or WW4sb-NNN(d)	Discrete Sampling Soil	Surface[3] and Subsurface[4]	• MEC metals[5] • Geochemical metals (Ca, Mg, & Mn) • Explosives[6] • SVOCs[5] • Nitrocellulose • TOC & pH	Surface Soil: TBD Subsurface Soil: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	
Group 8 MRS (RVAAP-063-R-01)						
MC Sampling GR8ss-NNN(m)	Incremental Sampling Soil	Surface[3]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC & pH	Surface Soil: 4 Rinse Blank: 1 Field Duplicate: 1 (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Incremental Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	The SI Report recommended additional MC sampling at the Group 8 MRS based on previous surface soil results above screening criteria. Currently, a total of 4 IS surface soil samples are proposed at the site. Discrete surface and/or subsurface samples may be collected based on the results of the DGM field activities and target anomaly investigation if MEC/MD is identified. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required.
MC Sampling GR8ss-NNN(d)or GR8sb-NNN(d)	Discrete Sampling Soil	Surface[3] and Subsurface[4]	• MEC metals[5] • Geochemical metals Ca, Mg, & Mn) • Explosives[6] • SVOCs[7] • PCBs[8] • Nitrocellulose • TOC & pH	Surface Soil: TBD Subsurface Soil: TBD Rinse Blank: TBD Field Duplicate: TBD (Field Duplicates included at 1 per 10 per matrix)	Sample Homogenization, 9/8/06, SOP EI-FS-010; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Sampling Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	

SAP Worksheet #18- Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number[1]	Matrix	Depth (ft)	Analytical Group	Estimated Number of Samples[2] (identify field duplicates)	Sampling SOP Reference	Rationale for Sampling Location
Investigative Derived Waste						
MC Sampling IDW-WC-NNN	Discrete Sampling Solids and Liquid Wastes	NA	• TCLP metals (ICP & CVAA) • Explosives (Full List) • TCLP SVOCs • Corrosivity as pH • Reactivity (Total Sulfide and Total Cyanide) • Ignitability (Flashpoint)	Solids: TBD Aqueous: TBD	Sample Homogenization, 9/8/06, SOP EI-FS-010; Sample Compositing, 9/8/06, SOP EI-FS-011; Decontamination, 9/8/06, SOP EI-FS-014 Soil Sampling: Discrete Hand Auger, 9/08/06, SOP EI-EI-FS-100; Trowel/Spoon, 9/11/06, SOP EI-FS-101; Soil Probe Core, 9/11/06, SOP EI-FS-103	Characterization of Investigative Derived Waste.

Notes:

[1] Refer to Worksheet #30 for descriptions of sample locations and ID numbers.

[2] Equipment rinse blanks will not required if disposable equipment will be used.

[3] Surface samples consist of samples collected between 0-1 foot bgs at six inch sample intervals for both IS and discrete samples

[4] Subsurface samples consist of samples collected at depths greater than 1 foot bgs.

[5] MEC Metals to include analysis for the following analytes (unless otherwise indicated on table): Aluminum, Antimony, Barium Cadmium, Chromium (III and VI), Copper, Iron, Lead, Zinc, Strontium (Sr), and Mercury

[6] Explosives analysis via USEPA Method 8330B to include the following analytes: Octagon (HMX), Cyclonite (RDX), 1,3,5-Trinitrobenzene, 1,3-Dinitrobenzene, Tetryl, Nitrobenzene, 2,4,6-Trinitrotoluene, 4-Amino-Dintrotoluene, 2-Amino-Dinitrotoluene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2,4/,2,6-dinitrotoluene Mix, 2-Nitrotoluene, 3-Nitrotoluene, 4-Nitrotoluene, Nitroguanidine, Pentaerythrito Tetranitrate (PETN), 3,5-Dinitroaniline, and Nitrocellulose

[7] SVOCs analysis via USEPA Method 8270C to include the following analytes: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine)

[8] PCB analysis via USEPA Method 8082A to include the following analytes: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260

[9] Propellants (nitrocellulose, nitroguanidine and nitroglycerine) to be analyzed for the IS sample to be collected at the firing point for the 40mm Firing Range MRS only.

Al = Aluminum
Sb = Antimony
Ca = Calcium
CVAA = Cold Vapor Atomic Absorption
ft = feet
IDW = investigative derived waste
ICP = Inductively Coupled Plasma
IRP = Installation Restoration Program
IS = Incremental Sampling
Fe = Iron
Pb = Lead
MC = munitions constituents
MD = munitions debris
MEC = munitions and explosives of concern
MFD-H = maximum fragmentation distance horizontal
Mg = Magnesium
Mn = Manganese
PCB = Polychlorinated Biphenyl
SOP = standard operating procedure
SVOC = semivolatile organic compound
TBD = To Be Determined
TCLP = Toxicity Characterization Leaching Procedure
TOC = Total Organic Carbon

SAP Worksheet #19 - Analytical SOP Requirements Table

Matrix (IS and/or Discrete Collection Method)	Analytical Group	Analytical and Preparation Method / SOP Reference[2]	Sample Size	Containers (number, size, and type)[1]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Soil (IS & Discrete) and Wet Sediment (Discrete)	MEC & Geochemical Metals	Preparation: USEPA 3050B (Without Grinding)[3, 4] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2	2 gram sub-sample	IS: 1x Double poly bag Discrete: 1x 4oz Teflon-lined (T-lined) jar	Cool 4ºC ± 2ºC	180 days
Soil (IS)	MC Explosives	Preparation: USEPA 8330B (With Grinding) Analysis: USEPA 8330B Rev 5	10 gram sub-sample	IS:1x Double poly bag	Cool 4ºC ± 2ºC	14 days for extraction and 40 days for analysis
Soil, Wet Sediment & Solid IDW (Discrete)		Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5		Discrete: 1x 8oz T-lined jar		
Soil (IS)	SVOCs	Preparation: USEPA 3546 (With Grinding) Analysis: USEPA 8270C Rev 9	30 gram sub-sample	IS:1x Double poly bag	Cool 4ºC ± 2ºC	14 days for extraction and 40 days for analysis
Soil, Wet Sediment & Solid IDW (Discrete)	SVOCs	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev. 3		Discrete: 1x 8oz T-lined jar		
Soil (IS)	PCBs	Preparation: USEPA 3546 (With Grinding) Analysis: USEPA 8082A	30 gram sub-sample	IS:1x Double poly bag	Cool 4ºC ± 2ºC	14 days for extraction and 40 days for analysis
Soil, Wet Sediment and Solid IDW (Discrete)	PCBs	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8082A		Discrete: 1x 8oz T-lined jar		
Soil (IS)	Nitrocellulose	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding)	50 gram sub-sample	IS: 1x Double poly bag	Cool 4ºC ± 2ºC;	14 days
Soil and Wet Sediment (Discrete)		Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)		Discrete: 1x 8oz T-lined jar; Amber in dark		
Soil (IS & Discrete) and Wet Sediment (Discrete)	TOC	Preparation and Analysis: USEPA Method Lloyd Kahn (Without Grinding)[3] CC-TOC solid Rev 3	1-2 gram sub-sample	IS: 1x Double poly bag Discrete: 1x 4oz T-lined jar	Cool 4ºC ± 2ºC	28 days
Soil (IS & Discrete) and Wet Sediment/Solid IDW (Discrete)	pH	Preparation and Analysis: USEPA Method 9045D (Without Grinding)[3] CC-24b Rev 3	1-2 gram sub-sample	IS: 1x Double poly bag Discrete: 1x 4oz T-lined jar	Cool 4ºC ± 2ºC	ASAP (Not published)
Surface Water	MEC Metals (total)	Preparation: USEPA 3010C Analysis: USEPA 6010C 6225B Rev 8 & 6105B-6000 Rev 2	50-100 mL	1x 500-mL poly	HNO_3 to pH<2, Cool 4ºC ± 2ºC	180 days

SAP Worksheet #19 - Analytical SOP Requirements Table (continued)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[2]	Sample Size	Containers (number, size, and type)[1]	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation / analysis)
Surface Water	MC Explosives	Preparation: USEPA 3535A Analysis: USEPA 8330B Rev 5	1-L	Two (2x) 1-L amber bottles	Cool 4ºC ± 2ºC; Amber in dark	7 days for extraction and 40 days for analysis
Surface Water	SVOCs	Preparation: USEPA 3510C Analysis: USEPA 8270C Rev. 3	1-L	Two (2x) 1-L amber bottles	Cool 4ºC ± 2ºC; Amber in dark	7 days for extraction and 40 days for analysis
Surface Water	Nitrocellulose	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5	1-L	Two (2x) 1-L amber bottles	Cool 4ºC ± 2ºC; Amber in dark	7 days for extraction and 40 days for analysis
Aqueous IDW	TCLP metals (ICP & CVAA)	Preparation: USEPA 1311/3010C/7470A Analysis: USEPA 6010C/7470A CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2	50-100 mL	1x 1-L HDPE	Cool 4ºC ± 2ºC	180 days (28 for Hg) for TCLP extraction and 180 days (28 for Hg) for analysis
Aqueous IDW	TCLP SVOCs	Preparation: USEPA 1311/3510C Analysis: USEPA 8270C CL-8b Rev 4	1-L	Two (2x) 1-L amber bottles	Cool 4ºC ± 2ºC	14 days for TCLP extraction; 7 days for extraction and 40 days for analysis
Aqueous IDW	Reactivity (Total Sulfide and Total Cyanide)	Preparation and Analysis: USEPA 9030B and 9012, CC-1 Rev 8 & CC-Reactive Sulfide Dist Rev 0	500-mL for CN; 250-mL for S	1x 1-L HDPE CN 1x 1-L HDPE S	Cool 4ºC ± 2ºC; NaOH pH>12 CN; Zinc Acetate for Sulfide	7 days for Sulfide 14 days for Cyanide
Aqueous IDW	Ignitability (Flashpoint)	Preparation and Analysis: USEPA 1010A CC-37 Rev 2	10 to 20-mL	1x 4oz T-lined jar	Cool 4ºC ± 2ºC	7 days
Aqueous IDW	pH	Preparation and Analysis: USEPA Method 9040C, CC-24b Rev 3	100-mL	1x 250mL HDPE	Cool 4ºC ± 2ºC	ASAP (No published)
Solid IDW	TCLP metals (ICP & CVAA)	Preparation: USEPA 1311/3010C/7470A Analysis: USEPA 6010C/7470A CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2	100 gram sample	1x 16oz T-lined jar	Cool 4ºC ± 2ºC	180 days (28 for Hg) for TCLP extraction and 180 days (28 for Hg) for analysis
Solid IDW	TCLP SVOCs	Preparation: USEPA 1311/3510C Analysis: USEPA 8270C, CL-8b Rev 4	100 gram sample	1x 16oz T-lined jar	Cool 4ºC ± 2ºC	14 days for TCLP extraction; 7 days for extraction and 40 days for analysis
Solid IDW	Reactivity (Total Sulfide and Total Cyanide)	Preparation and Analysis: USEPA 9030B and 9013A/9012, CC-1 Rev 8 & CC-Reactive Sulfide Dist Rev 0	0.5 gram for S; 25 grams for CN	1x 8oz T-lined jar	Cool 4ºC ± 2ºC	7 days for Sulfide 14 days for Cyanide
Solid IDW	Ignitability (Flashpoint)	Preparation and Analysis: USEPA 1030 CC-37 Rev 2	1-2 gram sample	1x 4oz T-lined jar	Cool 4ºC ± 2ºC	7 days

SAP Worksheet #19 - Analytical SOP Requirements Table (continued)

Notes:

[1] Sample size is a minimum; the containers listed will be filled to compensate for any required reanalysis or reextractions. For samples requiring Matrix Spike (MS)/Matrix Spike Duplicate (MSD) containers listed should be tripled. Like sample containers may be combined at the laboratories discretion to minimize sample volumes.

[2] Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

[3] For IS samples not requiring grinding, the entire air-dried and sieved sample will be sub sampled with 30 or more randomly located increments removed to form each sub-sample required prior to grinding samples for explosives, SVOC or PCB analysis.

[4] A determination as to whether inorganics will be ground as part of IS processing will be made by the Ohio EPA following results of IS samples collected for the first seven MRSs included in the work plan (Shaw, 2011).

HNO_3 = nitric acid.
Hg = mercury
ICP = Inductively Coupled Plasma
IDW = Investigation Derived Waste
IS = Incremental Sampling
L = liters
MC = munitions constituents
mL = milliliters
PCBs = polychlorinated biphenyls
SVOCs = semivolatile organic compounds
TCLP = Toxicity Characteristic Leaching Procedures
TOC = total organic carbon
USEPA = U.S. Environmental Protection Agency

SAP Worksheet #20 - Field Quality Control Sample Summary Table

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Erie Burning Grounds (RVAAP-002-R-01)								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface Soil (IS)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis: USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3010C (Lab Filtered for dissolved fraction) Analysis: USEPA 6010C 6225B Rev 8 & 6105B-6000 Rev 2	3	1 per 10	1 per 20	NA	1 per day	6
Explosives[6]	Surface Soil (IS)	Preparation: USEPA 8330B (With Grinding—Puck Mill) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3535A Analysis: USEPA 8330B Rev 5	3	1 per 10	1 per 20	NA	1 per day	6
SVOCs[7]	Surface Soil (IS)	Preparation: USEPA 3550C (With Grinding—Puck Mill) Analysis: USEPA 8270C Rev 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3550C (Without Grinding) Analysis: USEPA 8270C Rev 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3510C Analysis: USEPA 8270C Rev 9	3	1 per 10	1 per 20	NA	1 per day	6

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Erie Burning Grounds (RVAAP-002-R-01) continued								
PCBs[8]	Surface Soil (IS)	Preparation: USEPA 3540C (With Grinding—Puck Mill) Analysis: USEPA 8082A	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3540C (Without Grinding) Analysis: USEPA 8082A	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface Soil (IS)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding—Puck Mill)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5	3	1 per 10	1 per 20	NA	1 per day	6
TOC	Surface Soil (IS)	Preparation and Analysis: Lloyd Kahn Method CC-TOC solid Rev 3 (Without Grinding)[4]	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		6	1 per 10	1 per 20	NA	1 per day	9
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Fuze and Booster Quarry (RVAAP-016-R-01)								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface Soil (IS)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Fuze and Booster Quarry (RVAAP-016-R-01) continued								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3010C (Lab Filtered for dissolved fraction) Analysis: USEPA 6010C 6225B Rev 8 & 6105B-6000 Rev 2	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface Soil (IS)	Preparation: USEPA 8330B (With Grinding—Puck Mill) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3535A Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
SVOCs[7]	Surface Soil (IS)	Preparation: USEPA 3546 (With Grinding—Puck Mill) Analysis: USEPA 8270C Rev. 3	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev. 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation: USEPA 3510C Analysis: USEPA 8270C Rev 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
PCBs[8]	Surface Soil (IS)	Preparation: USEPA 3546 (With Grinding—Puck Mill) Analysis: USEPA 8082A	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (With Grinding—Puck Mill) Analysis: USEPA 8082A	TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Fuze and Booster Quarry (RVAAP-016-R-01) continued								
Nitrocellulose	Surface Soil (IS)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface Water (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
TOC & pH	Surface Soil (IS)	Preparation and Analysis: Lloyd Kahn Method and 9045D (Without Grinding)[4] CC-TOC solid Rev 3 & CC-24b Rev 3	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Wet Sediment (IS)		4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
40mm Firing Range (RVAAP-032-R-01)								
Metals (Aluminum & Lead) Geochemical metals (Ca, Mg, Mn and Fe)—ICP	Surface Soil (IS)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2	2	1 per 10	1 per 20	NA	1 per day	5
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface Soil (IS)	Preparation: USEPA 8330B (With Grinding—Puck Mill) Analysis: USEPA 8330B Rev 5	3[9]	1 per 10	1 per 20	NA	1 per day	6
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
40mm Firing Range (RVAAP-032-R-01) continued								
Nitrocellulose	Surface Soil (IS)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding)	3[9]	1 per 10	1 per 20	NA	1 per day	6
	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
TOC & pH	Surface Soil (IS)	Preparation and Analysis: Lloyd Kahn Method and 9045D CC-TOC solid Rev 3 & CC-24b Rev 3 (Without Grinding)[4]	2	1 per 10	1 per 20	NA	1 per day	5
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Sand Creek Dump (RVAAP-034-R-01)								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
SVOCs[7]	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Sand Creek Dump (RVAAP-034-R-01) continued								
TOC & pH	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: Lloyd Kahn Method and 9045D (Without Grinding)[4] CC-TOC solid Rev 3 & CC-24b Rev 3	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
SVOCs[7]	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
TOC & pH	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: Lloyd Kahn Method and 9045D CC-TOC solid Rev 3 & CC-24b Rev 3 (Without Grinding)[4]	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Block D Igloo-TD (RVAAP-061-R-01)								
Metals (Al, Fe, Pb and Sb) Geochemical metals (Ca, Mg, & Mn)	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3050B Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
TOC & pH	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: Lloyd Kahn Method and 9045D CC-TOC solid Rev 3 & CC-24b Rev 3	TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Water Works #4 Dump (RVAAP-062-R-01)								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface Soil (IS)	Preparation: USEPA 3050B Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface Soil (IS)	Preparation: USEPA 8330B (With Grinding—Puck Mill)[3] Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
SVOCs[7]	Surface Soil (IS)	Preparation: USEPA 3546 (With Grinding—Puck Mill) (Analysis: USEPA 8270C Rev. 3	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev. 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface Soil (IS)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD
TOC & pH	Surface Soil (IS)	Preparation and Analysis: Lloyd Kahn Method and 9045D CC-TOC solid Rev 3 & CC-24b Rev 3 (Without Grinding)[4]	TBD	1 per 10	1 per 20	NA	1 per day	TBD
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Group 8 MRS (RVAAP-063-R-01)								
MEC metals[3] Geochemical metals (Ca, Mg, & Mn)	Surface Soil (IS)	Preparation: USEPA 3050B (Without Grinding)[4,5] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 and 7196A Rev 1	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Explosives[6]	Surface Soil (IS)	Preparation: USEPA 8330B (With Grinding—Puck Mill)[3] Analysis: USEPA 8330B Rev 5	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 8330B (Without Grinding) Analysis: USEPA 8330B Rev 5	TBD	1 per 10	1 per 20	NA	1 per day	TBD
SVOCs[7]	Surface Soil (IS)	Preparation: USEPA 3546 (With Grinding—Puck Mill) (Analysis: USEPA 8270C Rev. 3	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8270C Rev. 9	TBD	1 per 10	1 per 20	NA	1 per day	TBD
PCBs[8]	Surface Soil (IS)	Preparation: USEPA 3546 (With Grinding—Puck Mill) Analysis: USEPA 8082A	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation: USEPA 3546 (Without Grinding) Analysis: USEPA 8082A	TBD	1 per 10	1 per 20	NA	1 per day	TBD
Nitrocellulose	Surface Soil (IS)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (With Grinding)	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)	Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5 (Without Grinding)	TBD	1 per 10	1 per 20	NA	1 per day	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Analytical Group	Matrix (IS and/or Discrete Collection Method)	Analytical and Preparation SOP Reference	No. of Sampling Locations	No. of Field Duplicate Pairs[1]	No. of MS/MSDs[1]	No. of Trip Blanks	No. of Equip. Blanks[2]	Total No. of Samples
Group 8 MRS (RVAAP-063-R-01) continued								
TOC & pH	Surface Soil (IS)	Preparation and Analysis: Lloyd Kahn Method and 9045D (Without Grinding)4 CC-TOC solid Rev 3 & CC-24b Rev 3	4	1 per 10	1 per 20	NA	1 per day	7
	Surface and Subsurface Soil (Discrete)		TBD	1 per 10	1 per 20	NA	1 per day	TBD
Investigative Derived Waste								
TCLP metals (ICP & CVAA)	Aqueous & Solids	Preparation: USEPA 1311/3010C/7470A Analysis: USEPA 6010C/7470A, CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2	TBD	NA	NA	NA	NA	TBD
Explosives—Full List	Aqueous & Solids	Preparation: USEPA 8330B Analysis: USEPA 8330B Rev 5	TBD	NA	NA	NA	NA	TBD
TCLP SVOCs	Aqueous & Solids	Preparation: USEPA 1311/3510C Analysis: USEPA 8270C, CL-8b Rev 4	TBD	NA	NA	NA	NA	TBD
Corrosivity as pH	Aqueous & Solids	Preparation and Analysis: USEPA 9045D/9040C, CC-24b Rev 3	TBD	NA	NA	NA	NA	TBD
Reactivity (Total Sulfide and Total Cyanide)	Aqueous & Solids	Preparation and Analysis: USEPA 9030B and 9013A/9012, CC-1 Rev 8 & CC-Reactive Sulfide Dist Rev 0	TBD	NA	NA	NA	NA	TBD
Ignitability (Flashpoint)	Aqueous & Solids	Preparation and Analysis: USEPA 1030/1010A, CC-37 Rev 2	TBD	NA	NA	NA	NA	TBD

SAP Worksheet #20 - Field Quality Control Sample Summary Table (continued)

Notes;

[1] Field duplicates pairs are collected at a frequency of ten percent (1 per 10) and matrix spikes at five percent (1 per 20) of the total number of samples collected per matrix.

[2] Equipment blanks are collected at a frequency of one per day per matrix per sampling technique. However, will not be required if disposable equipment is used.

[3] MEC Metals to include analysis for the following analytes (unless otherwise indicated on table): Aluminum, Antimony, Barium Cadmium, Chromium (III & VI), Copper, Iron, Lead, Zinc, Strontium, and Mercury.

[4] For IS samples not requiring grinding, the entire air-dried and sieved sample will be sub sampled with 30 or more randomly located increments removed to form each sub-sample required prior to grinding samples for explosives, propellants, SVOC or PCB analysis.

[5] A determination as to whether inorganics will be ground as part of IS processing will be made by the Ohio EPA following results of IS samples collected for the first seven MRSs included in the work plan (Shaw, 2011).

[6] Explosives analysis via USEPA Method 8330B to include the following analytes: Octagon (HMX), Cyclonite (RDX), 1,3,5-Trinitrobenzene, 1,3-Dinitrobenzene, Tetryl, Nitrobenzene, 2,4,6-Trinitrotoluene, 4-Amino-Dintrotoluene, 2-Amino-Dinitrotoluene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, 2,4/,2,6-Dinitrotoluene Mix, 2-Nitrotoluene, 3-Nitrotoluene, 4-Nitrotoluene, Nitroguanidine, Pentaerythrito Tetranitrate (PETN), 3,5-Dinitroaniline, and Nitrocellulose.

[7] SVOCs analysis via USEPA Method 8270C to include the following analytes: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, N-Nitrosodiphenylamine & Diphn, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

[8] PCB analysis via USEPA Method 8082A to include the following analytes: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.

[9] The IS sample from the 40mm Firing Range firing point will be analyzed for propellants only (nitrocellulose, nitroguanidine and nitroglycerine). Nitroquanidine and nitroglycerine to be analyzed using USEPA Method 8330B.

Al = aluminum
Ca = calcium
Cd = cadmium
Cu = copper
DNT = dinitrotoluene
HMX = octogen
ICP = Inductively Coupled Plasma
Fe = iron
IS = Incremental Sampling
MC = munitions constituents
Mg = magnesium
Mn = manganese
MS/MSD = matrix spike/matrix spike duplicate
NA = Not Applicable
NG = nitroguanidine
RDX = cyclonite
SVOC = semivolatile organic compounds
TBD = To Be Determined
TCLP = Toxicity Characterization Leaching Procedure
TNT = trinitrotoluene
TOC = total organic carbon
USEPA = U.S. Environmental Protection Agency
Zn = Zinc

SAP Worksheet #21 - Project Sampling SOP References Table

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
1	FSAP, 03/01, Section 5.1	USACE	NA	N	Documents observations, sampling information, and other pertinent information on project sites.
	Field Logbook, 9/8/06, SOP EI-FS-001	Shaw			
2	FSAP, 03/01, Section 5.4.3	USACE	NA	N	Provides requirements for the completion of Chain of Custody documentation.
	Chain of Custody Documentation—Paper, 9/8/06, SOP EI-FS-003	Shaw			
3	FSAP, 03/01, Section 5.4.3	USACE	NA	N	Includes procedure for completion and attachment of custody seals on environmental samples and shipping containers.
	Custody Seals, 9/8/06, SOP EI-FS-005	Shaw			
4	FSAP, 03/01, Section 5.4.1	USACE	NA	N	Provides requirements for completion and attachment of sample labels on environmental sample containers.
	Sample Labeling, 9/8/06, SOP EI-FS-006	Shaw			
5	Sample Homogenization, 9/8/06, SOP EI-FS-010	Shaw	NA	N	Establishes method for homogenizing soil, sediment, and other solid/semi-solid matrices so that a uniform matrix is available for sampling.
6	FSAP, 03/01, Section 6.0	USACE	Shipping Container	N	Includes sample packaging, shipping, and requirements for Non Hazardous Samples.
	Shipping and Packaging of Non Hazardous Samples, 9/8/06, SOP EI-FS-012	Shaw			
7	FSAP, 03/01, Section 6.0	USACE	Shipping Container	N	Includes sample packaging, shipping, and requirements for Hazardous Samples.
	Packaging and Shipping of DOT – Hazardous Samples, 9/5/06, SOP EI-FS-013	Shaw			
8	FSAP, 03/01, Section 4.3.8	USACE	NA	N	Standard to be implemented for decontamination of contact sampling equipment.
	Decontamination of Contact Sampling Equipment, 9/8/06, SOP EI-FS-014	Shaw			

SAP Worksheet #21 - Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
9	FQAPP, 03/01, Section 12.0	USACE	NA	N	Establish the means by which all subcontracted environmental analytical data will be reviewed for completeness and usability.
	Data Usability Review, 9/8/06, SOP EI-FS-020	Shaw			
10	FSAP, 03/01, Section 4.5.2.1.1	USACE	Hand Auger	N	Methods/procedures for sampling of subsurface soils using hand auger.
	Hand Auger Sampling, 9/8/06, SOP EI-FS-100	Shaw			
11	FSAP, 03/01, Sections 4.5.2.1.2 and 4.5.2.2.1	USACE	Trowel / Spoon	N	Methods/procedures for sampling of surface soils using trowels/spoons.
	Trowel/Spoon Surface Soil Sampling, 9/11/06, SOP EI-FS-101	Shaw			
12	FSAP, 03/01, Section 4.5.2.2.2	USACE	Soil Probe or Core Type	N	Methods/procedures for sampling of subsurface soils using soil probe or core-type sampler.
	Soil Sampling using a Soil Probe or Core-Type Sampler, 9/11/06, SOP EI-FS-103	Shaw			
13	FSAP, 03/01, Section 4.3.2.6	USACE	Water Level Meter	N	Methods/procedures for taking water level measurements.
	Water Level Meas., 9/11/06, SOP EI-FS-108	Shaw			
14	FSAP, 03/01, Section 4.6.2.1.3	USACE	Kemmerer Sampler	N	Methods/procedures for sampling water using a Kemmerer sampler.
	Depth Water Samplers, 9/21/06, SOP EI-FS-112;	Shaw			
15	FSAP, 03/01	USACE	Bailer	N	Methods/procedures for sampling water using a Bailer sampler.
	Bailer Samplers, 9/21/06, SOP EI-FS-109;	Shaw			
16	FSAP, 03/01, Section 4.6.2.1.2	USACE	Dipper or Pond Grab Sampler	N	Methods/procedures for sampling surface water or grab sample using a grab sampler.
	Surface water/Grab/Pond Sampler, 9/21/06, SOP EI-FS-113;	Shaw			

SAP Worksheet #21 - Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and / or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
17	FSAP, 03/01, Section 4.5.2.2.2	USACE	Core	N	Methods/procedures for sampling of sediment using core sampler.
	Sediment sampling using a Core Sampler, 9/21/06, SOP EI-FS-123	Shaw			
18	Sediment Sampling using Ponar/Ekman Type Systems, 9/21/06, SOP EI-FS-124	Shaw	Ponar / Ekman	N	Methods/procedures for sampling of sediment using Ponar/Ekman sampler.
19	FSAP, 03/01, Section 4.3.3	USACE	Water Level Meter and Conductivity, Temp and pH meter	N	Methods/procedures for taking water quality measurements.
	Water Quality Meas., 9/22/06, SOP EI-FS-204	Shaw			

Notes:

FSAP = Facility-Wide Sampling and Analysis Plan
FQAPP = Facility-Wide Quality Assurance Project Plan
NA = Not Applicable
SOP = Standard Operating Procedure
USACE = U.S. Army Corps of Engineers

SAP Worksheet #22 - Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Verification Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Global Positioning System (GPS)	Calibrated as per manufacturer's instructions.	Daily	As per manufacturer's instructions.	As per manufacturer's instructions.	Field Geophysicist/Field Team Leader	Standard Operating Procedure (SOP)-T-GIS-006 Field Data Collection and Data Management for GIS in Munitions and Explosives of Concern (MEC) Projects
Photo Ionization Detector (PID)	Calibrated as per manufacturer's instructions.	In accordance with manufacturer's and/or project-specific requirements	As per manufacturer's instructions.	As per manufacturer's instructions.	Field Sampler	SOP EI-GS008: Standards for Conducting Soil Gas Surveys
Water Quality Meter	Calibrated as per manufacturer's instructions.	In accordance with manufacturer's and/or project-specific requirements	As per manufacturer's instructions.	As per manufacturer's instructions.	Field Sampler	SOP EI-FS204

Only equipment requiring calibration verification, frequency acceptance criteria, corrective action, responsible person, and SOP reference is listed here. It is also possible that additional equipment will be added during field activities based on conditions encountered. If additional equipment is required, this worksheet will be updated accordingly.

SAP Worksheet #23 - Analytical SOP References Table

Reference Number	Title, Revision Date, and / or Number [1]	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
6230B Rev 4 & 6105B-6000 Rev 2	Acid Digestion of Solids for Total Metals Inductively Coupled Plasma Emission—OES 6000 Series	Definitive	Soil / Sediment / IDW	MEC metals (Al, Cd, Cr III, VI; Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg)—ICP Geochemical metals (Ca, Mg, & Mn)—ICP TCLP ICP Metals	Trace ICP	CT Laboratories Baraboo, WI	No
7196A Rev 1	Chromium, Hexavalent (Colorimetric)	Definitive	Soil Sediment	Metals	Discrete FIA	CT Laboratories Baraboo, WI	No
8330B Rev 5	Explosives by 8330B with extended analyte list.	Definitive	Soil / Sediment / IDW	Explosives—Puck Mill (HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ)	HPLC	CT Laboratories Baraboo, WI	No
8082A Rev 11	PCB compounds by Gas Chromatography	Definitive	Soil / Sediment	PCBs	GC	CT Laboratories Baraboo, WI	No
8270C Rev 9	Analysis of SVOCs by GC/MS	Definitive	Soil / Sediment	SVOCs	GC/MS	CT Laboratories Baraboo, WI	No
8270 Rev 9	Analysis of SVOCs by GC/MS 8270	Definitive	IDW	TCLP SVOCs	GC/MS	CT Laboratories Baraboo, WI	No
6120B Rev. 8	Mercury Cold Vapor Atomic Absorption	Definitive	IDW	TCLP Mercury	CVAA	CT Laboratories Baraboo, WI	No
CC-NC Rev 0 & CC-IC Rev 5	Preparation of Nitrocellulose Soils and Waters for Analysis of Nitrate/Nitrite by Ion Chromatography Ion Chromatography	Definitive	Soil / Sediment	Nitrocellulose	IC	CT Laboratories Baraboo, WI	No
CC-TOC solid Rev 3	Total Organic Carbon in Soil	Definitive	Soil / Sediment	TOC	TOC Analyzer with solids module	CT Laboratories Baraboo, WI	No
CC-24b Rev 3	pH—Soils and Waste	Definitive	Soil	pH	Electrode	CT Laboratories Baraboo, WI	No

SAP Worksheet #23 - Analytical SOP References Table (continued)

Reference Number	Title, Revision Date, and / or Number [1]	Definitive or Screening Data	Matrix	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
6225B Rev 8 6105B-6000 Rev 2	Total Metals Sample Prep for ICP Inductively Coupled Plasma Emission—OES 6000 Series	Definitive	Surface Water	MEC metals (Al, Cd, Cr III, VI;, Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg)—ICP Geochemical metals (Ca, Mg, & Mn)—ICP	Trace ICP	CT Laboratories Baraboo, WI	No
8330B Rev 5	Explosives by 8330B with extended analyte list.	Definitive	Surface Water	Explosives—Puck Mill (HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix,2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ)	HPLC	CT Laboratories Baraboo, WI	No
CC-NC Rev 0 & CC-IC Rev 5	Preparation of Nitrocellulose Soils and Waters for Analysis of Nitrate/Nitrite by Ion Chromatography Ion Chromatography	Definitive	Surface Water	Nitrocellulose	IC	CT Laboratories Baraboo, WI	No
8270C Rev 9	Analysis of SVOCs by GC/MS	Definitive	Surface Water	SVOCs	GC/MS	CT Laboratories Baraboo, WI	No
8082A Rev 11	PCB compounds by Gas Chromatography	Definitive	Surface Water	PCBs	GC	CT Laboratories Baraboo, WI	No
7196A Rev 1	Chromium, Hexavalent (Colorimetric)	Definitive	Surface Water	Metals	Discrete FIA	CT Laboratories Baraboo, WI	No
CL-8b Rev 4	TCLP/ SPLP Extraction, Nonvolatile Fractions	Definitive	Aqueous & Solids	TCLP Extraction	Extraction Vessel	CT Laboratories Baraboo, WI	No
CC-37 Rev 2	Flashpoint by Pensky-Martens Closed Cup tester	Definitive	Aqueous & Solids	Ignitability (Flashpoint)	Pensky- Martens Device	CT Laboratories Baraboo, WI	No
CC-1 Rev 8	Cyanide, Total and Amenable to Chlorination	Definitive	Aqueous & Solids	Reactivity (Total Cyanide)	Lachat	CT Laboratories Baraboo, WI	No
CC-Reactive Sulfide Dist Rev 0	Reactive Sulfide Distillation	Definitive	Aqueous & Solids	Reactivity (Total Sulfide)	Titration	CT Laboratories Baraboo, WI	No

SAP Worksheet #23 - Analytical SOP References Table (continued)

Notes

[1] Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

Al = aluminum
Ca = calcium
Cd = cadmium
Cu = copper
FIA = flow injection analyzer
FPD = flame photometric detector
GC = gas chromatograph
DNT = dinitrotoluene
HMX = octogen
HPLC = high performance liquid chromatography
ICP = Inductively Coupled Plasma
ICP = Inductively Coupled Plasma
IDW = investigative derived waste
Fe = iron
MC = munitions constituents
Mg = magnesium
Mn = manganese
MS/MSD = matrix spike/matrix spike duplicate
NA = Not Applicable
NG = nitroguanidine
PCB = polychlorinated biphenyl
PETN = Pentaerythrito Tetranitrate
RDX = cyclonite
SPLP = Synthetic Precipitation Leaching Procedure
Sr = strontium
TBD = To Be Determined
SVOC = semivolatile organic compounds
TCLP = Toxicity Characteristic Leaching Procedure
TNT = trinitrotoluene
TOC = total organic carbon
USEPA = U.S. Environmental Protection Agency
Zn = Zinc

SAP Worksheet #24 - Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Shimadzu LC10A	SW-846 8330B	Initial calibration prior to sample analysis as needed. See Worksheet 28.1 for details.	Min. of 5 calibration standards with the lowest standard concentration at or below the limit of quantitation (LOQ) which will be set at the laboratory's reporting limits (RLs). Once calibration curve or line is generated, the lowest calibration standard must be reanalyzed. The apparent signal-to-noise ratio at the LOQ must be at least 5:1. If linear reg. is used, r≥0.995. If using internal standardization, relative standard deviation (RSD) ≤15%.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate.	Laboratory Analyst	8330B Rev 5
Thermo ICAP 6500	SW-846 6010C	Initial calibration prior to sample analysis. See Worksheet 28.2 for details.	Initial calibration for all analytes (ICAL): Three standards and a calibration blank; acceptance criteria; r ≥0.995	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Laboratory Analyst	6230 Rev 4 6150B-600 Rev2
AA digestion block	SW-846 7470A	Initial calibration prior to sample analysis. See Worksheet 28.10 for details.	Initial calibration for all analytes (ICAL) Minimum 5 standards and a calibration blank with linear least squares regression: R≥0.995.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Laboratory Analyst	6120B Rev. 8
Dionex DX-120	SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB	Initial calibration prior to sample analysis as needed. See Worksheet 28.7 for details.	ICAL r≥0.995.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Laboratory Analyst	CC-IC Rev 5
Gas Chromatograph (GC)/Mass Spectrometer (MS)	SW-846 8270C	ICAL prior to sample analysis for each solvent and every 12 hour shift. See Worksheets 28.8 and 28.9 for details.	Average response factor (RF) for SPCCs: SVOCs ≥ 0.050. RSD for RFs for CCCs: SVOCs—RSD≤30%and one option below; Option 1: RSD for each analyte ≤15% Option 2: linear least squares regression r ≥0.995 Option 3: nonlinear regression - coefficient of determination (COD) r2 ≥0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.	Laboratory Analyst	8270 Rev 9 and 8270 Rev. 3

SAP Worksheet #24 - Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
Gas Chromatograph (GC)/Electron Capture Detector (ECD)	SW-846 8082A	ICAL prior to sample analysis for each solvent and every 12 hour shift. See Worksheet 28.3 for details.	Minimum five-point initial calibration (ICAL) for all analytes. One of the options below: Option 1: RSD for each analyte ≤ 20%; Option 2: linear least squares regression: r ≥ 0.995; Option 3: nonlinear regression: coefficient of determination (COD) r2 ≥ 0.99 (6 points shall be used for second order; 7 points shall be used for third order).	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin. Quantitation for multi-component analytes such as Aroclors or PCBs must be performed using a 5-point calibration. Results may not be quantitated using a single point.	Laboratory Analyst	8082A Rev 11
Discrete Flow Injection Analyzer (FIA)	SW846 7196A	Initially and as needed	Five-six (minimum of three) initial calibration. r≥ 0.995 for regression line.	Correct the problem. Repeat initial calibration.	Laboratory analyst	CC-34 CC-34B
Shimadzu Total Organic Carbon (TOC) Analyzer 5000A	Lloyd Kahn Method	Daily ICAL prior to sample analysis. See Worksheet 28.4 for Details.	Minimum of 3 standards and a calibration blank. r ≥ 0.995.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Laboratory Analyst	CC-TOC solid Rev 3
Orion pH Meter 920A	SW-846 9045D	Initial calibration prior to sample analysis. See Worksheets 28.5 and 28.6 for Details.	±0.05 pH units	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Laboratory Analyst	CC-24b Rev 3

Notes:

[1] Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #25 - Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Shimadzu LC10A	Lamp and guard column inspection. Pump maintenance.	SW-846 8330B	Leak and pressure test, guard column and lamp performance	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Replace lamp, replace guard column, tighten fittings, recalibrate, reanalyze	Laboratory section Supervisor	8330B Rev 5
Thermo ICAP 6500	Torch, nebulizer, spray chamber, autosampler, pump tubing maintenance,	SW-846 6010C	Check connections, flush lines, clean nebulizer	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Reconnect sample pathways, recalibrate, reanalyze affected samples	Laboratory Section Supervisor	6105-6000 Rev 2
Dionex DX-120	Check and change in-line filter(s). Change tubing, clean detector, change bad supports	SW-846 9056/CRREL-ECB ERDC SOP M-NC-ECB	Leak and pressure test, guard column and lamp performance	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Replace lamp, replace guard column, tighten fittings, recalibrate, reanalyze	Laboratory section Supervisor	CC-IC Rev 5
GC/MS	Replace/clean ion source, clean injector, replace injector liner, replace/clip capillary column, flush/replace tubing on purge and trap, replace trap	SW-846 8270C	Ion source, injector liner, column, column flow,	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Repeat maintenance activity or remove from service	Laboratory Section Supervisor	5280B Rev 9

SAP Worksheet #25 Analytical Instruments and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
GC	Replace/clean detector, clean injector, replace injector liner, replace/clip capillary column, replace septa, check flow rates, check autosampler	SW-846 8082A	Detector, injector liner, column, column flow, autosampler	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Repeat maintenance activity or remove from service	Laboratory Section Supervisor	8082A Rev 11
TOC Analyzer	Check autosampler, replace syringe, replace o-rings, clean/replace catalyst, replace tubing, clean sample boat		Tubing, sample boat(s) o-rings, syringe, catalyst	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Repeat maintenance activity or remove from service	Laboratory Section Supervisor	CC-IC Rev5
Lachat QuickChem 8000	Clean autosampler, clean	SW-846 7196A	Detector, autosampler, pump, manifolds, valves	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Repeat maintenance activity or remove from service	Laboratory Section Supervisor	CC-34
Shimadzu TOC Analyzer 5000A	IR tube maintenance	Lloyd Kahn Method	Check connections, clean IR tube	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Clean out IR tube, check humidifier, recalibrate, reanalyze	Laboratory Analyst	CC-TOC solid Rev 3
Discrete FIA	Colorimetric detector maintenance	SW-846 7196A	Check Detector, check autosampler pump manifold valves	As needed	Passing Calibration	Repeat maintenance activity	Laboratory analyst	CC-34
AA digestion block	Pump tubing, absorption cell, and lens cleaning.	SW-846 7470A	Check connections, flush sample lines	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Reconnect sample pathways, recalibrate, reanalyze affected samples	Laboratory Analyst	6120B Rev. 8

SAP Worksheet #25 Analytical Instruments and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
Orion pH Meter 920A	Probe and solution inspection	SW-846 9045D	Check buffer and probe solutions	Frequency determined by instrument remaining in calibration and free of interference	Passing calibration	Remake or purchase new buffer standards, replace probe solutions, reanalyze	Laboratory Analyst	CC-24b Rev 3

Notes

[1] Laboratory Standard Operating Procedures are subject to revision and updates during duration of the project, lab will use the most current revision of the SOP at the time of analysis. Any changes in the lab SOP will be submitted to the USACE and Ohio EPA in a Field Change Notice for review and approval prior to implementation of the changes in the SOP.

SAP Worksheet #26 - Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Technician or Project Chemist / Shaw
Sample Packaging (Personnel/Organization): Field Technician or Project Chemist / Shaw
Coordination of Shipment (Personnel/Organization): Project Chemist / Shaw
Type of Shipment/Carrier: Federal Express or United Parcel Service—Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receipt Technicians for all labs with oversight from Eric Korthals, Project Manager, CT Laboratories, Inc.
Sample Custody and Storage (Personnel/Organization): Sample Management Technicians for all labs with oversight from Eric Korthals, Project Manager, CT Laboratories, Inc.
Sample Preparation (Personnel/Organization): Sample Prep Technicians for all labs with oversight from Eric Korthals, Project Manager, CT Laboratories, Inc.
Sample Determinative Analysis (Personnel/Organization): Sample Analysts for all labs with oversight from laboratory supervisors and Eric Korthals, Project Manager, CT Laboratories, Inc.
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): minimum 30 days after final report sent to Shaw
Sample Extract/Digest Storage (No. of days from extraction/digestion): minimum 30 days after final report sent to Shaw
Biological Sample Storage (No. of days from sample collection): Not Required, No biological samples
SAMPLE DISPOSAL
Personnel/Organization: Sample Management Technicians, with oversight from Eric Korthals, Project Manager, CT Laboratories, Inc.
Number of Days from Analysis: minimum 30 days after final report sent to the Shaw

SAP Worksheet #27 - Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Sample custody can be defined as physical possession of samples, having samples within visual range, or having samples located in a restricted access area. Sample possession during all sampling efforts must be traceable from the time of collection until the results are verified and reported. The sample custody procedures provide a mechanism for documentation of all information related to sample collection and handling. The primary piece of documentation to ensure sample custody is the Chain of Custody (COC) Form. Shaw personnel are responsible for providing evidence of sample custody from the time of collection until the laboratory receives the samples. The laboratory will be able to provide documentation of sample custody from that point to sample disposal.

As part of appropriate documentation, all sample bottles will be adequately labeled. The label will present sample identification and collection information. It will be preprinted from the sample tracking system or completed with indelible ink. At a minimum, all sample labels will include the following sample information:

- Field sample location and unique sample identifier.
- Project name and number.
- Analysis requested for each bottle.
- Method of preservation for each bottle.
- Date and time of collection.
- Initials of sample technician.

Transfer of custody and shipping procedures will include:

- The Shaw PM instructing sampling team personnel in the proper COC procedures before sampling begins.
- A COC entry made in the field for each sample. This document will accompany the samples in shipment, and a copy will be maintained at the site for placement in the project files at the conclusion of field activities. The custody of individual sample containers will be documented by recording each sample identification number and the number of bottles on the appropriate COC form.
- COC records initiated in the field will be placed in a plastic bag and taped to the underside of the top of the shipping cooler used for sample transport.
- Each time responsibility for custody of the sample changes, the new custodian will sign and date the record.
- All coolers must be secured at the site with two custody seals prior to transport. Custody seals should be signed and dated by the person relinquishing custody of the samples being shipped. They should be placed over the opening of each cooler so that the cooler cannot be opened without breaking the seal.
- A copy of the waybill will be added to the project file and a copy provided in the RI report.

Samples packaging and shipment: Samples that are collected for off-site laboratory analysis that require overnight shipment will be generally prepared by:

- Securely wrapping and taping each collected bottle in bubble wrap (or other similar shock-absorbing material).
- A temperature blank will be included in each cooler. The temperature will be recorded upon receipt at the laboratory to verify sample temperatures during transport.
- At least three sides of the container must be wrapped or surrounded with material when placing the samples into the shipping cooler. Adequate ice will be placed in doubled sealed bags and added to the cooler around and over the top of the sample containers to form a cooling layer to help ensure proper preservation during shipment.
- Samples should be precooled to the desired temperature prior to packing for shipment.
- Temperature blanks are Nalgene® bottles containing water that will be included in each sample cooler.
- Completed and signed COCs will be placed into the cooler in a protective resealable plastic bag and taped to the underside of the cooler lid. A minimum of 2 custody seals will be applied across the opening of the cooler and the lid secured by wrapping the cooler with clear plastic packing tape.
- The cooler will then be ready for shipment according to the methods required by the overnight delivery service. At a minimum, the laboratory address, telephone number, and contact name should be included on the original air bill and, if multiple packages are sent, on each sample cooler.

SAP Worksheet #27 - Sample Custody Requirements Table (continued)

Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):
All samples to be analyzed by the fixed-base laboratory will be shipped via overnight courier service. Upon receipt, per the attached Laboratory SOP, a representative of the laboratory shall check the integrity of the custody seals, then locate, sign, and date the COC. The temperature will be recorded to verify the sample temperatures during transport. The laboratory is responsible for verifying that the COC and containers are in agreement. The COC, a Cooler Receipt Form, and information regarding any discrepancies between the COC and bottle labels will be faxed to the Shaw Project Chemist prior to preparation for analysis. The Laboratory Information Management System will provide evidence of sample custody from receipt by the laboratory until appropriate disposal (see Worksheet 26 and laboratory SOPs).

Sample Identification Procedures:
A sample numbering system will be utilized in the field to uniquely identify each sample collected at RVAAP. The sample number will be traceable to the MRS, location, and depth (where applicable). The sample identification and description will be recorded by the MC Sampling Lead or representative in the sample collection logs.

Sampling Nomenclature: XXXmm-NNN(n)-####-tt

Where:

XXX = Area Designator	EBG = Erie Burning Grounds FBQ = Fuze and Booster Quarry 40F = 40mm Firing Range SCD = Sand Creek Dump BDT = Block D Igloo–TD WW4 = Water Works #4 Dump GR8 = Group 8 IDW = Investigative Derived Waste
mm = Sample Location Type	sb = soil boring/subsurface soil location ss = surface soil location sd = sediment sample location sw = surface water location wc = waste characterization
NNN = Sequential Sample Location Number	Unique, sequential number of each sample location beginning with the number following from the last number used from previous investigation stations and extending into any subsequent investigative phases (i.e., 001-999). Shaw will coordinate the next available sample location number at each MRS with the REIMS administrator.
(n) = special identifier	Option use (as needed) to identify special sample matrices or sample location characteristics (e.g., m = incremental sample, d = discrete sample)
#### = Sequential Sample Number	Unique, sequential number for each sample beginning with last sampling location, specific to each MRS, and extending into subsequent investigative phases (i.e., 0001-9999).
tt = Sample Type	so = soil sample sd = sediment sample sw = surface water sample fb = field blank er = equipment rinsate tb = trip blank

SAP Worksheet #27 - Sample Custody Requirements Table (continued)

Chain of Custody Procedures:

- Project Name will be identified on the COC form.
- Project Number will be identified on the COC form.
- Shaw contact information will be listed on the COC form. This information should include Shaw PM; Shaw Project Chemist; and Shaw address, telephone numbers, and facsimile number.
- Analysis and required analytical methods should be listed on the COC form (refer to Worksheet 19).
- Required turnaround time and report format will be listed on the COC form.
- Each sample should be listed on the COC form using the sampling nomenclature listed above, sample description, date of sampling, time of sampling, and number of containers being submitted to the laboratory.
- Sampler will sign and relinquish COC form, and dates and times of relinquishment will be included.

SAP Worksheet #27 - Sample Custody Requirements Table (continued)

Example Field Log Sheet

Shaw® Shaw Environmental & Infrastructure, Inc.

Shaw Project Number: _____ **Site:** _____

Item Number: _____

Field Sample Identification Number: _____
Date Sample: _____ (Month/Date/Year)
Time Sample: _____ (Military Time)
Sample Depth: _____ (Ft/bgs)

Sample Location:
☐ Wall of Excavation ☐ Floor of Excavation ☐ Well ☐ Other (list):_____
Sample Matrix:
☐ Soil ☐ Sediment ☐ Water ☐ Tissue ☐ Air
Physical Description of the field sample: _____
_____

Sampling Conditions:
☐ Rain ☐ Snow ☐ Extreme Heat ☐ Extreme Cold ☐ Other (list):_____
Temperature: _____°F

Sample Collection Tools:
☐ Trowel ☐ Pump ☐ Other (list): _____

Sample Collection Process:
☐ Discrete Grab ☐ Composite_____ (Describe Composite Method used example: 5 point)

Is Sample a Field Quality Control Sample?:
☐ **Field Duplicate Sample** (Typically, duplicates are collected one per ten field samples check you site FSAP or QAPP for Frequency) Duplicate or replicate samples are defined as a sample collected from the same sample point or location)
☐ If a Field Duplicate Sample list the Sample Identification of the duplicated sample: _____.
☐ **Field Blank** (Defined as a blank sample exposed to the sampling conditions at the site and transported to the laboratory and treated as an environmental sample).
Was Field Blank collected using laboratory grade deionized water? ☐ YES ☐ NO (if no, note source of water :_____)
☐ **Equipment Blank** (Defined as sample created by pouring water over or through decontaminated field sampling equipment that is considered ready to collect or process an additional sample.)
Was Equipment Blank collected using laboratory grade deionized water? ☐ YES ☐ NO (if no, note source of water :_____) Equipment blank collected following field sample number:_____.
☐ **Trip Blank** (Defined as a sample prepared by the laboratory using laboratory grade deionized water and shipped with the sample containers to the site and returned to the laboratory with the field samples for analysis. Trip blanks have not been exposed to the environment or the sampling procedures and should be carried with the sample bottles in the field. Trip blanks are only necessary when collecting volatile samples.

Sample Control:
Field Custody maintained throughout the sampling process?
☐ Yes ☐ No (if no list why):_____
Field sample listed on Chain-of-Custody Record?
☐ Yes ☐ No (if no list why):_____
All required analysis and analytical methods for this field sample have been listed on the Chain-of-Custody?
☐ Yes ☐ No (if no list why):_____
Analytical requirements for this field sample have been reviewed against the site FSAP, Workplan, or QAPP?
☐ Yes ☐ No (if no list why):_____

Comments:_____
_____
_____

Signature of Sampler: _____ **Name Printed:** _____

QC Reviewed
Initials:_____ Date :_____(Month/Day/Year)
*It is not necessary for every field logbook to be quality control checked.

Shaw® Shaw Environmental & Infrastructure, Inc.

Site Name: _____ **Shaw Project Number:**_____

Sample Number: _____	**Sample Location Sketch**
Date Sampled: _____ (Month/Day/Year)	
Time Sampled: _____ (Military Time)	
Laboratory Analysis Requested: (Methods Must be Listed on the Chain-of-Custody)	
☐ Volatiles ☐ Pesticides ☐ Semivolatiles ☐ PCBs	
☐ Metals ☐ TPH DRO ☐ Cyanide ☐ TPH GRO	
☐ Full TCLP ☐ Explosives ☐ RCI	
Other List:_____	
Sample Type: ☐ Investigative ☐ Confirmation ☐ IDW	
Analytical Laboratory: _____	**Photograph Log Number:** _____
GPS Coordinates: _____(If Available)	**Scale of Sample Sketch:** **Each Grid Equals** _____ ft^2
PID:	**Calibration Date:**_____(Month/Day/Year)
O2/LEL:	**Calibration Date:**_____(Month/Day/Year)
Sketch Legend:	
= Road ¦ Boundary of Excavation | Wall × Sample Point Ø Well Tree	
Equipment Decontamination Technique:	
Comments:	
Sampler Name:_____ (Printed)_____ **Date** (Month/Date/Year)	

SAP Worksheet #27 - Sample Custody Requirements Table (continued)
Example Chain of Custody Form

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Company:
Project Contact:
Telephone:
Project Name:
Project #:
Location:
Sampled By:

CT LABORATORIES
1230 Lange Court, Baraboo, WI 53913
608-356-2760 Fax 608-356-2766
www.ctlaboratories.com

Lab Use Only
Place Header Sticker Here:

Program:
QSM RCRA SDWA NPDES
Solid Waste Other _____

PO #

Report To:
EMAIL:
Company:
Address:

Invoice To:*
EMAIL:
Company:
Address:

**Client Special Instructions*

**Matrix:*
GW - groundwater SW - surface water WW - wastewater DW - drinking water
S - soil/sediment SL - sludge A - air M - misc/waste

**Turnaround Time*
Normal RUSH*
Date Needed:
_____
Rush analysis requires prior CT Laboratories' approval
Surcharges:
24 hr 200%
2-3 days 100%
4-9 days 50%

Collection Date	Collection Time	Matrix	Grab/ Comp	Sample ID Description	Filtered? Y/N	ANALYSES REQUESTED (Fill in Spaces with Bottles per Test)	Total # Containers	Designated MS/MSD	CT Lab ID # (Lab use only)

Relinquished By:	Date/Time	Received By:	Date/Time	*Lab Use Only*
Received by:	Date/Time	Received for Laboratory by:	Date/Time	Ice Present Yes No Temperature _____ Cooler # _____

SAP Worksheet #27 - Sample Custody Requirements Table (continued)
Example Chain of Custody Form

CT Laboratories Terms and Conditions

Where a purchaser (Client) places an order for laboratory, consulting or sampling services from CT Laboratories (CTL), CTL shall provide the ordered services pursuant to these Terms and Conditions, and the related Quotation, or as agreed in a negotiated contract. In the absence of a written agreement to the contrary, the Order constitutes an acceptance by the Client of CTL's offer to do business under these Terms and Conditions, and an agreement to be bound by these Terms and Conditions. No contrary or additional terms and conditions expressed in a Client's document shall be deemed to become a part of the contract created upon acceptance of these Terms and Conditions, unless accepted by CTL in advance of the start of the project and in writing.

1. ORDERS AND RECEIPT OF SAMPLES

1.1 The Client may place the Order (i.e., specify a Scope of Work) either by submitting a purchase order to CTL in writing, by telephone (confirmed in writing) or by negotiated contract. Whichever option the Client selects for placing the Order, the Order shall not be valid unless it contains sufficient specification to enable CTL to carry out the Client's requirements. In particular, samples must be accompanied by: a) adequate instruction on type of analysis requested, and b) complete written disclosure of the known or suspected presence of any hazardous substances, as defined by applicable federal or state law. Where any samples which were not accompanied by the required disclosure, cause interruptions in the lab's ability to process work due to contamination of instruments or work areas, the Client will be responsible for the costs of clean up and recovery.
1.2 The Client shall provide one week's advance notice of the sample delivery schedule, or any changes to the schedule, whenever possible. Upon timely delivery of samples, CTL will use its best efforts to meet mutually agreed turnaround times. All turnaround times will be calculated from the point in time when CTL has determined that it can proceed with defined work following receipt, inspection of samples, and resolution of any discrepancies in Chain-of-Custody forms and project guidance regarding work to be done (Sample Acceptance). In the event of any changes in the sample delivery schedule by the Client, prior to Sample Acceptance, CTL reserves the right to modify its turnaround time commitment, to change the date upon which CTL will accept samples, or refuse Sample Acceptance for the affected samples.
1.3 CTL reserves the right, exercisable at any time, to refuse or revoke Sample Acceptance for any sample which in the sole judgment of CTL: a) is of unsuitable volume; b) may pose a risk or become unsuitable for handling, transport, or processing for any health, safety, environmental or other reason, whether or not due to the presence in the sample of any hazardous substance and whether or not such presence has been disclosed to CTL by the Client; or c) holding times cannot be met, due to passage of more than 48 hours from the time of sampling or 1/2 the holding time for the requested test, whichever is less.
1.4 Prior to Sample Acceptance, the entire risk of loss or damage to samples remains with the Client. In no event will CTL have any responsibility or liability for the action or inaction of any carrier shipping or delivering any sample to or from CTL's premises. Client is responsible to assure that any sample containing any hazardous substance which is to be delivered to CTL's premises will be packaged, labeled, transported and delivered properly and in accordance with applicable laws.

2. PAYMENT TERMS

2.1 Services performed by CTL will be in accordance with prices quoted and later confirmed in writing or as stated in the Price Schedule. Invoices may be submitted to Client upon completion of any sample delivery group. Payment in advance is required for all Clients except those whose credit has been established with CTL. For Clients with approved credit, payment terms are net 30 days from the date of invoice by CTL. All overdue payments are subject to an additional interest and service charge of one and one-half percent (1.5%) (or the maximum rate permissible by law, whichever is lesser) per month or portion thereof from the due date until the date of payment. All fees are charged or billed directly to the Client. The billing of a third party will not be accepted without a statement, signed by the third party that acknowledges and accepts payment responsibility. CTL may suspend work and withhold delivery of data under this order at any time in the event Client fails to make timely payment of its invoices. Client shall be responsible for all costs and expenses of collection including reasonable attorney's fees. CTL reserves the right to refuse to proceed with work at any time based upon an unfavorable Client credit report.

3. CHANGE ORDERS, TERMINATION

3.1 Changes to the Scope of Work, price, or result delivery date may be initiated by CTL after Sample Acceptance due to any condition which conflicts with analytical, QA or other protocols warranted in these Terms and Conditions. CTL will not proceed with such changes until an agreement with the Client is reached on the amount of any cost, schedule change or technical change to the Scope of Work, and such agreement is documented in writing.
3.2 Changes to the Scope of Work, including but not limited to increasing or decreasing the work, changing test and analysis specification or acceleration in the performance of the work may be initiated by the Client after sample acceptance. Such a change will be documented in writing and may result in a change in cost and turnaround time commitment. CTL's acceptance of such changes is contingent upon technical feasibility and operational capacity.
3.3 Suspension or termination of all or any part of the work may be initiated by the Client. CTL will be compensated consistent with Section 2 of these Terms and Conditions. CTL will complete all work in progress and be paid in full for all work completed.

4. WARRANTIES AND LIABILITY

4.1 Where applicable, CTL will use analytical methodologies which are in substantial conformity with published test methods. CTL has implemented these methods in its Laboratory Quality Manuals and referenced Standard Operating Procedures and where the nature or composition of the sample requires it, CTL reserves the right to deviate from these methodologies as necessary or appropriate, based on the reasonable judgment of CTL, which deviations, if any, will be made on a basis consistent with recognized standards of the industry and/or CTL's Laboratory Quality Manuals. Client may request that CTL perform according to a mutually agreed Quality Assurance Project Plan (QAPP). In the event that samples arrive prior to agreement on a QAPP, CTL will proceed with analyses under its standard Quality Manuals then in effect, and CTL will not be responsible for any resampling or other charges if work must be repeated to comply with a subsequently finalized QAPP.
4.2 CTL shall start preparation and/or analysis within holding times provided that Sample Acceptance occurs within 48 hours of sampling or 1/2 of the holding time for the test, whichever is less. Where resolution of inconsistencies leading to Sample Acceptance does not occur within this period, CTL will use its best efforts to meet holding times and will proceed with the work provided that, in CTL's judgment, the chain-of-custody or definition of the Scope of Work provide sufficient guidance. Reanalysis of samples to comply with CTL's Quality Manuals will be deemed to have met holding times provided the initial analysis was performed within the applicable holding time. Where reanalysis demonstrates that sample matrix interference is the cause of failure to meet any Quality Manual requirements, the warranty will be deemed to have been met.
4.3 CTL warrants that it possesses and maintains all licenses and certifications which are required to perform services under these Terms and Conditions provided that such requirements are specified in writing to CTL prior to Sample Acceptance. CTL will notify the Client in writing of any decertification or revocation of any license, or notice of either, which affects work in progress.
4.4 The warranty obligations set forth in Sections 4.1, 4.2 and 4.3 are the sole and exclusive warranties given by CTL in connection with any services performed by CTL or any Results generated from such services, and CTL gives and makes NO OTHER REPRESENTATION OR WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. No representative of CTL is authorized to give or make any other representation or warranty or modify this warranty in any way.
4.5 Client's sole and exclusive remedy for the breach of warranty in connection with any services performed by CTL, will be limited to repeating any services performed, contingent on the Client's providing, at the request of CTL and at the Client's expense, additional sample(s) if necessary. Any reanalysis requested by the Client generating Results consistent with the original Results will be at the Client's expense. If resampling is necessary, CTL's liability for resampling costs will be limited to actual cost or one hundred or one hundred fifty dollars ($150) per sample, whichever is less.
4.6 CTL's liability for any and all causes of action arising hereunder, whether based in contract, tort, warranty, negligence or otherwise, shall be limited to the lesser amount of compensation for the services performed or $100,000. All claims, including those for negligence, shall be deemed waived unless suit thereon is filed within one year after CTL's completion of the services. Under no circumstances, whether arising in contract, tort (including negligence), or otherwise, shall CTL be responsible for loss of use, loss of profits, or for any special, indirect, incidental or consequential damages occasioned by the services performed or by application or use of the reports prepared.
4.7 In no event shall CTL have any responsibility or liability to the Client for any failure or delay in performance by CTL which results, directly or indirectly, in whole or in part, from any cause or circumstance beyond the reasonable control of CTL. Such causes and circumstances shall include, but not be limited to, acts of God, acts of Client, acts or orders of any governmental authority, strikes or other labor disputes, natural disasters, accidents, wars, civil disturbances, equipment breakdown, matrix interference or unknown highly contaminated samples that impact instrument operation, unavailability of supplies from usual suppliers, difficulties or delays in transportation, mail or delivery services, or any other cause beyond CTL's reasonable control.

5. RESULTS, WORK PRODUCT

5.1 Data or information provided to CTL or generated by services performed under this agreement shall only become the property of the Client upon receipt in full by CTL of payment for the whole Order. Ownership of any analytical method, QA/QC protocols, software programs or equipment developed by CTL for performance of work will be retained by CTL, and Client shall not disclose such information to any third party.
5.2 Data and sample materials provided by Client or at Client's request, and the result obtained by CTL shall be held in confidence (unless such information is generally available to the public or is in the public domain or Client has failed to pay CTL for all services rendered or is otherwise in breach of these Terms and Conditions), subject to any disclosure required by law or legal process.
5.3 Should the Results delivered by CTL be used by the Client or Client's client, even though subsequently determined not to meet the warranties described in these Terms and Conditions, then the compensation will be adjusted based upon mutual agreement. In no case shall the Client unreasonably withhold CTL's right to independently defend its data.
5.4 CTL reserves the right to subcontract services ordered by the Client to another laboratory or laboratories, if, in CTL's sole judgment, it is reasonably necessary, appropriate or advisable to do so, and with the Client's permission. CTL will in no way be liable for any subcontracted services and all applicable warranties, guarantees and insurance are those of the subcontracted laboratory.
5.5 CTL shall dispose of the Client's samples 30 days after the analytical report is issued, unless instructed to store them for an alternate period of time or to return such samples to the Client, in a manner consistent with U.S. Environmental Protection Agency regulations or other applicable Federal, state or local requirements. Any samples for projects that are canceled or not accepted, or for which return was requested, will be returned to the Client at their own expense. CTL reserves the right to return to the Client any sample or unused portion of a sample that is not within CTL's permitted capability or the capabilities of CTL's designated waste disposal vendor(s).
5.6 Unless a different time period is agreed to in any order under these Terms and Conditions, CTL agrees to retain all records for five (5) years.
5.7 In the event that CTL is required to respond to legal process related to services for Client, Client agrees to reimburse CTL for hourly charges for personnel involved in the response and attorney fees reasonably incurred in obtaining advice concerning the response, preparation to testify, and appearances related to the legal process, travel and all reasonable expenses associated with the litigation.

6. INSURANCE

6.1 CTL shall maintain in force during the performance of services under these Terms and Conditions, Workers' Compensation and Employer's Liability Insurance in accordance with the laws of the states having jurisdiction over CTL's employees who are engaged in the performance of the work. CTL shall also maintain during such period, Comprehensive General and Contractual Liability (limit of $2,000,000 per occurrence/ aggregate), Comprehensive Automobile Liability, owned and hired, ($1,000,000 combined single limit), and Professional/Pollution Liability Insurance (limit of $5,000,000 per occurrence/aggregate). Any Client required changes to these limits or conditions may result in a change in cost to the Client.

7. AUDIT

7.1 Upon prior notice to CTL, the Client may audit and inspect CTL's records and accounts covering reimbursable costs related to work done for the Client, for a period of one (1) year after completion of the work. The purpose of any such audit shall be only for verification of such costs, and CTL shall not be required to provide access to cost records where prices are expressed as fixed fees or published unit prices.

SAP Worksheet #27 - Sample Custody Requirements Table
Example Custody Seal

SAP Worksheet #27 - Sample Custody Requirements Table (continued)
Example Laboratory Sample Receipt Checklist

CT LABORATORIES
delivering more than data from your environmental analyses

Sample Condition Report

Folder #:
Client:

Project Name:
Project #:

Coolers:
Custody Seals Present :

Seal Intact?
Ship Method:
Adequate Packaging:

Notes:

Print Date / Time:
Received Date / Time / By:

Log-In Date / Time / By:
PM:

Temperature: On Ice:
COC Present:? Complete?

Numbers:
Tracking Number:
Temp Blank Enclosed?

Sample ID / Description	Container	# Cont.	Condition Code	Filt.?	Tests

Condition Code Condition Description

SAP Worksheet #28.1 - QC Samples Table

Matrix	Surface Water, Sediment, Soil, Aqueous IDW, and Solid IDW
Analytical Group	Explosives
Concentration Level	Low
Analytical Method / SOP Reference	Aq: 3535A/8330B So: 8330B Aqueous: 8330B Rev 5 Solids: 8330B Rev 5
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ level of quantitation (LOQ) Project QLs for all target compounds are specified in: Worksheet 15.1 for explosives for solids Worksheet 15.2 for explosives for aqueous	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel / Shaw Chemist / Data Validator	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the LOQ and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2 LOQ). Apply J-flag to sample and duplicate pair.	Field Personnel / Shaw Chemist/Data Validator	Field Precision	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	Initial calibration prior to sample analysis as needed (see CCV passing criteria below)	Min. of 5 calibration standards with the lowest standard concentration at or below the LOQ. Once calibration curve or line is generated, the lowest calibration standard must be reanalyzed. The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear reg. is used, ≥0.995. If using internal standardization, RSD≤15%.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.1 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Retention time window position establishment and verification for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift for position establishment. Each calibration verification standard for retention time verification.	Position shall be set using the midpoint standard of the calibration curve or the value in the CCV run at the beginning of the analytical shift. Analyte shall be within established window for each calibration verification. Each analyte shall be within established window.	Correct problem, and then reanalyze all samples analyzed since the last acceptable retention time check. If they fail, redo ICAL and reset retention time window. Flagging criteria are not appropriate for initial verification. For CCV, apply a Q-flag to all results for analytes outside the established window. No samples shall be run without a verified retention time window at the initial verification.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Immediately following ICAL.	All analyte(s) and surrogates within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Retention time (RT) window width calculated for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change)	RT width is ± 3 times standard deviation for each analyte RT from 72-hour study.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Method Blank (MB) and Grinding Blank (GB)	MB: One per preparatory batch per matrix GB: Between each sample (for solid matrix only)	No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct the problem. Any sample associated with a blank that fail these criteria checks shall be reprocessed in a subsequent preparation batch, except when the sample analysis resulted in a nondetect. If no sample volume remains for reprocessing, the results shall be reported with appropriate data qualifying code “B.”	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.1 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	A solid reference material containing all reported analytes must be prepared (e.g., ground and subsampled) and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's MQOs. QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation only, it is therefore taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits. QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous %Recovery = (Calculated Value / True Value) *100%	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Matrix Spike Duplicates (MSD) or Sample Duplicates (SD)	One MSD or SD per preparatory batch per matrix	For matrix evaluation only, it is therefore taken post grinding from same ground sample as parent subsample is taken. Percent recovery must meet LCS limits and relative percent difference (RPD) < 20%. QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for explosives solids Worksheet 15.2 for explosives aqueous %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.1 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Surrogate Spikes	All field and QC samples	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. QC acceptance criteria for all target compounds as specified in: Worksheet 15.1 for Explosives solids Worksheet 15.2 for Explosives aqueous %Recovery = (Calculated Value / True Value) *100%	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met. Alternative surrogates are recommended when there is obvious chromatographic interference.	Analyst/Prep analyst	Accuracy (Individual sample preparation efficiency control)	See Method / SOP QC Acceptance Limits
Quantitation Verification and Confirmation	When target analytes are detected on the primary column using the UV Detector (HPLC) at concentrations exceeding the Limit of Detection (LOD). Confirmation analysis is not needed if LC/MS or LC/MS/MS was used for the primary analysis.	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Report from both columns. If there is a > 40% RPD between the two column results, data must be J-flagged accordingly. Secondary column—must be capable of resolving (separating) all of the analytes of interest and must have a different retention time order relative to the primary column. Any HPLC column used for confirmation analysis must be able to resolve and quantify all project analytes. Detection by HPLC UV, LC/MS or LC/MS/MS. Calibration and calibration verification acceptance criteria is the same as for the primary analysis.	Analyst	Representativeness and Precision	See Method / SOP QC Acceptance Limits
Soil sample triplicate	At the sub-sampling step, one sample per batch. Cannot be performed on any type of blank sample.	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the quantification range of the method. The RSD for results above the RL must not exceed 20%.	Corrective action must be taken if this criterion is not met (e.g., the grinding process should be investigated to ensure that the samples are being reduced to a sufficiently small particle size). Apply J-flag if corrective action does not solve problem and no sample available.	Analyst	Representativeness and Precision	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results between LOD and LOQ	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.2 - QC Samples Table

Matrix	Surface water, Sediment, Soil, Aqueous IDW, and Solids IDW
Analytical Group	ICP and TCLP ICP Metals
Concentration Level	Low
Analytical Method / SOP Reference	Aq: 6010C and 1311/6010C So: 6010C and 1311/6010C Solids: 6230B Rev 4 & 6105B-6000 Rev 2 Aqueous: 6225B Rev 8 & 6105B-6000 Rev 2
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ Level of quantitation (LOQ) Project QLs for all target compounds are specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Not Applicable for TCLP ICP Metals	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel/ Shaw Chemist	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Not Applicable for TCLP ICP Metals	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the LOQ and the remaining pair is nondetect, then the data will be qualified as estimated “J” or rejected “R” depending upon the severity (i.e., >2 LOQ).	Field Personnel/ Shaw Chemist	Field Precision	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	Initial calibration prior to sample analysis.	Initial calibration for all analytes (ICAL): Minimum one high standard and a calibration blank; No acceptance criteria unless more than one standard is used, in which case r ≥0.995.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Linear dynamic range or High-level calibration check standard	Every 6 months	Within ± 10% of true value.	Not Applicable	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.2 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Low-level calibration check standard	Daily, after one-point ICAL.	Within ± 20% of true value. Low-level calibration check standard should be less than or equal to the reporting limit.	Correct problem, then reanalyze. Flagging criteria are not appropriate. No samples may be analyzed without a valid low-level calibration check standard.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	ICP: within ± 10% of true value;	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Calibration blanks	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > limit of detection (LOD).	Correct problem. Reprepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst	Laboratory Representativeness (Absence of interference/ contamination)	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Worksheet 15.7 for TCLP ICP metals aqueous and Solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct the problem. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.2 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Worksheet 15.7 for TCLP ICP metals aqueous and Solids %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS. QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Not Applicable for TCLP ICP Metals %Recovery = (Calculated Value − Sample Value / True Value) *100%	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional QC tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Matrix Spike Duplicates (MSD) or Sample Duplicates	One per preparatory batch per matrix	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.3 for ICP metals solids Worksheet 15.4 for ICP metals aqueous Not Applicable for TCLP ICP Metals %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Interference check solutions (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all nonspiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples. If corrective action fails, apply Q-flag to all results for specific analyte(s) in all samples associated with the ICS.	Analyst	Accuracy	See Method / SOP QC Acceptance Limits
Serial Dilution Test	Each preparatory batch	Five-fold dilution must agree within ± 10% of the original measurement. Only applicable for samples with concentrations >50x LOQ for ICP.	Perform postdigestion spike (PDS) addition. Flagging criteria are not appropriate.	Analyst	Precision (field samples)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.2 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Postdigestion spike (PDS) addition	When dilution test fails or analyte concentration in all samples <50x MDL	Recovery within 75-125% of expected result. The spike addition should produce a level between 10x to 100x LOQ.	Run all associated samples in the preparatory batch by method of standard additions (MSA). For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	See Method / SOP QC Acceptance Limits
Method of standard additions (MSA) or Internal Standard calibration	When matrix interference is confirmed.	Document use of MSA in the case narrative.	Not Applicable	Analyst	Accuracy	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.3 - QC Samples Table

Matrix	Sediment & Soil
Analytical Group	PCBs
Concentration Level	Low
Analytical Method / SOP Reference	Aq: 3510C/8082A So: 3546/8082A Aqueous: 8082A Rev 11 Solids: 8082A Rev 11
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ LOQ. Project QLs for all target compounds are specified in: Worksheet 15.12 for PCBs for solids	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel / Shaw Chemist / Data Validator	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCBs for solids	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the limits of quantitation (LOQ) and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2LOQ). Apply J-flag to sample and duplicate pair.	Field Personnel / Shaw Chemist/Data Validator	Field Precision	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	ICAL prior to sample analysis for each solvent and every 12 hour shift.	Minimum five-point initial calibration (ICAL) for all analytes. One of the options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression: r≥ 0.995; Option 3: nonlinear regression: coefficient of determination (COD) r2 ≥ 0.99 (6 points shall be used for second order; 7 points shall be used for third order).	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin. Quantitation for multi-component analytes such as chlordane and toxaphene must be performed using a 5-point calibration. Results may not be quantitated using a single point.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.3 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Retention time (RT) window width calculated for each analyte and surrogate	At method set-up and after major maintenance (e.g., column change).	RT width is ± 3 times standard deviation for each analyte RT from a 72-hour study.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Retention time window position establishment for each analyte	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Second source calibration verification (ICV)	Immediately following ICAL.	All project analytes within established retention time windows. GC methods: All project analytes within ±15% of expected value from the ICAL.	Correct problem, rerun ICV. If that fails, repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Continuing calibration verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes within established retention time windows. GC methods: All project analytes within ±15% of expected value from the ICAL	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Retention time windows are updated per the method.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheet 15.12 for PCB solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.3 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	LCS containing all analytes to be reported with QC acceptance criterion using in-house limits (75-125% if in-house control limits are not available). In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use LCS acceptance criteria. QC acceptance criterion using in-house limits (75-125% if in-house control limits are not available). In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids %Recovery = (Calculated Value / True Value) *100%	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Matrix Spike Duplicates (MSD) or Sample Duplicates (SD)	One MSD or SD per preparatory batch per matrix	MSD: For matrix evaluation, use LCS acceptance criteria. QC acceptance criterion using in-house limits (75-125% if in-house control limits are not available). In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. MSD or sample duplicate: RPD ≤25% (between MS and MSD or sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.12 for PCB solids %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results between LOD and LOQ	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref:US EPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.4 - QC Samples Table (continued)

Matrix	Sediment & Soil
Analytical Group	Total Organic Carbon (TOC)
Concentration Level	Low
Analytical Method / SOP Reference	So: Lloyd Kahn Method Solids: CC-TOC solid Rev 3
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ LOQ. Project QLs for all target compounds are specified in: Worksheet 15.5 for TOC solids	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel/ Shaw Chemist	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the limits of quantitation (LOQ) and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e. >2 LOQ).	Field Personnel/ Shaw Chemist	Field Precision	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	Daily ICAL prior to sample analysis	Minimum of 3 standards and a calibration blank. r≥ 0.995.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Within ± 10% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.4 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Continuing calibration verification (CCV)	After every 15 field samples and at the end of the analysis sequence.	Within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. Project QLs for all target compounds are specified in: Worksheet 15.5 for TOC solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100% %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS. QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids %Recovery = (Calculated Value − Sample Value / True Value) *100%	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional QC tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.4 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Matrix spike duplicate (MSD) or sample duplicate (replicate)	One per preparatory batch per matrix	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.5 for TOC solids %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Correct problem and reanalyze sample and duplicate. Apply J-flag if sample cannot be rerun or reanalysis does not correct problem. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Results reported	Quadruplicate analysis is required.	Report the average and the range.	Not Applicable	Analyst	Precision	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.5 - QC Samples Table

Matrix	Soil
Analytical Group	pH
Concentration Level	Not Applicable
Analytical Method / SOP Reference	So: 9045D Solids: CC-24b Rev 3
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Continuing calibration verification (CCV)	Prior to sample analysis and every 10 samples.	Calibrate the meter using two points, pH 4 and pH 7 or pH 4 and pH 10. The third standard should be within ±0.05 of true value.	Correct problem, rerun calibration verification. If that fails. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery or within ±0.05 of true value. QC acceptance criteria for all target compounds as specified in: Worksheet 15.6 for pH solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Sample Duplicates (SD)	One per preparatory batch per matrix	Within ±0.1 pH units (between sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.6 for pH solids RPD = (Difference between S and SD) * 100 / (Average of S and SD)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.6 - QC Samples Table

Matrix	Aqueous and Solids IDW
Analytical Group	Total Cyanide, Sulfide, pH, and Flashpoint
Concentration Level	Low
Analytical Method / SOP Reference	So: 9013A, 9030B, 9045D, and 1030 Solids: CC-1 Rev 8, CC-Reactive Sulfide Dist Rev 0, CC-37 Rev 2, & SOP CC-24b Rev 3
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Initial Calibration (ICAL)	Daily ICAL prior to sample analysis	For cyanides and sulfides: Six standards and a calibration blank. r ≥ 0.995. For cyanides: All calibration standards must be distilled if samples are expected to contain sulfides.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Distilled standards (one high and one low) (Cyanide only)	Once per multipoint calibration.	Within ± 15% of true value. (Cyanide only)	Correct problem, then repeat distilled standards. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until distilled standards have passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Within ± 15% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL. Project QLs for all target compounds are specified in: Worksheet 15.7 for cyanide and sulfide solids NA for pH and flashpoint solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.6 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for cyanide, sulfide, pH, and ignitability solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100% %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use QC acceptance criteria specified by DoD for LCS. QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for cyanide and sulfide solids NA for pH and flashpoint solids %Recovery = (Calculated Value − Sample Value / True Value) *100%	Examine the project-specific DQOs. If the MS falls outside of DoD criteria, additional QC tests are required to evaluate matrix effects. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Matrix spike duplicate (MSD) or sample duplicate (replicate)	One per preparatory batch per matrix	MSD: For matrix evaluation use QC acceptance criteria specified by DoD for LCS. MSD or sample duplicate: RPD ≤ 20% (between MS and MSD or sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for cyanide, sulfide, pH, and ignitability solids %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Correct problem and reanalyze sample and duplicate. Apply J-flag if sample cannot be rerun or reanalysis does not correct problem. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results must be confirmed (cyanide and sulfide)	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.7 - QC Samples Table

Matrix	Surface water, Sediment, & Soil
Analytical Group	Nitrocellulose
Concentration Level	Low
Analytical Method /SOP Reference	So: 9056 / CRREL-ECB ERDC SOP M-NC-ECB Solids: CC-NC Rev 0 & CC-IC Rev 5.
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ LOQ. Project QLs for all target compounds are specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel/ Shaw Chemist	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the limits of quantitation (LOQ) and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (>2LOQ).	Field Personnel/ Shaw Chemist	Field Precision	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	Initial calibration prior to sample analysis.	Initial calibration for all analytes (ICAL) r≥0.995.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Once after each ICAL, prior to beginning a sample run.	All analytes within ± 10% of true value and retention times within appropriate windows.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.7 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Retention time (RT) window width calculated for each analyte	After method set-up and after major maintenance (e.g., column change).	RT width is ± 3 times standard deviation for each analyte RT over a 24-hour period.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Retention time window position establishment for each analyte	Once per multipoint calibration.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Midrange continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All project analytes within established retention time windows. Within ±10% of true value	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed. Retention time windows are updated per the method.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ LOQ and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project LOQs for all target compounds are specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous	Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	Laboratory in-house limits not to exceed ±50%. Control limits may be not greater than ± 3 times the standard deviation of the mean LCS recovery. QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.7 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use laboratory in-house LCS limits (not to exceed ±50%). QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous %Recovery = (Calculated Value − Sample Value / True Value) *100%	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst/Prep analyst	Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Matrix Spike Duplicates (MSD) or Sample Duplicates	MSD: One per preparatory batch per matrix Sample Duplicate: One per every 10 samples per matrix.	MSD: For matrix evaluation, use laboratory in-house LCS limits (not to exceed ± 20%). RPD ≤ 25% (between MS and MSD). Sample duplicate: %D ≤ 25% (between sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.8 for Nitrocellulose solids Worksheet 15.9 for Nitrocellulose aqueous %Recovery = (Calculated Value − Sample Value / True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	MSD: Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference. Sample Duplicate: Correct problem and reanalyze sample and duplicate. Apply J-flag if sample cannot be rerun or reanalysis does not correct problem. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (field samples)	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: CRREL-ECB ERDC SOP M-NC-ECB, V1.0 (CRREL, 2005) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.8 - QC Samples Table

Matrix	Surface water, Sediment, & Soil
Analytical Group	SVOCs
Concentration Level	Low
Analytical Method / SOP Reference	Aq: 8270C So: 8270C Aqueous: 8270C Rev 9 Solids: 8270C Rev 9
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Equipment Blank and/or Field Blank	1 per 20 field samples or per day per matrix per sampling technique	All Target Compounds <½ LOQ. Project QLs for all target compounds are specified in: Worksheet 15.10 for SVOC solids Worksheet 15.11 for SVOC aqueous	If the criterion is not met for the field blanks, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the blank contamination and usefulness of the data. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch using the 5x/10x rule.	Field Personnel / Shaw Chemist	Field Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Field Duplicate	1 per 10 field samples per matrix	QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOC solids Worksheet 15.11 for SVOC aqueous	If the criterion is not met for the field duplicates, a careful examination of the sampling techniques, sample media, and analytical procedure in conjunction with other analytical QC criteria will be conducted to identify the cause of the high RPD and the usefulness of the data. If one of the duplicate pair is detected above the limits of quantitation (LOQ) and the remaining pair is nondetect, then the data will be qualified as estimated or rejected depending upon the severity (i.e., >2LOQ).	Field Personnel/ Shaw Chemist	Field Precision	See Method / SOP QC Acceptance Limits
MS Tuning	Prior to initial calibration and every 12 hours during sample analysis	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate and problem must be corrected. No samples may be accepted without a valid tune.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.8 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Initial Calibration (ICAL)	Initial calibration prior to sample analysis. Minimum of 5 point.	Average response factor (RF) for SPCCs: SVOCs ≥ 0.050. RSD for RFs for CCCs: SVOCs—RSD≤30%and one option below; Option 1: RSD for each analyte ≤15% Option 2: linear least squares regression r ≥0.995 Option 3: nonlinear regression - coefficient of determination (COD) r^2 ≥0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Once after each initial calibration	Value of second source for all analytes within ±20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. Flagging criteria are not appropriate. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units. With each sample, the RRT shall be compared with the most recently updated RRT. If using SIM mode, at least two ions per analyte should be monitored unless confirmed in full scan.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate. Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to reestablish the retention times.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem, then repeat the breakdown check. Flagging criteria are not appropriate.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.8 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Continuing Calibration Verification (CV)	Daily, before sample analysis, and every 12 hours of analysis time	Average RF for SPCCs: SVOCs ≥ 0.050. %Difference/Drift for CCCs: SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or nonlinear calibration.)	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun CV. If that fails, repeat initial calibration. Corrective action may include reanalysis of samples. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the noncompliant IS. Flagging criteria are not appropriate for failed standards. Sample results are not acceptable without a valid IS verification.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ. Project QLs for all target compounds are specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Representativeness (Absence of interference/ contamination)	See Method / SOP QC Acceptance Limits
Laboratory Control Sample (LCS)	One LCS per preparatory batch	Contains all analytes to be reported, including surrogates. QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous %Recovery = (Calculated Value/True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.8 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Matrix Spike (MS)	One MS per preparatory batch per matrix	For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous %Recovery = (Calculated Value/True Value) *100%	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. For matrix evaluation only. If MS results are outside the LCS limits, the data shall be evaluated to determine the source of difference and to determine if there is a matrix effect or analytical error.	Analyst	Accuracy (Field Samples)	See Method / SOP QC Acceptance Limits
Matrix Spike Duplicates (MSD) or Sample Duplicates	One per preparatory batch per matrix	MSD: For matrix evaluation, use LCS acceptance criteria specified by DoD, if available. Otherwise, use in-house LCS control limits. MSD or sample duplicate: RPD ≤ 30% (between MS and MSD or sample and sample duplicate). QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous %Recovery = (Calculated Value − Sample Value/True Value) *100% RPD = (Difference between MS and MSD) * 100 / (Average of MS and MSD)	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met. The data shall be evaluated to determine the source of difference.	Analyst	Precision and Accuracy (Field Samples)	See Method / SOP QC Acceptance Limits
Surrogate Spikes	All field and QC samples	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. QC acceptance criteria for all target compounds as specified in: Worksheet 15.10 for SVOCs solids Worksheet 15.11 for SVOCs aqueous %Recovery = (Calculated Value/True Value) *100%	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met. Alternative surrogates are recommended when there is obvious chromatographic interference.	Analyst	Accuracy (Individual sample preparation efficiency control)	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results between LOD and LOQ	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.9 - QC Samples Table

Matrix	Aqueous and Solids IDW
Analytical Group	TCLP SVOCs
Concentration Level	Low
Analytical Method / SOP Reference	Aq & So: 1311/3510C/8270C Aqueous: CL-8b Rev 4. Solids: CL-8b Rev 4
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
MS Tuning	Prior to initial calibration and every 12 hours during sample analysis	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples. Flagging criteria are not appropriate and problem must be corrected. No samples may be accepted without a valid tune.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Initial Calibration (ICAL)	Initial calibration prior to sample analysis. Minimum of 5 point.	Average response factor (RF) for SPCCs: SVOCs ≥ 0.050. RSD for RFs for CCCs: SVOCs—RSD≤30%and one option below; Option 1: RSD for each analyte≤15% Option 2: linear least squares regression r≥0.995 Option 3: nonlinear regression - coefficient of determination (COD) r^2 ≥0.99 (6 points shall be used for second order, 7 points shall be used for third order)	Correct problem then repeat ICAL. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed. Calibration may not be forced through the origin.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Once after each initial calibration	Value of second source for all analytes within ±20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. Flagging criteria are not appropriate. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Retention time window position establishment for each analyte and surrogate	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	Not Applicable	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.9 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units. With each sample, the RRT shall be compared with the most recently updated RRT. If using SIM mode, at least two ions per analyte should be monitored unless confirmed in full scan.	Correct problem, then rerun ICAL. Flagging criteria are not appropriate. Laboratories may update the retention times based on the CCV to account for minor performance fluctuations or after routine system maintenance (such as column clipping). If the RRT has changed by more than ±0.06 RRT units since the last update, this indicates a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to reestablish the retention times.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem, then repeat the breakdown check. Flagging criteria are not appropriate.	Analyst	Laboratory Representativeness	See Method / SOP QC Acceptance Limits
Continuing Calibration Verification (CV)	Daily, before sample analysis, and every 12 hours of analysis time	Average RF for SPCCs: SVOCs ≥ 0.050. %Difference/Drift for CCCs: SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or nonlinear calibration.)	DoD project level approval must be obtained for each of the failed analytes or corrective action must be taken. Correct problem, then rerun CV. If that fails, repeat initial calibration. Corrective action may include reanalysis of samples. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since last acceptable CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Internal standards verification	Every field sample, standard, and QC sample.	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard.	Inspect mass spectrometer and GC for malfunctions. Reanalysis of samples analyzed while system was malfunctioning is mandatory. If corrective action fails in field samples, apply Q-flag to analytes associated with the noncompliant IS. Flagging criteria are not appropriate for failed standards. Sample results are not acceptable without a valid IS verification.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.9 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Method Blank (MB)	One per preparatory batch	No analytes detected > ½ reporting limit (RL) and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL Project QLs for all target compounds are specified in: Worksheet 15.7 for TCLP SVOCs aqueous and solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct problem. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Representativeness (Absence of interference/ contamination)	See Method / SOP QC Acceptance Limits
Laboratory Control Sample (LCS)	One LCS per preparatory batch	Contains all analytes to be reported, including surrogates. QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than ± 3 times the standard deviation of the mean LCS recovery. QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for TCLP SVOCs aqueous and solids %Recovery = (Calculated Value/True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Surrogate Spikes	All field and QC samples	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for TCLP SVOCs aqueous and solids %Recovery = (Calculated Value/True Value) *100%	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary. Apply Q-flag to all associated analytes if acceptance criteria are not met. Alternative surrogates are recommended when there is obvious chromatographic interference.	Analyst	Accuracy (Individual sample preparation efficiency control)	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results between LOD and LOQ	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #28.10 - QC Samples Table

Matrix	Aqueous and Solids IDW
Analytical Group	TCLP Mercury
Concentration Level	Low
Analytical Method / SOP Reference	Aq & So: 1311/7470A Aqueous/Solids: CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2
Field Sampling Organization	Shaw Environmental
Analytical Organization	CT Laboratories, Inc.

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Initial Calibration (ICAL)	Initial calibration prior to sample analysis.	Initial calibration for all analytes (ICAL) Minimum 5 standards and a calibration blank with linear least squares regression: R≥0.995.	Correct problem then repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until ICAL has passed.	Analyst	Laboratory Precision	See Method / SOP QC Acceptance Limits
Initial calibration verification (ICV) (Second Source)	Once after each initial calibration, prior to sample analysis.	Value of second source for all analyte(s) within ± 10% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat initial calibration. Flagging criteria are not appropriate. Problem must be corrected. No samples may be run until calibration has been verified.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	CVAA: within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification. Problem must be corrected. Results may not be reported without a valid CCV. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Calibration blanks	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Reprepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed. Apply B-flag to all results for specific analyte(s) in all samples associated with the blank.	Analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits
Method Blank (MB)	One per preparatory batch per matrix	No analytes detected > ½ reporting limit (RL) and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. Project QLs for all target compounds are specified in: Worksheet 15.7 for TCLP mercury aqueous and solids	The source of the contamination is investigated and eliminated before proceeding with further analysis. Correct the problem. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply B-flag to all results for the specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid method blank. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Representativeness (Absence of interference / contamination)	See Method / SOP QC Acceptance Limits

SAP Worksheet #28.10 - QC Samples Table (continued)

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator	Measurement Performance Criteria
Laboratory Control Sample (LCS)	One LCS per preparatory batch per matrix	QC acceptance criteria specified by DoD, if available. QC acceptance criteria for all target compounds as specified in: Worksheet 15.7 for TCLP mercury aqueous and solids Ref.: DoD QSM, if available, otherwise laboratory's own in-house criteria. %Recovery = (Calculated Value / True Value) *100%	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to specific analyte(s) in all samples in the associated preparatory batch. Problem must be corrected. Results may not be reported without a valid LCS. Flagging is only appropriate in cases where the samples cannot be reanalyzed.	Analyst/Prep analyst	Laboratory Accuracy	See Method / SOP QC Acceptance Limits
Serial Dilution Test	Each preparatory batch	Five-fold dilution must agree within ± 10% of the original measurement. Only applicable for samples with concentrations >50x MDL for CVAA.	Perform postdigestion spike (PDS) addition. Flagging criteria are not appropriate.	Analyst	Precision (field samples)	See Method / SOP QC Acceptance Limits
Method of standard additions (MSA)	When matrix interference is confirmed	Document use of MSA in the case narrative.	Not Applicable	Analyst	Accuracy	See Method / SOP QC Acceptance Limits
Results reported between LOD and LOQ	All positive results must be confirmed	Not Applicable	Apply J-flag to all results between LOD and LOQ.	Analyst	Representativeness	See Method / SOP QC Acceptance Limits

Ref: USEPA Test Methods for Evaluating Solid Waste Physical/Chemical Methods, Update IV (USEPA, 2007) and DoD Quality Systems Manual for Environmental Laboratories, Final Version 4.2 (DoD, 2010).

SAP Worksheet #29 - Project Documents and Records Table

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field / Communication Logbooks and Log Sheets	Not Applicable	Chain of Custody Records	Department of Defense Quality Systems Manual for Environmental Laboratories, Version 4.2 (2010)	No Applicable
Daily Tailgate Safety Meeting Forms		Sample Receipt Confirmation Forms	Facility-wide Sampling and Analysis Plan (2011)	
Site Maps with Sampling Locations		Internal Sample Tracking Forms	USACE Louisville Chemistry Guidelines, Version 5 (2002)	
Chain of Custody Records		Extraction and Prep Logs Books	Laboratory Accreditation Certificates or Letters	
Custody Seals		Laboratory Information Management System (LIMS) Login	Communication Logbooks	
Air Bill Records		Standard Logbooks	Data Review-noted in Logbooks	
		Non Conformance Records	Electronic Data Deliverables (EDDs) with site specific goals evaluated and or entered	
		Communication Logbooks	PDF and hardcopy of Final Laboratory Data Report	
		Sample Chronology (time of receipt, extraction, and analysis)	Weekly Health and Safety Communications	
		Identification of quality control (QC) samples (Blanks, Duplicates, Matrix Spike/Matrix Spike Duplicate, Laboratory Control Samples)	Safety Audit Checklists (if performed)	
		Definitions of Laboratory Data Qualifiers		
		Documentation of Lab QC Issues		
		Instrument Calibration Logbooks		
		Instrument Maintenance Logbooks		
		Electronic Data Deliverables		
		Laboratory Name		
		Case Narrative		
		Laboratory Sample Accession Numbers		
		Reporting Forms		
		Reporting Checklists- for Completeness		
		Signature of laboratory sign-off		
		Method Detection Limits (MDL) Studies		
		PE Results		
		Laboratory Accreditation Certificates or Letters		
		Site Uniform Federal Policy Quality Assurance Project Plan/Sampling and Analysis Plan (UFP-QAPP/SAP)		
		Sample Disposal Records		

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SAP Worksheet #30 - Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical SOP	Data Package Turnaround Time	Laboratory / Organization (name and address, contact person and telephone number)	Backup Laboratory / Organization [1] (name and address, contact person and telephone number)
MC Sampling Soil, Wet Sediment, Surface Water, and IDW	MC and Geochemical metals (See Worksheet 20 for MRS and analyte list breakouts).	**MC Soil/Sediment Samples:** EBG-ss/sb/sd-NNN or FBQ-ss/sb/sd-NNN or 40F-ss/sb/sd-NNN or SCD-ss/sb/sd-NNN or BDT-ss/sb/sd-NNN or WW4-sssb/sd-NNN or GR8-ss/sd-NNN **MC Surface Water Samples:** EBGsw-NNN or FBQsw-NNN or 40Fsw-NNN or SCDsw-NNN or BDTsw-NNN or WW4sw-NNN or GR8sw-NNN **Field Duplicate Samples:** EBGsd/sw-NNN-fd or FBQss/sb/sd/sw-NNN-fd or 40Fss/sb/sd/sw-NNN-fd or SCDss/sb/sd/sw-NNN-fd or BDTss/sb/sd/sw-NNN-fd or WW4ss/sb/sd/sw-NNN-fd or GR8ss/sb/sd/sw-NNN-fd **MC Investigative Derived Material Samples:** IDW-wc-NNN	Soils/Wet Sediment: Preparation: USEPA 3050B (Without Grinding)[2,3] Analysis USEPA 6010C 6230B Rev 4 & 6105B-6000 Rev 2 Surface Water: Preparation: USEPA 3010C Analysis: USEPA 6010C, 6225B Rev 8 & 6105B-6000 Rev 2	Form I's = 14 Calendar Days Hardcopy Shaw Level 4 CLP Like & EDD = 21 Calendar Days	CT Laboratories, Inc. 1230 Lange Court Baraboo, WI 53913-3109 Eric Korthals Tel 608-356-2760 Fax 608-356-2766 ekorthals@ctlaboratories.com	ALS Laboratory Group 960 West Levoy Drive Salt Lake City, UT 84123 Kevin Griffiths Tel 801-266-7700 Fax 801-268-9992 kevin.griffiths@alsenviro.com
	Explosives (See Worksheet 20 for MRS and analyte list breakouts).		Soil & Sediment: Preparation: USEPA 8330B (With Grinding—Puck Mill)[2,3] Analysis: USEPA 8330B Rev 5 Wet Sediment: Preparation: USEPA 8330B Analysis: USEPA 8330B Rev 5 Surface Water: Preparation: USEPA 3535A Analysis: USEPA 8330B Rev 5			
	SVOCs (See Worksheet 20 for MRS and analyte list breakouts).		Soil: Preparation: USEPA 3546 (With Grinding—Puck Mill)[2] Analysis: USEPA 8270C Rev 9 Wet Sediment: Preparation: USEPA 3546 Analysis: USEPA 8270C Rev 9 Surface Water: Preparation: USEPA 3510C Analysis: USEPA 8270C Rev 9			
	Nitrocellulose (See Worksheet 20 for MRS and analyte list breakouts).		Soil Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB (With Grinding—Puck Mill)[2] CC-NC Rev 0 & CC-IC Rev 5 Wet Sediment Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB (Without Grinding)[2] CC-NC Rev 0 & CC-IC Rev 5 Surface Water Preparation and Analysis: USEPA 9056/CRREL-ECB ERDC SOP M-NC-ECB CC-NC Rev 0 & CC-IC Rev 5			
	PCBs (See Worksheet 20 for MRS and analyte list breakouts).		Soil: Preparation: USEPA 3546 (With Grinding—Puck Mill)[2] Analysis: USEPA 8082A Wet Sediment: Preparation and Analysis: USEPA 3546 Analysis: USEPA 8082A			
	TOC (See Worksheet 20 for MRS and analyte list breakouts).		Soil & Wet Sediment: Preparation and Analysis: USEPA Method Lloyd Kahn and 9045D (Without Grinding)[2] CC-TOC solid Rev 3			
	pH (See Worksheet 20 for MRS and analyte list breakouts).		Soil & IDW: Preparation and Analysis: USEPA 9040C/9045D (Without Grinding)[2] CC-24b Rev 3			
	TCLP metals (ICP & CVAA) (See Worksheet 20 for MRS and analyte list breakouts).		IDW: Preparation: USEPA 1311/3010C/7470A Analysis: USEPA 6010C/7470A, CL-8b Rev 4, 6225B Rev 8, & 6105B-6000 Rev 2			
	TCLP SVOCs (See Worksheet 20 for MRS and analyte list breakouts).		IDW: Preparation: USEPA 1311/3510C Analysis: USEPA 8270C, CL-8b Rev 4			
	Reactivity (Total Sulfide and Total Cyanide) (See Worksheet 20 for MRS and analyte list breakouts).		IDW: Preparation and Analysis: USEPA 9030B and 9013A/9012, CC-1 Rev 8 & CC-Reactive Sulfide Dist Rev 0			
	Ignitability (Flashpoint) (See Worksheet 20 for MRS and analyte list breakouts).		IDW: Preparation and Analysis: USEPA 1010/1030, CC-37 Rev 2			

SAP Worksheet #30 - Analytical Services Table (continued)

Notes:

[1] If a backup laboratory is required due to laboratory loading or any other issues, ALS Laboratory Group will serve as a backup laboratory. Eric Korthals will still serve as the Laboratory PM for this Shaw project for both ALS Laboratory Group and CT Laboratories, Inc. on this project. CT Laboratories, Inc. will notify the Shaw Project Chemist, Maqsud Rahman, prior to any sample transfers. All laboratories carry NELAC/ELAP accreditation and have proper instrumentation and qualifications to perform the analysis required by this project.

[2] For incremental samples (IS) samples not requiring grinding, the entire air-dried and sieved sample will be sub sampled with 30 or more randomly located increments removed to form each sub-sample required prior to grinding samples for explosives propellants, SVOC or PCB analysis.

[3] A determination as to whether inorganics will be ground as part of the IS analysis process will be made by the Ohio EPA following the results of the IS sampling for the first seven MRS in the work plan (Shaw, 2011).

BDT = Block D Igloo–TD
CLP = Contract Laboratory Program
EDD = electronic data deliverable
EBG = Erie Burning Grounds
FBQ = Fuze and Booster Quarry
GR8 = Group 8 MRS
ICP = Inductively Coupled Plasma
IDW = investigative derived waste
MC = munitions constituents
MRS = munitions response site
PCB = polychlorinated biphenyl
SCD = Sand Creek Dump
sb = soil boring sample
sd = sediment sample
ss = surface soil sample
sw = surface water sample
SVOC = semivolatile organic compound
TOC = total organic carbon
TCLP = Toxicity Characteristic Leaching Procedure
wc = waste characterization sample
WW4 = Water Works #4 Dump
40F = 40mm Firing Range
USEPA = U.S. Environmental Protection Agency

SAP Worksheet #31 - Planned Project Assessment Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Review of Sampling and Analysis Plan (SAP) with Field Staff	1/prior to sampling start up	Internal	Shaw	Dave Crispo, Senior Environmental Engineer/Shaw	Dave Crispo, Senior Environmental Engineer/Shaw	Dave Crispo, Senior Environmental Engineer/Shaw	Dave Cobb, Project Manager/Shaw
Daily Quality Control (QC) Report	Daily	Internal	Shaw	Braden Livingstone, Unexploded Ordnance QC Specialist (UXOQCS)/Shaw	Dave Cobb, PM/ Shaw	Dave Cobb, PM/Shaw	Braden Livingstone, UXOQCS, Shaw
Laboratory Assessment for Appropriate Certifications, Capacity and SAP Review with Staff	1/prior to sampling start up	Internal	Shaw	Maqsud Rahman, Project Chemist/Shaw	David Berwanger Laboratory Director/CT Laboratories, Inc.; Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	David Berwanger Laboratory Director/CT Laboratories, Inc.; Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	Maqsud Rahman, Project Chemist/Shaw
Daily Tailgate Safety Meeting	Daily	Internal	Shaw	Robert Harrison, UXO Safety Officer (UXOSO)/ Shaw	Dave Cobb, PM/Shaw; Jim Joice, H&S Manager, CIH/Shaw	Dave Cobb, PM/Shaw; Jim Joice, H&S Manager, CIH/Shaw	Braden Livingstone, UXOSO/Shaw
Field Sampling and chain-of-custody (COC) Review Against SAP Requirements	Daily	Internal	Shaw	Maqsud Rahman, Project Chemist/Shaw	Dave Cobb, PM/Shaw; Dave Crispo, Senior Environmental Engineer/Shaw	Dave Cobb, PM/Shaw; Dave Crispo, Senior Environmental Engineer/Shaw	Maqsud Rahman, Project Chemist/Shaw
Laboratory Report Deliverables and Analytical Results Against SAP Requirements Data Verification	Per Sample Delivery Group	Internal	Shaw	Maqsud Rahman, Project Chemist/Shaw	Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	Maqsud Rahman, Project Chemist/Shaw

SAP Worksheet #32 - Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Review of SAP with Field Staff	Contained with written Daily QC report for that day.	Dave Cobb, PM/Shaw	Immediately, not to exceed 24 hours	Daily QC Report would be amended with corrective action	Dave Cobb, PM/Shaw	Immediate within 24 hours
Laboratory Assessment for Appropriate Certifications, Capacity and SAP Review with Staff	Receipt of copies of certifications. Email traffic concerning lab capacity prior to sampling start-up. SAP sign-off sheet received from laboratory.	Dave Cobb, PM/Shaw	Immediate	Response to email	Dave Cobb, PM/Shaw	48 hours after notification
Daily Tailgate Safety Meeting	Verbal debriefing and daily sign-off log. If a safety violation occurs, a Supervisor Injury Employee Report is completed.	Dave Cobb, PM/Shaw; Jim Joice, H&S Manager, CIH/Shaw	Immediately, not to exceed 24 hours	Included as part of the process of the Supervisor Injury Employee Report	Charlie Thomas, UXOSO/Shaw	Immediate within 24 hours
Daily QC Report	Contained in RI Report.	Dave Cobb/PM, Shaw	Immediately, not to exceed 24 hours	Daily QC Report would be amended with corrective action	Dave Crispo, Senior Environmental Engineer/Shaw	Immediate within 24 hours
Field Sampling and COC Review Against SAP Requirements	Communication may be in the form of email traffic.	Dave Cobb, PM/Shaw; Dave Crispo, Senior Environmental Engineer/Shaw	24 hours after sampling	Response to email	Dave Cobb, PM, Shaw	48 hours after notification
Laboratory Report Deliverables and Analytical Results Against SAP Requirements	Communication may be in the form of email traffic.	Dave Cobb, PM/Shaw; Maqsud Rahman, Project Chemist/Shaw; Eric Korthals, PM/CT Laboratories, Inc.	24 hours after completion of analytical work	If required laboratory reports will be amended and corrections noted in the analytical narrative	Dave Cobb, PM/Shaw; Maqsud Rahman, Project Chemist/Shaw;	72 hours after notification

SAP Worksheet #32 - Assessment Findings and Corrective Action Responses (continued)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (name, title, organization)	Timeframe for Response
Validation	Communication may be in the form of email traffic requesting additional laboratory forms, back up data that may be missing, and/or clarification of the analytical report.	Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	24 hours after finding deficiency	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report	Maqsud Rahman, Project Chemist/Shaw;	Up to 7 days
Data Verification	Communication may be in the form of email traffic requesting additional laboratory forms, back up data that may be missing and/or clarification of the analytical report.	Dan Elwood, Laboratory QA Officer/CT Laboratories, Inc.	24 hours after finding deficiency	If required, laboratory reports will be amended and corrections noted in the analytical narrative and contained with the validation report	Maqsud Rahman, Project Chemist/Shaw;	Up to 7 days

SAP Worksheet #33 - QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Daily Quality Control (QC) Report	Completed daily	First workday following the date covered by the report	QC Manager	USACE project representative (see Section 6.6 of work plan)
Final Project Remedial Investigation (RI) Report	After completion of all field work	Project document delivery schedule is provided in the work plan	Shaw Project Manager or designee	USACE Project Manager and regulatory agencies/stakeholders

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Field Staff Training	Personnel assigned to the project, including field personnel and subcontractors, will be qualified to perform the tasks to which they are assigned. This includes but is not limited to basic sampling techniques; field testing methodology, task-specific sampling methods, maintenance of environmental paperwork, and how to avoid cross contamination. In addition to education and experience, specific training may be required to qualify individuals to perform certain activities. Training will be documented appropriately and the forms placed in the project file as a record. Project personnel will receive an orientation to the full project Sampling and Analysis Plan (SAP), Remedial Investigation (RI) Work Plan, and the Accident Prevention Plan (APP) addendums as appropriate to their responsibilities before participation in project activities. Training of field personnel will be provided by the Senior Unexploded Ordnance Supervisor (SUXOS), UXO Quality Control Specialist (UXOQCS), or by a qualified designee.	Internal	Dave Cobb / Shaw Charlie Thomas / Shaw Maqsud Rahman / Shaw
SAP Addendum	A copy of the reviewed and approved version of the SAP addendum will be distributed to the laboratory and be available for review for all Shaw personnel involved in this project. It is the responsibility of the Shaw Project Chemist to ensure delivery of a copy of the SAP addendum to the laboratory. The Laboratory Quality Assurance (QA) Officer is responsible for review of the SAP addendum with laboratory staff. The Shaw PM and the SUXOS are responsible for ensuring that all staff have reviewed the final SAP addendum.	Internal / External	Dave Cobb / Shaw Maqsud Rahman / Shaw Charlie Thomas / Shaw David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs
Laboratory Quality Systems Manual	CT Laboratories, Inc. has a detailed Quality Assurance Manual, Revision 8, dated January 21, 2009, that is designed to meet the quality program requirements of National Environmental Laboratory Accreditation Conference (NELAC) and International Organization for Standardization (ISO) Guide 25. ALS Laboratory Group has a detailed Quality Assurance Project Plan, Revision 13, dated September 1, 2009 that is designed to meet the quality program requirements of NELAC and ISO Guide 25. The Quality Systems Manuals are included in Attachment C of this SAP-Quality Assurance Project Plan (QAPP) addendum.	Internal / External	David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group Maqsud Rahman / Shaw

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Laboratory Staff Training	Laboratory senior management staff retains oversight responsibility for the data integrity program and retains the ultimate responsibility for execution of the data integrity program elements. Senior laboratory management staff is responsible for providing the resources required to conduct Standard Operating Procedures (SOPs), ethics training, and operate data integrity evaluation procedures. Laboratory employees receive technical ethics training during new employee orientation. All employees are required to attend ethics refresher training and to sign an ethical conduct agreement annually, which verifies their understanding of the laboratory's ethics policy and the analyst's ethical responsibilities. Training on data integrity procedures and SOPs are conducted by the individual departments' group leaders within the laboratory. All records of training are retained at the laboratory in the individual staff training folders and are maintained by the laboratory quality assurance officer. All information related to staff qualifications, experience, external training courses, and education are placed into the individual's training file. Verification documentation for laboratory orientation, health and safety, and quality assurance training is also maintained with the training file. Additional training documentation is added to the files as it occurs. This includes data for initial and continuing demonstrations of proficiency, performance evaluations, study data and notes, and attendance lists from individual and group training sessions.	Internal	David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group
Laboratory Certifications or Accreditations	CT Laboratories, Inc. and ALS Laboratory Group have current Environmental Laboratory Accreditation Program (ELAP) and NELAC accreditations and/or approvals. CT Laboratories, Inc. has Navy certification approvals to meet the Department of Defense (DoD) Quality Systems Manual (QSM) V4.2 requirements during the current accreditation transition period. The ELAP for CT Laboratories, Inc. will be included in the SAP addendum once available (anticipated March 2010). The laboratory accreditations are included in Attachment E.	Internal / External	David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group Maqsud Rahman / Shaw

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Field Logbooks	The sample number will be traceable to the site, location, and depth (where applicable). The sample identification and description will be recorded by the munitions constituents (MC) Sampling Lead in the sample collection logbook/log sheets. The UXOQCS will perform daily reviews of field logbooks/log sheets each day of sampling.	Internal	Charlie Thomas / Shaw
Sample Location Verification	The SUXOS will verify that the MC Sampling Lead has collected the samples from the proper locations and depths as described in Worksheet 18.	Internal	Mario Villarreal / Shaw
Chain of Custody—Field Level	The MC Sampling Lead will complete the chain-of-custody (COC) form during field sampling in accordance with the sample matrices and analytical tests required as described in Worksheet 19. Prior to placement in the cooler, the SUXOS will review the COC form against the field logbooks/log sheets and Worksheets 18 and 19 to ensure that the samples, sample volumes, and sample nomenclature match and the required analytical tests have been notated. A review of the COC form for completeness will also be conducted.	Internal	Mario Villarreal / Shaw
Chain of Custody – Shaw Project Chemist	Upon completion of the COC form, the MC Sampling Lead will either fax or email the completed COC form to the Shaw Project Chemist. A review of the COC form against Worksheets 18 and 19 will be conducted to ensure that the samples, sample volumes, and sample nomenclature match and the required analytical tests have been notated. A review of the COC form for completeness will also be conducted.	Internal	Maqsud Rahman / Shaw

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Chain of Custody – Analytical Laboratory	All samples to be analyzed by the fixed-base laboratory will be shipped via overnight courier service. Upon receipt, a representative of the laboratory will check the integrity of the custody seals, then locate, sign, and date the COC. The laboratory is responsible for verifying that the COC and containers are in agreement. The COC, a Cooler Receipt Form, and information regarding any discrepancies between the COC and bottle labels will be faxed to the Shaw Project Chemist prior to preparation for analysis. The Laboratory Information Management System (LIMS) will provide evidence of sample custody from receipt by the laboratory until appropriate disposal.	Internal	Eric Korthals / CT Labs Kevin Griffiths / ALS Group
LIMs Login—Analytical Laboratory	A review of the COC form against the laboratory LIMS login and the project analytical requirements as contained in Worksheet 19 will be conducted to ensure that the login is correct and the proper analytical tests have been assigned.	Internal	Eric Korthals / CT Labs Kevin Griffiths / ALS Group
LIMs Login—Shaw Project Chemist	A secondary review of the COC form against the laboratory LIMS login and the project analytical requirement as contained in Worksheet 19 will be conducted to ensure that the login is correct and the proper analytical tests have been assigned.	External	Maqsud Rahman / Shaw
Sample Receipt Form—Shaw Project Chemist	CT Laboratories, Inc. will provide within 48 hours of receipt of samples a copy of the sample receipt form. Any discrepancies between the COC and the sample containers will be noted and contained as part of the analytical record.	External	Maqsud Rahman / Shaw

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Laboratory Corrective Action and Report Procedure	Routine corrective action is defined as procedures used to return out of control analytical systems back to control. This level of corrective action applies to all analytical QC parameters and analytical system specification as defined in the laboratory SOPs. Bench analysts have full responsibility and authority for performing routine corrective action. Routine corrective actions are documented as part of the analytical record. Defective processes, holding time violations, systematic errors, and quality defects that occur are to be reported by the bench chemist immediately to the section supervisor and a nonconformance record initiated. The section supervisor will notify the designated Laboratory PM who will then notify the Shaw Project Chemist. All notifications must be made in a timely manner. The nonconformance record should become part of the analytical record.	Internal / External	David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group Maqsud Rahman / Shaw
Analytical Data Package—Laboratory	All data produced by the laboratory will be required to undergo several levels of review, which will include two levels of management review at the laboratory. The laboratory will review the data packages internally for completeness and verify that all of the required forms and raw data are included for each data package type. The laboratory will provide sample results, final complete Contract Laboratory Program (CLP)-like data packages, and electronic data deliverables (EDDs). Any detection between the limits of quantitation (LOQs), to be set at the laboratory reporting limits (RL), and the limits of detection (LODs) will be noted as estimated values "J." Nondetects will be reported to the LOQ (LOD for metals). The laboratory will provide data results within the specified turnaround time (TAT). The data includes batch QC results, including laboratory control sample (LCS)/ laboratory control sample duplicates (LCS/LCSD), matrix spike/matrix spike duplicates (MS/MSD), matrix spike/matrix duplicates (MS/MD) for metals, surrogate spikes, and method blanks unless otherwise stipulated by the Shaw Project Chemist. The TAT begins at the time the samples are received by the laboratory to the time the laboratory faxes the final results to the Shaw Project Chemist (as designated in this document) with the following exceptions:	Internal	David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
	• Holidays do not count as calendar days • TAT for samples received by a laboratory representative after 1500 hours begins at 0800 hours of the next business day. The final complete analytical data package will be sent to Shaw also within the specified TAT of sample receipt. A complete data package consists of the analytical reports, required QA/QC reports, and the EDD disks. A copy of the data package will be included with the EDD. The laboratory will provide one original electronic copy and one PDF-formatted copy (on a CD) of hardcopy data packages. All electronic data shall match the hardcopy reports provided.		
Analytical Data Package—Laboratory	Shaw requires the submission of the reporting levels for the data packages be in accordance with the most current version of the USACE Louisville Chemistry Guidance (LCG) for samples submitted to the laboratory. Any reporting levels that are required other than specified in the LCG will be designated on the chain-of-custody forms. Data qualifiers and data qualifying conventions provided in Section I and Attachment A of the LCG must be used for reporting of electronic and hard-copy data packages. All data packages are unbound and systematically organized. All pages within the data package are stamped legibly with consecutive page numbers. The completed, original COC, with records of sample transfers, acknowledgments, receipt conditions and any discrepancies, must be submitted with the data package. Any out-of-control event or changes in the analytical program shall be clearly indicated on the COC and stated in the case narrative.		David Berwanger / CT Labs Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group
Analytical Data Package / Laboratory QC – Shaw Project Chemist	The Shaw Project Chemist will verify that data has been received for all samples that have been sent to the laboratory. An evaluation of these data will be performed to determine whether the laboratory met the QC requirements as stated in the analytical methods and laboratory SOPs. Refer to Worksheets 19 and 28.	External	Maqsud Rahman / Shaw

SAP Worksheet #34 - Sampling and Analysis Verification (Step I) Process Table (continued)

Verification Input	Description	Internal/ External	Responsible for Verification (name, organization)
Laboratory Electronic Data Deliverables	The laboratory will provide one original electronic copy and one PDF-formatted copy (on a CD) of hardcopy data packages. All electronic data shall match the hardcopy reports provided. To limit transcription errors, electronic data transfer should be performed through the laboratory's LIMS system. The EDD format is used to transfer information from sample analyses. It is meant to capture as much information as possible. However, it is recognized that not all fields may be relevant or available. Therefore, only a limited number of the fields are required. It is recognized that files in this format may be significantly empty. The format specification has been broken into subsections relating to the basic types of information. The file should not contain laboratory QC samples (e.g., method blanks, surrogates). It may contain field QC data such as field duplicates, results from split samples, trip blanks, and equipment rinsates. The EDDs will be provided either on CD/DVD with the data package or via e-mail and will be prepared in accordance with the Ravenna Environmental Information Management System (REIMS) requirements. Project specific action goals as defined in Worksheet 15 will be added and evaluated. Any QC issues that may impact the data use will be evaluated.	External	Maqsud Rahman / Shaw

SAP Worksheet #35 - Sampling and Analysis Validation (Steps IIa and IIb) Process Table

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa	Field SOPs	Ensure that all sampling Standard Operating Procedures (SOPs_ were followed.	Dave Crispo, Shaw
IIa	Analytical SOPs	Ensure that all laboratory analytical SOPs were followed.	Dan Elwood / CT Labs Eric Korthals / CT Labs Kevin Griffiths / ALS Group
IIa	Documentation of Method QC Results	Establish that all method quality control (QC) were analyzed for and in control as listed in the analytical SOPs. If method quality assurance (QA) was not in control, the laboratory will have contacted Shaw of a nonconformance situation prior to report generation for guidance.	Maqsud Rahman, Shaw
IIa/IIb	Documentation of SAP QC Sample Results	Establish that all Sampling and Analysis Plan (SAP)-addendum required QC samples were collected. Establish that the collected QC samples met the required limits as established in the SAP addendum.	Dave Crispo, Shaw Maqsud Rahman, Shaw
IIa/IIb	Documentation of Analytical Reports for Completeness	Ensure that from the chain-of-custody (COC) generated in the field to the delivery of the analytical data that the appropriate analytical samples have been collected, appropriate site identifications have been used, and the correct analytical methods have been applied. Review the analytical reports to establish that all required forms, case narratives, samples, COC forms, logbooks, and raw data have been included.	Maqsud Rahman, Shaw
IIb	Project Quantitation Limits	Review laboratory analytical results to ensure they met the project quantitation limits specified in SAP addendum Worksheet 15.	Maqsud Rahman, Shaw
IIa/IIb	Data Verification	Data verification will be performed on all samples. Data verification ensures that sample analysis was performed as stated in the SAP addendum and per the laboratory SOPs.	Maqsud Rahman, Shaw

SAP Worksheet #35 - Sampling and Analysis Validation (Steps IIa and IIb) Process Table (continued)

Step IIa / IIb	Validation Input	Description	Responsible for Validation (name, organization)
IIa/IIb	Data Validation	Full level data validation will be performed on all munitions constituents (MC) samples. The investigation derived waste (IDW) samples will only require limited validation (see worksheet 36). Data will be validated in accordance with criteria as specified in Worksheets 12, 15, 19, and 28 and cited USEPA SW-846 methodology. Validation qualifiers will be consistent with the *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (OSWER 9240.1-45; EPA 540-R-04-004)* (USEPA, October 2004) and *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (EPA-540-R-08-01)* (USEPA, June 2008), if required. The laboratory will provide electronic data deliverables in Excel format that have been generated by the laboratory's Laboratory Information Management System (LIMS) system. The data validator may use the Excel format in their validation procedures and populate the validation qualifiers. The validation report and electronic data deliverable (EDD) turnaround time is 30 calendar days from data package receipt.	Maqsud Rahman, Shaw

SAP Worksheet #36 - Sampling and Analysis Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
MC Sampling IIa/IIb	Soil, Sediment, and Surface Water	MEC metals (Al, Cd, Cr^{3+},Cr^{6+} Cu, Fe, Pb, Zn, Sb, Sr, Ba, and Hg)—ICP Geochemical metals (Ca, Mg, & Mn)—ICP (Actual metals lists vary per MRS—See Worksheet 18)	Project Validation Criteria as per SAP addendum Worksheets 12, 15, 19, and 28 and cited USEPA SW-846 methodology. Validation qualifiers will be consistent with the *EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (OSWER 9240.1-45; EPA 540-R-04-004)* (USEPA, October 2004) and *EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review (USEPA-540-R-08-01)* (USEPA, June 2008), if required. Electronic excel files may be utilized to expedite the validation process and the validation qualifier fields populated. The validation report and EDD turnaround time is 30 calendar days from data package receipt.	Maqsud Rahman, Shaw
	Soil, Sediment, and Surface Water	Explosives—Puck Mill (HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/,2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ) (Actual explosives lists vary per MRS—See Worksheet 18)		
	Soil, Sediment, and Surface Water	SVOCs		
	Soil and Sediment	PCBs		
	Soil, Sediment, and Surface Water	Nitrocellulose		
	Soil and Sediment	TOC		
	Soil	pH		

SAP Worksheet #36 - Sampling and Analysis Validation (Steps IIa and IIb) Summary Table (continued)

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator (title and organizational affiliation)
MC Sampling IIa/IIb	Aqueous and Solids	TCLP Metals	A limited validation will be performed for the IDW samples to assess laboratory performance, including a review of: completeness, chain-of-custody, holding times, QC results reported on summary forms (LCS, Method blanks, MS/MSD, equipment blank), detection and reporting limits, and other contractual items. Criteria for QC results will be compared to criteria as per SAP addendum Worksheets 12, 15, 19, and 28 and cited USEPA SW-846 methodology.	Maqsud Rahman, Shaw
		TCLP SVOCs		
		Corrosivity as pH		
		Flashpoint		
		Total Cyanide		
		Total Sulfide		

Sb = Antimony
Al = aluminum
Ba = barium
Ca = calcium
Cd = cadmium
Cu = copper
Cr^{3+} = trivalent chromium
Cr^{6+} = hexavalent chromium
DNT = dinitrotoluene
EDD = electronic data deliverable
ICP = Inductively Coupled Plasma
IDW = investigative derived waste
LCS = laboratory control sample
Pb = lead
Fe = iron
MC = munitions constituents
Mg = magnesium
Mn = manganese
Hg = mercury
MRS = munitions response site
MS = matrix spike
MSD = matrix spike duplicate
NG = nitroguanidine
HMX = octogen
OSWER = Office of Solid Waste Emergency Response
PETN = Pentaerythrito Tetranitrate
QC = quality control
RDX = cyclonite
SAP = sampling and analysis plan
Sr = strontium
SVOC = semivolatile organic compound
TCLP = Toxicity Characterization Leaching Procedure
TNT = trinitrotoluene
TOC = total organic carbon
USEPA = U.S. Environmental Protection Agency
Zn = zinc

SAP Worksheet #37 - (UFP-SAP Manual Section 5.2.3) - Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
It is the joint responsibility of the project team listed in this Sampling and Analysis Plan (SAP) addendum to ensure that the data collected meet the requirements listed in this SAP addendum. The data validation and review and assessment of the field and lab procedures will determine the usability in the current remedial investigations (RI) per the work plan addendum. The evaluation and use of the e^2M Site Inspection (SI) Report and Installation Restoration Program (IRP) data is discussed in Worksheets #10 and 13.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
The data review process is outlined in Shaw SOP EI-FS-020 and is consistent with the requirements for data reduction, validation, and reporting presented in Section 9.0 and specific routine procedures to assess data precision, accuracy, and completeness in Section 12.0 of the *Facility-Wide Quality Assurance Project Plan* (FQAPP) (SAIC, 2011). Data review process encompasses data verification, data validation, and data usability assessment. The data reported for each analyte will include the result, limits of detection (LOD), and limits of quantitation (LOQ). In addition, any positive value detected between the LOD and the LOQ will be reported as an estimated "J" concentration. During data review, Shaw will ensure that only data of known and documented quality, meeting project quality objectives are used in making environmental decisions will be used.

The data sets will be fully validated suitable for risk assessment in accordance with the Uniform Federal Policy (UFP)-SAP and the analytical methods performed to ensure the data quality objectives are met. Data qualification will be consistent with U.S. Environmental Protection Agency (USEPA) data validation guidance. Usability is not limited to data validation and includes the review and assessment of the field and lab procedures as defined in the UFP-SAP. These will be monitored by the project team throughout the project. The data validation reports, qualifiers applied to data in conjunction with this UFP-SAP, field logbooks, progress reports, and corrective action reports will be used to assess overall usability as it applies to data sets. Excel electronic data deliverable (EDD) files will be generated by the laboratory and utilized to expedite the validation process and the validation qualifier fields populated in accordance with Appendix A of the *Facility-Wide Sampling and Analysis Plan* (FSAP) (SAIC, 2011). The Project Chemist completes the data review process by reviewing areas in which data nonconformances were identified by the validator. If data are determined to be unusable (e.g. "R-flagged"), impacts (e.g. critical samples/analytes) to the project are evaluated on a case-by-case basis to determine if resampling or reanalysis is warranted through a corrective action report to ensure that only reliable results are used by the project and that enough usable data is available to support the decisions being made. The corrective action report addresses how this problem will be resolved and corrective actions implemented.

From a data usability standpoint, samples found due to blank contamination will be considered nondetect at the reporting limit or level of contamination (whichever is higher) because of the probability that concentrations are from laboratory or field contamination and not necessarily indicative at the site. This is consistent with *EPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual* (Part A) and previous blank assessments conducted. The Shaw Project Manager will assess data usefulness based on the project data quality objectives (DQOs). The condition of LODs or LOQs exceeding the screening criteria occurs occasionally in the realm of chemical analysis with the given current USEPA methodology, especially for ecological assessments. When this occurs, Sections 5.3.3 and 5.3.5 of *EPA Risk Assessment Guidance for Superfund Volume I Human Health Evaluation Manual* (Part A) provide guidance for the risk assessor. In some cases ½ of the LOD or LOQ is used as a proxy concentrations (detected in some samples), and in some cases the chemical is removed all together (nondetect for all samples). The data is then ready for the RI report after this final usability review.

SAP Worksheet #37 (UFP-SAP Manual Section 5.2.3) - Usability Assessment (continued)

A summary of the overall project accuracy, precision, representativeness, completeness, comparability, and sensitivity is then discussed in the final RI report. This includes a discussion and impacts of the validation qualifications, blank assessments, sampling and analytical completeness, and analytical sensitivity analysis.

Identify the personnel responsible for performing the usability assessment:
Members of the project team listed in this SAP addendum are responsible for the ensuring the usability of the data sets as defined in this SAP addendum. Following the receipt of all the analytical results, the project team (personnel listed below) will review the data to ensure that the sampling and data meets the DQOs. The following personnel or their designee will perform the usability assessment as it applies to their project discipline and oversight responsibilities:

- Dave Cobb, Shaw PM
- Maqsud Rahman, Shaw Project Chemist
- Dave Crispo, Senior Environmental Engineer
- Cindy Hassan, Shaw Senior Human Health Risk Assessor
- Mark Weisberg, Shaw Senior Ecological Risk Assessor
- Dan Elwood, CT Laboratories, Inc. QA Officer
- Travis McCoun, USACE COR
- Glen Beckham—USACE PM

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:
The RI Report (which will include the screening level human health and ecological risk assessments) will summarize the RI, conclusions, and any recommendations. The appendices of the RI Report will include the following supporting documents: analytical data reports, data validation narratives, field documentation, daily QC reports and a data usability study for IRP data. The data usability study will determine the ability of the data collected under the IRP to be included in the screening level risk assessments in the RI and for applicable sites where a feasibility study (FS) will be completed (Sand Creek Dump and Water Works #4 Dump MRSs). This study will assess the usability of the data by comparing it to the data sources, analytical methods, detection limits, background comparability criteria, qualified data, depth of collection, and collection methodology (i.e. incremental sampling versus discrete).

Glossary of Quality Assurance and Related Terms

Acceptance criteria—Specified limits placed on characteristics of an item, process, or service defined in requirements documents.

Accuracy—The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components that are due to sampling and analytical operations; a data quality indicator. Examples of QC measures for accuracy include proficiency testing samples, matrix spikes, laboratory control samples (LCSs), and equipment blanks.

Action limit/level—The numerical value that causes a decision maker to choose or accept one of the alternative actions. It may be a regulatory threshold standard, such as a maximum contaminant level for drinking water; a risk-based concentration level; a technology limitation; or a reference-based standard.

Activity—An all-inclusive term describing a specific set of operations or related tasks to be performed, either serially or in parallel (e.g., research and development, field sampling, analytical operations, equipment fabrication), that, in total, result in a product or service.

Aliquot—A measured portion of a sample taken for analysis.

Analyte—A property which is to be measured.

Analytical batch—A group of samples, including quality control samples, which are processed together using the same method, the same lots of reagents, and at the same time or in continuous, sequential time periods. Samples in each batch should be of similar composition and share common internal quality control standards.

Assessment—As defined in the UFP-QAPP, the evaluation process used to measure the performance or effectiveness of a system and its elements against specific criteria. Glossary of Quality Assurance and Related Terms Examples include, but are not limited to, audits, proficiency testing, management systems reviews, data quality assessments, peer reviews, inspections, or surveillance.

Audit (quality)—A systematic and independent examination to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives.

Bias—The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value).

Blank—A sample subjected to the usual analytical or measurement process to establish a zero baseline or background value; a sample that is intended to contain none of the analytes of interest. A blank is used to detect contamination during sample handling preparation and/or analysis.

Calibration—A comparison of a measurement standard, instrument, or item with a standard or instrument of higher accuracy to detect and quantify inaccuracies and to report or eliminate those inaccuracies by adjustments.

Calibration standard—A substance or reference material used for calibration. *See also Calibration.*

Certification—The process of testing and evaluation against specifications designed to document, verify, and recognize the competence of a person, organization, or other entity to perform a function or service, usually for a specified time.

Chain of Custody—An unbroken trail of accountability that ensures the physical security of samples, data, and records.

Characteristic—Any property or attribute of a datum, item, process, or service that is distinct, describable, and/or measurable.

Coefficient of variation (CV)—A measure of precision (relative dispersion). It is equal to the standard deviation divided by the arithmetic mean. *See also Relative standard deviation.*

Co-located samples—See Field duplicates, co-located samples.

Comparability—The degree to which different methods or data agree or can be represented as similar. Comparability describes the confidence that two data sets can contribute to a common analysis and interpolation.

Completeness—A measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under correct, normal conditions.

Configuration—The functional, physical, and procedural characteristics of an item, experiment, or document.

Conformance—An affirmative indication or judgment that a product or service has met the requirements of the relevant specification, contract, or regulation; also, the state of meeting the requirements.

Contaminants of concern (COC)—The matrix-specific list of chemical compounds and analytes determined to be pertinent to a specific site or project; sometimes used interchangeably with target analytes.

Continuing calibration verification—A check of the initial calibration that is performed during the course of an analytical shift at periodic intervals using a Calibration Check Standard. Continuing calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and nonlinear calibration models. The purpose is to assess the continued capability of the measurement system to generate accurate and precise data over a period of time.

Contractor—Any organization or individual contracting to furnish services or items or to perform work.

Corrective action—Any measures taken to rectify conditions adverse to quality and, where possible, to preclude their recurrence.

Data quality indicators (DQIs)—The quantitative statistics and qualitative descriptors that are used to interpret the degree of acceptability or utility of data to the user. The principal data quality indicators are precision, accuracy/bias, comparability, completeness, representativeness, and sensitivity. Also referred to as data quality attributes.

Data quality objectives (DQOs)—Qualitative and quantitative statements derived from the data quality objectives (DQO) process, as defined by EPA QA/G-4. DQOs can be used as the basis for establishing the quality and quantity of data needed to support decisions.

Data quality objective (DQO) process—A systematic planning tool based on the scientific method that clarifies study objectives, defines the appropriate type, quantity and quality of data and specifies tolerable levels of potential decision errors needed to answer specific environmental questions and to support proper environmental decisions. The DQO process is one type of systematic planning process. *See also Systematic planning process.*

Data reduction—The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collating them into a more useful form. Data reduction is irreversible and generally results in a reduced data set and an associated loss of detail.

Data review—The process of examining and/or evaluating data to varying levels of detail and specificity by a variety of personnel who have different responsibilities within the data management process. It includes verification, validation, and usability assessment.

Data user—Technical and other personnel responsible for engineering, scientific, and legal evaluations that are the basis for site decisions. Data users are responsible for determining data needs required to satisfy project objectives from their perspective (remedy, risk, compliance, etc.).

Decision-maker—Project manager, stakeholder, regulator, etc., who has specific interests in the outcome of site-related activities and will use the collected data to make decisions regarding the ultimate disposition of the site or whether to proceed to the next study phase.

Definitive data—Analytical data of known quality, concentration, and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Suitable for final decision-making. *See also Screening data.*

Design—The specifications, drawings, design criteria, and performance requirement; also, the result of deliberate planning, analysis, mathematical manipulations, and design processes.

Detection limit—A measure of the capability of an analytical method to distinguish samples that do not contain a specific analyte from samples that contain low concentrations of the analyte; the lowest concentration or amount of the target analyte that can be determined to be different from zero by a single measurement at a stated level of probability. Detection limits are analyte- and matrix-specific and may be laboratory-dependent. *See also Method detection limit, Quantitation limit, and Sample quantitation limit.*

Distribution—(1) The appointment of an environmental contaminant at a point over time, over an area, or within a volume; (2) a probability function (density function, mass function, or distribution function) used to describe a set of observations (statistical sample) or a population from which the observations are generated.

Document—Written text such as a report, standard operating procedure, plan. Once written, documents can be revised or amended, unlike records which are not revised once written.

Document control—The policies and procedures used by an organization to ensure that its documents and their revisions are proposed, reviewed, approved for release, inventoried, distributed, archived, stored, and retrieved in accordance with the organization's requirements.

Environmental conditions—The description of a physical matrix (e.g., air, water, soil, sediment) or a biological system expressed in terms of its physical, chemical, radiological, or biological characteristics.

Environmental data—Any parameters or pieces of information collected or produced from measurements, analyses, or models of environmental processes, conditions, and effects of pollutants on human health and the ecology, including results from laboratory analyses or from experimental systems representing such processes and conditions. It also includes information collected directly from measurements, produced from models, and compiled from other sources such as databases or the literature.

Environmental data operations—Any work performed to obtain, use, or report information pertaining to environmental processes and conditions.

Environmental monitoring—The process of measuring or collecting environmental data.

Environmental processes—Any manufactured or natural processes that produce discharges to, or that impact, the ambient environment.

Environmental programs—An all-inclusive term pertaining to any work or activities involving the environment, including but not limited to characterization of environmental processes and conditions; environmental monitoring; environmental research and development; the design, construction, and operation of environmental technologies; and laboratory operations on environmental samples.

Equipment blank—A sample of water free of measurable contaminants poured over or through decontaminated field sampling equipment that is considered ready to collect or process an additional sample. The purpose of this blank is to assess the adequacy of the decontamination process. Also called rinse blank or rinsate blank.

Estimate—A characteristic from the sample from which inferences on parameters can be made.

Field blank—A blank used to provide information about contaminants that may be introduced during sample collection, storage, and transport; also a clean sample exposed to sampling conditions, transported to the laboratory, and treated as an environmental sample.

Field duplicate (replicate) samples—(1) A generic term for two (or more) field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner and provide precision information for the data collection activity. (2) The UFP-QAPP recognizes two categories of Field Duplicates Samples defined by the collection method, field duplicate, co-located samples and field duplicate, subsamples. *See also Field duplicate, co-located samples and Field duplicate, subsamples.*

Field duplicate, co-located samples—Two or more independent samples collected from side-by-side locations at the same point in time and space so as to be considered identical. These separate samples are said to represent the same population and are carried through all steps of

the sampling and analytical procedures in an identical manner. These samples are used to assess precision of the total method, including sampling, analysis, and site heterogeneity. Examples of co-located samples include ambient air monitoring samples, surface water grab samples, and side-by-side sample core soil samples.

Field duplicate (replicate), subsamples—Duplicate (replicate) samples resulting from one sample collection at one sample location. For example, duplicate (replicate) subsamples may be taken from one soil boring or sediment core.

Finding—An assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding may be positive or negative and is normally accompanied by specific examples of the observed condition.

Graded approach—The objective process of establishing the project requirements and level of effort according to the intended use of the results and the degree of confidence needed in the quality of the results.

Guidance—A suggested practice that is not mandatory, intended as an aid or example in complying with a standard or requirement.

Guideline—A suggested practice that is not mandatory in programs intended to comply with a standard.

Hazardous waste—Any waste material that satisfies the definition of hazardous waste given in 40 CFR 261, "Identification and Listing of Hazardous Waste."

Holding time—The period of time a sample may be stored prior to its required analysis.

Inspection—The examination or measurement of an item or activity to verify conformance to specific requirements.

Instrument blank—An aliquot of analyte-free water or solvent processed through the instrumental steps of the measurement process to determine the presence of carryover from the previous analysis. Analysis does not include any sample preparation.

Instrument performance check sample—A sample of known composition analyzed concurrently with environmental samples to verify the performance of one or more components of the analytical measurement process. Those components can include retention time, resolution, recovery, degradation, etc.

Interference—A positive or negative effect on a measurement caused by a analyte other than the one being investigated or other factors.

Internal standard—A standard added to a test portion of a sample in a known amount and carried through the entire determination procedure as a reference for calibrating and controlling the precision and bias of the applied analytical method.

Investigative organization—An entity contracted by the lead organization for one or more phases of a data collection operation.

Laboratory control sample—A sample of known composition prepared using contaminant-free water or in inert solid that is spiked with analytes of interest at the midpoint of the

calibration curve or at the level of concern. It is analyzed using the same sample preparation, reagents, and analytical methods employed for regular samples.

Laboratory duplicates/replicates—Two or more representative portions taken from one homogeneous sample by the laboratory and analyzed in the same laboratory. Laboratory duplicate/replicate samples are quality control samples that are used to assess intralaboratory preparatory and analytical precision.

Laboratory fortified blank—A low-level laboratory control sample (e.g., at the quantitation limit) used to evaluate laboratory preparatory and analytical sensitivity and bias for specific compounds.

Lead organization—An entity responsible for all phases of the data collection operation.

Limit of Detection (LOD)—An estimate of the minimum amount of a substance that an analytical process can reliably detect. An LOD is analyte- and matrix-specific and may be laboratory dependent.

Limit of Quantitation (LOQ)—The lowest quantity of a substance that can be distinguished from the absence of that substance (a *blank value*) within a stated confidence limit.

Management—Those individuals directly responsible and accountable for planning, implementing, and assessing work.

Management system—A structured, nontechnical system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for conducting work and producing items and services.

Matrix—The material of which the sample is composed, such as water, soil/sediment, or other environmental medium.

Matrix spike—A sample prepared by adding a known concentration of a target analyte to an aliquot of a specific homogenized environmental sample for which an independent estimate of the target analyte concentration is available. The matrix spike is accompanied by an independent analysis of the unspiked aliquot of the environmental sample. Spiked samples are used to determine the effect of the matrix on a method's recovery efficiency.

Matrix spike duplicate—A homogeneous sample used to determine the precision of the intralaboratory analytical process for specific analytes (organics only) in a sample matrix. The duplicate sample is prepared simultaneously as a split with the matrix spike sample, and each is spiked with identical, known concentrations of targeted analyte(s).

Mean (arithmetic)—The sum of all the values of a set of measurements divided by the number of values in the set; a measure of central tendency.

Measurement performance criteria—Acceptance limits selected for project-specific sampling and analytical systems that will be used to judge whether project quality objectives are met. *See also data quality indicators.*

Method—A body of procedures and techniques for performing an activity (e.g., sampling, chemical analysis, quantitation), systematically presented in the order in which they are to be executed.

Method blank—A sample of a matrix similar to the batch of associated samples (when available) in which no target analytes or interferences are present at concentrations that impact the analytical results. It is processed and analyzed simultaneously with samples of similar matrix and under the same conditions as the samples.

Method detection limit—Minimum concentration of a substance that can be reported with 99 percent confidence that the analyte concentration is greater than zero. *See also Detection limit and Quantitation limit.*

Method detection limit studies—A statistical determination that defines the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

Must—When used in a sentence, a term denoting a requirement that has to be met.

Nonconformance—A deficiency in a characteristic, documentation, or a procedure that renders the quality of an item or activity unacceptable or indeterminate; nonfulfillment of a specified requirement.

Objective evidence—Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measurements, or tests that can be verified.

Observation—An assessment conclusion that identifies a condition (either positive or negative) that does not represent a significant effect on an item or activity. An observation may identify a condition that has not yet caused a degradation of quality.

Organization—A public or private company, corporation, firm, enterprise, or institution, or part thereof, whether incorporated or not, that has its own functions and administration.

Outlier—A data point that is shown to have a low probability of belonging to a specified data population.

Parameter—A quantity, usually unknown, such as a mean or a standard deviation characterizing a population. *Parameter* is commonly misused for *variable*, *characteristic*, or *property*.

Precision—The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves. Precision is usually expressed as standard deviation, variance, or range, in either absolute or relative terms. Examples of QC measures for precision include field duplicates, laboratory duplicates, analytical replicates, and internal standards.

Procedure—A specified way to perform an activity.

Process—A set of interrelated resources and activities that transforms inputs into outputs. Examples of processes include analysis, design, data collection, operation, fabrication, and calculation.

Proficiency testing (PT) sample—A sample, the composition of which is unknown to the laboratory or analyst, which is provided to that laboratory or analyst to assess capability to produce results within acceptable criteria. PT samples can fall into three categories: (1)

prequalification, conducted prior to a laboratory beginning project work, to establish initial proficiency; (2) periodic (e.g., quarterly, monthly, or episodic), to establish ongoing laboratory proficiency; and (3) batch-specific, which is conducted simultaneously with analysis of a sample batch. A PT sample is sometimes called a performance evaluation sample.

Proficiency testing sample, ampulated—A PT sample that is received as a concentrate and must be diluted to volume before being treated as an analytical sample. It can only be single blind.

Proficiency testing sample, full volume—A PT sample that is received by the laboratory ready to be treated as an analytical sample. It does not require dilution and therefore can be single or double blind.

Proficiency testing sample, site-specific—A PT sample created using a well-characterized contaminated matrix and treated as an analytical sample by the laboratory to test its capabilities.

Project—An organized set of activities within a program.

Project quality objectives (PQOs)—Qualitative and quantitative statements derived from a Systematic Planning Process (e.g., EPA QA/G-4 DQO process) that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors. PQOs will be used as the basis for establishing the quality and quantity of data needed to support decisions.

Project quantitation limit—The lowest concentration or amount of the target analyte required to be reported from a data collection project.

Preliminary Remediation Goals—Specific project action limits for target analytes.

Quality—The totality of features and characteristics of a product or service that bears on its ability to meet the stated or implied needs and expectations of the user.

Quality assurance—An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the client.

Quality assurance project plan (QAPP)—A formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria.

Quality control—The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality.

Quality control sample—One of any number of samples, such as a PT sample, intended to demonstrate that a measurement system or activity is in control.

Quality management—That aspect of the overall management system of the organization that determines and implements the quality policy. Quality management includes strategic planning, allocation of resources, and other systematic activities (e.g., planning, implementation, and assessment) pertaining to the quality system.

Quality Management Plan—A formal document that describes the quality system in terms of the organization's structure, the functional responsibilities of management and staff, the lines of authority, and the required interfaces for those planning, implementing, and assessing all activities conducted.

Quality system—A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required quality assurance (QA) and quality control (QC) activities.

Quantitation limit—The minimum concentration of an analyte or category of analytes in a specific matrix that can be identified and quantified above the method detection limit and within specified limits of precision and bias during routine analytical operating conditions.

Raw data—The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, hard copies of electronic data, magnetic tapes, untabulated sample results, QC sample results, printouts of chromatograms, instrument outputs, and handwritten notes.

Readiness review—A systematic, documented review of the readiness for the start-up or continued use of a facility, process, or activity. Readiness reviews are typically conducted before proceeding beyond project milestones and prior to initiation of a major phase of work.

Reagent blank—An aliquot of water or solvent free of measurable contaminants analyzed with the analytical batch and containing all the reagents in the same volume as used in the processing of the samples. The method blank goes through preparatory steps; the reagent blank does not.

Record (quality)—A document that furnishes objective evidence of the quality of products, services, or activities and that has been verified and authenticated as technically complete and correct. Records may include photographs, drawings, magnetic tape, and other data recording media.

Recovery—A measure of bias. Typically, a known concentration of analyte is spiked into an aliquot of sample. Both the spiked aliquot and an unspiked aliquot of sample are analyzed and the percent recovery is calculated.

Relative percent difference (RPD)—A unit-free measure of precision between duplicate analyses.

Relative standard deviation (RSD)—A unit-free measure of precision or variability. The RSD is also known as the Coefficient of Variation (CV) which is the standard deviation expressed as a percentage of the mean.

Remediation—The process of reducing the concentration of a contaminant (or contaminants) in air, water, or soil matrices to a level that poses an acceptable risk to human health.

Replicate samples—Multiple duplicate samples.

Representativeness—A measure of the degree to which data accurately and precisely represent a characteristic of a population, a parameter variation at a sampling point, a process condition, or an environmental condition.

Reproducibility—The precision, usually expressed as variance, that measures the variability among the results of measurements of the same sample at different laboratories.

Requirement—A formal statement of a need and the expected manner in which it is to be met; documented statements that specify activities that must be done; the mandated activities.

Sample quantitation limit (SQL)—Quantitation limit adjusted for dilutions, for changes in sample volume or size, and extract and digestate volumes, percent solids, and cleanup procedures.

Scientific method—The principles and processes regarded as necessary for scientific investigation, including rules for formulation of a concept or hypothesis, conduct of experiments, and validation of hypotheses by analysis of observations.

Screening data—Analytical data of known quality, concentration, and level of uncertainty. The levels of quality and uncertainty of the analytical data are consistent with the requirements for the decision to be made. Screening data are of sufficient quality to support an intermediate or preliminary decision but must eventually be supported by definitive data before a project is complete.

Secondary Data—Data not originally collected for the purpose for which they are now being used. In addition, the level of QA/QC provided at the time of the original data collection may be unknown.

Self-assessment—The assessments of work conducted by individuals, groups, or organizations directly responsible for overseeing or performing the work.

Sensitivity—The capability of a test method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. Examples of QC measures for determining sensitivity include laboratory-fortified blanks, a method detection limit study, and initial calibration low standards at the quantitation limit.

Service—The result generated by activities at the interface between the supplier and the customer; the supplier's internal activities to meet customer needs. Such activities in environmental programs include design, inspection, laboratory and/or field analysis, repair, and installation.

Shipping container temperature blank—A container of water designed to evaluate whether or not samples were adequately cooled during sample shipment.

Specification—A document stating requirements and referring to or including drawings or other relevant documents. Specifications should indicate the means and criteria for determining conformance.

Spike—A substance that is added to an environmental sample to increase the concentration of target analytes by known amounts. A spike is used to assess measurement accuracy (spike recovery). Spike duplicates are used to assess measurement precision.

Split sample—Two or more representative portions taken from a sample in the field or laboratory, analyzed by at least two different laboratories and/or methods. Prior to splitting, a sample is mixed (except volatiles, oil and grease, or when otherwise directed) to minimize sample heterogeneity. These are quality control samples used to assess precision, variability, and data comparability between different laboratories. (Split samples should be used when accompanied by a PT sample.)

Standard deviation—A measure of the dispersion or imprecision of a sample or population distribution; expressed as the positive square root of the variance, with the same unit of measurement as the mean.

Standard Operating Procedures (SOPs)—A written document that details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks.

Storage blank—A sample composed of water free of measurable contaminants and stored with a sample set in the same kind of sample container. Storage begins upon receipt of sample shipment at the laboratory. The storage blank is analyzed at the end of the sample storage period to assess cross-contamination occurring during sample storage (typically analyzed only for volatile organic compounds).

Supplier—Any individual or organization furnishing items or services or performing work according to a procurement document or a financial assistance agreement. *Supplier* is an all-inclusive term used in place of any of the following: vendor, seller, contractor, subcontractor, fabricator, or consultant.

Surrogate spike or analyte—A pure substance with properties that mimic the analyte of interest (organics only). Surrogates are brominated, fluorinated, or isotopically labeled compounds unlikely to be found in environmental samples. These analytes are added to samples to evaluate analytical efficiency by measuring recovery.

Systematic planning process—Systematic planning is a process that is based on the scientific method and includes concepts such as objectivity of approach and acceptability of results. Systematic planning is based on a common sense, graded approach to ensure that the level of detail in planning is commensurate with the importance and intended use of the work and the available resources. This framework promotes communication among all organizations and individuals involved in an environmental program. Through a systematic planning process, a team can develop acceptance or performance criteria for the quality of the data collected and for the quality of the decision.

Target analytes—The project-specific list of analytes for which laboratory analysis is required; sometimes used interchangeably with contaminants of concern.

Technical Systems Audit (TSA)—A thorough, systematic, on-site qualitative audit of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system.

Traceability—The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project.

Trip blank—A clean sample of water free of measurable contaminants that is taken to the sampling site and transported to the laboratory for analysis without having been exposed to sampling procedures. Trip blanks are analyzed to assess whether contamination was introduced during sample shipment (typically analyzed for volatile organic compounds only).

Usability assessment—Evaluation of data based upon the results of data validation and verification for the decisions being made. In the usability step, reviewers assess whether the process execution and resulting data meet quality objectives based on criteria established in the QAPP.

Validation—Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled. Data validation is a sampling and analytical process evaluation that includes evaluating compliance with methods, procedures, or contracts, and comparison with criteria based upon the quality objectives developed in the project QAPP. The purpose of data validation is to assess the performance associated with the sampling and analysis to determine the quality of specified data.

Variance (statistical)—A measure or dispersion of a sample or population distribution.

Verification—Confirmation by examination and provision of objective evidence that the specified requirements (sampling and analytical) have been completed. This is to be a completeness check.

List of Acronyms and Abbreviations

ADR ..... Automated Data Review
AEC ..... Army Environmental Command
AOC ..... Area of Concern
bgs ..... below ground surface
BIP ..... Blow in Place
BRAC ..... Base Realignment and Closure
CAS ..... Chemical Abstract Service
CDQAR ..... Chemical Data Quality Assurance Report
CERCLA ..... Comprehensive Environmental Response, Compensation, and Liability Act
CF ..... Calibration Factor
CHPPM ..... Center for Health Promotion and Preventive Medicine
COC ..... Chain of Custody
COPC ..... Chemical of Potential Concern
COR ..... Contracting Officer Representative
CQAR ..... Chemical Quality Assurance Report
CUG ..... Cleanup Goals
DoD ..... Department of Defense
DMM ..... Discarded Military Munitions
DOT ..... Department of Transportation
DQI ..... Data Quality Indicator
DQO ..... Data Quality Objective
ERIS ..... Environmental Restoration Information System
ERM ..... Environmental Restoration Manager
EPC ..... Exposure Point Concentration
ESL ..... Ecological Screening Level
FADL ..... Field Activity Daily Log
FSAP ..... Field Sampling and Analysis Plan
FWCUG ..... Facility-Wide Cleanup Goal
GOCO ..... Government-Owned, Contractor-Operated
HE ..... High Explosive
HHRAM ..... Human Health Risk Assessor's Manual
HPLC ..... High Performance Liquid Chromatography
HQ ..... Hazard Quotient
ICP ..... Inductively Coupled Plasma
ICP/MS ..... Inductively Coupled Plasma/Mass Spectrometry
IDW ..... Investigative Derived Waste
IATA ..... International Air Transportation Association
IRP ..... Installation Restoration Program
IS ..... Incremental Sampling
LCD ..... Laboratory Control Duplicate
LCS/LCD ..... Laboratory Control Sample/Laboratory Control Duplicate
LOD ..... Limit of Detection

LOQ .....Limit of Quantitation
mg/kg .....milligrams per kilogram
MC .....Munitions Constituents
MCL.....Maximum Contaminant Level
MDL .....Method Detection Limit
MEC.....Munitions and Explosives of Concern
MFD-H.....Maximum Fragmentation Distance–Horizontal
MMRP.....Military Munitions Response Program
MRS .....Munitions Response Sites
MS/MSD .....Matrix Spike/Matrix Spike Duplicate
NGB .....National Guard Bureau
OHARNG .....Ohio Army National Guard
Ohio EPA.....Ohio Environmental Protection Agency
ORC .....Ohio Revised Code
OSHA.....Occupational, Safety, and Health Administration
PETN.....Pentaerythritol Tetranitrate
PG .....Professional Geologist
PMP.....Project Management Plan
PPE.....Personal Protective Equipment
PRG.....Preliminary Remediation Goal
QA.....Quality Assurance
QAPP .....Quality Assurance Project Plan
QC .....Quality Control
RAB .....Restoration Advisory Board
RF.....Response Factor
RI.....Remedial Investigation
RIP .....Remedy in Place
RL .....Reporting Limit
RPD .....Relative Percent Difference
RSD .....Relative Standard Deviation
RVAAP.....Ravenna Army Ammunitions Plant
SAP .....Sampling and Analysis Plan
SD .....Standard Deviation
Shaw.....Shaw Environmental & Infrastructure, Inc.
SI.....Site Inspection
SLERA.....Screening Level Ecological Risk Assessment
SOP .....Standard Operating Procedure
SUXOS .....Senior Unexploded Ordnance Supervisor
TBC.....To Be Calculated
TBD.....To Be Determined
UFP .....Uniform Federal Policy
USACE .....United States Army Corps of Engineers
USEPA .....United States Environmental Protection Agency
UXO.....Unexploded Ordnance

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ATTACHMENT A
SHAW AND LABORATORY KEY PERSONNEL RÉSUMÉS

Dave Cobb, Shaw Project Manager

Mr. Cobb holds a Bachelor's Degree in Civil Engineer and a Master's Degree in Environmental Engineering. Mr. Cobb has 20 years of experience spanning the full range of environmental remediation services, including Remedial Investigations (RIs); Feasibility Studies (FSs); treatability studies; Proposed Plans, Records of Decision (RODs), and Decision Documents (DDs); corrective action plans; conceptual designs, design reviews, and design analyses; remedial actions/corrective actions; long-term groundwater monitoring; and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) five-year reviews. He has managed investigation and remediation projects in excess of $35M under fixed price and cost reimbursable contracts.

Project Manager, Ravenna AAP PBA, Ravenna, OH. Under this $9.6M PBA for the implementation of a CERCLA-based environmental remediation program at Ravenna AAP, Mr. Cobb and his team provided environmental remediation services to meet the specified performance goal (Interim Remedy-in-Place) at Load Lines 1-4, where soils and dry sediments were contaminated with explosives, SVOCs, inorganics (metals), and PCBs. Mr. Cobb was responsible for control and management of contract and budgetary issues; interaction and reporting to the Army; ensuring compliance with all federal and state regulations, and seeking the involvement and concurrence of Ohio EPA regulators; interaction and reporting to the project insurer; resource management; risk evaluations; review and approval of health and safety (H&S) and quality assurance (QA) programs; and oversight of procurement and technical staff.

Mr. Cobb and his team were responsible for taking the four load lines from the RI stage through Interim Remedy-In-Place via the CERCLA process and in accordance with the Director's Findings and Orders for the facility. Mr. Cobb managed the remedial investigation sampling, preparation of CERCLA documents in accordance with RVAAP-specific and regulatory requirements, preparation of human health and ecological risk evaluations, MEC avoidance activities, and the development and implementation of soil removal activities.

Mr. Cobb mobilized field crews within three weeks of approval of the Record of Decision (ROD). The approved removal actions were substantially complete within 4 months, including excavation of approximately 9,000 cy, field screening and confirmatory sampling, backfill of excavated areas, and the characterization and off-site disposal of waste material. Shaw used risk-based CUGs to evaluate the remedy. Mr. Cobb worked closely with USACE, AEC, and installation personnel, and developed an open, professional relationship with Ohio EPA.

On another TO issued to support the Load Lines 1-4 PBA (under the USACE–MARC), Mr. Cobb managed structural surveys of buildings that posed a safety hazard to the Load Lines 1-4 work. He supervised the development of safety measures required for excavation activities and oversaw the removal of propellants and igniter tubes at Load Line 1.

Under his direction, the TOs associated with RVAAP accomplished over 25,000 labor hours without a recordable incident.

Project Manager, Ravenna AAP Environmental Services TO, Ravenna, OH. Awarded in September 2008, Mr. Cobb is responsible for managing this $1.6M TO to bring three sites to the CERCLA ROD stage for the purpose of selecting and implementing environmental remedies. Shaw is also required to develop updated data quality objectives for an active range site that is being expanded. All four sites have either known or suspected MEC-related material and contaminants that will be addressed during investigation activities.

Project Manager Longhorn AAP PBA, Karnack, TX. Under an $18M PBA, managed by USACE Tulsa District for AEC through the USACE Louisville MARC, Mr. Cobb managed the remediation of 29 sites contaminated with explosives, VOCs, perchlorate, and metals through September 2008. Project scope included CERCLA document preparation including RI/FS reports, NFA RODs and implementation of TCRAs; soil and groundwater remediation; transportation and disposal of hazardous materials; groundwater monitoring; O&M and optimization of a groundwater treatment plant; high-hazard risk assessment; negotiations with regulators; groundwater modeling, and a facility-wide baseline ecological risk assessment. During his three years of managing the project,

Mr. Cobb was responsible for all facets of project management. He interacted with and reported to the Army; negotiated with EPA Region 6 (lead agency) and the Texas Commission on Environmental Quality (TCEQ); managed all contract and budgetary issues; communicated with the project insurer; managed community and Restoration Advisory Board (RAB) relations; managed risk evaluations and reviewed and approved the H&S and QA programs. He oversaw procurement and technical staff, and supported the Army in facility transfer issues. This project accomplished over 53,000 man-hours without a reportable incident. All work was completed in accordance with CERCLA requirements.

Project Manager, Fort Sam Houston, Camp Bullis PBA, San Antonio, TX. Under this $7.8M PBA, Mr. Cobb managed the remediation and closure of multiple landfills containing construction debris, solid waste, and impacted soils at Fort Sam Houston (FTSH) and Landfill 8 at Camp Bullis. The Camp Bullis landfill was identified as a possible CWM disposal site and required MEC avoidance activities in support of reaching the contractual performance goal (RIP). Mr. Cobb used an innovative subsurface drilling program to comply with the Army's no-access requirements. Remediation activities included preparation of regulatory documents, capping and closure of 115 acres of landfill, groundwater remediation using in situ enhanced bioremediation, groundwater monitoring, and landfill inspection/maintenance. All work was performed in accordance with TCEQ, RCRA, CERCLA, and the installation's facility-wide permits. Work was managed by USACE Tulsa District for AEC, through the USACE Louisville MARC.

Work began in late 2005 and RIP was achieved on the FTSH landfills (6 total) in September 2007. The Camp Bullis landfill achieved RIP by March 2008. Shaw's negotiations with TCEQ, on behalf of the Army, resulted in the cessation of groundwater monitoring requirements at the FTSH landfills within 1.25 years of achieving RIP. This resulted in a significant reduction of LTM costs for the Army and a streamlined document process that shortened the project schedule. The project is currently in the RA(O)/LTM stages of work with all remedies implemented.

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Dave Crispo, P.E., Sr Environmental Engineer

Mr. Crispo holds a Bachelor's Science Degree in Civil Engineering. Mr. Crispo is a Registered Professional Engineer in Ohio with more than 17 years of experience in the environmental industry. He is currently serving as the Senior Environmental Engineer on Shaw's performance-based, fixed-price TOs at RVAAP. Mr. Crispo's field experience includes soil remediation design and project planning; asbestos abatement; environmental sampling and monitoring; hazardous waste transportation and disposal; and bioremediation system design, installation, and operation and maintenance. Mr. Crispo has comprehensive experience in the preparation of environmental samples under the Contract Laboratory Program protocols. He has performed environmental sampling and waste characterization activities in all media, such as soil, water, sludge, structures, liquids, and debris at various Superfund Sites for both the USACE and the EPA in support of site assessments and remedial actions. Mr. Crispo has extensive working knowledge of various state waste site cleanup and permitting regulations throughout the eastern U.S., including Ohio. He is proficient in federal regulations pertaining to the CERCLA, RCRA, and the Toxic and Hazardous Substances Control Act.

Project Engineer, Ravenna AAP PBA, Ravenna, OH. As Senior Environmental Engineer on this $9.8 million PBA, Mr. Crispo prepared the remedial design and various field documents for the excavation and offsite disposal of over 14,000 cubic yards of soils and dry sediments contaminated with MEC, propellants, SVOCs and inorganics at RVAAP pursuant to CERCLA and NCP requirements in coordination with the Ohio EPA. Mr. Crispo used his extensive knowledge of remedial construction design and hazardous waste and remediation services experience to identify the "means and methods" for executing the cleanup of contaminated lands to a level of risk acceptable to the Ohio EPA. Mr. Crispo coordinated MEC oversight activities with trained MEC personnel and ensured that all excavation activities were supervised to provide adequate on site safety measures associated with MEC and/or MC.

Project Engineer, Ravenna AAP A/E PBA, Ravenna, OH. Mr. Crispo is currently the Senior Environmental Engineer on the $1.6 million Environmental Services fixed unit price contract managed by the Louisville District. His role consists of technical oversight of documents and additional field sampling required under CERCLA in order to achieve ROD at three AOCs. He is evaluating the current conditions at each site for subsurface anomalies and contaminants in surface soil, subsurface soil, sediment, and surface water consisting of primarily PAHs, inorganics (arsenic, lead, chromium, manganese), explosives (2,4,6-TNT, 2,4-DNT and 2,6-DNT) and propellants (nitrocellulose). The AOCs are currently in different phases of the CERCLA process and documents to be prepared and/or overseen by Mr. Crispo include DQO, RI, FS, PP and ROD.

Project Engineer, Longhorn Army Ammunition Plant PBA, Karnack, TX. Under this $18 million PBA managed by USACE Tulsa District for USACE, Mr. Crispo prepared multiple focused feasibility studies, time-critical removal action memorandums, and sampling work plans for three sites at LHAAP. He evaluated the COCs in conjunction with established federal and state human health criteria in order to provide appropriate remediation goal options. He prepared the remedial strategies for contaminants in soil and groundwater consisting primarily of chlorinated solvents, metals (lead, antimony, arsenic, nickel, and chromium), explosives (2,4,6-TNT, 2,4-DNT, 2,6-DNT and nitrotoluene) and perchlorate pursuant to CERCLA and NCP requirements utilizing his in-depth knowledge of federal and Texas environmental, construction, and permitting regulations.

Technical Lead, Environmental Remediation PBC, Fort Carson, CO
Mr. Crispo is involved in project startup and transition activities for environmental remediation services for this $42 million PBA. Mr. Crispo manages all technical support required for GIS and data input acquired from previous contractors, is responsible for technical oversight associated with soil and groundwater remediation and monitoring activities at 11 groundwater and nine landfill sites and oversees preparation of plan/design reports required in accordance with RCRA investigation requirements. Contaminants in soil consist of chlorinated solvents and inorganics.

Groundwater contaminants consist primarily of chlorinated solvents. He prepared contract-required documents that included the Project Management Plan, Communication Plan, Quality Assurance Plan, and Safety Health and Emergency Response Plan and has responsibility for ensuring compliance with these and other facility-wide documents. Challenges encountered under the PBA at Fort Carson included responding to unknown conditions not previously identified and providing adequate response to satisfy both the Army and regulators.

Maqsud Rahman, Project Chemist

Dr. Rahman holds a Bachelor's, a Master's and a Ph.D. degree in Chemistry. Dr. Rahman has 30 years of research experience in the area of organic, inorganic, analytical chemistry. For the past seventeen years he is functioning as Senior Scientist at the U.S. EPA T&E Facility working in the area of evaluation of water quality online sensors, analytical method development, laboratory setup and QA/QC. He is also functioning as Project chemist for a number of USACE projects. He has authored 40 papers and conference proceedings. He has presented over 20 papers at various conferences symposiums and workshops. He has inspections a number of commercial analytical laboratories. He has experience in test method development for RCRA regulated hazardous wastes.

Support for U.S.A. EPA's Water Awareness Technology Evaluation Research and Security Center, Lead Scientist.

Dr. Rahman designed and conducted contaminant minimum-dose threshold concentration studies for water quality sensors. The study successfully developed the technique to initiate, trigger, and send warnings when a drinking water supply is contaminated by readily available toxic contaminants before reaching life threatening levels. He designed and performed kinetic studies of toxic chemicals such as sodium fluoroacetate, carbofuran, and nicotine in drinking water. Dr. Rahman successfully led the development of ion chromatography (IC) based analytical methods to analyze sodium fluoroacetate and nicotine. This development allowed hundreds of samples to be analyzed in-house in real time, generating quality data and saving valuable research time and $1,000's in analytical costs. The analytical method development and kinetic studies of sodium fluoroacetate were presented at the Louisville Chemistry Conference in 2007. Dr. Rahman also facilitated the development of a unique Gas Chromatography/Mass Spectrometry (GC/MS) analytical method to extract and identify the reaction intermediate compounds generated during the kinetic studies of nicotine. This development resulted in several different intermediate compounds being identified and thus provided a clear understanding of nicotine oxidation in nature. The study has provided detailed information about the possible contamination of water systems (including drinking water) resulting from nicotine contamination.

Dr. Rahman conducted bench-scale experiments to examine the sensor response of water quality parameters to various contaminants in a drinking water matrix, which includes drinking water from several cities. The study determined that commercially available multi-parameter monitors can trigger and provide responses (below life threatening levels) to water quality parameters which are related to contaminants concentrations. The technique is applicable to municipal water supplies. Dr. Rahman's performance has been highly commended by the client.

USACE: Fort Carson Army Base: Project Chemist

Provide analytical support for site investigation, remedial actions, monitoring activities, and other environmental task at Fort Carson Army Installation (Fort Carson), Colorado. Dr. Rahman evaluated 12 commercial laboratories and inspected the selected laboratory. He provided expert direction and guidance for calibration procedures and frequency, following QC protocols and resolving and analytical issues with the analytical laboratories. He also performed data review and data validation in accordance with the appropriate protocol for hundreds of samples. His leadership resulted consistently in high quality defensible data which the client uses with a very high level of confidence.

USACE Louisville: Ravenna Army Ammunition Plant: Project Chemist

Dr. Rahman prepared the QAPP for soil remediation of RCRA hazardous waste and RCRA hazardous waste in accordance with Louisville Chemistry Guideline (LCG) and EPA requirements. He provided expert direction and guidance for calibration procedures and frequency, following QC protocols and resolving and analytical issues with the analytical laboratories. He also performed data review and data validation in accordance with LCG for hundreds of samples. His leadership resulted consistently in high quality defensible data which the client uses with a very high level of confidence.

USACE, Louisville, Gun Ranges, Project Chemist

In collaboration with the USACE Chemist, Dr. Rahman developed a unique test method to identify low level at indoor gun ranges. The method includes synthesis of new visualization reagents and their application to detect lead at low levels. This technique involves solubilizing elemental lead with nitric acid and "exposing it with potassium iodide solution in the formation of lead iodide which has distinct yellow color. The technique resulted in optimization of the cleaning effort and achieving USARC cleaning standards. The reagents and methodology have been successfully applied to cleanup of over 180 DoD gun ranges. Dr. Rahman also conducted laboratory inspections and performed data verification of over 2,200 samples.

USACE, Louisville, Blue Grass Army Depot, Nike Missile and Fort Knox, Project Chemist

Dr. Rahman conducted numerous inspections of the contract laboratories to ensure all work was done in accordance with Louisville Chemistry Guidelines (LCG). His work covered both RCRA and CERCLA. He prepared several QAPPs in accordance with LCG as well as EPA Region requirements and performed data review and verification in accordance with LCG on more than 1,500 samples. The sites included Nike Missile, Blue Grass Army Depot, and Fort Knox. Parameters included VOC's, SVOCs, pesticides, PCBs, explosives, metals, and dioxins/furans. Dr. Rahman also participated in preparing the site QAPPs at various sites. Dr. Rahman has performed data review and validation on the AFCEE Wright Patterson Air Force Base Project.

EPA National Academy of Engineering (NAE), Arsenic Removal in POU Devices, Project Chemist

Dr. Rahman provided technical and analytical support for testing and evaluation of the performance of 15 Point-of-Use (POU) devices selected by NAE as having potential for removing arsenic from drinking water sources. NAE, supported by The Grainger Foundation, established the Grainger Challenge Prize for Sustainability for the design and creation of a workable, sustainable, economical system for removing arsenic in groundwater in countries such as Bangladesh, Nepal and India. Dr. Rahman provided support for experimental setup, performed analytical work and reviewed ICP metal analysis data. Dr. Rahman's contributions will have a significant effect on the lives of millions of people in developing countries.

EPA, Bench Scale Chemical Oxidation treatment for contaminated water and soil, Lead Scientist

Dr. Rahman designed and performed bench scale studies of water and soil contaminated with MTBE, beta-methyl naphthalene, n-hexadecane and diesel fuel using chemical oxidation techniques. Over 90 percent reduction of MTBE and significant reduction of n-hexadecane and diesel fuel were observed. Dr. Rahman wrote a number of articles and made several presentations on these studies.

EPA, Pilot Scale Chemical Oxidation treatment for MTBE contaminated Soil, Principal Investigator

Dr. Rahman performed pilot scale study of treating MTBE contaminated soil by chemical oxidation technique. 90 percent reduction of MTBE was observed. Dr. Rahman made presentations of this study.

EPA, Land Treatment of soil and Sediments, Principal Investigator

Dr. Rahman conducted studies to investigate the potential of land treatment for detoxifying solid matrices that are contaminated with a range of organic contaminants. During the study, he performed pilot scale land treatment with various levels of biosolids, to remove PAHs from (a) East River, New York and (b) Milwaukee Harbor. Significant removal contaminants were achieved by this study.

David Berwanger, Laboratory Director, CT Laboratories, Inc.

David Berwanger holds an AS in Chemistry, University of Cincinnati, 1970 and a BS, Chemistry, University of Cincinnati, 1972. He has over 30 years of experience with varied technical and managerial positions in the laboratory arena. His expertise includes analytical laboratory instrumentation, LIMS and productivity/cost consulting, as well as environmental laboratory management. He is experienced with the project management, client service, sales, and business management components of the industry, as well as the technical, analytical chemistry, and computer automation facets. Mr. Berwanger has a history of identifying and implementing process improvements and automation. He developed software tools for the laboratory, designed field sampling equipment improvements and managed a mobile air analytical services laboratory. At CT Laboratories, Mr. Berwanger ensures the operations are aligned to meet the program requirements for each of our project areas, from US EPA, Army Corps of Engineers, and AFCEE to State, municipal, and individual private clients. He is currently serving as the Governor's appointed industry representative to the oversight Board for the Wisconsin State Laboratory of Hygiene.

Dan Elwood, Quality Assurance Officer, CT Laboratories, Inc.

Dan Elwood holds degrees in Biochemistry, University of WI Madison, 1972 and Physical Sciences, Edgewood College, 1990. He has 30 years of experience with varied technical and managerial experience in the environmental laboratory arena. He has provided analytical chemistry and quality assurance expertise in managing a variety of high profile, challenging projects. His experience in the combination of regulatory agency requirements, analytical chemistry, research and method development, data validation, remedial investigations, field sampling, and project management help ensure that the data produced by CT Laboratories are of the highest quality and are appropriate for the requirements of specific projects and programs. He manages the laboratory's State and Federal accreditation and proficiency testing programs and conducts the laboratory's Health and Safety Program. Under EPA's CLP program, Mr. Elwood authored special analytical service (SAS) procedures and directed data validation activities. He has participated in peer review and commenting on proposed regulatory program and analytical method modifications.

Eric Korthals, Project Manager, CT Laboratories, Inc.

Eric Korthals holds a MS in Biology, University of WI-LaCrosse, 1986 and BS Biology with Chemistry Minor, University of WI- LaCrosse, 1984. He has over 20 years of experience as an analytical chemist providing inorganic and microbiology analytical method development, laboratory analysis, management oversight and project management in support of environmental remediation and monitoring projects nationwide. He has five years of experience as CT Laboratories' Project Manager, responsible for project scoping, coordination, data reporting and review for Department of Defense, EPA and other high profile projects nationwide. CT Laboratories' Project Management is structured so that the PM is involved in the sample log-in verification process, as well as final report and EDD generation. His duties include technical review of project-specific Statements of Work and QAPPs to ensure data generated by the laboratory meets individual project objectives. His extensive background in toxicity, life sciences and wetlands issues is frequently utilized by clients as well as laboratory staff. Mr. Korthals is knowledgeable regarding State and Federal regulatory requirements, as well as field sampling issues.

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ATTACHMENT B
SHAW SAMPLING STANDARD OPERATING PROCEDURES

Provided on CD

STANDARD OPERATING PROCEDURE

Subject: Field Logbook

1. PURPOSE

This procedure is intended to communicate the requirements for selection, use, and maintenance of all field logbooks. Field logbooks are often used to document observations, sampling information, and other pertinent information on project sites. They are considered legal documents and should be maintained and documented accordingly as part of the project file.

2. SCOPE

This procedure is applicable to all Shaw E & I site operations where field logbooks are utilized to document all site activities and pertinent information.

3. REFERENCES

- Nielsen Environmental Field School, 1997, *Field Notebook Guidelines*

4. DEFINITIONS

- **Significant detail**—Any piece and/or pieces of information or an observation that can be considered pertinent to the legal reconstruction of events, description of conditions, or documentation of samples and/or sampling procedures.
- **Significant event**—Any event or events that could influence or be considered pertinent to a specific task or function and therefore require documentation in the Field Logbook.
- **Field Logbook**—Logbooks used at field sites that contain detailed information regarding site activities that must include dates, times, personnel names, activities conducted, equipment used, weather conditions, etc. Field logbooks can be used by a variety of different field personnel and are part of the project file.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient

detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 General

Each site or operation, as applicable, will have one current Logbook, which will serve as an index of all activities performed at the site or in the task performance. The Logbook is initiated at the start of the first applicable activity. Summary entries are made for every day that covered activities take place. Multiple field logbooks may be used depending upon the number of different types of field personnel conducting work and the various activities at the site. These field logbooks and the site logbooks shall be made part of the project files.

Information recorded in field logbooks includes observations (significant events and details), data, calculations, time, weather, and descriptions of the data collection activity, methods, instruments, and results. Additionally, the field logbook may contain descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

6.2 Equipment and Materials

- Logbook(s), bound with numbered pages, hard-covered, waterproof preferred. One per project or separate significant task (example-treatment residual composite collection).
- Indelible black or dark blue ink pen
- Other items needed to perform required tasks: compass, ruler, calculator, etc.

6.3 Preparation

Site personnel responsible for maintaining field logbooks must be familiar with the SOPs for all tasks to be performed.

Field logbooks are project files and should remain with project documentation when not in use. *Personnel should not keep Field logbooks in their possession when not in use. Field logbooks should only leave the project site for limited periods, and they should always be returned to the site files or the designated on-site location (Sampler's Trailer, etc.)*.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered prior to initial use of the field logbook.

The front cover shall include the following information:

- Project Number
- Project Name and Task(s) included in logbook
- Dates covered by logbook—the starting date must be entered on the first day of use
- Logbook number—if more than one logbook will be needed to cover project/task(s)

The inside front cover shall contain a listing and sign-off of each person authorized to make entries and/or review the logbook. All persons who make entries or review/approve such entries must signify their authority to enter into the logbook via their signature and the date of their signing on the inside front cover. If initials are used for entries instead of full names, the initials must be entered beside the full name on the inside cover.

6.4 Operation

The following requirements must be met when using a field logbook:

- Record significant details and/or events, work, observations, material quantities, calculations, drawings, and related information directly in the field logbook. If data-collection forms are in use, the information on the form need not be duplicated in the field logbook. However, any forms used to record site information *must be referenced* in the field logbook.
- Information must be factual and unbiased.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Write in black or dark blue indelible ink.
- Do not erase, scribble over, or blot out any entry. Do not use White-Out or like correction items. Before an entry has been signed and dated, changes may be made; however, care must be taken not to obliterate what was written originally. Indicate any deletion by a single line through the material to be deleted. Any change shall be initialed and dated. Error codes (Attachment 1) should be added to the end of the deleted entry. All error codes should be circled.
- Do not remove any pages from the book.
- Do not use loose paper and copy into the field logbook later.
- Record sufficient information to completely document field activities and all significant details/events applicable to the project/task(s) covered by the logbook.
- All entries should be neat and legible.

Specific requirements for field logbook entries include the following:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial, date, and if used, code all changes properly.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:

  a) Date and time

  b) Name of individual making entry

  c) Detailed description of activity being conducted including well, boring, sampling, location number as appropriate

  d) Unusual site conditions

  e) Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction and speed) and other pertinent data

  f) Sample pickup (chain-of-custody form numbers, carrier, time)

  g) Sampling activities/sample log sheet numbers

  h) Start and completion of borehole/trench/monitoring well installation or sampling activity

i) Health and Safety issues, such as PPE upgrades, monitoring results, near-misses, and incidents associated with the logbook areas

j) Instrumentation calibration details

Entries into the field logbook shall be preceded with the time of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In such cases, the field logbook must reference the automatic data record or form.

While sampling, make sure to record observations such as color and odor. Indicate the locations from which samples are being taken, sample identification numbers, the order of filling bottles, sample volumes, and parameters to be analyzed. If field duplicate samples are being collected, note the duplicate pair sample identification numbers. If samples are collected that will be used for matrix spike and/or matrix spike/matrix spike duplicate analysis, record that information in the field logbook.

A sketch of the station location may be warranted. All maps or sketches made in the field logbook should have descriptions of the features shown and a direction indicator. There must be at least one fixed point with measurements on any map drawn. Maps and sketches should be oriented so that north is towards the top of the page.

Other events and observations that should be recorded include (but are not limited to) the following:

- Changes in weather that impact field activities
- Visitors to the site associated with the covered task(s). Note their time of arrival and departure and provide a brief summary of their purpose on site.
- Subcontractor activities applicable to the covered task(s)
- Deviations from procedures outlined in any governing documents, including the reason for the deviation. Deviations from procedures must be accompanied with the proper authorization.
- Significant events that may influence data, such as vehicles in the vicinity of VOC sampling efforts
- Problems, downtime, or delays
- Upgrade or downgrade of personal protective equipment

6.5 Post-Operation

To guard against loss of data due to damage or disappearance of field logbooks, all original completed logbooks shall be securely stored by the project. All field logbooks will be copied at the end of each work shift and attached to the daily reports.

At the conclusion of each activity or phase of site work, the individual responsible for the field logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, initialed, coded, and dated). The completed field logbook shall be submitted to the project records file.

6.6 Restrictions/Limitations

Field logbooks constitute the official record of on-site technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by Shaw personnel and their subcontractors. They are documents that may be used in court to indicate and defend dates, personnel, procedures, and techniques employed

during site activities. Entries made in these notebooks should be factual, clear, precise, and as non-subjective as possible. Field logbooks, and entries within, are not to be utilized for personal use.

7. ATTACHMENTS

- Attachment 1, Common Data Error Codes

8. FORMS

None.

Attachment 1
Common Data Error Codes

COMMON DATA ERROR CODES

- RE Recording Error
- CE Calculation Error
- TE Transcription Error
- SE Spelling Error
- CL Changed for Clarity
- DC Original Sample Description Changed After Further Evaluation
- WO Write Over
- NI Not Initialed and Dated at Time of Entry
- OB Not Recorded at the Time of Initial Observation

All Error Codes should be circled.

STANDARD OPERATING PROCEDURE

Subject: Chain of Custody Documentation - Paper

1. PURPOSE

The purpose of this procedure is to provide the requirements for completion of written Chain of Custody (COC) documentation and to provide a suggested Chain of Custody Form for project use.

2. SCOPE

This procedure is applicable to all Shaw E & I efforts where samples are transferred among parties, including to off-site testing facilities. Adherence to this procedure is not required whenever the same individual/team is performing the sampling and testing within the same workday, and transfer to the testing process is being documented by other means, e.g. sampling and then field-screening in a mobile laboratory.

3. REFERENCES

- U.S. Environmental Protection Agency, 1986, *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846*, Third Edition.
- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3.
- Shaw E & I, 2002, *Sampler's Training Course Handout*.

4. DEFINITIONS

- **Custody**—The legal term used to define the control and evidence traceability of an environmental sample. A sample is considered to be in an individual's custody when it is in actual physical possession of the person, is in view of the person, is locked in a container controlled by the person, or has been placed into a designated secure area by the person.
- **Chain of Custody Form**—A form used to document and track the custody and transfers of a sample from collection to analysis or placement in a designated secure area within the testing facility.
- **COC Continuation Page**—Additional page(s) that may be included with a Chain of Custody form. The continuation page(s) contain the information on additional samples contained within the *same* cooler/shipping container associated with the cooler/shipping container Chain of Custody form.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Documentation

All Chain of Custody documentation must be completed in indelible ink. All corrections must be performed using standard single-line cross-out methods, and the initials of the individual making the change must be included beside the corrected entry.

6.2 Continuation Pages

Continuation pages may be utilized for shipping containers/coolers with sufficient samples/sample containers that all of the lines of the Chain of Custody form are used before the documentation of the cooler/shipping container is complete. The number of pages in total must be filled out. *All samples entered onto a Continuation Page must be included in the same cooler/shipping container as those on the Chain of Custody form itself.*

6.3 Header Information

- Each Chain of Custody form must be assigned a unique Reference Document Number–use the Project/proposal number followed by a unique numeric sequence or current date (if only one cooler sent per day). Continuation Pages should contain the same Document Reference Number as the Chain of Custody form that they are associated with. The project team should maintain a log of Chain of Custody Reference Document Numbers.
- The page identifier and total page count section must be completed. Total pages include the Chain of Custody form and any attached Continuation Pages.
- Project number, name, and location information must be completed for all forms.
- If available, the laboratory Purchase Order Number should be included on the appropriate line.
- The name and phone number of the *Project Contact* should be included; the Project Contact should be a responsible individual that the laboratory may access to address analytical issues. This person is usually the analytical lead for the project.
- The *Shipment Date* should be provided on the applicable lines.
- If shipping by carrier, the *Waybill/Airbill Number* must be included. Note: couriers will not sign custody documents. Therefore, inclusion of the waybill/airbill number on the Chain of Custody is the *only* means of documenting the transfer to the carrier.
- Laboratory Destination and Contact information should be provided.

- The Sampler(s) names should be provided on the appropriate line. This line should include all persons whose initials appear on any of the sample containers, to provide the laboratory a means of cross-referencing containers.
- The "Send Report To" information should be completed. If multiple reports/locations are needed, the information should be provided on a separate page included with the Chain of Custody documents.

6.4 Sample Information Section–Including on Continuation Page(s)

During actual sampling, each sample must be entered on the COC form at the time of collection in order to document possession. The sampler must not wait until sampling is completed before entering samples on the COC.

- Complete the *Sample ID Number* for each line. If there are multiple container types for a sample, use additional lines to indicate the needed information.
- Ensure that the *Sample Description* matches the description on the sample label–the laboratory will use this information for cross-referencing.
- Provide the *Collection Date* and *Time*. These must match those on the sample label and Field Logbook/Logsheets.
- Indicate whether the sample is a Grab or Composite sample.
- Indicate the *Matrix* of the sample. Use the Matrix Codes listed on the Chain of Custody form.
- Indicate the *Number of Containers* and the *Container Type*. If a sample has multiple container types, use multiple lines and cross-out the information spaces to the left of the container blocks. *Failure to do this may cause the laboratory to log-in each container type as a separate sample/lab-ID, resulting in a confused report and invoice.*
  - Alternatively, if each sample has the same number/type container types, use "various" in the *Container Type* block and provide detail in the *Special Instructions* section, e.g., "Each sample consists of one 16-oz jar, two pre-weighed VOC w/DI water, and one pre-weighed VOC w/Methanol."
- Check the appropriate *Preservative* box for each line/container type.
- Write in and check the *Analyses Requested* boxes for each line/container type. The appropriate method number (e.g., EPA Method 8260C) must be written as well as the method name.
- Indicate the *Turn-around Time Requested* for each sample.
- Use the *Special Instructions* section to provide important information to the laboratory, e.g., samples that may require dilution or samples that will need to be composited by the laboratory. This section may also be used to inform the laboratory of additional information contained in attachments to the Chain of Custody package.
- Circle the appropriate *QC/Data Package Level* requested.

6.5 Custody Transfer Section

- The first *Relinquished By* space must be completed by the individual who will either transfer the samples or seal the shipping container.

- If the samples will be transferred to a courier, write the courier/carrier company in the *Received By* box and enter the Date and Time that the shipping container was closed.
- All other transfers must be performed in person, and the Relinquisher must witness the signing by the Receiver.
- A copy of the Chain of Custody form and all associated Continuation Pages should be maintained in the project files.

7. ATTACHMENTS

None.

8. FORMS

- Shaw E & I Chain of Custody Form
- Shaw E & I COC Continuation Page

Shaw® Shaw E & I

FS003.1_0

Ref. Document # _____

Shaw E & I Chain of Custody Form

Page _____ of ___

Project Number: _____

Project Name / Location: _____

Purchase Order #: _____

Shipment Date: _____

Waybill/Airbill Number: _____

Lab Destination: _____

Lab Contact Name / ph. #: _____

Project Contact: _____
(Name & phone #)

Send Report To: _____

Phone/Fax Number: _____

Address: _____

City: _____

Sampler's Name(s): _____

Sample ID Number	Sample Description	Collection Information			Matrix	# of containers	Container type	Preservative						Analyses Requested									Turn Around Time Requested
		Date	Time	G/C				HCL	NaOH	HNO_3	H_2SO_4	Ice											

Special Instructions:

QC/Data Package Level Required:

I II III IV/Project Specific: _____

Relinquished By:	Date:	Received By:	Date:
	Time:		Time:
Relinquished By:	Date:	Received By:	Date:
	Time:		Time:
Relinquished By:	Date:	Received By:	Date:
	Time:		Time:

G/C Codes

C = Composite G = Grab

Matrix Codes

DW = Drinking Water	SO =Soil
GW = Ground Water	SL = Sludge
WW = Waste Water	CP = Chip Samples
SW = Surface Water	WP = Wipe Samples
LIQ = Other Liquid	SOL = Other Solid
AS = Air Sample	SED = Sediment

Shaw E & I COC Continuation Page

COC Ref. Document # _____ Page _____ of _____

Project Number: _____ Shipment Date: _____

Project Name / Location: _____

Sample ID Number	Sample Description	Collection Information			Matrix	# of containers	Container type	Preservative						Analyses Requested										Turn Around Time Requested
		Date	Time	G/C				HCL	NaOH	HNO_3	H_2SO_4	Ice												

STANDARD OPERATING PROCEDURE

Subject: Custody Seals

1. PURPOSE

The purpose of this procedure is to provide the requirements for completion and attachment of Custody Seals on environmental samples and shipping containers.

2. SCOPE

This procedure is applicable to all Shaw E & I efforts where sample legal defensibility and custody integrity is desired. Adherence to this procedure is not required whenever the same individual/team is performing the sampling and testing within the same workday, and transfer to the testing process is being documented by other means, i.e. sampling and then field-screening in a mobile laboratory.

3. REFERENCES

- U.S. Environmental Protection Agency, 1986, *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods, SW-846*, Third Edition.
- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans, EM200-1-3*
- Shaw E & I, 2002, Sampler's Training Course Handout.

4. DEFINITIONS

- **Custody**—The legal term used to define the control and evidence traceability of an environmental sample. A sample is considered to be in one's custody if it is in actual physical possession of the person, is in view of the person, has been locked in a container controlled by the person, or has been placed into a designated secure area by the person.
- **Custody Seal**—Commercially available thin strips of adhesive paper with write-in lines for the date/time and identification of the using party. Custody seals are placed over the caps of sample containers and along the cover seals of shipping containers as a means to detect tampering before arrival at the testing facility. All Shaw E & I strategic alliance laboratories provide Custody Seals in their sample container supply kits.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Completing the Custody Seal Information

- All Custody Seals must be completed in indelible ink. All corrections must be made using standard single-line cross-out methods, and the initials of the individual making the change must be included beside the corrected entry.
- Each Custody Seal attached must be completed by writing the *Date*, at a minimum, and signing with *full signature* by the person responsible for the sealing of the sample.
- If a space is provided, the *Time* should also be added.

6.2 Attaching the Custody Seals

Whenever possible, custody seals should be attached over the sample container lids during actual sampling and not when the samples are packaged for shipment. This will provide confidence in legal custody and will demonstrate non-tampering during the sample collection process.

Do not attach custody seals to VOC sample containers, as contamination may occur. For these samples, the custody seal should be used to seal the folded plastic zip bag that holds the sample containers.

- For sample jars, the completed Custody Seal should be placed across the top of the lid with the edges below the lid/jar interface and attached to the jar material. This will require the visible breaking of the seal in order to open the container.
- Sample coolers and shipping containers should have Custody Seals attached in such a manner that the seal extends lengthwise from the top edge of the lid to the side of the cooler/container.

7. ATTACHMENTS

None.

8. FORMS

None.

STANDARD OPERATING PROCEDURE

Subject: Sample Labeling

1. PURPOSE

The purpose of this procedure is to provide the requirements for completion and attachment of sample labels on environmental sample containers.

2. SCOPE

This procedure is applicable to all Shaw E & I projects/proposals where samples will be collected.

3. REFERENCES

- U.S. Environmental Protection Agency, 1986, *Test Methods for Evaluating Solid Waste; Physical/Chemical Methods*, SW-846, Third Edition.
- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3
- Shaw E & I, 2002, Sampler's Training Course Handout.

4. DEFINITIONS

- **Sample Label**—Any writing surface with an adhesive backing that can be used to document sample identification information. The sample label is attached to the sample container as a means of identification and, in some commercially available or laboratory-supplied containers, may be pre-attached. All Shaw E & I strategic alliance laboratories provide sample labels or pre-labeled containers in their sample container supply kits.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

- All sample labels must be completed in indelible ink. All corrections must be performed using standard single-line cross-out methods, and the initials of the individual making the change must be included beside the corrected entry.
- Sample labels should be completed and attached as samples are collected. Do not wait until final packaging to attach and/or complete the sample labels.
- Sample labels must be attached to the non-sealing portion of the container. Do not place labels on or across sample container caps.
- If the laboratory has provided pre-labeled containers, make sure to fill one for each parameter set needed. Laboratory pre-labeled containers are often bar-coded and it is important to provide a complete container set for each sample.
- The following information must be recorded on the Sample Label:
  - Sample Identification Number
  - Date and Time collected
  - Initials of person(s) responsible for collection
- If a space is provided, the *Analysis Requested* should also be added.
- If a *Description* is provided, remember it must match that on the Chain of Custody form for cross-referencing purposes.
- Cover the completed and attached label with clear plastic tape to prevent bleeding of the ink if it becomes wetted. *Do **not** perform this step for pre-weighed VOC vials, as the final weight values will be influenced by the mass of the tape. Protect these containers by enclosing the rack/holder in a plastic bag within the cooler.*

7. ATTACHMENTS

None.

8. FORMS

None.

STANDARD OPERATING PROCEDURE

Subject: Sample Homogenization

1. PURPOSE

The purpose of this procedure is to establish the method for homogenizing samples prior to containerization. Proper homogenization is very important because it helps ensure that sample aliquots are representative of the whole collected sample and helps minimize sampling error so that other errors included in the measurement process, such as laboratory sample preparation and test measurement, can be better assessed.

2. SCOPE

This procedure applies to Shaw Environmental & Infrastructure (Shaw E & I) personnel responsible for the collection of environmental samples. The sample matrix must be amenable to mixing. This SOP applies to the collection of samples that are to be tested for all analytes except volatile analytes.

3. REFERENCES

- American Society for Testing and Materials (ASTM), 1998, Reducing Samples of Aggregate to Testing Size, C702.
- U.S. Army Corps of Engineers, Requirements for the Preparation of Sampling and Analysis Plans, EM 200-1-3, Section E-2, Homogenizing Techniques.

4. DEFINITIONS

- **Homogenize**—The use of physical mixing motions to make a uniform sample matrix.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

Sampling equipment materials shall be selected so as to minimize contamination of samples. Sampling equipment shall be either new (never used previously), documented to have been decontaminated, or dedicated to each specific sampling point. Samples for organic constituent/compound analysis should be collected and mixed using non-reactive material such as glass or stainless steel bowls, trowels, and/or spoons. Samples for metals analysis should be collected and mixed using equipment made of stainless steel, glass, or Teflon®.

Certain types of solid matrices may not be amenable to mixing using conventional techniques. For example, certain solids may require grinding and thorough mixing to ensure that the analytes of interest within the sample are homogeneously distributed. It is extremely important that soil and sediment samples be homogenized to ensure that the entire sample is as representative as possible of the media being sampled.

6.1 Solid Samples

The following two methods are examples for homogenizing solid samples. Other homogenization techniques may be employed using approved standard methods such as ASTM C702, Reducing Samples of Aggregate to Testing Size.

6.1.1 Quartering

- Place the sample on a hard, clean, level surface such as a pan. If such a surface is too small for the desired quantity, a clean sheet of plastic may be used.
- Mix the solid material by turning the entire quantity over three times with a trowel or shovel. For the third time, shovel the material into a cone-shaped pile.
- Carefully press down on the apex of the pile to create a soil layer of uniform thickness and diameter.
- Divide the material in the sample pan or on the plastic into quarters

  Option 1

  – Mix each quarter individually
  – Then mix two quarters to form halves
  – Mix each formed half and then fill the appropriate sample jars/containers

  Option 2

  – Remove two diagonally opposite quarters including any fine material
  – Mix the remaining material, build it into a cone, and press down to flatten as before
  – Divide the flattened material into quarters, discard two diagonally opposing sections, and repeat
  – Repeat the process until only enough sample remains to fill the required containers and proceed to fill the sample jars.

6.1.2 Mixing in a Bowl

- Place the sample in a bowl. Samples for organic constituent/compound analysis should be mixed using bowls and stirrers made of glass or stainless steel, while samples for metals analysis should be mixed using equipment made of glass, stainless steel, or hard plastic. Make sure the bowl is large enough to accommodate the sample, with extra volume to allow for mixing the sample.

- Mix the sample with the stirrer. If round bowls are used for sample mixing, adequate mixing is achieved by stirring the material in a circular fashion, reversing direction, and occasionally turning the material over. High moisture samples are more difficult to homogenize. Use an adequate mixing motion for as long as needed to determine by visual observation that the sample media has taken on a uniform appearance.

6.2 Liquid Samples

Most aqueous samples do not require homogenization since water is well mixed due to diffusion and bulk convection. If the sample matrix is a viscous liquid, semi-solid, or an aqueous one with suspended solids, the sample will require mixing.

Do **not** shake the sample and do not agitate the sample in **any** way if collecting for volatile parameters. Volatile sample containers should be either filled directly from the sample source or if transferring from a large container, such as an automatic sampler reservoir, filled first and **without agitation**.

For non-volatile parameters, mix either using an appropriate stirrer or by gentle swirling and then immediately transfer the material into the appropriate containers. The sample should be mixed frequently during the container-filling step, in particular if there are a large number of containers, so that the condition of the bulk sampled fluid will be approximately the same when each parameter-specific sample container is filled.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Shipping and Packaging of Non Hazardous Samples

1. PURPOSE

The purpose of this procedure is to provide general instructions in the packaging and shipping of non-hazardous samples. The primary use of this procedure is for the transportation of samples collected on site to be sent off site for physical, chemical, and/or radiological analysis.

2. SCOPE

This procedure applies to the shipping and packaging of all non-hazardous samples. Non-hazardous samples are those that do not meet any hazard class definitions found in 49 CFR 107-178, including materials designated as Class 9 materials and materials that represent Reportable Quantities (hazardous substances) and/or materials that are not classified as *Dangerous Goods* under current IATA regulations.

In general most soil, air, and aqueous samples, including those that are acid or caustic preserved do **not** qualify as *hazardous materials* or *dangerous goods*. An exception is methanolic soil VOC vials: these containers are flammable in any quantity and **must** be packaged, shipped, and declared as *Dangerous Goods* whenever transported by air.

The Class 9 "Environmentally Hazardous" designation should only be applied to samples if they are known or suspected (via screening) to contain a sufficient concentration of contaminant to pose a health and/ or environmental risk if spilled in transport. Samples for which screening has shown a potential hazard (i.e. flammability) or those that are derived from a known hazard, including a site/facility with confirmed contamination by an *infectious substance* must also be shipped in accordance with the applicable DOT/IATA requirements. Refer to Shaw E & I SOP FS013.

Improper shipment of hazardous materials, especially willful misrepresentation and shipment as non-hazardous materials, is a violation of federal law and is punishable by fines and possible imprisonment of the guilty parties. It is also a violation of Shaw E & I policy and can result in disciplinary action up to and including termination of employment.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3, Washington, D.C.
- U.S. Department of Transportation Regulations, 49 CFR Parts 108-178
- International Air Transport Association (IATA), *Dangerous Goods Regulations*, current edition.

4. DEFINITIONS

- **Cooler/Shipping Container**—Any hard-sided insulated container meeting DOT's or IATA's general packaging requirements.
- **Bubble Wrap**—Plastic sheeting with entrained air bubbles for protective packaging purposes.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Packaging

- Use tape and seal off the cooler drain on the inside and outside to prevent leakage.
- Place packing material on the bottom on the shipping container (cooler) to provide a soft impact surface.
- Place a large (30-55 gallon or equivalent) plastic bag into the cooler (to minimize possibility of leakage during transit).
- Starting with the largest glass containers, wrap each container with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.
- Pack the largest glass containers in the bottom of the cooler, placing packing material between each of the containers to avoid breakage from bumping.
- Double-bag the ice (chips or cubes) in gallon- or quart-sized resealable plastic freezer bags and wedge the ice bags between the sample bottles.
- Add bagged ice across the top of the samples.
- When sufficiently full, seal the inner protective plastic bag, and place additional packing material on top of the bag to minimize shifting of containers during shipment.
- Tape a gallon-sized resealable plastic bag to the inside of the cooler lid, place the completed chain of custody document inside, and seal the bag shut.
- Tape the shipping container (cooler) shut using packing tape, duct tape, or other tear-resistant adhesive strips. Taping should be performed to ensure the lid cannot open during transport.
- Place a custody seal on two separate portions of the cooler, to provide evidence that the lid has not been opened prior to receipt by the intended recipient.

6.2 Labeling

- A “This Side Up” arrow should be adhered to all sides of the cooler, especially ones without obvious handles.
- The name and address of the receiver and the shipper must be on the top of the cooler.
- The airbill must be attached to the top of the cooler.

6.3 Shipping Documentation

- A Cooler Shipment Checklist (Attachment 1) should be completed and kept in the project file.

7. ATTACHMENTS

- Attachment 1, Shaw E & I Cooler Shipment Checklist

8. FORMS

None.

Shaw® Shaw E & I

Attachment 1
Shaw E & I Cooler Shipment Checklist

Shaw™
Shaw E & I, Inc.

Project Name _____ Project Number _____
Address _____ Date _____ Time _____
City, State, Zip _____ Fax No. _____
Site Contact No. _____

SAMPLE CHECKLIST	YES	NO	COMMENTS
SAMPLE LIDS ARE TIGHT AND CUSTODY SEALS IN PLACE?	❒	❒	
ARE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER LABEL INFORMATION LEGIBLE AND COMPLETE?	❒	❒	
HAVE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER SAMPLING DATA BEEN LOGGED INTO THE SAMPLE LOG BOOK?	❒	❒	
DO SAMPLE NUMBERS AND SAMPLE DESCRIPTIONS ON THE LABELS MATCH THOSE ON THE COC?	❒	❒	
HAVE THE SAMPLES BEEN PROPERLY PRESERVED?	❒	❒	
HAVE THE CHAIN OF CUSTODIES BEEN FILLED OUT COMPLETELY AND CORRECTLY?	❒	❒	
DOES THE ANALYTICAL SPECIFIED ON THE COC MATCH THE ANALYTICAL SPECIFIED IN THE SCOPE OF WORK?	❒	❒	
HAVE THE COC'S BEEN PROPERLY SIGNED IN THE TRANSFER SECTION?	❒	❒	

PACKAGING CHECKLIST	YES	NO	COMMENTS
HAS EACH SAMPLE BEEN PLACED INTO AN INDIVIDUAL PLASTIC BAG?	❒	❒	
HAS THE DRAIN PLUG OF THE COOLER BEEN TAPED CLOSED WITH WATER PROFF TAPE FROM THE INSIDE?	❒	❒	
HAVE ALL THE SAMPLES BEEN PLACED INTO THE COOLER IN AN UPRIGHT POSITION?	❒	❒	
IS THERE ADEQUATE SPACING OF SAMPLES SO THAT THEY WILL NOT TOUCH DURING SHIPMENT?	❒	❒	
HAVE AN ADEQUATE NUMBER OF BLUE ICE PACKS OR WATER ICE BEEN PLACED AROUND AND ON TOP OF THE SAMPLE?	❒	❒	
HAS FRESH BLUE ICE OR WATER ICE BEEN ADDED TO THE COOLER THE DAY OF THE SHIPMENT?	❒	❒	
HAS THE COOLER BEEN FILLED WITH ADDITIONAL CUSHIONING MATERIAL?	❒	❒	
HAS THE COC BEEN PLACE IN A ZIPLOCK BAG AND TAPED TO THE INSIDE OF THE LID OF THE COOLER?	❒	❒	
HAVE CUSTODY SEALS BEEN PLACED ONTO THE LID?	❒	❒	
HAS THE COOLER BEEN LABELED "THIS SIDE UP"?	❒	❒	
IF REQUIRED, HAS THE COOLER BEEN LABELED WITH THE DOT PROPER SHIPPING NAME, UN NUMBER AND LABEL?	❒	❒	
HAS THE LABORATORY PERFORMING THE ANALYSES BEEN NOTIFIED OF THE SHIPMENT OF SAMPLES?	❒	❒	

PROBLEMS/RESOLUTIONS: _____

_____

_____

PREPARED BY: _____ SIGNATURE _____

STANDARD OPERATING PROCEDURE

Subject: Packaging and Shipping of DOT/IATA-Hazardous Samples

1. PURPOSE

The purpose of this procedure is to provide general instructions for packaging and shipping of hazardous samples, as defined by DOT and/or IATA, including Class 9 "Environmentally hazardous substances." The primary use of this procedure is for the transportation of samples collected on site to be sent off site for physical, chemical, biological (*infectious substance*), and/or radiological analysis in accordance with applicable laws and regulations and without destroying sample integrity.

2. SCOPE

This procedure applies to the packaging and shipping of all DOT/IATA-hazardous samples. Samples must be packaged and shipped as hazardous materials if they meet any of the hazard class definitions in 49 CFR 107-178, including Reportable Quantities, and/or if they can be classified as a *Dangerous Good* under IATA. All IATA classified materials designated for air transport, even in Limited Quantities, **must** be declared, packaged, and shipped as *Dangerous Goods.* Examples include methanolic VOC soil samples and any samples from a project/facility known to be impacted by an *infectious substance.*

Improper shipment of hazardous materials, especially willful misrepresentation and shipment as non-hazardous materials, is a violation of federal law and is punishable by fines and possible imprisonment of guilty parties. It is also a violation of Shaw E & I policy and can result in disciplinary action up to and including termination of employment.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM200-1-3, Washington, D.C.
- U.S. Department of Transportation Regulations, 49 CFR Part 107-178
- *Dangerous Goods Regulations*, current edition, International Air Transport Association (IATA)

4. DEFINITIONS

- ***Dangerous Goods* Airbill**—Form required when offering *Dangerous Goods* as defined in IATA regulations for air transport. The "*Dangerous Goods* Airbill" must be completed and signed by a responsible and qualified person. Some carriers require a typed or computer-generated form.
- **Inner packaging**—Packaging in immediate contact with the hazardous materials to be shipped, such as a sample jar or vial.
- **Limited Quantity**—In the IATA Tables, the maximum total amount of a *Dangerous Good* that can be transported without using UN-specification containers, such as a non-UN tested cooler.

- **Outer packaging**—Packaging into which one or more inner packages can be placed, such as a sturdy plastic cooler meeting general packaging requirements or a 5-gallon UN-specification plastic pail.
- **Performance-Oriented Packaging**—Packaging designed for and tested to be used for shipment of DOT-hazardous materials. Also known as "UN-specification" packaging.
- **Qualified person**—An individual with appropriate DOT/IATA Hazardous Materials training, including General Awareness, Function-Specific, and Safety training, necessary to properly classify samples as hazardous materials and to complete all subsequent shipping steps.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for the maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for recording information in sufficient detail to provide objective documentation (i.e. checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

A Qualified Person **must** perform or oversee the classification, packaging, and completion of all related declaration and shipping papers. *It is a violation of federal law to pre-complete these documents and provide them to an unqualified person without providing minimal training to that person.* This training **must** be documented and may take the form of a verbal discussion, hands-on demonstration, or detailed written instructions, including a task-specific SOP, with review provided by the Qualified Person.

The basic packaging and shipping procedures are as follows:

- Determine the traits of the material to be shipped and compare them to the specific hazard class definitions in the appropriate regulations. If the material falls within one or more hazard class definitions, it is deemed "hazardous". Select the most accurate proper shipping name and packing group combination, and prepare the package according to the prescribed requirements for quantity limitations, authorized packaging, marking, labeling, and documentation.
- Check the current IATA regulations to make sure the carrier accepts the material(s) and/or does not have its own special requirements for shipment.
- If shipping multiple inner packages that each meet a separate hazard class definition, consult the "Separation and Segregation" table in the appropriate regulations for guidance on

packaging and prepare as an over-pack with individual marking and labeling on the outer packaging.

- If shipping multiple inner packages that meet the same hazard class(es) but represent both solid and liquid matrices, prepare as an over-pack with individual marking and labeling on the outer packaging.
- If shipping hazardous material that meets more than one hazard class definition, check the hazard precedence table in the appropriate regulations to determine primary and subsidiary classes.

6.1 Additional Inner Packaging Requirements

- Place each sample container into a resealable plastic baggie.
- Fold over and tape the bag seal onto the sample jar to prevent the closure from unsealing.
- Several IATA packing instructions require containerizing of glass/plastic sample jars into a sealed primary receptacle such as a metal can before placing them into outer-packaging, i.e. the cooler.
  - Wrap the bagged sample container with bubble-wrap or other packing material to prevent breakage against the sides of the primary receptacle, and place it into the primary receptacle.
  - Seal the primary receptacle and label it with the Sample ID and any hazard information and place it into a plastic bag to protect the label.

6.2 Additional Outer Packaging Requirements

- Samples that in total qualify as Excepted Quantities or Limited Quantities do not require the use of UN-specification packaging and may be shipped in sturdy coolers, pails, or any packaging that meets general packaging requirements.
- Samples that do not qualify as Excepted Quantities or Limited Quantities require UN-specification packaging. For such samples that also require cooling to meet sample preservation requirements, UN-specification coolers are available from several Haz-Mat packaging vendors.
- If using a cooler of any kind, seal off the cooler drain on the inside and outside with tape to prevent leakage.
- Place cushioning and/or absorbent material on the bottom of the outer packaging to provide a soft impact surface.
- Place a plastic bag into the container (to minimize the possibility of leakage during transit).
- Wrap glass inner packagings with sufficient bubble wrap to ensure the best chance to prevent breakage of the container.
- For methanolic soil VOC vials, place vials into the supplied rack/holder or box and then place it into a tied off plastic bag to keep out moisture.
- Pack the largest inner packagings in the bottom of the container with cushioning material between each to avoid breakage from bumping.
- If cooling is required, double-bag the ice (chips or cubes) in gallon- or quart-size freezer Ziploc-type resealable plastic bags, and wedge the ice bags between the inner packages and/or primary receptacles. Also add bagged ice across the top of the samples/receptacles.

- When sufficiently full, seal the plastic bag that lines the outer packaging, and place additional cushioning material on top of the bag to minimize shifting of contents during shipment.
- Tape a gallon Ziploc-type bag to the inside of the container lid, place the completed chain of custody document inside, and seal the bag shut.
- Tape the outer packaging closed using packing tape, duct tape, or other tear-resistant adhesive strips.
- Place a custody seal on two separate portions of the outer packaging to provide evidence that the lid remains sealed during transit.

6.3 Marking and Labeling

- If the package contains any liquids, orientation arrows must be applied to two opposite faces of the package (front and back or both ends).
- The proper shipping name, UN number, and all other required markings, as well as the appropriate hazard class label, must be placed on the same face of the package in close proximity to each other.
- Consignor and consignee information should appear on some face of the package in addition to appearing on the shipping papers that are enclosed in a pouch attached to the package.

6.4 Shipping Documentation

- If a sturdy cooler is used, whether UN-specification or not, complete a Cooler Shipment Checklist (see Attachment 1) and keep it in the project file.
- A Dangerous Goods Airbill must be completed, inserted into an adhesive pouch, and attached to the package in close proximity to the proper shipping name and hazard class label.
- Many carriers require a typed or computer-generated Dangerous Goods Airbill.
- If the Dangerous Goods Airbill has an area specifically designated for a “24-Hour Emergency Response” telephone number, insert “800-424-9300” into that space. If it does not, write “24-Hour Emergency Response Telephone Number: 800-424-9300” in the “Additional Handling Information” section of the airbill. Immediately following the telephone number, write “ERG-*xxx*,” where *xxx* is the 3-digit Emergency Response Guidebook page number that corresponds to the hazardous material being shipped.
- The shipper must sign the certification on the airbill.
- Prior to carrier pickup, a copy of the Dangerous Goods Airbill must be faxed to CHEMTREC at 703-741-6037 with a Shaw coversheet addressed to “ITCR.”

7. ATTACHMENTS

- Attachment 1, Shaw E & I Cooler Shipment Checklist

8. FORMS

None.

Shaw® Shaw E & I

Attachment 1
Shaw E & I Cooler Shipment Checklist

Shaw™
Shaw E & I, Inc.

Project Name _____ Project Number _____
Address _____ Date _____ Time _____
City, State, Zip _____ Fax No. _____
Site Contact No. _____

SAMPLE CHECKLIST	YES	NO	COMMENTS
SAMPLE LIDS ARE TIGHT AND CUSTODY SEALS IN PLACE?	❒	❒	
ARE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER LABEL INFORMATION LEGIBLE AND COMPLETE?	❒	❒	
HAVE ALL SAMPLE NUMBERS, DATES, TIMES AND OTHER SAMPLING DATA BEEN LOGGED INTO THE SAMPLE LOG BOOK?	❒	❒	
DO SAMPLE NUMBERS AND SAMPLE DESCRIPTIONS ON THE LABELS MATCH THOSE ON THE COC?	❒	❒	
HAVE THE SAMPLES BEEN PROPERLY PRESERVED?	❒	❒	
HAVE THE CHAIN OF CUSTODIES BEEN FILLED OUT COMPLETELY AND CORRECTLY?	❒	❒	
DOES THE ANALYTICAL SPECIFIED ON THE COC MATCH THE ANALYTICAL SPECIFIED IN THE SCOPE OF WORK?	❒	❒	
HAVE THE COC'S BEEN PROPERLY SIGNED IN THE TRANSFER SECTION?	❒	❒	

PACKAGING CHECKLIST	YES	NO	COMMENTS
HAS EACH SAMPLE BEEN PLACED INTO AN INDIVIDUAL PLASTIC BAG?	❒	❒	
HAS THE DRAIN PLUG OF THE COOLER BEEN TAPED CLOSED WITH WATER PROFF TAPE FROM THE INSIDE?	❒	❒	
HAVE ALL THE SAMPLES BEEN PLACED INTO THE COOLER IN AN UPRIGHT POSITION?	❒	❒	
IS THERE ADEQUATE SPACING OF SAMPLES SO THAT THEY WILL NOT TOUCH DURING SHIPMENT?	❒	❒	
HAVE AN ADEQUATE NUMBER OF BLUE ICE PACKS OR WATER ICE BEEN PLACED AROUND AND ON TOP OF THE SAMPLE?	❒	❒	
HAS FRESH BLUE ICE OR WATER ICE BEEN ADDED TO THE COOLER THE DAY OF THE SHIPMENT?	❒	❒	
HAS THE COOLER BEEN FILLED WITH ADDITIONAL CUSHIONING MATERIAL?	❒	❒	
HAS THE COC BEEN PLACE IN A ZIPLOCK BAG AND TAPED TO THE INSIDE OF THE LID OF THE COOLER?	❒	❒	
HAVE CUSTODY SEALS BEEN PLACED ONTO THE LID?	❒	❒	
HAS THE COOLER BEEN LABELED "THIS SIDE UP"?	❒	❒	
IF REQUIRED, HAS THE COOLER BEEN LABELED WITH THE DOT PROPER SHIPPING NAME, UN NUMBER AND LABEL?	❒	❒	
HAS THE LABORATORY PERFORMING THE ANALYSES BEEN NOTIFIED OF THE SHIPMENT OF SAMPLES?	❒	❒	

PROBLEMS/RESOLUTIONS: _____

PREPARED BY: _____ SIGNATURE _____

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STANDARD OPERATING PROCEDURE

Subject: Decontamination of Contact Sampling Equipment

1. PURPOSE

This procedure is intended to provide minimal guidelines for the decontamination of contact sampling equipment. Contact sampling equipment is equipment that comes in direct contact with the sample or the portion of a sample that will undergo chemical analyses or physical testing.

2. SCOPE

This procedure applies to all instances where non-disposable direct contact sampling equipment is utilized for sample collection and no project-specific procedure is in place. This procedure is not intended to address decontamination of peristaltic or other sampling pumps and tubing. The steps outlined in this procedure must be executed between each distinct sample data point.

3. REFERENCES

- U.S. Environmental Protection Agency, Region 4, 2001, *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*, 980 College Station Road, Athens, Georgia. November.
- US Army Corp of Engineers, Washington, D.C., 2001, Requirements for the Preparation of Sampling and Analysis Plans (EM-200-1-3), February.

4. DEFINITIONS

- **Soap**—A standard brand of phosphate-free laboratory detergent, such as Liquinox®.
- **Organic Desorbing Agent**—A solvent used for removing organic compounds. The specific solvent would depend upon the type of organic compound to be removed. See Attachment 1 for recommendations.
- **Inorganic Desorbing Agent**—An acid solution for use in removing trace metal compounds. The specific acid solution would depend upon the type of inorganic compound to be removed. See Attachment 1 for recommendations.
- **Tap water**—Water obtained from any municipal water treatment system. An untreated potable water supply can be used as a substitute for tap water if the water does not contain the constituents of concern.
- **Distilled Water**—Water that has been purified via distillation. Distilled water can be purchased in most stores and is acceptable as a final rinse in non-trace analytical decontamination processes. Examples would include disposal profiling, HazCat, and other gross screening applications.
- **Analyte-free water**—Water that has been treated by passing through a standard deionizing resin column, and for organics either distillation or activated carbon units. At a minimum, the finished water should contain no detectable heavy metals or other inorganic compounds, and/or no detectable organic compounds (i.e., at or above analytical detection limits). Type I and Type II Reagent Grade Water meet this definition as does most laboratory-supplied blank water.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

Wear appropriate eye protection including safety goggles when working with corrosive liquids, especially when diluting concentrated materials to create low-percentage solutions and follow all project Health and Safety requirements. Decontamination wastes are to be recovered and handled as impacted project waste materials and must be disposed of in accordance with regulatory requirements.

A decontamination area should be established. Implements can either be immersed in a 5-gallon bucket containing each solution/rinse or the solutions can be contained in hand-held units made of an inert and compatible material; such as a Teflon™ wash bottle. The analyte-free water needs to be placed in a container that will be free of any compounds of concern.

Consult Attachment 1 for the decontamination solutions/solvents appropriate to the task. The minimum steps for decontamination are as follows:

1. Remove particulate matter and other surface debris by brushing and/or dipping in the soap solution.
2. Rinse thoroughly with tap water.
3. If necessary, rinse with other applicable solutions/solvents. If hexane is used, be sure to follow it with isopropyl alcohol to allow for the final water rinses to properly mix and contact the surface.
4. Final rinse three times to make sure all residual solutions/solvents are removed.
5. Place decontaminated equipment on a clean surface appropriate for the compounds of concern and allow to air dry.

7. ATTACHMENTS

- Attachment 1, Recommended Decontamination Procedures.

8. FORMS

None.

Attachment 1
Recommended Decontamination Procedures

Compound	Detergent Wash	Tap Water	Inorganic Desorbing Agent	Tap Water	Organic Desorbing Agent[1]	Final Water Rinse[4]	Air Dry
Organic Constituents							
Volatile Organic Compounds	✓	✓			Methanol Purge & Trap grade	✓	✓
Base Neutrals/Acid Extractables/PCBs/Pesticides	✓	✓			Hexane followed by Isopropyl Alcohol	✓	✓
Organic Bases[2]	✓	✓	1% nitric acid	✓	Isopropyl Alcohol	✓	✓
Organic Acids[3]	✓	✓	1% nitric acid		Isopropyl Alcohol	✓	✓
Inorganic Constituents							
Trace Metals and Radio Isotopes	✓	✓	10% Nitric acid -Trace metals grade	✓		✓	✓
Cations/Anions	✓	✓				✓	✓
Acidic Compounds	✓	✓				✓	✓
Basic Compounds (caustic)	✓	✓	1% nitric acid	✓		✓	✓

1 – All organic solvents must be Pesticide Grade or better. The selection of appropriate solvent rinses should first consider if a *known or suspected* contaminant requires removal from sampling equipment. Secondly, identify whether the subsequent analytical protocol would be impacted by the proposed solvent or an impurity thereof (e.g., residual acetone present in isopropyl alcohol would be measured with certain volatile organics analysis).
2 - Organic bases include amines, hydrazines.
3 - Organic acids include phenols, thiols, nitro and sulfonic compounds.
4- Use a grade of water appropriate to the application. For trace level analysis this must be Analyte Free Water. For non-trace applications store-bought distilled water is sufficient

Adapted from: Appendix E, Requirements for the Preparation of Sampling and Analysis Plans (EM-200-1-3), February 2001. US Army Corp of Engineers, Washington, D.C.

Revision 1- 3/2006

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STANDARD OPERATING PROCEDURE

Subject: Data Usability Review

1. PURPOSE

The purpose of this procedure is to establish the means by which all subcontracted environmental analytical data will be reviewed for completeness and usability based upon comparison to the project action/decision levels and Data Quality Objectives before use in the intended decision-making processes.

2. SCOPE

This procedure applies to all subcontracted analytical data including faxed or e-mailed preliminary reports.

By way of its requirements, this procedure prohibits verbal communication of analytical results and establishes minimum deliverable standards that must be provided for all subcontracted analytical data reports–including faxed or e-mailed preliminary reports. These minimum standards include the following:

- Sample Results
- Chain of Custody – unless already available to the reviewer
- Sample Receipt Documentation – unless already available to the reviewer
- QC Summary – Laboratory Control Blank, Laboratory Control Spike, Matrix Spike, Matrix Spike Duplicate, Post-digest Spike
- Surrogate Summary – (if applicable)
- Hold-time Compliance Summary – or signed certification that all requirements were met
- Initial and Continuing Calibration Information – or signed certification that it meets prescribed requirements
- GC/MS Tuning Information – (if applicable) or signed certification that it meets prescribed requirements

This procedure should be performed only by or under the oversight of properly qualified individuals. Oversight may be accomplished through provision of a project-specific and well-defined checklist, training in its use, regular QA checks, and real-time availability for issue resolution.

3. REFERENCES

- U.S. Environmental Protection Agency, *National Functional Guidelines for Inorganic Data Review*, EPA 540/R-94-013.
- U.S. Environmental Protection Agency, *National Functional Guidelines for Organic Data Review*, EPA 540/R-94-012.

- U.S. Department of Defense, 2002, Department of Defense Quality Systems Manual for Environmental Laboratories, Final, June.
- U.S. Army Corps of Engineers, Requirements for the Preparation of Sampling and Analysis Plans, EM-200-1-3.

4. DEFINITIONS

- **Data Usability Review (DUR)**—The cursory review of an analytical data package for completeness and compliance with the ordered analysis, specified quality, and method/project-specific protocols before the data is used as input to a particular project decision-making process. The DUR process identifies any potential data quality issues and informs the data users of the effect on the data usability.
- **Data Quality Objectives**—The empirical statements and quantitative measures necessary for a given set of measurements to be usable in the planned decision.
- **Data Quality Indicators**—Field and laboratory measures for which compliance with specified requirements or limits can be construed to support attainment of the Data Quality Objectives in a given data set.
- **Analytical Data Package**—The manner in which analytical results are provided from subcontractor laboratories. Analytical Data Packages can be received via fax, e-mail, or postal mail.
- **QC Summary**—A summary table of laboratory QC sample results.
- **Laboratory Control Blank (LCB)**—Reagent Water or Clean Solid Matrix analyzed in the same manner as a sample to determine the Target Analyte concentration contribution due to contamination in the entire analytical system.
- **Laboratory Control Spike (LCS)**—Reagent Water or Clean Solid Matrix spiked with a known concentration of target analytes and analyzed as a sample to determine the method accuracy of the analytical system.
- **Matrix Spike**—A sample spiked with a known concentration of target analyte and analyzed along with the rest of the analytical batch. The percent recovery of the target analytes is used to determine the effect on accuracy due to the sample matrix.
- **Matrix Spike Duplicate**—A duplicate of the Matrix Spike used to determine the analytical precision, expressed as Relative Percent Difference (RPD) of the analytical system.
- **Surrogate Compound**—In several organic methods, a compound similar in structure and chemical behavior to the target analytes, which is added to each Sample and QC Sample at a known concentration before the analysis begins. The surrogate recovery is used to approximate the recovery of the target compounds based upon the behavior of chemically similar analytes.
- **Post-digest Spike**—In metals analyses, used to determine the possibility of chemical interferences and digestion deficiencies. If the normal QC results are unacceptable, a known concentration of the target analyte is added to the sample digestate. The recovery is then used to determine if reanalysis or data qualification is warranted.
- **QC Acceptance Range**—The limits that define QC results demonstrating compliant accuracy and precision.
- **Qualified Person**—An individual capable through knowledge, education, formal training, and/or experience in the establishment and verification of analytical Data Quality Objectives. The

Qualified Person is usually a chemist or environmental professional with several years of environmental analytical experience.

- **Trip Blank**—In VOC analysis, a container of Reagent Grade Water that is included in the sample cooler and analyzed by the laboratory to determine if cross-contamination may have occurred in shipping.
- **Ambient or Field Blank**—Reagent Grade Water containerized during sample collection activities and analyzed at the laboratory. The results are used to determine if sample results may be biased by site environmental factors.
- **Equipment Blank**—Final rinseate collected during sample equipment decontamination and analyzed by the laboratory. The results indicate the effectiveness of the decontamination procedure.
- **Field Duplicate**—An additional sample aliquot or, in some cases, a collocated sample that is collected and analyzed. The results are compared with the original samples as an indication of the overall precision of the entire sampling and analytical process.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that the activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 First-Level Review of the Data Package

Verify that the package contains all of the required elements listed in Section 2. If any items are missing, contact the laboratory immediately and correct the situation.

Compare the reported results to the Chain of Custody request, and verify that all expected samples and analyses results were reported. If results are missing, contact the laboratory and correct the situation. If the “missing” data is not available yet, perform partial review of the data provided and hold the package for follow-up once the non-reported results are provided.

6.2 Second-Level Review

Consult the project Chemical Quality Plan (SAP, QAPP, etc.) for information concerning sample types and analysis requirements.

Compare the reported analytes, methods, and detection limits to those in the project plan for the specific analyses. Be sure to account for indicated and reasonable increased reporting limits due to dilutions or sample effects. Address any discrepancies with the laboratory directly.

Compare the results to project action-levels, and circle or otherwise mark all results above the limits.

6.3 QC Level Review

Consult the project Data Usability Review Checklists and/or the project Chemical Quality Plan and evaluate all provided QC results against project acceptance limits.

Mark or flag any results that are outside of the project limits and note on the applicable checklist (if using one).

Also evaluate any Field QC results such as Duplicates and Trip Blanks against requirements and note any issues.

6.4 Usability Review

If all QC results for all samples are within the acceptance ranges, complete the appropriate section of the checklist and then date and sign the completed checklist.

If all QC is acceptable and you are not using a checklist, you must indicate data usability directly on the data package itself or on a separate cover sheet. To do this, date and initial the QC Summary pages and write "QC acceptable data OK for use" on the cover sheet or QC Summary page.

If any QC is non-compliant, review its impact to use as project data by referencing the QC Results Impact Table attached to this SOP and consult with the Qualified Person to determine final acceptability. Note on the Data Report itself or checklist all discrepancies and the reasons for data acceptance, qualification, or rejection. If a Qualified Person has made the decision, this should also be noted.

If any of the data is determined to be unusable, immediately notify the Project Manager and project site personnel.

6.5 Reporting of Usability Review Results

Project personnel must be provided either a spreadsheet summary of the results with an attached, signed and dated Statement of Usability, or the complete Data Package with the project-specific Data Usability Review documentation. At **no time** are results to be communicated verbally.

7. ATTACHMENTS

- Attachment 1, Project QC Impact Table

8. FORMS

None.

Attachment 1
Project QC Impact Table

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
DISPOSAL				
Trip Blank Contaminated	No effect	No effect	No effect	No effect
LCB Contaminated	No effect on data	No effect on data	No effect unless contamination is >10% of action-level→reject	No effect unless contamination is =/> the difference between result and action-level
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable and the RL is at most 20% of action-level→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted Otherwise, flag and qualify that results may in fact be greater than action-level	If MS/MSD are acceptable or Surrogates are acceptable and LCS is within 10% of acceptance limit and result is above action-level→Data accepted Otherwise, flag and qualify result as suspected to be above action-level	No effect on data
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable evaluate potential bias in QC and accept data	No effect on data
Matrix Spike Low %R	If MSD and LCS acceptable and Surrogates or Post-spike within range Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range Data is accepted with precision qualifier	No effect on data	No effect on data
Matrix Spike High %R	No effect on data	No effect on data	No effect on data	No effect on data
MS/MSD RPD High	No effect on data	No effect on data	No effect on data	No effect on data
Surrogate %R Low	If surrogate %R values are at least 70% of acceptance limit, Data is acceptable	If surrogate %R values are at least 70% of acceptance limit, Data is acceptable	No effect on data	No effect on data
Surrogate %R High	No effect on data	No effect on data	If surrogate %R values are within 30% of acceptance limit→Data is acceptable	No effect on data

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
REMEDIATION or TREATMENT MONITORING				
Trip Blank Contaminated	No effect	No effect	If TB is greater than 10% of action-level or result→reject data	No effect
Duplicate Precision outside limits	No effect unless Duplicate is either above or within 50% of action-level - in this case qualify sample data and report with Duplicate result as "highest probable value"	No effect unless Duplicate is either above or within 30% of action-level - in this case qualify result as "assumed above action-level"	If Duplicate is either above or within 20% of action-level→qualify result as "assumed above action-level"	No effect-report result even if Duplicate is below action-level
LCB Contaminated	No effect on data	No effect on data	If LCB is greater than 10% of action-level or sample result→Data is unacceptable	No effect on data
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	No effect on data
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable evaluate for bias→Data accepted	No effect on data
Matrix Spike Low %R	If %R>50 and LCS acceptable-Data accepted	If %R>50 and LCS acceptable-Data accepted	If %R>50 LCS acceptable→Data accepted (evaluate potential low bias in results below action-level)	No effect
Matrix Spike High %R	No effect on data	No effect on data	If MSD and LCS acceptable and Surrogates or Post-spike within range→Data is accepted with precision qualifier	No effect on data
MS/MSD RPD High	No effect on data unless perceived native concentration in MS or MSD result would be above action-level. In this case, reject data as highly suspect and advise review of sampling and lab sub-sampling procedures	No effect on data unless perceived MS or MSD native concentration would be above action-level. In this case, qualify results as potentially above action-level	If the perceived native result of either the MS or MSD is greater than 110% of action-level→qualify data as being above action-level	No effect on data

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
Surrogate %R Low	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	No effect on data	No effect on data
Surrogate %R High	No effect on data	No effect on data	If Surrogate %R is greater than 120% of acceptance limit, Data is unacceptable	No effect on data
VERIFICATION or CLOSURE ANALYSIS				
LCB Contaminated	No effect on data Comment LCB contamination	No effect on data Comment LCB contamination	If LCB is greater than 10% of action-level or sample result, Data is unacceptable	If LCB is greater than 10% of action-level or sample result, Data is unacceptable
LCS Low Recovery	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted
LCS High Recovery	No effect on data	No effect on data	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted (evaluate potential bias in reported result)	If MS/MSD are acceptable or Surrogates are acceptable→Data accepted
Matrix Spike Low %R	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier
Matrix Spike High %R	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier	If MSD and LCS acceptable and Surrogates or Post-spike within range, Data is accepted with precision qualifier
MS/MSD RPD High	No effect on data	If sample result is greater then 90% of action-level, Data is unacceptable	If RPD is greater than 110% of acceptance limit, Data is unacceptable	If RPD is greater than 110% of acceptance limit, Data is unacceptable

QC Data Discrepancy	Result Non-detect	Result >10% Below Action-level	Result Within 10% of or Above Action-level	Result Greater than 10% Above Action-level
Surrogate %R Low	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are at least 80% of acceptance limits, Data is acceptable
Surrogate %R High	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits, Data is acceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits and other QC is within acceptance limits, Data is acceptable	If any Surrogate %R is greater than 110% of acceptance limit, Data is unacceptable	1) If confined to one Surrogate in a fraction, Data is acceptable 2) If surrogate %R values are within 20% of acceptance limits, Data is acceptable

STANDARD OPERATING PROCEDURE

Subject: Hand Auger Sampling

1. PURPOSE

The purpose of this document is to provide the methods and procedure for sampling of soils and other solids using hand auger techniques. Hand auger sampling can be used when matrices are composed of relatively soft and non-cemented formations, to reach depths of up to 5 feet below ground surface, dependent on site conditions. Samples for Volatile Organic Compound (VOC) analysis should not be collected via hand auger methods. However, a hand auger may be utilized to penetrate to and expose the undisturbed material at the desired depth for sampling by more applicable methods.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where soil samples will be collected via hand auger methods and no project-specific procedure exists.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, SectionC.6, EM200-1-3, Washington, D.C.
- American Society of Testing and Materials, D1452-80 (re-approved 2000), *Standard Practice for Soil Investigation and Sampling by Auger Borings*, West Conshohocken, PA.

4. DEFINITIONS

- **Hand Auger**—A sample collection device consisting of metal rods with a T-bar handle and a detachable metal head. The auger head is a hollow metal tube with two cutting edges at the bottom curved into each other to hold the material pushed up into the tube as the auger is forced deeper. All trace environmental samples should be collected using stainless steel auger heads. See ASTM D1452 for a description of various types of augers available for use.
- **Sand Auger**—A type of auger with the cutting edges bent toward and touching each other. The design allows for the trapping of loosed materials in the auger tube.
- **Mud Auger**—A type of auger head with the top several inches open at the sides to allow for reduction of suction during removal from wetted and highly plastic materials, such as mud and lagoon solids.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be sent to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for recording information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Equipment

The following equipment should be used when conducting hand auger sampling:

- Decontaminated commercial hand auger, stainless steel construction for trace environmental sampling (any of those mentioned in ASTM D1452 are acceptable). If samples will be collected at depth, the auger head will require decontamination prior to collection of the targeted-depth sample. Alternatively, one auger can be used to remove the material to the targeted depth, and the sample can be collected using a different, clean dedicated auger.
- Engineers rule or stiff measuring tape
- Stainless steel spoons or scoops–decontaminated or dedicated
- Decontaminated or dedicated stainless steel bowl

6.2 Sampling

The following procedure should be used for hand auger sampling:

1. Don a pair of clean gloves.
2. If desired, place plastic sheeting around the targeted location to keep sampled material in place. Use a knife to cut an access hole for the sample location.
3. Remove any surficial debris (e.g. vegetation, rocks, twigs) from the sample location and surrounding area.
4. Place the bucket of the hand auger on the ground with the teeth down, and, while holding the T-handle, rotate it in a clockwise direction while pushing straight downward until the bucket is full.
5. Extract the auger by pulling upward with a slight rocking or rotating motion (counter-clockwise) until the head is fully out of the hole.
6. Measure the depth of the sample bottom with the rule or tape and compare to the desired sampling depth.
7. Remove the soil with a spoon or scoop. If the material represents the desired sample, place it into the bowl. If it is not the material to be sampled, empty the auger bucket onto the ground or plastic and repeat steps 4 through 6 until the desired sample aliquot is collected, placing it into the sample bowl. Remember to either decontaminate the auger head or use a fresh one to collect the actual sample aliquot.

8. If collecting a sample for VOC analysis, expose the desired depth by following steps 4 through 6 and then collect the sample from undisturbed material, using a corer or syringe-type sampling device.

9. Homogenize the non-VOC sample and transfer the sample directly into the sample container(s). Cap the sample container(s), label, complete documentation, and place into the sample cooler.

10. Measure the depth from which the sample was taken and record it in the field logbook or sheet.

11. Repeat steps 4 through 10 for deeper samples from the same hole.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Trowel/Spoon Surface Soil Sampling

1. PURPOSE

The purpose of this document is to provide the methods and procedure for sampling of surface soils using trowels or spoons. Trowels or spoons can be used when matrices are composed of relatively soft and non-cemented formations and to depths of up to 12 inches into the ground surface, dependent on site conditions. Samples for Volatile Organic Compound (VOC) analysis should not be collected via trowel or spoon method. However, a trowel or spoon may be utilized to penetrate to and expose the undisturbed material at the desired depth for sampling by more applicable methods.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where surface soil samples will be collected via trowel or spoon methods.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, SectionC.6, EM200-1-3, Washington, D.C.

4. DEFINITIONS

- **Trowel**—A sample collection device with a curved and pointed metal blade attached to a handle. All trace environmental samples should be collected using stainless steel blades.
- **Spoon**—A sample collection device with a round metal blade attached to a handle.
- **Surface Soil**—Soil that is removed from the surface no greater than 6 inches below grade after removing vegetation, rocks, twigs, etc.
- **Weathered Soil**—The top ⅛ to ¼ inch of soil impacted by heat from sun, rain, or foot traffic that could evaporate, dilute, or otherwise deposit contaminants from an adjacent location, thereby misrepresenting the actual soil characteristic.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for the maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Equipment

- Decontaminated trowel or spoon, stainless steel construction for trace environmental sampling. If samples will be collected at depth (0-6 inches), the trowel or spoon will require decontamination prior to collection of the targeted-depth sample. Alternatively, a different trowel or spoon can be used to remove the material to the targeted depth and the sample collected using a clean dedicated trowel or spoon.
- Engineers rule or stiff measuring tape
- Decontaminated stainless steel mixing bowl

6.2 Sampling

1. Don a pair of clean gloves.
2. If desired, place plastic sheeting around the targeted location to keep sampled material in place. Use a knife to cut an access hole for the sample location.
3. Remove any surficial debris (e.g. vegetation, rocks, twigs) from the sample location and surrounding area until the soil is exposed. Once exposed, the soil surface is designated as “at grade,” or 0 inches.
4. Use a trowel to scrape and remove the top 1/8 to 1/4 inch of weathered soil. (A spoon can be interchanged with trowel).
5. If collecting a sample that includes VOC analysis, collect the VOC sample aliquot first following more applicable methods.
6. With a new trowel, place the point of the blade on the ground. While holding the handle of the trowel, partially rotate the blade in a clockwise/counter-clockwise motion while pushing at a downward angle until the blade is inserted to the required depth or the blade is nearly covered. Be certain that the trowel is not inserted to a depth where the soil will touch the handle or other non-stainless steel portion of the trowel or the sampler’s hand.
7. With a prying motion lift up the trowel with soil on the blade and place soil into the stainless steel mixing bowl.
8. Repeat steps 6 and 7 until the required depth of soil is placed into the mixing bowl.
9. Measure the depth of the sample location with a rule or tape to verify the sampling depth and record in the field logbook.
10. Homogenize the non-VOC sample and transfer the sample directly into the sample container(s). Cap the sample container(s), label the containers, complete the documentation, and place the containers into the sample cooler.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Soil Sampling using a Soil Probe or Core-Type Sampler

1. PURPOSE

The purpose of this document is to provide the methods and procedure for sampling of soils and other solids using soil probes and core-type devices. These samplers can be used when matrices are composed of relatively soft and non-cemented formations. They are utilized to collect near-surface core samples and can also be placed into boreholes at specified depths. Soil probe/corer samplers provide an intact depth-specific sample for geotechnical, chemical, radiological, or biological analysis

2. SCOPE

This procedure is applicable to all Shaw E & I projects where soil samples will be collected via hand-operated soil probe/corer methods and no project-specific procedure exists. This procedure is not applicable to drilling or direct push methods.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM-200-1-3.
- American Society for Testing and Materials, *Standard Practice for Soil Investigation and Sampling by Auger Borings*, D1452-80 (re-approved 2000).
- U.S. Environmental Protection Agency, 1994, *Soil Sampling*, EPA/ERT SOP 2012, November.

4. DEFINITIONS

- **Soil Corer**—A sample collection device consisting of extension rods, a T-handle, and a sampling head. The sampling head is a thin-walled two-piece metal tube, split lengthwise, into which a metal or plastic sleeve is placed. The tube halves are held together with screw-locked ends, the bottom one having a point. The sleeve fills with material as the sampler is forced downward, allowing for an undisturbed core to be collected
- **Soil Probe**—A core sample collection device consisting of a thin-walled metal tube with a cutting edge on the bottom. The tube is cut-away from its tip to approximately one-third of the way to its top to allow material to enter. The top of a soil probe is removable, and a plastic or metal sleeve is inserted through the top and is held in place by the reduced diameter of the tube at the top of the cutout. Soil probes can be attached to extension rods and T-handles or may be of one-length construction. Samples collected from a soil probe are almost always submitted to the laboratory intact.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

The sampling procedure is as follows:

1. Assemble the sampler by inserting the appropriate sample tube and close the ends. If using extension rods, attach the sampler by its top to the bottom rod. Attach the T-handle either to the extension rod or directly to the sampler head.

2. If desired, place plastic sheeting around the targeted location to keep sampled material in place. Use a knife to cut an access hole for the sample location.

3. Don a pair of clean sample gloves.

4. Remove any surficial debris (e.g. vegetation, rocks, twigs) from the sample location and surrounding area.

5. If the sample will be collected from a depth beyond the surface, use a hand-auger to remove the overburden and expose the “target” sample depth. Measure the depth of the hole with a rule or stiff tape to confirm that the target depth has been reached.

6. If the sampling depth is below where the sampling device can be seen while sampling, measure the distance from the tip to top of the sampler and mark the extension rod at this distance plus the depth of the hole with tape as a reference.

7. Change sample gloves just prior to collecting the sample, especially if an auger was used to expose the target depth

8. To collect the sample using a Soil Corer, place the point of the assembled corer directly on the ground or in the auger hole and, while holding it vertical, push straight down into the soil. Do not twist. A slide hammer may be required for hard or stiff materials.

9. A Soil Probe should be placed into the location and pushed downward with a twisting motion to allow the cutting edge to work. Do not drive or hammer the sampler as this will damage the cutting tip.

10. Continue to force the sampler downward until either the top joint is touching the ground or the reference mark is even with the top of the auger hole. This will ensure that the entire sleeve is filled with material.

11. Extract the sampler by pulling upward with a slight rocking or twisting motion until the head is fully out of the hole.

12. Wipe the sampler head with a cloth or towel and remove it from the T-handle or extension rod.

13. Disassemble the sampler and remove the sleeve. Also perform any field screening desired (e.g., PID screen).

14. For a Soil Probe sample, the sleeve will most likely be submitted intact. Wipe the outside of the sleeve and use a knife to cut off any material sticking from the end so that the ends are even. Place Teflon™ tape over the ends and cap both ends. Be sure to label the top and bottom of the sample interval.

15. A Soil Corer sample may be submitted intact, especially for geotechnical parameters. If this is the case, wipe the outside of the sleeve and use a knife to cut off any material sticking from the end so that the ends are even. Place Teflon™ tape over the ends and cap, labeling the sleeve and marking the top and bottom of the sample interval.

16. If the Soil Corer sample will be aliquotted into other containers, use a knife to split the sleeve lengthwise and remove the top section to expose the sample.

17. If sampling for Volatile Organic Compounds (VOCs), collect sample aliquots from the intact core first using an EnCore™ or other syringe-type device.

18. Place the remaining material directly into sample jars or into a mixing bowl for homogenization and containerization. Cap the sample container(s), label it/them, complete the documentation, and place the sample container(s) into the sample cooler.

19. Decontaminate the sampler.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Sampling of Aqueous Liquids via Bailer

1. PURPOSE

The purpose of this procedure is to provide the methods and techniques to be utilized when sampling aqueous liquids using bailer methods. This procedure does not apply to the use of depth-integrated modified bailer systems such as the Kemmerer Sampler. Bailers should not be utilized when sampling for trace levels of VOCs in wells containing high solids loads or wells that have been purged using micro techniques.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where samples will be collected using a bailer. These may include groundwater wells, water treatment pools, frac tanks, and other containers.

It is not applicable to direct push groundwater sampling. See Procedure EI-GS009 for suggested direct push groundwater sampling methods.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, Section C.2, EM200-1-3, Washington, D.C.
- American Society of Testing and Materials, D6634-01, *Standard Guide for Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells*, West Conshohocken, PA.
- American Society of Testing and Materials, D4448-01, *Standard Guide for Sampling Ground-Water Monitoring Wells*, West Conshohocken, PA.

4. DEFINITIONS

- **Bailer**—A device used to collect aqueous liquid samples typically consisting of a long tube with a check valve system attached to a rope or cable. The bailer is lowered into the liquid, and once the desired depth is reached, the check valve is set by causing an upward motion. Bailers are constructed of stainless steel, polyethylene plastic, or Teflon™. Those made of polyethylene and Teflon™ can be considered disposable and utilized for one-time use.
- **Single check valve bailer**—The most commonly used type of bailer; a tubular bailer with a bottom check valve that allows water to enter the bailer while it is lowered. The weight of the water in the bailer closes the check valve upon retrieval.
- **Top-filling bailer**—A tubular bailer that is only open on the top. The bailer is lowered beneath the water surface and water enters the top of the bailer. This type of bailer should **not** be used for environmental sampling. However, it is a very effective well purging device.
- **VOC sampling device/attachment**—A detachable spigot usually constructed of polyethylene or Teflon™ that can be attached to the bottom of a bailer to regulate the flow while emptying the device, preventing agitation of the liquid as it exits.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure and utilizing materials of a construction specified in the project plans or applicable to the contaminants of concern and other aspects of the sampling effort. These may include well diameter, well construction materials, depth to water, and the presence of DNAPL or LNAPL contaminants. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager or designee is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Equipment

The following equipment should be used for sampling aqueous liquids using bailer methods:

- Dedicated bailer; construction depending upon contaminants of concern and intended data use per the project plan. Disposable bailers should be utilized for one sample location only.
- Dedicated polyethylene/Teflon™-coated string or Teflon™-coated steel cable for lowering and raising the bailer.
- Tripod with mechanical winch for lowering and raising the bailer (typically only for deep or large-diameter wells).
- Plastic sheeting.

6.2 Sampling

The following procedure should be used when sampling aqueous liquids using bailer methods:

1. Don a pair of clean gloves.
2. Securely attach the required amount of string or cable to the bailer.
3. Spread a new piece of plastic sheeting around the well so as to keep the bailer rope from contacting the ground. This step is not necessary if sampling treatment pools or storage tanks.
4. If required, unlock the well cover and remove the cap.
5. If sampling a well, measure the static water level and total well depth as described in Procedure EI-FS108.

6. Purge the well as detailed in Procedure EI-FS110 using a separate bailer or other device. **Do not purge and sample with the same bailer.** The project planning documents should specify a well purging endpoint, which may include either of the following:
   - A selected number of well volumes
   - Water property stabilization as indicated by pH, conductivity, turbidity, or temperature measurements, etc.
7. Collect the sample immediately after purging, if applicable, by slowly lowering the bailer to the desired sampling depth and stopping briefly.
8. Set the check valve by pulling upward on the string/cable and then slowly raise the bailer to the surface.
9. Wipe the bailer body with a paper towel or tissue to prevent liquid on the outside from entering the sample containers.
10. If using one, attach the VOC device to the bottom of the bailer.
11. Transfer the groundwater sample immediately to the sample bottles.
    - Fill VOA vials first by opening the VOC device spigot and allowing the liquid to slowly fill the container without agitation and to a meniscus slightly above the top of the vial.
    - Cap and check all VOA vials for entrained air by slowly tipping and observing for bubbles. If any are present, discard the sample and collect again as above.
    - If not using a VOC attachment, the liquid can be collected by pushing up on the check valve or pouring from the top of the bailer.
12. Continue lowering and retrieving the bailer as needed to fill all required sample bottles.
13. Add preservatives to the samples as needed, and place the sample bottles on ice.
14. Note that most sample bottles come with preservatives already added. If such is the case, do not overfill the bottles.
15. Replace the well cap, if required, and lock the cover.
16. Record the sampling information.
17. Dispose of or decontaminate the bailer and string/rope as required in the project plan.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Depth Integrated Water Samplers

1. PURPOSE

The purpose of this document is to provide the methods and procedures for sampling of water using depth integrated sampling devices such as the Kemmerer® sampler and the weighted bottle.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where water samples will be collected from specific depths using a depth integrated sampler and where there is no overriding project/ program plan in place.

The Kemmerer® sampler is a practical method for collecting at-depth, discrete water samples from wells or surface water bodies where the collection depth exceeds the lift capacity of pumps. The weighted bottle can be used to obtain at-depth, discrete water samples from surface water.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, Section C.2, EM200-1-3, Washington, D.C.
- Wildlife Supply Company (WILDCO) web site: www.wildco.com.

4. DEFINITIONS

- **Kemmerer® Sampler**—A sampling device consisting of a sample tube and spring-loaded caps/plugs located at both ends of a tube container oriented in either the horizontal or vertical position. Once lowered to the desired sampling depth, a weighted messenger is dropped down the sample line, tripping a release mechanism that closes the ends of the container. The common name for the sampler is a "bottle sampler." These samplers can be constructed of PVC, clear acrylic, stainless steel, brass, and Teflon™ and can be used to collect water samples from lakes, ponds, rivers, and monitoring wells. These devices can be operated using a hand line or a winch for deep-water operations.
- **Weighted Bottle**—A sampling device consisting of a glass bottle, a weighted holding device, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling. These devices can be operated using a hand line or a winch for deep-water operations.
- **Messenger**—A metal weight, usually lead, with a hole through its core that is used to activate the spring closure on a Kemmerer® sampler. The messenger is dropped onto the closure activation mechanism by sliding it down a line. It activates the closure by the force of its weight upon impact.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure and utilizing materials of a construction specified in the project plans or applicable to the contaminants of concern and other aspects of the sampling effort. These aspects may include well diameter, well construction materials, depth to water, and the presence of DNAPL or LNAPL contaminants. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager or designee is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Kemmerer® Sampler

Equipment

- Decontaminated commercial sampling device with appropriate material of construction for the target compounds and/or planned sampling activity
- Rope or line with graduations, on winch if required—this is the “tag line”
- Separate line for messenger, if sampler requires one
- Carpenter’s chalk
- Plastic sheeting to keep emptying area clean
- Sample bottles, cooler, and preservatives

Sampling Process

1. Don a pair of clean gloves.
2. Place plastic sheeting around the area where the sampler will be emptied.
3. Inspect the sampler to ensure that the drain valve is closed.
4. Determine the depth for sampling, and measure and mark the sampler line at the desired depth with chalk.
5. Attach the tag line and, if required, the messenger lines to the sampler. If the messenger has a separate line, make sure it is at least as long as the tag line. *Do not place the messenger on the line at this time.*

6. Carefully open and lock the sampler. From this point on, handle it only by the tag line and take care not to strike it on the release mechanism.
7. Attach the free end of the tag line to a secure holding place to keep from losing the sampler.
8. Being careful not to contact the sampler, slowly lower it into the water until the desired sample depth is reached. Make sure that the rope/line does not become entangled.
9. If the messenger will be sent down the tag line, loosen the tag line end from the holding place while maintaining tension on the line to maintain depth. Verify the depth by location of the chalk mark before proceeding to step 10.
10. Thread the messenger onto the tag or messenger line and allow it to fall and trip the device.
11. Prepare and clear the sample receiving area, and then slowly raise the sampler out of the water.
12. Remove the messenger from the line to keep from accidentally tripping the device when retrieving the sample. Carefully open the sample valve and fill the appropriate sample containers.
13. If collecting samples for VOC analysis, collect these samples first.
14. Complete all required documentation, and place the sample into a cooler or other specified container.
15. Decontaminate the sampler on the inside and outside while open. Dry and return the sampler to its closed position when completed, if applicable.

6.2 Weighted Bottle

Equipment

- Decontaminated commercial sampling device with appropriate material of construction for environmental sampling
- Rope or line with graduations, on winch if required—this is the “tag line”
- Carpenter’s chalk
- Plastic sheeting to keep emptying area clean
- Sample bottles, cooler, and preservatives

Sampling

1. Don a pair of clean gloves.
2. Place plastic sheeting around the area where the sampler will be emptied.
3. Determine the depth for sampling and measure and mark the sampler line at the desired depth with chalk.
4. Attach the tag line to the weighted bottle holding device.
5. Place the stopper in the bottle and verify that it is attached to the tag line at a location above where the end of the tag line is attached to the weighted bottle holding device. From this point on, take care not to release the stopper from the bottle.
6. Attach the free end of the tag line to a secure holding place to keep from losing the sampler.

7. Being careful not to contact the sampler, slowly lower it into the water until the desired sample depth is reached. Make sure that the rope/line does not become entangled.
8. Remove the stopper from the bottle with a sharp jerk of the tag line to allow the water to fill the bottle completely.
9. Prepare and clear the sample receiving area, and then slowly raise the sampler out of the water.
10. Carefully open the bottle and fill the appropriate sample containers.
11. If collecting samples for VOC analysis, collect these samples first.
12. Complete all required documentation, and place the sample into a cooler or other specified container.
13. Decontaminate the sampler on the inside and outside while open and allow it to dry.

7. ATTACHMENTS

None.

8. FORMS

None.

STANDARD OPERATING PROCEDURE

Subject: Surface Water Sampling

1. PURPOSE

The purpose of this document is to provide methods, procedures, and guidance for sampling of surface waters or liquids in lakes, streams, pits, sumps, lagoons, and similar reservoirs for environmental analysis.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where surface water sampling will be performed and where no project/program plan or procedure is in place to direct those activities.

The procedure presents two methods of sampling: direct immersion of sampling containers and use of a pond sampler.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3, Appendix C, Washington, D.C.
- U.S. Environmental Protection Agency, 1994, *Surface Water Sampling,* EPA/ERT SOP 2013.

4. DEFINITIONS

- **Pond Sampler**—A type of liquid sampling device consisting of an adjustable aluminum or fiberglass pole with an adjustable clamp to hold a container on one end. The pole allows for grab samples to be obtained at distances as far as 10 to 12 feet from the edge of the source without the need to contact the medium.
- **Grab Sample**—A single sample representative of a specific location at a given point in time.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager or designee is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations,

reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

Safety Note: *Surface water sampling can sometimes require the use of boats for access into or across bodies of water. Observe all boating safety considerations in the HASP including donning of proper life jackets. If sampling from a bank, do not overreach; use a Pond Sampler whenever possible and do not attempt to remove the container from the clamp while still in contact or close proximity to the water body. Do not wade into a water body unless the depth is well known, currents are flowing at a safe speed, appropriate personnel have determined it is safe, and a spotter is available.*

6.1 Direct Immersion

The following procedure shall be used for direct immersion sampling:

- Don a pair of clean gloves.
- Obtain the required sample container(s).
- If entering the water body, always do so with as little bottom disturbance as possible and wait for the water around the planned sampling area to return to its undisturbed state (clarity) before sampling.
- Collect each liquid sample by slowly submerging the sample container with minimal surface disturbance. If sampling in a stream or current, make sure the open end of the sample container is pointed upstream.
- Withdraw the container from the liquid with minimal disturbance; cap and wipe the outside of the container with a towel or cloth.
- If collecting samples for VOC analysis, make sure that the VOA vial is slightly overfilled before capping, and check for bubbles or trapped air by inverting. If the sample integrity is compromised, discard the sample and repeat the collection process.
- Complete all required documentation, and place the sample containers into a cooler or other specified container.

6.2 Pond Sampler

The following procedure shall be used for sampling with a pond sampler:

- Don a pair of clean gloves.
- Place plastic sheeting around the area where the sampler will be emptied.
- Assemble the pond sampler and secure the sample container or collection jar/bottle/beaker in the adjustable clamp.
- If entering the water body, always do so with as little bottom disturbance as possible and wait for the water around the planned sampling area to return to its undisturbed state (clarity) before sampling.
- Collect each liquid sample by extending the container end outward and slowly submerging the sample container while holding the Pond Sampler handle with minimal surface disturbance. If sampling in a stream or current, make sure the open end is pointed upstream.

- Retrieve the container with minimal surface disturbance, retract any extensions, transport the sample while still attached to the emptying area, and remove it from the clamp.
- Alternatively, if sampling with a partner, the partner can remove the collection container from the clamp and carry it to the transfer area.
- If the container is the one to be used for the sample, remove it from the clamp, cap, and label.
- If the sampler was used to collect a fill container, remove the lid(s) from the required sample containers and slowly transfer the sample into the appropriate containers; cap and label each one.
- Fill containers for VOC analysis first, making sure that the VOA vial is slightly overfilled before capping, and check for bubbles or trapped air by inverting. If the sample integrity is compromised, discard the sample and repeat the vial filling process.
- Complete all required documentation, and place the samples into a cooler or other specified container.
- After each use (i.e. between sample locations), the pond sampler must be disassembled and decontaminated, especially at the clamp area.

Sample jars or beakers are attached to the pole using the clamps for collecting the sample. With a pond sampler device, sample jars can be attached directly to the sample pole and the sample directly filled into the sample jar, or a sampling beaker can be attached to the pole and the collected sample then transferred to an appropriate sample jar. If sample jars are filled directly, they should be wiped clean prior to being placed in the cooler for shipment. If sampling beakers are used, they can be disposed of or decontaminated prior to reuse.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Sediment sampling using a Core Sampler

1. PURPOSE

The purpose of this document is to provide the methods and procedures for collecting sediment samples using sediment/gravity core samplers. These samplers are usually used to collect intact sediment cores in shallow waters. However, they can be mounted onto deep-water drill rigs or similar systems.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where sediment core samples will be collected and no project-specific procedure is in place.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans,* Appendix C, Section C.6, EM200-1-3, Washington, D.C.
- Wildlife Supply Company (WILDCO) web-site at http://www.wildco.com/

4. DEFINITIONS

- **Sediment/Gravity Core Sampler**—A sampling device consisting of a hollow metal tube with a tapered nose-piece collar and a check valve system. The check valve allows water to flow through the sampler body on descent and prevents wash-out of the sample as it is retrieved. The tube is divided lengthwise and accepts a brass or plastic insert sleeve that actually holds the sample. The sampler can be attached to an extension handle and/or drive hammer.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

Always tie off to rails or hooks on boats, wear life jackets when appropriate, and abide by all water body safety rules in the project HASP. Sampling that requires either a boat or conveyance across a walkway or other system that exposes personnel to potential of falling in, including sampling for proposal purposes, ***must be*** *performed under an approved HASP and with proper personnel numbers, including a dedicated and unoccupied spotter.*

6.1 Equipment

The following equipment is used for collecting sediment samples with a core sampler:

- Decontaminated commercial sediment/gravity corer with extension handle(s), stainless steel construction for trace environmental sampling
- Brass or plastic sleeves—consult project plan
- Drive hammer, if required
- Plastic sheeting to keep emptying area clean
- Carpenter's chalk or duct/electrical tape
- Plastic or metal shallow pan to empty sampler into

6.2 Sampling Procedure

The procedure for collecting sediment samples with a core sampler is as follows:

1. Don a pair of clean gloves.
2. Place plastic sheeting around the area where the sampler will be emptied to keep sampled material in place.
3. Assemble the sampler by placing an insert sleeve into the tube and attaching the nose-piece and top collar (usually done with screw threads)
4. Attach to an extension or drive hammer system with sufficient length to reach the bottom plus 2- to 3-times the sampler length. Mark the extension at the point equal to the water depth plus the length of the corer tube and nose-piece above the bottom of the corer.
5. Slowly lower the sampler until the bottom is felt.
6. Make sure that the handle/extension is straight up, and push down in a straight direction to force the sampler into the bottom sediment. If using a drive hammer, be sure that the system is straight during each drive.
7. Continue to push/drive the sampler until the mark of the extension is at water level, indicating that the entire sampler has been driven into the sediment.
8. Withdraw the sampler by pulling straight up. It may be necessary to twist slightly while pulling.
9. Retrieve the sampler from the water and place the corer body into the shallow pan.
10. Disassemble the sampler and retrieve the sleeve. Place Teflon™ tape over each end and cap. Label the ends Top and Bottom (T/B).

11. Clean and dry the sleeve; then attach a completed sample label, document the sample, and place it into an appropriate container.

    Alternatively, a plastic sleeve can be split lengthwise and then the sample retrieved. Always collect volatile fractions first using a syringe-type or VOC-core sampler.

12. Decontaminate the sampler.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Sediment Sampling using Ponar/Ekman Type Systems

1. PURPOSE

The purpose of this document is to provide the methods and procedures for sampling of sediments using clamshell-type sampling devices such as the Ponar and Ekman systems. These sampling systems can be utilized to collect non-core sediment samples. If core samples are desired, alternative methods should be used.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where non-core sediment samples will be collected via clamshell sampling device methods and no project/program specific procedure is in place..

3. REFERENCES

- U.S. Army Corps of Engineers, *Requirements for the Preparation of Sampling and Analysis Plans,* Appendix C, Section C.6, EM200-1-3, Washington, D.C.
- Wildlife Supply Company (WILDCO) web-site at http://www.wildco.com.

4. DEFINITIONS

- **Clamshell Device**—A sampling device consisting of spring-loaded jaws that activate either by contact with the bottom or by other means and entrap the collected materials for retrieval. These devices can be operated via hand line or with a winch for deep-water operations.
- **Ekman Sampler**—A type of clamshell device designed for use in soft bottoms. The Ekman sampler rests on the bottom and uses a messenger system to activate the closure spring. The sampler scoops up the material caught between the jaws upon closure.
- **Ponar Sampler**—A type of clamshell device designed for hard and gravelly bottoms. Unlike the Ekman, a Ponar sampler self-activates its closure mechanism after it penetrates into the bottom material. Ponar samplers are heavy (45 lbs.) and require a winch to operate.
- **Messenger**—A metal weight, usually lead, with a hole through its core that is used to activate the spring closure on clamshell devices. The messenger is dropped onto the closure activation mechanism by sliding it down a line. It activates the closure by the force of its weight upon impact.

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw E & I employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw E & I employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager, or designee, is responsible for ensuring that activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

Safety Notes: *These sampling devices are spring activated; they close with great force and are capable of causing injury. Care should be used when opening and securing these devices in the "ready" position. Do not handle by the trip line and always transport in the closed position. Always use proper life-saving equipment and personnel numbers when sampling from a boat or barge. Consult the project Health and Safety Plan for requirements.*

6.1 Equipment

The following equipment should be used when sampling sediments using clamshell-type sampling devices:

- Decontaminated commercial clamshell sampling device, stainless steel construction for trace environmental sampling
- Rope or line with graduations, on winch if required
- Weighted line with graduations to determine depth to bottom, or depth finder if available
- Separate line for messenger if applicable
- Carpenter's chalk
- Plastic sheeting, to keep emptying area clean
- Plastic or metal shallow pan, to empty sampler into–decontaminated or dedicated
- Stainless steel spoons or scoops–decontaminated or dedicated
- Decontaminated or dedicated stainless steel bowl

6.2 Sampling

The following procedure should be used when sampling sediments using clamshell-type sampling devices:

1. Don a pair of clean gloves.
2. Place plastic sheeting around the area where the sampler will be emptied to keep sampled material in place.
3. Determine the depth to the bottom using the weighted line or depth finder and then mark the sampler's line at the distance representative of approximately 1m from the bottom with chalk.

4. Attach the line to the sampler and, if applicable, the messenger line. If the messenger has a separate line, make sure it is at least as long as the tag line. *Do not place the messenger on the line at this time.*

5. Carefully open and lock the sampler. From this point on, handle it only by the tag line and take care not to strike it on the release mechanism.

6. Attach the free end of the tag line to a secure holding place to keep from losing the sampler.

7. Being careful not to contact the sampler, slowly lower it into the water until the "1 meter-to-bottom" mark is reached. Make sure that the rope/line does not become entangled.

8. Slow the descent further and continue until the bottom is contacted. Contact with the bottom will be evidenced when the descent stops and slack appears in the line.

9. If sampling with a Ponar, the slack in the line should have activated the closure mechanism. If using a messenger-type system, thread the messenger onto the tag or trip line and allow it to fall and trip the device.

10. Free the device from the bottom by pulling straight up on the tag line, and slowly raise it until it is about 1 to 2 feet from the surface while being careful not to allow the rope/line coils to entangle on anything.

11. Prepare and clear the sample receiving area, and then slowly raise the sampler out of the water.

12. Allow clear water to drain, and swing the sampler onto the pan in the receiving area once the clear liquids have drained. Do not allow the fine particles to exit the sampler also.

13. If a messenger was used, remove it from the line to keep from accidentally tripping the device when retrieving the sample. Carefully open and lock the sampler and allow the sample to fill the pan. Put the sampler aside for cleaning and decontamination.

14. If collecting samples for VOC analysis, these samples should be taken first from the material in the pan using corer or syringe-type methods.

15. The remainder of the sample material should be mixed in the pan and placed into labeled sample containers or other plan-required receptacles using a spoon or scoop.

16. Complete all required documentation, and place the sample into a cooler or other plan-specified container.

17. Decontaminate the sampler on the inside and outside while open and closed to remove all particles. Dry the sampler and return it to its "closed" position when completed.

7. ATTACHMENTS

None.

8. FORMS

None.

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STANDARD OPERATING PROCEDURE

Subject: Water Quality Meter Use

1. PURPOSE

This procedure is intended to provide general guidance and methods for using a field meter to measure water quality parameters from groundwater or surface water that is being purged, sampled, or monitored.

2. SCOPE

This procedure is applicable to all Shaw E & I projects where water quality monitoring is required using a water quality meter. The water quality meter may be a stand-alone meter or it may be a combined multi-probe unit used to measure temperature, pH, specific conductance, and/or other water quality parameters. The most common methods used for measuring water quality are instruments that measure in-situ parameters in one of the following two ways:

- Water is extracted from its source using a pump and measured in a flow-through cell or in some instances captured and then measured in individual aliquots. This method is preferred when monitoring wells are sampled for laboratory analysis of chemical parameters, and groundwater purging is required.
- The meter is submerged directly into the sample source, such as a monitoring well or surface water body, to collect in-situ monitoring parameters.

3. REFERENCES

- U.S. Army Corps of Engineers, 2001, *Requirements for the Preparation of Sampling and Analysis Plans*, Appendix C, EM-200-1-3, Washington, D.C.
- American Society of Testing and Materials, *Standard Guide for Selection of Purging and Sampling Devices for Ground-Water Monitoring Wells*, D6634-01, West Conshohocken, PA.
- American Society of Testing and Materials, *Standard Guide for Sampling Ground-Water Monitoring Wells*, D4448-01, West Conshohocken, PA.

4. DEFINITIONS

- **Water Quality Meter**—A device used to measure specific field parameters indicative of water quality, such as temperature, pH, specific conductance, and/or other parameters. The meter may be stand-alone or it may be a combined multi-probe unit.
- **Pump**—An electric, compressed air, or inert gas-driven device that raises liquids by means of pressure or suction. The types of pumps that should be used for water quality monitoring should be chosen based on the well size and depth, the type of contaminants, and the specific factors affecting the overall performance of the sampling or monitoring effort. The types of pumps that may be used include centrifugal, peristaltic, centrifugal submersible, gas displacement, and bladder pumps.
- **pH**—The negative log of the hydrogen ion concentration (-log10 [H+]); a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. The scale is 0 to 14.

- **Turbidity**—A measure of overall water clarity determined by measuring the degree to which light traveling through a water column is scattered by the suspended organic (including algae) and inorganic particles. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU), but may also be measured in Jackson Turbidity Units (JTU).
- **Specific Conductance (SC)**—A measure of how well water can conduct an electrical current. Conductivity increases with increasing amount and mobility of ions such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, and iron, and can be used as an indicator of water pollution. The unit of conductance is expressed as microsiemens (1/1,000,000 siemen) per centimeter, or µS/cm.
- **Oxidation-Reduction (Redox) Potential**—A measure in volts of the affinity of a substance for electrons compared with hydrogen. Liquids that are more strongly electronegative than hydrogen (i.e. capable of oxidizing) have positive redox potentials. Liquids less electronegative than hydrogen (i.e. capable of reducing) have negative redox potentials.
- **Dissolved Oxygen (DO)**—Refers to the amount of oxygen expressed as mg/L that is contained in particular water. The amount of oxygen that can be held by the water depends on the water temperature, salinity, purity, and pressure.
- **Salinity**—The amount of dissolved salts in water, generally expressed in parts per thousand (ppt).

5. RESPONSIBILITIES

5.1 Procedure Responsibility

The Field Sampling Discipline Lead is responsible for maintenance, management, and revision of this procedure. Questions, comments, or suggestions regarding this technical SOP should be directed to the Field Sampling Discipline Lead.

5.2 Project Responsibility

Shaw employees performing this task, or any portion thereof, are responsible for meeting the requirements of this procedure. Shaw employees conducting technical review of task performance are also responsible for following appropriate portions of this SOP.

For those projects where the activities of this SOP are conducted, the Project Manager or designee is responsible for ensuring that those activities are conducted in accordance with this and other appropriate procedures. Project participants are responsible for documenting information in sufficient detail to provide objective documentation (checkprints, calculations, reports, etc.) that the requirements of this SOP have been met. Such documentation shall be retained as project records.

6. PROCEDURE

6.1 Equipment

The following equipment is recommended for use in performing water quality measurements:

- Water Quality Meter(s)
- Spare parts such as alkaline batteries (if used) and sensor probes
- Pump and discharge hose/line for use with a flow-through cell
- Paper towels or lint-free wipes

- De-ionized water
- Sample gloves
- Calibration solutions for all parameters being measured; within expiration dates
- Plastic sheeting
- Logbook or log sheets

6.2 General Instructions

- Ensure that the measuring range of the instrument encompasses the expected sample concentration or units.
- Before going to the field, locate all necessary field supplies such as deionized water, calibration solutions, decontamination supplies, and spare parts.
- Consult the instrument's operation manual as well as the project-specific sampling plan to verify that you have prepared the proper equipment and supplies to successfully complete the work.

6.3 Calibration

*Calibration **must** be performed **at least once per day** during operation. Calibrate the meter according to the instrument's operating manual. If sampling and monitoring is being performed for long periods of time, periodically check the instrument calibration using the operating manual's recommended frequency.*

In order to avoid limiting the field personnel to one particular model, only general calibration instructions are presented in this procedure.

- Locate a clean, protected area in which to set up and calibrate the instrument. Ensure that sufficient supplies of de-ionized water, clean paper towels, buffer solutions, and standard solutions are available.
- Inspect the meter and probes for damage. Some of the probes are very delicate or have a thin membrane installed over the probe. Be careful when handling the meter/probes so as not to damage them. If damaged, replace probes in accordance with the instrument's operating manual or obtain a different meter.
- Turn on the meter and allow it to "warm-up" for the manufacturer-specified time (usually 15 to 30 minutes). Check the battery power to determine if the meter has sufficient power to operate for the monitoring period. Replace the batteries, if necessary.
- Calibrate the meter according to the instrument's operating manual. In general, calibration is performed by immersing the probe(s) in aliquots of calibration standard solution(s) and following certain meter keystrokes to set the calibration for each parameter. *Do not immerse the probe into the stock container of the solution. Always transfer a small amount of the solution into a separate container to calibrate the probe(s).* If calibrating for multiple parameters using more than one solution, be sure to wipe off and rinse the probe with de-ionized water between solutions.
- Recheck each parameter after calibration by immersing the probe into the calibration solution and reading it like a sample reading. If the agreement is not within 25% of the solution's known concentration, repeat the calibration process with a new solution aliquot.

- Discard the used calibration solution aliquots when finished into an appropriate waste container.
- Record the calibration data in the field logbook or log sheet.

6.4 Operation of the Instrument

- If using a flow-through cell system, attach the extraction pump and lines in accordance with the pump and meter manufacturer's instructions. Allow the lines to fill and the probes to become immersed before switching the instrument to its measurement mode.
- If using a down-hole system, allow a few minutes for the probe to stabilize before taking a reading.
- Operate the meter in accordance with the instrument's operating manual.
- Collect the field parameter reading(s) per the project requirements, and record them in a field logbook or on log sheets.
- Decontaminate the meter before collecting data from the next sample source. For a flow-through system, flush the lines with three line volumes of de-ionized water or replace with new ones between samples.

7. ATTACHMENTS

None.

8. FORMS

None.

ATTACHMENT C
SUBCONTRACTOR LABORATORY QUALITY ASSURANCE MANUALS

Provided on CD

ALS Laboratory Group

ANALYTICAL CHEMISTRY & TESTING SERVICES

Quality Assurance Project Plan

Environmental Division (Salt Lake City, UT)

September 1, 2009

QUALITY ASSURANCE PROGRAM PLAN
OF
ALS LABORATORY GROUP

TABLE OF CONTENTS

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1.0 Introduction

QUALITY ASSURANCE PROGRAM PLAN OF ALS LABORATORY GROUP

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Quality Assurance Manager:	Robert P. Di Rienzo
Organics Technical Manager	Richard W. Wade
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Manual Version:	Revision ~~1~~2~~1~~3
Effective Date:	~~January~~ September 1, 2009
Approval for Implementation:	Concurrence

By: _____
Brent E. Stephens
~~Laboratory~~ Director
Date: 9/9/09

By: _____
Robert P. Di Rienzo
Quality Assurance Manager
Date: 9/9/09

By: _____
Richard W. Wade
Organics Technical Manager
Date: 9/9/09

By: _____
Jeffery S. Ward
Inorganics Technical Manager
Date: 09/09/09

1.1 Purpose

This Quality Assurance Program Plan (QAPP) describes the policies, procedures and accountabilities established by the Environmental Laboratory of ALS Laboratory Group, Environmental Division (Salt Lake City, UT) (ALS) to ensure that the environmental test results reported from the analysis of air, water, soil, waste, and other matrices are reliable and of known and documented quality. This document describes the quality assurance and quality control procedures followed to generate reliable analytical data.

This QAPP is designed to be an overview of ALS operations. Detailed methodologies and practices are written in ALS Standard Operating Procedures (SOPs). Where appropriate, ALS SOPs are referenced in this document to direct the reader to more complete information. A discussion of ALS SOPs is found in Section 9.2 of this plan, and a list of current SOPs is found in Appendix 14.11.

ALS maintains certifications pertaining to various commercial and government entities; these are listed in Appendix 14.1. Each certification requires that the laboratory continue to perform at levels specified by the programs issuing certification. Program requirements can be rigorous; they include semiannual performance evaluations as well as annual audits of the laboratory to verify compliance.

The State of Utah has primacy in administering certification of this laboratory to perform EPA methods. Thus, the Utah State Health Department certifies ALS to perform EPA methods under Utah Rule R444-14. For that reason, reference is made to Utah Rule R444-14 in this QAPP.

1.2 Quality Assurance Policy

ALS is committed to producing legally defensible analytical data of known and documented quality acceptable for its intended use and in compliance with the Safe Drinking Water Act, the Clean Water Act, and the Resource Conservation and Recovery Act. This QAPP is designed to satisfy the applicable requirements of the State of Utah and the United States Environmental Protection Agency (USEPA). ALS complies with the National Environmental Laboratory Accreditation Conference (NELAC) standards.

ALS corporate management has committed its full support to provide the personnel, facilities, equipment, and procedures required by this QAPP.

ALS management is committed to improvements of the management systems through compliance with NELAC 2003 and ISO 17025:2005 ALS management is also committed to compliance with project related requirements including EPA CLP SOWs and DoD QSM 4.1 Gray Boxes.

ALS management reviews its operations on an ongoing basis and seeks input from staff and clients to make improvements. See section 12.6 of this plan for details.

It is the policy of ALS that all employees shall be familiar with all quality documentation as specified in section 2.1.

1.3 Ethics Policy on Waste, Fraud, and Abuse

ALS policy on waste, fraud, and abuse is described in ALS SOP LAB-001, "Ethics and Data Integrity." It is the policy of ALS to generate accurate and reliable data in accordance with contractual and regulatory requirements.

It is also the policy of ALS to perform work for clients in the most efficient manner possible, avoiding waste of resources. It is the role of both ALS management and employees to ensure that work for clients is performed most efficiently and effectively by properly utilizing ALS purchased materials, equipment, and the time and ability of personnel.

1.4 Quality System

This QAPP and SOPs referenced in this document comprise the ALS Quality System. This Quality System includes all quality assurance policies and quality control procedures. Review of the Quality System is completed on an ongoing basis as described is section 12.6 of this QAPP. The Quality System is based on the required elements as specified in NELAC 2003 Chapter 5, section 5.1 through 5.16.. The structure of this documentation system is located in section 2.3.

1.5 Client Confidentiality

Documents provided to the laboratory are held in strict confidence by project management staff. Documents pertaining to quality assurance and analytical requirements are reviewed with appropriate managers and staff through the project specific meetings and LIMS profiles. and the project protocol worksheet (PPW). Project related information provided by clients is securely archived using procedures described in the SOP Lab-013 "Archives". The transmittal of final results is specified in the LIMSPPW and followed unless specific changes are made to the PPW by the Project Manager assigned to the client/project. Client communication procedures and documentation requirements are listed in the ALS SOP LAB-023 "Client Communication".

1.6 Data Integrity Policies

ALS policy is described in ALS SOP LAB-001, "Ethics and Data Integrity". It is the policy of ALS to generate accurate and reliable data in accordance with contractual and regulatory requirements. It is against ALS policy to improperly manipulate or falsify data or to engage in any other unethical conduct as defined in the ALS Laboratory Ethics SOP. ALS provides mandatory initial and annual refresher training to all employees on SOP Lab-001 "Ethics and Data Integrity".

The pertinent ALS Project Manager must approve deviations from contractual requirements (protocols) and/or SOPs. The Project Manager obtains approval for any such deviations, either in writing or by phone (documented in a phone log) from pertinent contract authorities. In addition, ALS requires that deviations from contractual requirements that might affect data quality be reported to clients. Any employee who knowingly manipulates and/or falsifies data or documents or engages in any unethical conduct is subject to immediate release from employment.

It is also the policy of ALS to perform work for clients in the most efficient manner possible, avoiding waste of resources and undue pressure on employees. It is the role of both ALS management and employees to ensure that work for clients is performed most efficiently and effectively by properly utilizing ALS purchased materials, equipment, and the time and ability of personnel.

ALS employees who are aware of, or reasonably suspicious of, any case of data manipulation, falsification of data, waste of resources, or other unethical practice or misconduct shall notify any manager. Under the direction of the laboratory director, every allegation of unethical conduct will be fully investigated.

1.7 Communication

Written and visual communication through email and computer systems is the cornerstone of effective communication at ALS. Computer workstations throughout the lab provide access to LIMS, ALS On-Line and email systems. All information essential for effective and consistent communication of analytical requirements and details affecting quality is available through these computerized systems

2.0 Laboratory Organization and Responsibility for Quality Assurance

2.1 Laboratory Organization

The Environmental Laboratory is organized around the functions described in the following sections. Appendix 14.2 of this QAPP contains a detailed organization chart. Each of these organizational elements has specific responsibilities for quality assurance in the laboratory. All employees are assigned a minium set of quality systems documents which includes this quality assurance manual along with management systems SOPs as listed in ALS SOP Lab-006 "Training". Other documentation associated with projects is distributed through project management and Horizon profiles as per ALS SOP Lab-023 "Client Communication".

All employees are required to implement the policies and procedures as assigned.

2.2 Responsibilities for Quality Assurance

2.2.1 ALS Laboratory Director

The Laboratory Director is responsible to ensure that:

- Ensure implementation of quality policy and applicable standards.
- Employees have sufficient experience and training to perform QAPP-related duties and procedures.
- The necessary facilities and equipment are available to meet the commitments of the laboratory.
- Sample handling, instrument calibration, sample analysis, and related activities are conducted and documented as described in this QAPP, its related Standard Operating Procedures (SOPs), and its referenced methods.

- Routine QC samples are prepared, analyzed, and reviewed as required by this QAPP.
- Regular internal and external audits are conducted and documented to assess compliance with this QAPP.
- Corrective action is initiated and completed to remedy discrepancies or problems identified in any laboratory process.

2.2.2 Quality Assurance

The Quality Assurance Manager reports directly to top management and is responsible to:

- Ensure implementation of quality policy and applicable standards.
- Understand, monitor and evaluate the quality assurance (QA) and quality control (QC) activities described in this QAPP and its references, reporting deficiencies and identifying resource requirements to the Laboratory Director.
- Conduct and document an annual internal audit of laboratory procedures to ensure compliance with this QAPP and its references.
- Conduct an annual review and update of this QAPP and ~~laboratory~~ Standard Operating Procedures (SOPs).
- Arrange for the analysis of QC and performance evaluation (PE) samples.
- Schedule and document the performance of annual MDL studies for QAPP-related methods and analytes.
- Maintain a record of ongoing personnel training for QAPP-related activities, reporting training deficiencies to the Laboratory Director.
- Maintain the laboratory corrective action program.

2.2.3 Inorganic Chemistry and Organic Chemistry

The managers of these operations report directly to the Laboratory Director and are responsible to:

- Ensure implementation of quality policy and applicable standards.
- Read, understand and follow this QAPP with its references.
- Ensure that each set of reported results meets the requirements specified in this QAPP and ~~meets~~ the client's requirements. ~~as defined in the applicable Project Protocol Worksheet (PPW).~~
- Ensure that personnel are trained and utilized effectively.
- Ensure that facilities and equipment are maintained and utilized effectively.
- Ensure that supplies are available and utilized effectively.
- Immediately report technical and quality problems to the Laboratory Director.

2.2.4 Project Managers

Project Managers report directly to the Laboratory Director. Project Managers are especially involved in the production and assurance of quality results. Client communication procedures and documentation requirements are listed in the ALS SOP LAB-023 "Client Communication". They are responsible to:

- Ensure implementation of quality policy and applicable standards.

- Complete and distribute a project related information Project Protocol Worksheet (PPW) for each project before the laboratory starts work on the project.
- Immediately communicate to the laboratory changes made to projects in progress and document these changes in the PPW as appropriate.
- Respond to client requests for information and coordinate responses to client audits.
- Perform a final review to verify that data reports submitted to the client meet all requirements.

2.2.5 Computer Support

Computer Support personnel are responsible to:

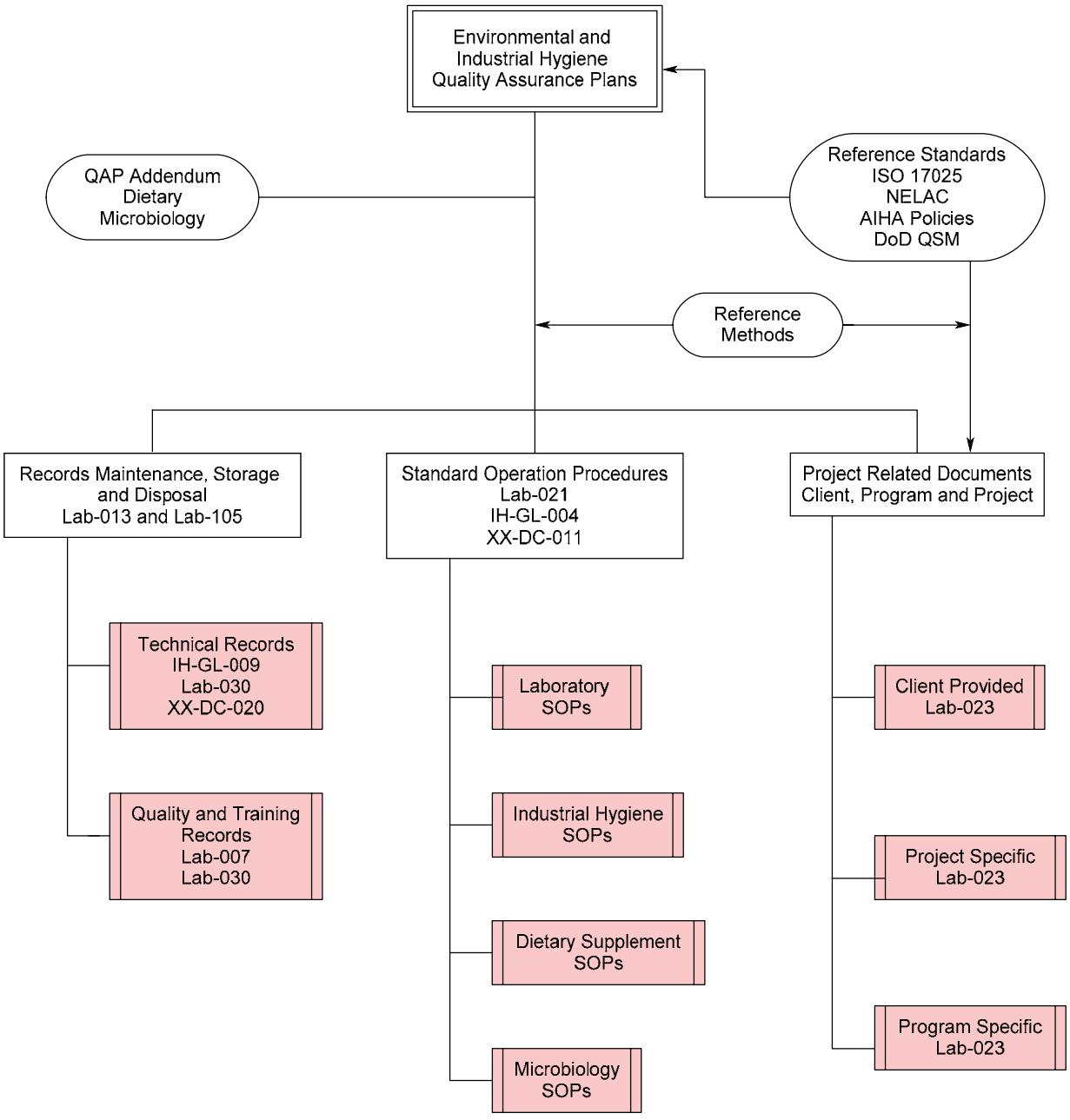
- Specify, procure, and maintain all computer hardware and software used at ALS.
- Program and maintain the ALS Laboratory Information Management System (LIMS).
- Perform backups and safely archive stored data.
- Document software produced at ALS.

2.3 QA Plan Implementation

The Laboratory Director is responsible to ensure that resources for implementation of the QAPP are available and that implementation is expedited. The Quality Assurance Manager is responsible to implement this QAPP and to verify laboratory compliance with it through internal audits and other reviews of performance. A copy of this QAPP is issued to each member of the ALS staff involved in QAPP-related activities. Each member of the laboratory staff is responsible to understand and follow this QAPP, produce results that conform to this QAPP, and meet client requirements. The Quality Assurance Manager has the authority to stop any laboratory process that does not meet the requirements of this QAPP. The Laboratory Director will designate deputies in case of absence of the Technical Directors and/or Quality Assurance Officer.

This Quality Assurance Plan is implemented through the distribution and hierarchy of the document system at ALS. The following flow chart diagrams the structure and relationship of documents used to implement quality policy at ALS.

ALS Laboratory Group Documentation Hierarchy



3.0 Personnel

The ALS environmental laboratory employs sufficient personnel to complete required chemical analyses and support activities. Support activities include personnel recruiting and management,

sample receiving and logging, computer programming and data processing, analytical report preparation, equipment procurement, and method development.

3.1 Key Personnel

Key personnel as defined by Utah Rule 444-14, "Rule for Certification of Environmental Laboratories," are identified in the following table with their corresponding ALS titles.

Rule 444-14 Title	ALS Title	Key Individual
Laboratory Director	Laboratory Director	Brent E. Stephens
Laboratory Supervisor	Inorganic Technical Manager	Jeffery S. Ward
Laboratory Supervisor	Organic Technical Manager	Richard W. Wade
Quality Assurance Officer	Quality Assurance Manager	Robert P. Di Rienzo

Appendix 14.3 of this QAPP contains key personnel, responsibilities for operational sections and ~~-~~biographies ~~of the key personnel~~ documenting applicable experience.

3.2 Laboratory Staff

In addition to key personnel, the ALS staff members directly responsible for the production of quality analytical results are assigned to the following positions:

3.2.1 Radiation Safety Officer (RSO)

The RSO is responsible for technical aspects and safety issues related to samples received under the ALS radiation license.

3.2.2 Chemist/Scientist

Chemists and Scientists perform analyses according to specified methods. They exercise technical judgment and review the results of other analysts. They are responsible to implement the requirements of this QAPP and verify its implementation in their review of others' work.

3.2.3 Project Manager/Client Service Representative

Project Managers and Client Service Representatives are responsible for clear, timely communication between clients and the laboratory. They are also responsible to ensure that the requirements of this QAPP and client QA/QC requirements are implemented.

3.2.4 Technician

Technicians work under the direction of a chemist or scientist to perform analyses. They are responsible to implement specific instructions in keeping with

this QAPP and client QA/QC requirements. Technicians exercise technical judgment as assigned based upon training and experience.

The education and experience of the ALS staff are summarized in Appendix14.4.

3.3 Training

All ALS staff assigned to perform tasks affecting or relating to environmental testing data quality receives training relative to pertinent areas of responsibility, both prior to performing work on client samples and on an ongoing basis. Such training comes from internal and external sources. The ALS training program specified in the ALS SOP Lab-006 "Training" includes quality training, technical training, safety training, and other training as described in this QAPP. ALS Managers are responsible to ensure that all staff training is initiated, completed, verified, and documented.

The specific training and experience of laboratory personnel are documented in individual training files maintained in accordance with ALS SOP LAB-007, "Record of Training," and include documentation of analytical proficiency through the analysis of QC and PT samples.

3.3.1 Quality Training

The ALS Quality Assurance Manager is responsible to orient new analytical personnel to the ALS QA program, policies, and procedures. This required orientation includes training classes and video presentations, as well as reading and understanding this QAPP. Quality orientations are presented on an as-needed basis as new employees are hired. The quality orientation has two goals: to communicate information and to emphasize the importance of implementing quality in the laboratory.

3.3.2 Technical Training

Technical training is accomplished through reading SOPs, using other training materials (manufacturer manuals, videos, and computer-based instruction), observation of others' performance, and performing tests under direct supervision. When possible, training is verified through the successful analysis of QC samples. The appropriate manager evaluates the acceptability of prior experience and training.

As laboratory SOPs are updated, assigned analysts receive notification. They are required to read the revised SOPs and document that reading in their training files before performing analyses using the revised procedure.

Demonstration of Capability – A demonstration of capability is conducted initially and at least annually for all methods. See ALS SOP Lab-006 section 5.6.

3.3.3 Safety Training

Managers are responsible for continuous laboratory safety training and ensuring safety awareness in the laboratory. See section 4.7. Training to handle and properly dispose of hazardous waste is provided, as appropriate, for each work area. Quarterly meetings of the Safety Committee provide a forum to identify and resolve safety concerns.

3.3.4 Other Training

The RSO directs training to handle radiological materials and mixed waste samples. All analysts must complete this training satisfactorily before working with radiological materials and samples. Training concerning the use of the computer system and automated data handling systems is conducted by both the appropriate managers and computer support personnel. Management training is conducted by ALS staff or by outside consultants.

4.0 Facilities

The ALS facility, constructed in 1988 and located at 960 West LeVoy Drive, was designed and built to function as a laboratory. The area used for chemical analyses and associated activities is approximately 25,000 square feet. It is a secure facility with electronically coded card key access for employees; visitors access the facility through a reception area. The floor plan of the ALS building is included in Appendix 14.5.

4.1 Laboratory Areas

Laboratory areas are segregated by HVAC systems to contain contamination and to eliminate potential contamination from specific laboratory areas that require low ambient chemical background levels for successful analysis. The facility is cleaned and maintained to ensure that contamination is minimized and that laboratory systems perform reliably.

4.2 Bench Space

Each area in the laboratory has adequate bench space for instrumentation and for the processes assigned to that area. Frequently, samples are placed on carts to allow efficient processing from preparation through analysis and into storage.

4.3 Storage Space

In addition to the bulk storage areas, each laboratory area has cabinet and under-bench storage. Some areas have walk-in storage as well.

4.4 Lighting

Each laboratory area was built with lighting designed for analytical work. The lighting has been upgraded to achieve more energy efficiency. Emergency lighting is provided in the event of a power failure.

4.5 Air-handling Systems

Laboratory ventilation is provided by single-pass airflow to the individual laboratories. The sample preparation and extraction laboratories are maintained at a negative pressure relative to the rest of the building. Air intakes and exhausts are positioned to reduce cross-contamination by taking advantage of the prevailing winds.

4.6 Laboratory Reagent Water System

Laboratory reagent water is prepared and maintained in a reservoir using a combination of deionization, reverse osmosis, and UV radiation. It is delivered throughout the laboratory by a constantly circulating system constructed of polyvinyl difluoride piping. The water supplied meets or exceeds the specifications for ASTM Type II water. The conductance of the reagent water system is monitored and maintained continuously to keep the reagent water within ASTM specifications.

4.7 Safety Considerations

The safety plan of ALS is described in detail in the document entitled, “Safety Manual and Chemical Hygiene Plan.”

The laboratory is equipped with safety showers and eyewashes. Fume hood face velocities are checked routinely, and maintenance is conducted to ensure correct hood performance.

Safety Showers and eyewashes are inspected in accordance with the applicable OSHA requirements on a yearly basis, not to exceed 12 months.

Fume hoods are performance tested semi-annually using a calibrated anemometer. The Chemical Hygiene Plan in Section 3, Part 2 outlines the fume hood evaluation criteria and procedure in Figure 3.2.2.

All safety inspection records, including equipment calibration and maintenance, are kept on file in the safety office for a minimum of five years.

Liquid waste is handled through three separate waste systems. Most of the drains lead to a conventional sanitary sewer system. Drains located in areas where acids are often used are connected to a glass piping system that leads to a 600-gallon neutralization tank containing limestone; the tank is connected to a 2,000-gallon mixing tank. The effluent from the neutralization tank is directed to the sanitary sewer system. The pH of the effluent from the neutralization tank is monitored continuously to ensure compliance with standards. Drains located in areas of potential organic chemical spills are connected to a separate glass piping system that leads to a 1,000-gallon holding tank. This tank is not connected to the sanitary sewer system. The liquid level of the tank is monitored, and the tank is emptied periodically to dispose of collected wastes in keeping with EPA and DOT regulations.

5.0 Equipment

5.1 Specifications

A comprehensive list of instrumentation and support equipment utilized at ALS is included in Appendix 14.6. Instrument specifications and the date of purchase are listed. Redundant instruments are maintained for particular analyses. The ALS Equipment List is organized by laboratory area with similar items grouped together.

5.2 Calibration Procedures

All instruments are calibrated before use, or the calibration is verified before use. Calibration requirements are detailed in the method SOPs and summarized in Appendix 14.7.

Analytical balance accuracy is checked before use each day and is verified on a regular schedule against NIST-traceable weights. ALS SOP LAB-015, “Balances,” describes the ALS balance program.

5.3 Preventive Maintenance, Schedules, and Documentation

Routine maintenance is performed on laboratory instruments and equipment according to manufacturer recommendations. Maintenance is provided under warranty, through service contracts, and by ALS in-house personnel. The ALS approach to preventive maintenance is described in ALS SOP LAB-002, “Preventive Maintenance for Analytical Instrumentation.” Records of routine maintenance and emergency maintenance are kept with the instruments in maintenance logbooks according to ALS SOP LAB-030, “Documentation – Maintaining Instrument Records, Notebooks, and Logbooks.”

5.4 Calibration of Support Equipment

All support equipment is maintained in proper working order and the equipment is calibrated or verified at least annually or as described by the following SOP:

Lab-015 "Balances"

Lab-010 "Refrigerator Units"

Lab-016 "Calibration Verification of Pipettors"

Lab-018 "Calibration of Thermometers"

6.0 Supplies and Services

6.1 Sample Containers

ALS supplies to clients glass or plastic containers with appropriate closures for sample shipping and storage, as required by environmental program regulations, See Appendix 14.8. The sample containers are precleaned when purchased, and they are used only once.

6.2 Laboratory Glassware

The glassware in general use in the laboratory is made of borosilicate unless otherwise specified in the analytical method. Volumetric glassware (pipettes, burettes, volumetric flasks, and graduated cylinders) must meet Class A specifications. Laboratory ware is inspected and cleaned according to the requirements of two ALS SOPs, LAB-011, "Glassware Cleaning for Inorganic Chemistry," and LAB-012, "Glassware Cleaning – Organic Analysis." Laboratory ware not suitable for continued use is discarded. Cleaned laboratory ware is stored in designated clean areas.

6.3 Reagents and Solvents

ACS reagent-grade chemicals and solvents are used unless otherwise specified in the analytical method or SOP. Representative samples of solvent lots are screened by the manufacturer or by ALS before use to ensure necessary purity.

Reagents, solvents, and solutions not stored in containers with commercial labels must be adequately labeled. At a minimum the label must contain the following information: identification of contents, concentration or purity, preparation and expiration dates (as applicable), date of initial opening (as applicable), notification of special storage requirements, and the initials of the responsible person. If it is impractical to record the required information on the label, the label can contain a unique identifier and a reference to a logbook with the necessary information. Additional details are given in ALS SOP LAB-003, "Labeling of Standards, Reagents and Solutions."

To maintain a record of traceability to the source or reference material, lot and other information (as described in SOP XX-DC-019, "Standards Purity, Preparation, Traceability and Verification") are indelibly recorded by the responsible analyst as described in the SOP.

Hazardous reagents, solvents, and solutions are handled in accordance with the ALS Safety Manual and Chemical Hygiene Plan. Hazardous materials are stored in locations that furnish ventilation, fire barriers, and segregation from incompatible materials, as required.

6.4 Analytical Services Procurement

Laboratories contracted to perform analytical services for ALS must maintain quality programs consistent with the quality requirements of ALS. Before a laboratory performs

subcontracted work for ALS, the Quality Assurance Manager must verify the acceptability of the quality program. At a minimum, this effort includes verification of necessary certifications. It can also include an on-site audit.

Procedures and documentation for using sub-contract laboratories are listed in the ALS SOP LAB-023 "Client Communication". All results provided to ALS by a subcontract laboratory are identified clearly in the analytical report to the ALS client. Under no circumstances will ALS PT samples be sent to a subcontract laboratory.

7.0 Laboratory Practices

7.1 Radioactive Materials

Some of the samples received at ALS are radioactive or potentially radioactive. These samples are handled in accordance with the ALS radioactive materials license.

Potentially radioactive samples are surveyed for external radiation by sample receiving personnel according to ALS SOP QS-DC-001, "Sample Receipt and Logging." Radioactive samples are prepared in laboratory areas under the direction of assigned personnel and analyzed in an area of the laboratory under procedures designed to prevent the transfer of radioactivity out of that area. The handling of radioactive samples at ALS is carried out under the direction of the ALS Radiation Safety Officer (RSO).

7.2 Waste Management

Analysts are trained and laboratory waste is managed according to the following SOPs:

- LAB-004, "Hazardous Waste Handling and Disposal"
- LAB-005, "General Laboratory Safety and Chemical Hygiene"
- EA-DC-002, "Processed Sample Storage & Disposal Control"

8.0 Laboratory Sample Handling Procedures

8.1 Applicability and Scope

ALS policy is to accept all samples provided by the client unless specific safety concerns (ie.. radioactivity and health concerns) are discovered. Samples accepted with documentation and/or quality problems are identified, documented and resolved with the client as described in sample receiving procedures (ALS SOP QS-DC-001).

Properly reported sample results begin with efficient and accurate introduction of pertinent information into the laboratory information management system (LIMS). This section describes ALS procedures for sample receipt, log-in, tracking through the laboratory, and disposal of residual materials. These procedures ensure the integrity of results by maintaining an unbroken chain-of-custody for each sample from receipt of the sample material to final disposal of any excess or residual product.

ALS purchases precleaned sample bottles to ship to clients. A table denoting recommended types of bottles, as well as use and descriptions of preservatives, is included in Appendix 14.8.

8.2 Sample Receipt

Procedures for receiving, processing, and storing environmental and radiochemistry samples and for ensuring continuity of the chain-of-custody are detailed in the following ALS Standard Operating Procedures:

- QS-DC-001, “Sample Receipt and Logging”
- QS-EP-100, “EPA Sample Receipt and Logging”
- XX-DC-006, “Chain-of-Custody and Laboratory Tracking”
- WA-DC-002, “Acceptance Criteria for Samples Processed Under the Radioactive Materials License”

8.2.1 Sample Receiving and Logging

The ALS Sample Receiving area is isolated from areas of the laboratory that perform analysis. The area is equipped with ventilation hoods and adequate bench space to ensure that the sample receiving process is safe, efficient, and not a source of cross-contamination in the laboratory.

ALS SOP QS-DC-001, “Sample Receipt and Logging,” specifies the procedures used to document the condition of shipped samples at the time of receipt, maintain the chain-of-custody, and provide internal laboratory sample tracking. When notified that a client is shipping samples to ALS, the Project Manager completes an internal Project Protocol Worksheet (PPW) or Horizon profile; this accompanies samples throughout the laboratory to notify each handler of the specific client requirements for that sample. If any discrepancies exist with respect to the field-generated chain-of-custody, client work request, or project requirements, as noted on the internal Project Protocol Worksheet or Horizon

profile, the Project Manager is notified. Discrepancies and/or problems with samples are also documented on a Client Related Information Report (CRIR) that is forwarded to the Project Manager to resolve any problems.

Samples requiring acidic or basic preservation are checked for proper pH in the sample receiving area. Note: VOCs are not checked for pH in sample receiving because the pH is checked immediately before analysis or in the case of 5035 after samples are analyzed. The Project Manager is immediately notified and provided with a CRIR if any discrepancies with protocol are found. Samples requiring temperature control are checked, and the temperature is recorded.

For receipt of potentially radioactive samples, the sample receiving personnel perform a screen on containers as detailed in QS-DC-001, "Sample Receipt and Logging". Survey instruments are calibrated annually or whenever repairs are necessary. Copies of calibration records are maintained by the Radiation Safety Officer (RSO) in the radiation safety file. It is the responsibility of the RSO and assigned ALS personnel to maintain current calibration of the survey equipment.

If samples are classified by the client as radiological samples, screening information is maintained by the RSO. This information is maintained with the ALS Radioactive Materials Inventory Tracking System (RMITS). The client is required to provide screening data before samples are accepted by ALS.

8.2.2 Sample Tracking

Sample handling in the laboratory is tracked using a computer-based Laboratory Information Management System (LIMS) and through the signatures on the hand-carried chain-of-custody documents. After samples are received by the laboratory, as described above, sample receiving personnel enter the sample information into the LIMS. As samples move throughout the laboratory, a status code is assigned and entered into the LIMS by the various analysts working with the sample as explained in ALS SOP XX-DC-006, "Chain-of-Custody and Laboratory Tracking."

When multiple analyses require splitting a sample, the custody documents are copied such that each split can be independently traced to its origin and appropriate entries can be entered into the LIMS.

8.2.3 Sample Storage and Security

Following receipt, environmental samples are stored in accordance with analytical method requirements for storage and preservation. Samples for organic and inorganic analysis are normally stored in a walk-in refrigerator in the sample receipt area. Samples to be analyzed for volatile analytes are stored separately from all other samples in a refrigerator. Samples are stored, under chain-of-custody, in the receiving area until transferred to an analyst to initiate the analytical process.

To maintain facility security and thus sample security, entrance to the ALS facility can be attained only through coded card key access, except at the main

business entrance; this is open only during normal business hours and monitored by a receptionist. All nonemployees are required to sign in with the receptionist at the main entrance.

8.2.4 Sample Disposal

Sample disposal is accomplished in accordance with the following ALS SOPs:

- LAB-004, "Hazardous Waste Handling and Disposal"
- EA-DC-002, "Processed Sample Storage and Disposal Control"
- ALS Safety Manual and Chemical Hygiene Plan (Section 2: Parts 2, 3, and 4)

The responsibility to implement ALS waste disposal procedures is assigned to specific personnel. The appropriate manager supervises the monitoring of waste produced in each laboratory and the training of laboratory personnel to waste disposal procedures. ALS is considered a generator of hazardous waste and abides by the regulations contained in the EPA Resource Conservation and Recovery Act (RCRA).

Laboratory supervisors are responsible for the proper disposal of hazardous waste generated in pertinent work areas. Special care is taken to ensure that all hazardous waste is accumulated in properly labeled containers; hazardous waste is never discarded improperly.

Hazardous liquid chemical waste is accumulated in plastic bottles, glass bottles, or metal five-gallon cans. Each of these containers is properly labeled. When one or two hazardous waste containers are full, designated persons in laboratory operations transfer the waste to 55-gallon steel drums in the Waste Storage Room. The individuals transferring the waste wear personal protective equipment. Each drum is labeled, and special care is taken to ensure that waste chemicals are transferred to the proper drums.

Assigned personnel are responsible for the ultimate disposal of hazardous waste from ALS. This is accomplished through the services of a commercial waste broker. A ALS employee is assigned as the Hazardous Materials Technician. This person is responsible to arrange for the proper transport, storage, and/or disposal of ALS hazardous waste and to:

- Ensure that proper containers and labels are available.
- Monitor the drums.
- Ensure the proper labeling of drums.
- Maintain complete records of the status of all hazardous waste drums.
- Complete documentation of shipments.

Personnel monitor the pH of the building effluent. An automated system is in place to accomplish this. Any unacceptable excursion outside established limits is noted, its cause determined, and corrective action taken.

After analysis, excess sample materials are stored in the long-term sample storage room for the duration of time required by contract. This area is kept locked. Samples are logged in, labeled, and stored so that they are easily retrieved. Samples requiring refrigeration are stored in a refrigerated unit and monitored for temperature requirements.

After the required hold time, samples are properly disposed of by authorized personnel in the manner prescribed by their hazard class, or in a conventional manner in the case of nonhazardous material. Samples are logged out when disposed of by assigned personnel, with the disposal date noted in a logbook.

A radioactive waste disposal log is used to track the disposal of radioactive material. The Radiation Safety Officer maintains records of use and disposal. Disposal of all chemicals is handled by assigned ALS safety personnel according to regulatory requirements as described in detail in ALS SOP LAB-004, "Hazardous Waste Handling and Disposal," and in the ALS Safety Manual and Chemical Hygiene Plan (Section 2: Parts 2, 3, and 4).

8.3 Chain-of-Custody

In order to ensure that legally defensible data are produced at ALS, chain-of-custody procedures have been established and are followed as described in ALS SOP XX-DC-006, "Chain-of-Custody and Laboratory Tracking."

An example of the ALS chain-of-custody form is included in Appendix 14.9. All signatures are in permanent black ink and strikeouts are initialed and dated.

9.0 Analytical Procedures

ALS policy is that all SOPs be compliant with the reference method. In the event that several methods are referenced in an SOP, all procedures must be compliant with all referenced methods. All SOPs include a section describing changes and clarifications from the reference method. In the event that an analytical method is modified, the SOP documentation must include a description of the modification, any justification of the method modification which includes, but is not limited to, method performance and recovery data, any other supporting data, and approval from the Technical Directors, Quality Assurance Officer, and Laboratory Director. In the event that an analytical method must be modified or is modified to perform on specific sample matrices, the modification and reason must be stated in the case narrative. All modified methods will be identified on the analytical report.

9.1 Reference Methods

Reference methods for environmental samples are drawn primarily from the current version of *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (SW-846), Third Edition. Reference methods for water analysis are taken from *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, March, 1983 with its

updates, and from *40 CFR*, Part 136. To a lesser extent, methods referenced in ALS SOPs come from the current EPA CLP Statements of Work, from ASTM guides, and from *Standard Methods for the Examination of Water and Waste Water*.

9.2 Laboratory SOPs

SOPs are reviewed during the internal audits and updated as necessary. Review of SOP documents is completed in accordance with ALS SOP Lab-027 "Internal Audits" and XX-DC-011, "Preparation of SOP Documents", section 4.0.

9.3 Historical Performance Limits

The table in Appendix 14.17 lists all analytical method and preparatory method combinations in which ALS routinely tracks and maintains statistical control limits. The laboratory can perform other methods upon a client request. The approval for use and the establishment of method limits is the responsibility of the Project Managers with approval and input from clients. The limits use will be from referenced sources when ever possible. Current historical control limits are listed in appendix 14.14.

10.0 Quality Control Procedures

Before environmental samples are analyzed, the analytical system must be in a controlled, reproducible state from which results of known and acceptable quality can be obtained. That state is verified through the use of Quality Control (QC) procedures intended to ensure accuracy, precision, selectivity, sensitivity, freedom from interference, and freedom from contamination. The QC procedures performed at ALS include: calibration and calibration verification; analysis and comparison of resultant data to predetermined control limits for method blanks, laboratory control samples, spiked matrix samples, duplicate matrix samples, and surrogates added to samples; analysis of performance evaluation samples; determination of Method Detection Limits (MDLs); and the tracking and evaluation of precision and accuracy. For specific analytical methods, other QC procedures are implemented as required by the method.

These QC procedures are performed and evaluated on a batch basis. An analytical batch must not exceed 20 field samples (to include field-derived samples, such as the matrix spike) that are of a similar matrix type. The samples in a batch are processed together, through each step of the analysis, to ensure that all samples receive consistent and equal treatment. Consequently, results from the batch QC samples are used to evaluate the results for all samples in the batch.

10.1 Calibration and Calibration Verification

Instrument calibration is a QC measure taken to verify selectivity and sensitivity. Calibration of instruments at ALS is accomplished through the use of reference materials of the highest quality obtainable. NIST-traceable reference materials are procured and used if they are available. When NIST-traceable reference materials are not available, certified reference materials from government agencies or reliable vendors are used. In all cases, written records are maintained that allow all analytical results to be traced unambiguously to the reference materials used for calibration. ALS SOP XX-DC-019,

"Standards Purity, Preparation, Traceability, and Verification," describes the process and record keeping responsibilities of analysts to ensure that all reagent and reference materials are traceable to their sources. In general, analytical instruments are initially calibrated with standard solutions made from the reference materials at levels appropriate for the analysis. This is called the initial calibration (IC). The IC is verified at the beginning of each analytical sequence with a standard solution independently prepared from a different lot of the reference material, preferably from a different vendor. This step is called initial calibration verification or ICV. At specified intervals throughout the analytical sequence, the calibration is verified again through the analysis of an independently prepared standard solution. This process is called the continuing calibration verification or CCV. If the IC, the ICV, or any CCV fail the criteria in the analytical method, the system is recalibrated. Only results generated under acceptable calibration conditions are reported. Specific calibration procedures are found in the SOPs associated with each method of analysis.

Alternative calibration sequences or procedures will be discussed with clients as per section 3.1.4 and 3.1.5 of the ALS SOP Lab-023 "Client Communication".

Calibration parameters set by the applicable ALS SOP or method reference shall not be exceeded without initiation of a NC/CAR (See ALS SOP Lab-020).

10.2 Analysis of Method Blanks

The method blank (or preparation blank) contains no sample material; it is treated as a sample in every other way. It is analyzed to monitor any contamination to which the analytical batch might have been exposed during analysis. A method blank is analyzed with every analytical batch. An acceptable blank result must be below one-half the Practical Quantitation Limit (PQL) established by ALS for the analytical method, or have a value less than 10% of the concentration found in the sample. Method QC Evaluation of the Method Blank is available in Appendix 14.10. A description of PQL/RL values is described in section 10.8. The ALS PQLs are specified in the analytical method SOPs and are set at the concentration of the lowest calibration standard. Special project requirements can impose a different standard for acceptability of blank results (i.e. Less than 10% of a regulatory limit) and PQL limits (i.e. 3 times the MDL). If the blank results are unacceptable, the samples in the batch are extracted or digested again and reanalyzed within the hold time. If that is not possible, the client is notified and appropriate action is taken.

10.3 Analysis of Laboratory Control Samples

A laboratory control sample (LCS) contains the analyte(s) of interest in known concentration(s); it is used to monitor accuracy. It measures the success of the analysis in recovering the analyte(s) of interest from a familiar sample matrix. An LCS is analyzed with every analytical batch. Unless otherwise specified, soil samples and other solid matrices are analyzed with an LCS made of clean sand spiked with the analyte(s) of interest. Water samples and other liquid matrices are analyzed with a method blank spiked with the analyte(s) of interest. The results of the LCS are reported as percent recovery:

$$\% \text{ Recovery} = [\frac{X}{K} \text{ x } 100$$

Where:
X = Measured value
K = Expected value

10.4 Analysis of Spiked Matrix Samples

A known concentration of the analyte(s) of interest is added to a second representative portion of a field sample to prepare a matrix spike. The matrix spike is used to monitor accuracy. It measures the success of the analysis in recovering the analyte(s) of interest from the type of field sample matrix in the batch. A matrix spike is analyzed with every analytical batch. The results are reported as percent recovery.

$$\% \text{ Recovery} = [\frac{(X_S - X_u)}{K} \text{ x } 100 \text{ Where:}$$

X_s = Measured value in the spiked sample
X_u = Measured value in the unspiked sample
K = Expected value

10.5 Analysis of Duplicate Matrix Spike Samples

A duplicate matrix spike sample or duplicate matrix sample is used to monitor the precision (repeatability) of an analysis. If a sufficient amount of the analyte(s) of interest is present in the field sample, a matrix duplicate sample is analyzed directly. If the analyte(s) of interest are not present in a sufficient amount, two additional portions of field sample are spiked with the analyte(s) of interest to ensure that meaningful results are obtained. A pair of duplicate samples (matrix/matrix duplicate or matrix spike/matrix spike duplicate) is analyzed with every analytical batch. The results of the analysis of duplicate samples are reported as relative percent difference (RPD).

$$\text{RPD} = [\frac{|X_1 - X_2|}{(X_1 + [X_2)/2]} \text{ x } 100$$

Where:
$|X_1 - X_2|$ = The absolute value of the difference between the two sample values
$(X_1 + X_2)/2][$ = The average of the two sample values

10.6 Analysis of Surrogates Added to Samples

Surrogates are compounds similar to the analyte(s) of interest but that are known *not* to be present in the environment. Examples are fluorinated or deuterated homologues of the organic analyte(s) of interest. When appropriate compounds are available, their use is specified in the analytical method SOP. When surrogates are used, they are added to the calibration solutions and to each field and QC sample in the batch. Surrogate recovery is

a measure of the accuracy and selectivity of the method in the sample matrix. Surrogate results are reported as percent recovery.

$$\% \text{ Recovery} = [\frac{X}{K} \text{ x } 100$$

Where:
X = Measured value
K = Expected value

10.7 Analysis of Performance Evaluation Samples

Proficiency testing (PT) samples are prepared by an authorized independent organization outside the laboratory.

They are received and analyzed at regular intervals to monitor laboratory accuracy. ALS Laboratories sends the PT sample results to the independent organization, where they are evaluated and then forwarded directly from that organization to the State of Utah or other regulatory entity. PT samples are introduced into the regular sample stream of the laboratory and analyzed as routine samples by analysts who regularly perform the method. Laboratory personnel follow all instructions provided by the PT provider. ALS notifies the State of Utah if any changes to the enrollment in certified PT programs occur.

At a minimum, PT samples from an authorized proficiency testing program are generally analyzed at least twice annually for each certified analyte to maintain EPA certification as administered under Utah Rule R444-14-13. The Laboratory Director or the Quality Assurance Manager can institute the analysis of additional PT samples or modify the performance evaluation program as appropriate. The following guidelines are followed by ALS:

- Averaging results is prohibited.
- Only qualified ALS laboratory employees analyze PT samples.
- Results are not discussed with outside entities or other ALS laboratories prior to the deadline for receipt of the results.
- ALS does not subcontract to other laboratories or receive from other laboratories any PT samples.

When a PT sample result is not acceptable, documented corrective action is taken to determine and correct any problem(s) leading to the unacceptable result. Refer to section 12.0 of this QAPP. A corrective action report is available upon request and pertinent reports, report forms, and documentation are stored in accordance with section 13.0 of this QAPP. If a remedial PT sample must be analyzed, only one remedial PT sample for an analyte or independent analyte group can be submitted in any 12-month period.

10.8 Method Detection Limits

The method detection limit (MDL) reflects the sensitivity of an analytical method to the matrix of interest. It is the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero in the matrix used for determination of the MDL.

MDLs in solid and aqueous matrices are determined annually in accordance with ALS SOP LAB-024, "Calculation of Method Detection Limits." This SOP follows the requirements of 40 CFR Part 136, Appendix B, July 1, 1995 edition.

Reporting Limits are set by ALS at the lowest calibration concentration except for methods that require deviation from multiple-point calibration or are not applicable to similar calibration requirements. Practical Quantitation Limits are typically synonymous with Reporting Limits. PQLs can be specified by a client as some multiplier of the MDL determination. In all cases, the Reporting Limit and the Practical Quantitation Limit must be higher than the applicable value derived from the current MDL study and no lower than the lowest calibration concentration, except as designated by the analytical procedure.

10.8.1 ALS analyzes Reporting Limit Verification Samples (RLVS) in each batch of samples. RLVS is a spiked LCS sample at the reporting limit. These samples are not used for batch evaluation unless specifically required by a client request or project. These samples are used to verify the reporting limits and are used for an alternate procedure to calculate limits of detection (LOD) or MDLs. The procedures for use to calculate LOD are specified in the ALS SOP Lab-024 "Calculation of Method Detection Limits".

10.9 Other Quality Control Procedures

Specific analytical methods might require additional quality control measures. Examples include the verification of GC/MS tuning every 12 hours and the verification of ICP interelement corrections. Both of these QC measures verify method selectivity.

Additional QC measures are implemented as part of the analytical method. The balances at ALS are maintained and checked according to ALS Lab-010, "Balances." The thermometers at ALS are evaluated for future use and calibrated according to ALS SOP Lab-018, "Calibration of Thermometers." Pipettors are maintained and calibrated in keeping with ALS SOP Lab-016, "Calibration of Pipettors."

10.10 Tracking and Evaluation of Accuracy and Precision

Assessment of the accuracy of an analytical measurement is based upon the analysis of samples of known composition. ALS relies upon the analysis of LCS samples to track accuracy. The percent recovery relative to the expected value is calculated and plotted on an accuracy chart (X chart) for tracking. Assessment of the precision (repeatability) of an analytical measurement is based upon repeated analysis of equivalent samples of known or unknown composition. ALS relies upon the analysis of pairs of matrix samples (M/MD) or spiked matrix samples (MS/MSD) to assess precision. The range of the pair is expressed as a relative percent difference (RPD). Control limits for the accuracy and precision charts are calculated assuming a normal (Gaussian) distribution of results. A set of historical data points are used to calculate mean values, two-standard deviation warning limits, and three-standard deviation control limits. The establishment and updating of control charts is described in ALS SOP QC-DC-001, "Establishing and Updating Control Limits."

When evaluating batch QC the analyst makes a sequence of decisions before reporting sample results regarding calibration, the method blank, LCS, surrogate recovery, matrix spike, and matrix spike duplicate recovery results. Appendix 14.10 contains a set of six flowcharts used by ALS analysts to evaluate batch QC. The first evaluation of QC acceptability is made according to the requirements stated in the analytical method. The second consideration is based upon any special project requirements. The flowcharts then are used to evaluate batch QC in the following order: calibration, method blank results, surrogate recovery results, LCS results, matrix spike recovery results, and duplicate results. Exhibit "MB Flow" (in Appendix 14.10) is a flowchart that summarizes the first set of decisions to be made by the analyst to evaluate the acceptability of method blank results. Exhibit "LCS Flow" is a flowchart that summarizes the second set of decisions to be made by the analyst to evaluate the acceptability of LCS results. Exhibit "MS Flow" is a flowchart that summarizes the set of decisions to be made by the analyst to evaluate the acceptability of matrix spike results. Exhibit "RPD Flow" is a flowchart that summarizes the set of decisions to be made by the analyst to evaluate the acceptability of duplicate results. Table 1 below, "QC Sample Evaluation," summarizes the decisions to be made by the analyst regarding relationships between LCS results, matrix spike results, and duplicate results to complete the evaluation of batch QC.

Table 1
Inorganic QC Data Evaluation

LCS Recovery	MS Recovery	MS/MSD or Sample/MD RPD	Blank	Response
+	+	+	+	Samples are reported with no exceptions.
+	+	+	–	See Method Blank Flowchart Appendix 14.10
+	+	–	+	Samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts
+	–	+	+	Samples are reported with a flag or note denoting that a matrix effect is suspected. See MS/MSD Flowchart
–	+	+	+	Samples are reprepared and reanalyzed. See LCS Flowchart
+	+	–	–	See Method Blank Flowchart and samples are reported with a flag or note denoting that a matrix effect is suspected. See MS/MSD and Duplicate Flowchart.
–	+	+	–	See Method Blank and LCS Flowcharts
–	+	–	+	See LCS, MS/MSD and Duplicate Flowcharts.
+	–	+	–	See MS/MSD and Method Blank Flowcharts.
+	–	–	+	See MS/MSD and Duplicate Flowcharts.
–	–	+	+	See LCS and MS/MSD Flowcharts.
+	–	–	–	See Method Blank, MS/MSD and Duplicate Flowcharts.
–	+	–	–	Samples are reprepared and reanalyzed.
–	–	+	–	Samples are reprepared and reanalyzed.
–	–	–	+	Samples are reprepared and reanalyzed.
–	–	–	–	Samples are reprepared and reanalyzed.

(+) = meets criteria (-) = does NOT meet criteria

Table 2
Organic QC Data Evaluation

LCS Recovery	MS Recovery	MS/MSD or Sample/MD RPD	Blank	Surrogate	Response
+	+	+	+	+	Samples are reported with no exceptions.
-	+	+	+	+	See LCS Flow Chart Appendix 14.10
+	-	+	+	+	Samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD Flowchart
+	+	-	+	+	Samples are reported with a flag or note denoting that a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts
+	+	+	-	+	See Method Blank Flowchart
+	+	+	+	-	See Surrogate Flowchart
-	-	+	+	+	See LCS and MS/MSD Flowchart
+	-	-	+	+	Samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts
+	+	-	-	+	See Method Blank Flowchart and samples are reported with a flag or note denoting that a matrix effect is suspected. See MS/MSD and Duplicate Flowchart.
+	+	+	-	-	See Method Blank Flowchart and Surrogate Flowchart
-	+	-	+	+	See LCS Flow Chart and samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts.
+	-	+	-	+	See Method Blank Flow Chart and samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts.
+	+	-	+	-	See Surrogate Blank Flow Chart and samples are reported with a flag or note denoting a matrix effect is suspected. See MS/MSD and Duplicate Flowcharts.
–	–	–	–	-	Samples are reprepared and reanalyzed.
Other situations can occur. Please see the appropriate Method QC Flowchart in Appendix 14.10					

(+) = meets criteria (-) = does NOT meet criteria

In addition to evaluating individual batch QC results against control limits, QC results from successive batches are also evaluated for possible trends. While a trend is not necessarily an out-of-control situation in itself, it can provide an early warning of a condition that can cause the system to go out of control. ALS SOP XX-DC-018, "Evaluation of Quality Control Data," describes in detail the assessment of QC data in the laboratory. The following conditions are trends that initiate action and/or monitoring.

- A series of seven successive points on the same side of the mean
- A series of five successive points going in the same direction
- A cyclical pattern of QC sample results
- Two successive points between warning limits and control limits
- A single QC value outside the control limits

The occurrence of a trend does not invalidate data that are otherwise in control. However, trends do require attention to determine whether a cause can be assigned to the trend so that appropriate preventative action can be undertaken.

11.0 Data Reduction, Verification, and Reporting

Data reduction, verification, and reporting are accomplished through extensive use of a Laboratory Information Management System (LIMS). The ALS LIMS is a commercial automated data handling system that incorporates a relational database with additional custom programming to interface with laboratory instruments and produce reports required by ALS clients. It is maintained by the ALS computer support staff and updated as necessary to accommodate new instrumentation and meet diverse client requirements.

11.1 Data Reduction

Data reduction consists of identifying the pertinent set of calibration standards, specifying the type of calibration to use (e.g., linear, calibration factor, quadratic), and calculating analytical results from the calibration equation. The actual calculations are performed by software residing in the analytical instrumentation or by the ALS LIMS after raw data have been transferred into it. Analyst involvement is limited to selecting standards, the type of calibration, and the sample set to which the calibration is applied.

Linear calibrations or the use of response factors are preferred for the reduction of data. ALS policy is to utilize the simplest appropriate equation that produces a good fit of the data. Other types of calibrations are available if required by the method or made necessary by special circumstances. The types of calibrations available are listed below in Table 2:

Table 2: Types of Calibration

Calibration Type	Equation
Linear	$y = mx + b$
Calibration Factor	$y = CFx$ where CF is the average of the individual response factors for each calibration point
Quadratic	$y = a + bx + cx^2$

11.2 Ensuring Accuracy of Calculations and Transcriptions

All of the software used for data reduction, verification, and reporting is documented and validated by the ALS computer support staff according to ALS SOPs LAB-101, "Computer Program Testing," and LAB-102, "Computer Program Documentation," or by the vendor from whom it is purchased. ALS software is controlled and secured according to ALS SOPs LAB-103, "Computer Software Control," and LAB-104, "Computer Software Security." A continuing effort is made at ALS to increase the use of automated data handling, improve efficiency, and minimize human error.

ALS also relies upon a system of peer review to ensure the quality of analytical reports. Peer review procedures are specified in the ALS SOP XX-DC-023 "Peer Review". An analyst, familiar with the analytical method used to produce the results (peer reviewer), reviews each report. The peer reviewer verifies that the calibration standards, type of calibration, and sample set with associated QC samples were selected correctly. The peer reviewer also verifies any manual transcriptions and calculations. The Manager can perform additional technical review.

11.3 Verification of Quality Control

The analyst is responsible to evaluate the QC results (method blank, surrogate recovery, LCS, matrix spike, and duplicate results) and to take any necessary actions described in section 10.0 of this document. Examples of necessary actions are:

- Reporting sample results with the correct qualifier (e.g., qualifier flag for sample results between the MDL and the PQL)
- Noting unusual situations in the case narrative (For example, although the blank contains an analyte above the PQL, sample results can be reported because all were less than the MDL.)
- Initiating corrective action when required

The peer reviewer is responsible to verify that QC results have been evaluated correctly and that necessary actions have been taken. Peer review procedures are specified in the ALS SOP XX-DC-023 "Peer Review". The peer review is considered complete when all issues raised by the peer reviewer have been resolved. Resolving issues raised by a peer reviewer can involve the manager and the Quality Assurance Manager.

11.4 Reporting

When the peer review has been completed, a report is generated. In most situations the report is produced from the LIMS. In some cases part or all of the report can be produced from the data system of the analytical instrument. The reports produced by ALS meet the following requirements:

- The report identifies the method used. If the method is modified, it is noted as "modified" in the report.
- Any abnormal sample conditions, deviation from hold time, irregularities in preservation or other situations that might affect the analytical results are noted in the report and associated with the analytical results.
- The contents of the report include:
  - The report title with the name, address, and telephone number of the laboratory
  - The name of the client or project and the client identification number
  - Description and laboratory identification number
  - The dates of sample collection, sample receipt, sample preparation, and analysis
  - The time of sample preparation and/or analysis if the required hold time for either activity is 48 hours or less
  - A method identifier for each method, including methods for preparation steps
  - The MDL or minimum reporting limit for the analytical results
  - The analytical results with qualifiers as required
  - A description of any quality control failures and deviations from the accepted method
  - The signature and title of the individual(s) who accept responsibility for the content of the report
  - The date the report is issued
  - Clear identification of any results generated by a subcontract laboratory
  - Page numbers and total number of pages

The Project Manager can review final reports for compliance with client requirements. The Quality Assurance Manager periodically reviews a representative selection of reports for compliance with this QAPP. Standard ALS deliverables are produced in accordance with ALS SOP XX-DC-020, "Deliverable and Data Package Preparation and Review."

12.0 Corrective Action, Preventative Action and Improvement

ALS laboratory operations are conducted in accordance with documented internal procedures (such as SOPs and this QAPP) and client-specific provisions communicated through the ALS project managersPPW. When any laboratory process does not meet internal ALS requirements or client-specific provisions, the nonconformance is identified and appropriate corrective action is taken. Corrective action is performed as a part of routine analysis and usually does not require formal documentation. An example of routine corrective action is troubleshooting an instrument and recalibrating it after calibration verification fails. Other corrective action requires formal documentation. An example is consistently poor recovery of analytes from an LCS.

12.1 Individuals Responsible to Take Corrective Action

All ALS staff members are responsible to initiate corrective action as necessary. Each employee is expected to understand laboratory procedures and client requirements governing the work performed and to take prompt action to ensure that those requirements are met. Managers are responsible to determine the extent of the nonconformance and the initial level of corrective action response. The Project Manager is responsible to evaluate the appropriateness of the corrective action response for the client. The Quality Assurance Manager is responsible to oversee the overall effectiveness of the corrective actions taken by the laboratory. The Laboratory Director is responsible to ensure that resources are allocated to correct nonconformances promptly and effectively. Procedures are outlined in ALS SOP LAB-020, "Nonconformance/Corrective Action Report (NC/CAR) Procedures." Appropriate corrective actions are listed in Appendices 14.7 and 14.10 of this QAPP.

12.2 Laboratory Responses to Unacceptable Results

Proficiency testing (PT) samples are prepared by an independent organization outside the laboratory. They are received and analyzed at regular intervals to monitor laboratory accuracy. Any failure to pass a PT sample is reported to the Manager, the Quality Assurance Manager, and the Laboratory Director. It requires documented corrective action. The Manager is responsible to ensure that the corrective action is completed. The Quality Assurance Manager is responsible to review and accept or reject the completed corrective action and its documentation.

Unacceptable results from QC sample analyses that can be addressed as part of the analytical process do not require formal documentation of corrective action. That type of problem and its resolution become part of the information in the laboratory notebook or the instrument maintenance log. Other nonconformances revealed by QC sample results or internal checks, including internal audits, must have documented corrective action. Managers are responsible to ensure that the corrective action is completed. The Quality Assurance Manager is responsible to review and accept or reject the completed corrective action with its documentation.

When a client contacts the laboratory to reveal a failure in the laboratory analytical system, documented corrective action is taken. The Project Manager is responsible to initiate the corrective action. The Manager is responsible to ensure that the corrective action is completed. The Quality Assurance Manager is responsible to review and accept or reject the completed corrective action with its documentation.

12.3 Verification and Documentation of Corrective Action

The ALS SOP governing documented corrective action is LAB-020, "Nonconformance/Corrective Action Report (NC/CAR) Procedures." Verification and documentation of corrective action are implemented in accordance with the SOP.

12.4 Reports to Laboratory Managers

In addition to the reports described in this section, reports concerning various aspects of quality assurance are furnished to the President and Laboratory Director. The Quality Assurance Manager provides reports of reviews of analytical reports, internal audits, and training. Managers report technical and quality problems directly to the Laboratory Director.

12.5 Internal Audits

Internal audits are conducted in accordance with ALS SOP Lab-027, "Internal Audits.". When internal and external audits or data assessments reveal a cause for concern with the quality of the data an investigation is initiated by quality assurance personnel to determine the extent of the problem. If the results of this investigation reveal the need for data recall an acknowledgement is sent to the client within five business days. This acknowledgment will describe the situation, corrective action plans and a time frame for implementation.

12.6 Improvement and Preventive Action

At ALS, improvement of the quality systems and preventive action is effected through an ongoing systems review by management using input from all staff.

ALS actively seeks employee and client input for improvements through surveys and questionnaires. Internally ALS maintains a process improvement website for employee to provide suggestions for improvements. For clients, ALS provides surveys and feedback on services provided. These automated systems report directly to the laboratory director for input into the management review process.

Preventive actions using quality control data and control charts to trend data are the cornerstone of the preventive action system. Emails on a daily basis identify trends in quality control samples. Trend analysis using control charts is forwarded to operations personnel for actions. Records of activities are maintained in the normal course of laboratory records.

Preventative actions include preventive instrument maintenance as listed in ALS SOP Lab-002 "Preventative Maintenance for Analytical Instruments". These actions are documented in run logbooks and maintenance logbooks in accordance with ALS SOP Lab-030 "Documentation: Maintenance of Records, Notebooks, and Logbooks".

Yearly, management and key personnel review strategic goals and necessary improvements through a strategic planning process, This process and review of actions items is available on ALS On-Line (Intranet) and is available to all employees. All employees are asked to participate in strategic planning sessions on a regular basis in operations, project management, and administration (includes finance, facilities, safety & health, and human resources) areas. These focused meetings review strategic plan goals, design implementation strategies and solicit ideas for improvements.

The top laboratory management team conducts an ongoing review of the operations and quality system. This management review process includes bi-weekly and monthly meetings as described below.

12.6.1 Management Review

The purpose of Management Review is to conduct a review of the laboratory's quality system and testing activities to ensure its continuing suitability and effectiveness. At ALS, improvement of the quality systems and preventive action is effected through ongoing review by management using input from all staff.

The management team conducts reviews of the business operations which includes laboratory policies and procedures, management reports, results of internal audits, external assessments, proficiency testing results, results of interlaboratory sample exchange programs, corrective actions deemed systematic, preventive actions, feedback from clients, changes in volume or types of testing, specific client complaints, effectiveness of training efforts, staffing resources, and relevant guidance documents. This review addresses compliance with the quality system and results in any procedural changes needed to comply.

This management review process and available records are outlined in the ALS SOP Lab-026 "Management Review"

12.6.2 Review by Operations Personnel

The Laboratory Director meets bi-weekly with the Technical managers, project management, and quality assurance personnel. The Laboratory Director reviews internal audits, external assessments, proficiency testing, corrective actions, feedback from clients, and other issues noted in the preceding section. The group discusses responses to the preceding items. The Laboratory Director submits written responses pertaining to corrective action and audit responses to the QAO. The Laboratory Director also maintains a record of pertinent events.

The Laboratory Director discusses procedural changes to the quality system as approved by senior management. The Laboratory Director develops schedules and monitors implementation of procedural changes. Quality Assurance Personnel track the progress of implementation.

- ♦ Quality System review is supported by the following documentation:
- Internal Audit Reports
- Response to Internal Audit Reports
- External Assessments
- Response to External Assessments
- Proficiency Testing Results
- Response to Proficiency Testing

- Client Feedback
- Response to Client Feedback
- Nonconformance/Corrective Action Reports
- Client Complaints
- Client Complaint/Corrective Action Reports
- QAO documentation of Annual Quality Systems Audit
- Response to Annual Quality Systems Audit

12.6.3 All pertinent documentation is retained.

13.0 Document Control and Record Keeping

The management and control of documents and records that define laboratory operations and chronicle laboratory activities are necessary to ensure that laboratory data are of known quality, retrievable, reproducible, and defensible. Records that must be maintained, controlled, or managed include sample receiving and chain-of-custody records, sample analysis data records, instrument and other laboratory maintenance records, quality control data, quality assurance documents, and all other records relating to or impacting the quality of analytical data.

The records management system is implemented through several ALS Standard Operating Procedures, including:

- XX-DC-006, "Chain-of-Custody and Laboratory Tracking"
- XX-DC-011, "Preparation of SOP Documents"
- LAB-021, "Document Control"
- XX-DC-020, "Deliverable and Data Package Preparation and Review"
- LAB-030, "Documentation – Maintaining Instrument Records, Notebooks and Logbooks"
- LAB-013, "Archives"
- QD-EP-1220, "Document Control and Report Preparation"
- LAB-007, "Record of Training"

The record system at ALS is designed to the meet regulatory requirements of Utah Rule 444-14. Documentation requirements are met through the implementation of the SOPs noted above.

Examples of documents that are controlled and tracked include:

- Standard Operating Procedures
- Analyst Notebooks
- Instrument Logbooks
- Standards Preparation Logbooks
- Instrument Hard Copy Output (e.g., chromatograms, strip charts)
- Computer Printouts (e.g., raw and processed data)
- Analytical Reports
- Data Packages
- Reference Methods
- Quality Assurance Plan
- Safety and Health Program and Procedures
- Training Records

13.1 Document Control

Document control procedures are described in ALS SOP LAB-021, "Document Control." Additional information concerning the generation and updating of these controlled documents is contained in ALS SOP XX-DC-011, "Preparation of SOP Documents."

Control of internally generated documents including Standard Operating Procedures and the Laboratory Quality Assurance Project Plan are maintained under document control procedures described in ALS SOP LAB-021 – "Document Control". Control of externally generated documents, such as methods, accreditation policies and requirements, reference manuals and other external documents are maintained under document control policies through the use of the ALS intranet.

13.1.1 Standard Operating Procedures

13.1.1.1 Retention and Distribution

The Quality Assurance Manager is responsible for the retention and distribution of Standard Operating Procedures, in accordance with ALS SOP LAB-021, "Document Control."

13.1.1.2 Revision of SOPs

Assignments are made to the responsible ALS manager or designee to review and update SOPs applicable to the area of responsibility. At times it is also necessary to obtain approval by specific clients before written SOPs can be modified. After revision, the Manger, Quality Assurance Manger, and Laboratory Director must approve the updated SOP. Updated SOPs are then distributed on line and to holders of controlled copies.

13.1.1.3 Retiring of SOPs

If it becomes necessary to retire an SOP, approval of the Laboratory Director, appropriate Manager, and Quality Assurance Manager must be obtained before retirement can take place. After retirement, the SOP is stored in the retired SOP file for future reference.

13.1.1.4 Review of SOPs

Review of all technical SOPs is completed during yearly internal audits. Review of all SOPs are completed on an as needed basis and documented as described in the ALS SOP XX-DC-011.

13.1.2 QA Program Plans

This QAPP is a controlled document with distribution to all ALS staff members involved in QAPP-related activities. The ALS Quality Assurance Manager can

distribute copies of the ALS QAPP to other persons, such as clients and subcontractors. Additionally, quality assurance program documents, project plan documents, and contractual Statement of Work documents generated by a client can be designated as controlled documents at the discretion of the ALS Project Manager, the ALS Quality Assurance Manager, or the Laboratory Director.

13.1.3 Records of Distribution

The Quality Assurance Manager maintains a record of the distribution of internally generated controlled documents. This record includes the document and version numbers, updates, and responsible persons.

13.2 Record Keeping

ALS uses an off-site, commercial record archive facility to retain its records. A filing system is maintained by the archivist to account for documents taken from archives until their return. Detailed pertinent procedures are found in ALS SOP LAB-013, "Archives." The Quality Assurance Manager and, by delegation, assigned ALS personnel, are responsible for the retention, retrieval, and disposition of final records of laboratory data and activities. This includes: data packages, once they are completed; analyst laboratory notebooks and instrument maintenance logs, once submitted for archival; and training records, as established by SOP.

13.2.1 Data Packages

All documentation that pertains to the analysis of a sample or group of samples that are being reported together must be compiled as a data package. SOPs addressing the preparation and control of data packages include:

- LAB-013, "Archives"
- QD-EP-1220, "Document Control and Report Preparation"
- XX-DC-020, "Deliverable and Data Package Preparation and Review"

Records or copies of records that relate to the analysis of field samples are compiled into data packages by the analyst. These data packages are initially stored, generally categorized according to client or project, in open-access files, allowing easy retrieval for review. Data packages are generally maintained in on-site archives until audited by the client or project administrator. Data packages can then be released to the client or archived off-site from the ALS laboratory facility, pending later release to the client. The client and/or regulatory requirements govern the length of time for data package retention. Unless specified by contract, applicable statute, or program, data packages are retained for five years.

13.2.2 Laboratory Notebooks and Logbooks

Laboratory notebooks and logbooks are retained by ALS for 10 years and are not released to clients. Laboratory notebooks are assigned to specific analysts, who are responsible for their maintenance. If corrections are required, a single-line cross-out and initials and date are entered.

13.2.3 Quality Assurance Records

Quality control sample results data are retained for five years. Records of internal audits, nonconformance reports, and corrective action reports are retained for five years.

13.2.4 Records of Audits and NC/CARs

The Quality Assurance Manager is responsible for maintaining and retrieving all records of audits, both internal and external, proficiency testing results, and nonconformance and corrective action records and reports.

13.2.5 Client Related Information

Project Managers are responsible for maintaining, archiving, and retrieving all contracts, -project requirements and QAPPs provided to ALS by clients and related to projects completed by ALS. They are also responsible for the destruction of materials provided on unsuccessful proposals and bidding opportunities. Specific procedures for client communication and required documentation are listed in the ALS SOP LAB-023 “Client Communication”.

14.0 Appendices

The following appendices are available upon request. These are dynamic documents; accordingly, they can change without notice or revision to this Quality Assurance Program Plan. Please contact the laboratory project manager for the current version, the current version is also available on ALS On-Line.

14.1 Accreditations and Certifications
See ALS On-Line or www.datachem.com
14.2 ALS Organization Chart
14.3 Key Personnel
14.4 ALS Staff Summary Table
14.5 Facilities Floor Plan
See ALS On-Line
14.6 Equipment List
See ALS On-Line
14.7 Summary of Calibration and Corrective Action Procedures
14.8 Sample Preservation and Hold Times
14.9 Chain-of-Custody
14.10 Batch QC and Corrective Action Flowcharts
14.11 ~~SOP~~ Master List of Documents ~~List~~
14.12 Definitions and Terms
14.13 Analytical Services Provided by ALS Laboratory Group
14.14 Historical Control Limits LCS and Surrogate
14.15 Method Detection and Reporting Limits
14.16 Marginal Exceedances
14.17 ALS Maintained Control Limits
14.18 DoD QSM Requirements

Certification/Validations/Accreditations

AGENCIES

- **AIHA** American Industrial Hygiene Association – expires 4/1/10
- **AIHA ELLAP** Environmental Lead Laboratory Accreditation Program – expires 4/1/10
- **NFESC** Naval Facilities Engineering Service Center – Looking for sponsor to renew – expired 9/08
- **USACE** U. S. Army Corps of Engineers—Self Declaration
- **USEPA** - Contract Laboratory Program – hold both inorganic and organic contracts for current SOWs

STATES

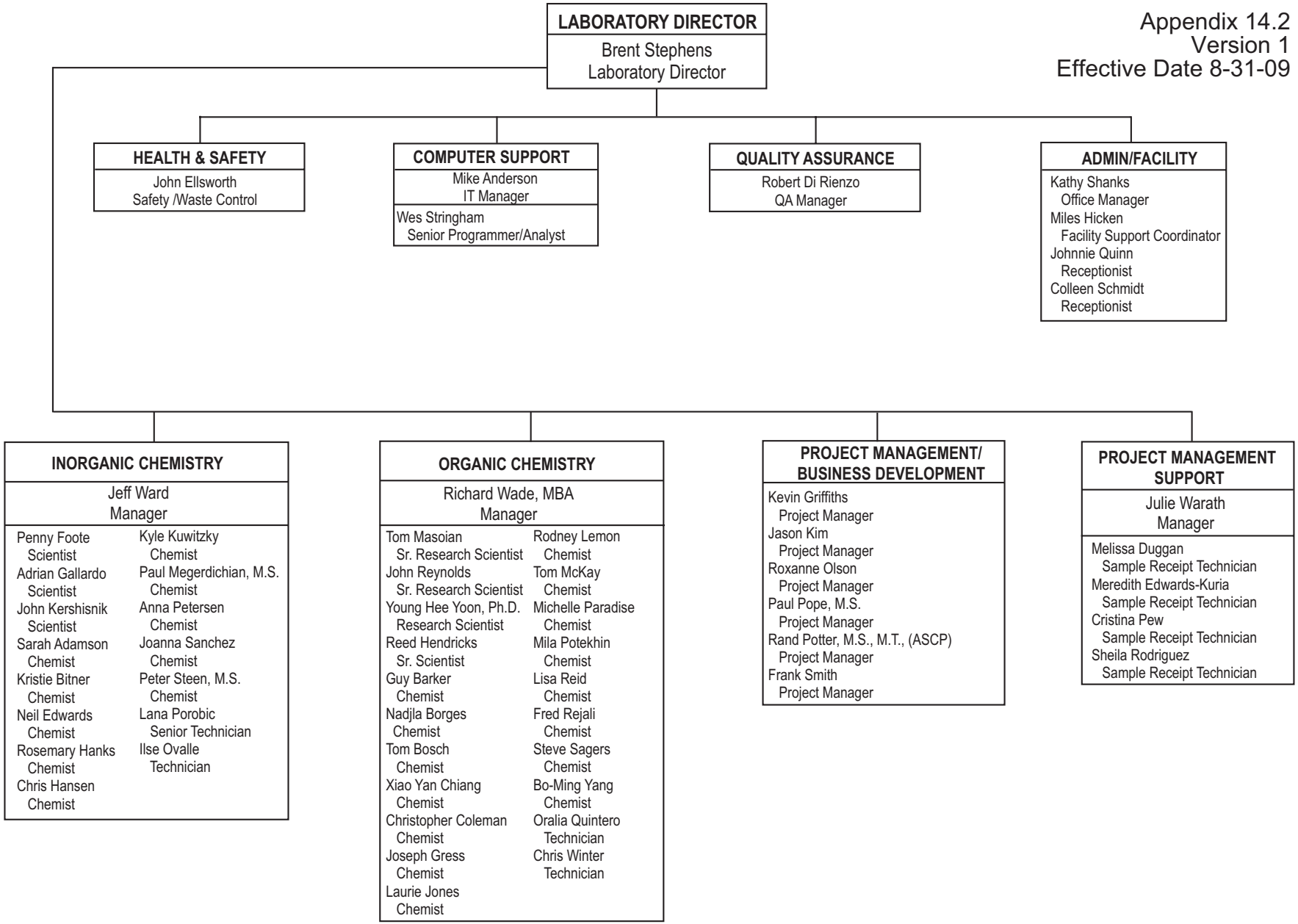
- **Iowa** (RCRA) – expires 8/1/10
- **Maryland** (SDWA) – expires 12/31/09
- **Nevada** (RCRA, SDWA, CWA) – expires 7/31/10
- **Utah NELAC** (RCRA, SDWA, CWA) – expires 11/30/09
- **Texas NELAC** (RCRA, Air) – expires 12/31/09
- **Oklahoma** (hazardous waste) – expires 8/31/10

Proficiency Testing Participation

- Water Pollution (WP) Performance Evaluation Study (NIST Approved)
- Water Supply (WS) Performance Evaluation Study (NIST Approved)
- Soil Samples Performance Evaluation Study (NIST Approved)
- EPA Contract Laboratory Program (CLP) blind audits
- AIHA Proficiency Analytical Testing (PAT) Program
- AIHA Environmental Lead Proficiency Analytical Testing (ELPAT) Program
- AIHA Bulk Asbestos Proficiency Testing Program
- AIHA Environmental Microbiology Proficiency Analytical Testing (EMPAT) Program
- AIHA Beryllium Proficiency Analytical Testing (BePAT) Program

SALT LAKE LABORATORY

Appendix 14.2
Version 1
Effective Date 8-31-09



Appendix 14.3
Version 1
Effective Date 9-1-09

ALS Laboratory Group
Key Personnel

Laboratory Director (Client Services, Support and Administrative Manager)	**Brent E. Stephens**
Inorganic Chemistry Manager	**Jeffery S. Ward**
Organic Chemistry Manager	**Richard W. Wade**
Quality Assurance Manager	**Robert P. Di Rienzo**
Computer Support Manager	**Mike R. Anderson**
Project Management Support Manager	**Julie A. Warath**

On November 1, 2008 DataChem Laboratories was purchased by ALS Laboratory Group, Environmental Division (Salt Lake City, UT). Titles and company names have been changed but no policy, procedures and personnel changes were made. This document includes new titles if any and the new company name only.

Brent E. Stephens
Laboratory Director

Brent E. Stephens is Laboratory Director at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem)

Under DataChem, Brent E. Stephens was Vice President/Laboratory Director at DataChem Laboratories (DataChem). He manages the technical operations of an industrial hygiene and environmental laboratory comprising approximately 80 persons. He also directs and manages all project management and business development of a scientific laboratory and all personnel. Mr. Stephens develops budget items relating to capital equipment expenditures, labor, and revenue expectations. His responsibilities include maintaining a well-trained, ethical, technical workforce, while fostering an atmosphere of personal responsibility for the cost-effective high-quality product supplied to DataChem clientele.

Prior to holding the position of Vice President/Laboratory Director, Mr. Stephens was the Vice President of Project Management and Business Development at DataChem. He managed and coordinated personnel, projects, and procurement of business from existing and potential clients. These responsibilities included coordinating business and projects with operations managers to ensure client satisfaction by communicating expectations; responding to data inquiries; overseeing preparation of price quotes and proposals; and hosting various regulators, clients, and potential clients as they toured and/or audited the laboratory. In an effort to obtain knowledge that could be critical in assisting clients in developing project plans and ensuring that existing clients were satisfied with the quality of work DataChem provided, Mr. Stephens also met with current clientele regularly and attended various trade shows, conferences, and regulatory meetings.

Mr. Stephens has been with DataChem since 1985; he has served as a Section Manager and as a Chemist (performing many of the inorganic analyses offered by DataChem). Past responsibilities included supervision of group leaders, chemists, and technicians responsible for the preparation and analysis of environmental and industrial hygiene samples. Methods used in his section included inductively coupled plasma and atomic absorption spectrophotometry. Mr. Stephens' duties included organization of workload by determining priorities, acquiring additional instrumentation and personnel as necessary, and interacting with project management to accurately assess analytical costs for contract proposals. He also wrote analytical Standard Operating Procedures that conformed to the requirements of various regulatory agencies.

Mr. Stephens graduated from the University of Utah in 1984 with a Bachelor of Science degree in Geology.

Jeffery S. Ward
Manager – Inorganics

Jeffery S. Ward is Manager of the Inorganic Chemistry Section at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem)

Under DataChem, Jeffery S. Ward was Manager of the Inorganic Chemistry Section at DataChem Laboratories (DataChem). He manages and supervises all activities and personnel assigned to the Section. His specific operational areas include metals analysis (emission and absorption spectroscopy); minerals analysis (X-ray diffraction and optical microscopy); wet chemistry (infrared, ultraviolet and visible spectroscopy, and automated colorimetry); radiochemistry; gravimetric analysis; and inorganic glassware cleaning. He supervises, schedules, and coordinates activities of Section personnel to meet specified requirements for environmental and industrial hygiene projects and commercial clients. Previously, Mr.

Ward was Manager of the Industrial Hygiene Inorganic Chemistry Section at DataChem. In that capacity he performed his current duties and also coordinated with the Environmental Inorganic Chemistry Section manager to facilitate efficient utilization of inorganic laboratory personnel and equipment.

Previously, Mr. Ward supervised the Project Management Section of the Customer Relations Department at DataChem. In that capacity he managed and supervised activities associated with the execution of all contracted projects administered by the Section. He managed and coordinated services provided to clients in support of laboratory analytical tasks. Mr. Ward assigned DataChem personnel to specific projects and served as a Project Manager for selected projects. As a Project Manager, he coordinated and supervised various phases of environmental analytical chemistry projects from initial discussions regarding sample collection through laboratory analysis, data reporting, and invoicing procedures. While serving as the laboratory liaison for engineering firms, he ensured adequate allocation of DataChem resources to meet project requirements, communicated daily to address client concerns, and resolved problems. Mr. Ward's primary focus as Project Manager concerned management of contracts originating through the U.S. Army Environmental Center.

Prior to his service as Project Manager, Mr. Ward was a Group Leader 2 in the DataChem Inorganic Chemistry Spectroscopy Section (Day). He was responsible for the management of activities associated with the Atomic Absorption Spectroscopy Laboratory under the direction of the Section Manager. He directed, organized, and coordinated the work assignments of analytical chemists assigned to the Atomic Absorption Laboratory. He also performed inorganic metals analysis by graphite furnace for the Environmental Protection Agency Contract Laboratory Program and for the U.S. Army Environmental Center (formerly USATHAMA). Prior to his assignment as Group Leader, Mr. Ward was a Chemist 2 in the Atomic Absorption Spectroscopy Laboratory and was responsible for the preparation and analysis of environmental, biological, and industrial hygiene samples by graphite furnace. His past responsibilities at DataChem involved the analysis of samples by X-ray diffraction.

Mr. Ward received a Bachelor's degree in Geology from the University of Utah in 1986.

Richard W. Wade
Manager – Organics

Richard W. Wade is Manager of the Organic Chemistry Section at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem)

Under DataChem, Richard W. Wade was Manager of the Organic Chemistry Section at DataChem. He directs activities of the Section including qualitative and quantitative analysis for industrial hygiene and environmental samples. He supervises and trains analytical personnel and provides technical management for laboratory methods and procedures. Mr. Wade also ensures that quality objectives and contract requirements are met and that methods are performed in accordance with Standard Operating Procedures (SOPs). Other duties include assigning and tracking samples and ensuring that sample data are reported on time. In addition, he provides technical expertise in maintenance and configuration of analytical instrumentation.

From 1997 through 2001 Mr. Wade was Manager of the Environmental Organic Chemistry Section. During this time he directly supervised chemists performing environmental methods.

From 1990 to 1997 Mr. Wade was Organic Chemistry Department Manager. In that capacity he directed the analytical programs for all organic analytical services including quantitative and qualitative analysis for environmental and industrial hygiene samples, custom analyses, method development, and air

monitoring. He developed and managed the Department budget, purchased analytical instrumentation, and negotiated terms with vendors. Mr. Wade supervised from five to seven Section Managers over the following areas: Organic Extraction, HPLC Analysis, Specialty GC/MS Analysis, Volatile Organic Analysis, Pesticide Analysis, and Air Monitoring. In addition he provided technical management and guidance for acceptable laboratory methods and procedures. Mr. Wade wrote many SOPs. He was also responsible for ensuring compliance with federal and state regulations. He participated in numerous laboratory audits from federal and state agencies as well as from many commercial clients, and responded to audit findings. His duties included evaluating data and defending data and procedures in verbal and written communications. He initiated corrective action when necessary. Mr. Wade negotiated technical issues with auditors and clients and worked closely with Project Managers to ensure that contractual requirements were met. He developed and implemented plans to regulate laboratory capacity in accordance with sample volume. This included planning for laboratory facilities, instrumentation, and personnel. He implemented programs for increasing laboratory efficiency and directed method development for special projects.

Functioning as a Section Manager at DataChem beginning in 1987, Mr. Wade increased GC/MS instrumental capacity with the purchase of seven Finnigan 5100 GC/MS systems. He trained additional personnel to operate the instruments and to process data and prepare reports. He continued to oversee the analytical performance for EPA-CLP and Rocky Mountain Arsenal (RMA) USATHAMA Contracts.

Beginning in 1981 Mr. Wade gained experience at DataChem as a gas chromatography/ mass spectroscopy specialist. He was instrumental in establishing GC/MS analytical capability at DataChem Laboratories and was the principal analyst regarding the award of initial EPA-CLP organic contracts to DataChem. Another major contract effort followed involving the analysis of samples from the U.S. Army's RMA in Colorado. Mr. Wade was responsible for method development and for the certification of GC/MS analytical methods pertinent to the RMA contract.

Following his college graduation, Mr. Wade worked for Becton Dickinson Immunodiagnostics of Salt Lake City, Utah, where he obtained experience in the analytical determination of steroids. This work involved automated radioimmunoassay, UV and IR spectroscopy, as well as organic synthesis and general chromatography. At DataChem Mr. Wade has accrued experience in the application of HPLC, gas chromatography, and mass spectrometry for the analysis of industrial hygiene and environmental samples.

Mr. Wade received a Master of Business Administration degree from the University of Utah in 2000. He received a Bachelor's degree in Chemistry from Brigham Young University in 1976.

Robert P. Di Rienzo
Quality Assurance Manager

Robert P. Di Rienzo is Quality Assurance Manager at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem)

Under DataChem, Robert P. Di Rienzo was a Vice President of DataChem Laboratories, Inc. (DataChem), involved with Quality Assurance and Information Technology. He is responsible for the quality systems and Information Technology used by the laboratory. As the Radiation Safety Officer, he is responsible for the radiation protection program and Radioactive Material License. Prior to this position he was the Laboratory Director for the Environmental Laboratory. He managed laboratory operations, including environmental and radiochemistry activities, and was responsible for the financial and performance aspects of laboratory operations. Prior to this position he was the Manager of Commercial Operations, supervising industrial hygiene, environmental, radiochemistry, and NIOSH laboratory

activities. While serving as a Project Manager for DataChem, he was responsible for DataChem's onsite testing and Clean Air Act compliance project management from 1996 – 1997.

Since 1984 Mr. Di Rienzo has managed and developed the technical capabilities of environmental testing laboratories. Prior to his employment at DataChem he was the General Manager at PACE Incorporated in Golden, Colorado. This facility had a technical staff of 40 employees and annual revenues of approximately $4 million. He prepared annual budgets and evaluated requests for instrumentation and personnel in order to meet client requirements. In addition, he performed financial and technical review of federal and commercial contracts to ensure compliance with policy and the laboratory's capabilities. Mr. Di Rienzo focused on continual improvement of quality and client service. In addition, he implemented training programs on safety, statistical process control, and program management training.

Before accepting the General Manager position at PACE, Mr. Di Rienzo was Operations Manager for that firm for two years. His responsibilities included developing the laboratory's capabilities to perform various QA/QC programs (*e.g.*, CLP, RCRA, and DOE protocols). Mr. Di Rienzo also focused on the continuous improvement of technical programs, development and implementation of safety programs, and increasing laboratory productivity and profitability. During this time he was involved with DOE and USACE projects encompassing RCRA waste, mixed waste, and CLP/DOE protocols.
Prior to joining PACE, Mr. Di Rienzo was Laboratory Director of the IT Laboratory (ITAS) in Cincinnati, Ohio for two years. The laboratory performed environmental testing for federal programs including U.S. EPA-CLP. The laboratory also performed comprehensive ambient air toxics testing for DOE and industrial hygiene testing involving the remediation of several large NPL sites. During his tenure at ITAS, Mr. Di Rienzo brought that laboratory to profitability; dramatically improved the quality of analytical data, as demonstrated by improved PE scores; and brought a strong customer focus to the operation that was reflected by decreased turnaround times for client reports and better on-time performance.

Mr. Di Rienzo served for seven years as Laboratory Manager at Brown & Caldwell Analytical (BCA) prior to his tenure at ITAS. His management responsibilities included technical management and development of all analytical departments of the $6 million/year operation. The laboratory performed a broad spectrum of chemical and biological tests for the State of California and various federal programs (DoD). Before his promotion to the position of Laboratory Manager at BCA, Mr. Di Rienzo was Organics Manager. In that position he developed and implemented all organics analyses at BCA. Under his direct supervision, 14 chemists were involved in investigation of groundwater contamination at several NPL sites in the San Francisco Bay area.

Mr. Di Rienzo received a Bachelor of Science degree in Environmental Toxicology from the University of California at Davis in 1981. From 1987 to 1989 he took classes in the Business Management Certificate Program at the University of California at Berkeley. He became a American Society for Quality, Certified Quality Auditor in 2004.

He is a member of the American Society for Quality (ASQ), The NELAC Institute (TNI), American Industrial Hygiene Association (AIHA), and Association of Analytical Chemists (AOAC) and has made numerous presentations at professional conferences on Testing Methods, Quality Systems, Information Technology, and Uncertainty.

Mr. Di Rienzo was a contributing member of the NELAC Quality System Committee and has been the chair person of TNI Quality Systems Expert Committee chairperson for the past five years. Mr. Di Rienzo as a Certified Quality Auditor has performed laboratory assessments for the AIHA using ISO/IEC 17025:2005 and AIHA polices.

Michael R. Anderson
Computer Support Manager

Michael R. Anderson is Computer Support Manager at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem).

He manages a staff of computer professionals and supervises utilization of mainframe/server computers and laboratory computers. In addition, Mr. Anderson is responsible for the implementation and support of the LIMS system, Internet/Intranet systems, E-mail system, and resource allocation of staff and equipment. Other responsibilities include maintaining the Local and Wide Area Networks, VPN and WEB site.

Mr. Anderson was the Manager of the Computer Section and a Programmer/Analyst at DataChem. He managed and coordinated computer personnel for both operations and development. He designed, coded and successfully implemented a LIMS system which included a sample logging and tracking package, graphic display of sample data, and computer-generated report forms of sample analyses.
Before his employment at DataChem Mr. Anderson was a Programmer/Analyst at U.S. Steel Corporation. In that capacity he designed, coded, and maintained the system of programs used for statistical analysis, contour map generation, ore reserve estimation, three dimensional diagram generation, and drill hole display. He also maintained the geological database and supervised data entry and verification.

Mr. Anderson received a Bachelor of Science degree in Computer Science from the University of Utah in 1984. He has many years of experience with computerized laboratory management systems.

Julie A. Warath
Project Management Support Manager

Julie A. Warath is a Manager in the Project Management Section at ALS Laboratory Group, Environmental Division (Salt Lake City, UT) formerly DataChem Laboratories, Inc. (DataChem).

She assigns tasks, including back-up support, for all current duties of the team; these include sample log-in, sample reporting, filing data packages, and preparing and shipping media. She performs personnel duties, including authorizing vacation leave and overtime, signing timecards, and evaluating the performance of team members. In addition, she evaluates current systems. Ms. Warath is responsible for the NIOSH contract, which includes sending PDF files. Her responsibilities for Army contracts include copying and mailing reports to clients.

Before her position as a manager, Ms. Warath was a Team Leader and held the same duties and responsibilities. Prior to being appointed to the Team Leader position, Ms. Warath was the Sample Control Coordinator for the Client Services Section at DataChem. She coordinated, directed, organized, and assisted assigned work projects and photocopied and distributed documentation to Section Managers. In addition, she distributed documents prepared by the Section Manager, monitored the status and progress of samples regarding the analytical and reporting process, and notified appropriate management and project personnel of samples that were not progressing through the laboratory as required. Ms. Warath also utilized computer systems to log and/or verify sample receipt data and information and updated major account logbooks. She was responsible for the NIOSH contract, which included mailing daily, monthly, and quarterly reports. In addition, Ms. Warath prepared daily mailings of analytical reports and invoices for clients and monitored invoicing and associated problems.

Prior to her employment at DataChem Ms. Warath was a Secretary for the Senior Vice President & Treasurer of First Continental Life & Accident Insurance Company. She processed accounts payable and receivable; handled bookkeeping for pension and supplementary contracts; typed annual and quarterly reports; typed checks, letters, and memos; and made journal entries and bank transfers.

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Adamson, Sarah	**7/17/2006**	**Chemist**	**BS 2004 Biochemistry**	**3**	**3**
	Qualified Methods:				
	1010				
	130.2				
	160.1				
	160.2				
	180.1				
	310.1				
	340.2/4500 (f) C				
	350.1				
	375.4				
	7196A				
	9012A/335.4				
	9040B/150.1				
	9045C				
	9050/120.1				
	9066/420.2				
	CLP-CN				
	Hach 8000 COD				
	IH-AN-021				
	NMAM 0500				
	NMAM 0600				
	NMAM 3500				
	NMAM 6014				
	NMAM 6015				
	NMAM 7401				
	NMAM 7600				
	NMAM 7902				
Anderson, Michael	**12/16/1985**	**Vice President Computer Support**	**BS 1984 Computer Science**	**29**	**29**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Aullman, Robert K.	**11/8/2004**	**Technician**	**BS 2000 Physics**	**7**	**5**
	1010				
	3010				
	3050				
	6010B				
	7470A/245.1				
	7471A				
	CLP-CN				
	CLP-HG				
	CLP-ICP				
	CLP-ICPMS				
	CLP-ICP-PREP				
	ELLAP Air Analysis ICP				
	ELLAP Dust Analysis ICP				
	ELLAP Paint Prep ICP				
	ELLAP Soil Analysis ICP				
	NMAM 0500				
	NMAM 0600				
	NMAM 6009				
	NMAM 7300				
	NMAM 9103				
Barker, Guy	**11/4/2008**			**5**	**1**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Bitner, Kristie F.	**4/4/1989**	**Chemist**	**BS 1982 Biology**	**20**	**20**
	200.8 3005 3010 3050 6020A 7470A/245.1 7471A CLP-HG CLP-ICPMS Metals by ICP-MS NMAM 6009 NMAM 7082 NMAM 9103 OSHA ID-145				
Bolinder, Vern	**8/1/1997**	**Manager - Facility Support/Engineering Manager**	**Studies - Marketing and Computer Science, Studies - Electronics**	**12**	**12**
	Not Applicable				
Borges, Nadjla	**11/6/2006**	**Assistant Technician**	**College Coursework Chemical Engineering**	**3**	**3**
	Not Applicable				
Bosch, Thomas	**7/3/2006**	**Chemist**	**BS 1980 Chemisty**	**28**	**11**
	8330 8332 CLP-Volatiles CLP-Volatiles-Trace LC/MS Meth				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Cheklin, Tanya	**4/3/1979**	**Chemist**	**BS 1970 Health and Environment**	**37**	**30**
	1311				
	1312				
	140.1				
	160.1				
	160.2				
	160.3				
	180.1				
	40 CFR50 Appendix G				
	7041				
	7060				
	7191				
	7420				
	7421				
	7740				
	7841				
	9040B/150.1				
	9050/120.1				
	9081				
	CLP-HG				
	ELLAP Air Analysis FLAA				
	ELLAP Dust Analysis FLAA				
	ELLAP Paint Analysis FLAA				
	ELLAP Soil Analysis FLAA				
	IH-A-020				
	IT-DC-001				
	IT-DC-PAINT				
	IT-DC-WIPES				
	NMAM 0600				
	NMAM 3500				
	NMAM 3500				
	NMAM 3506				
	NMAM 6001				
	NMAM 6009				
	NMAM 6010				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
	NMAM 6014				
	NMAM 6700				
	NMAM 7082				
	NMAM 7102				
	NMAM 7105				
	NMAM 7300				
	NMAM 7300-T				
	NMAM 7401				
	NMAM 7600				
	NMAM 7900				
	NMAM 7901				
	NMAM 7902				
	NMAM 8005				
	NMAM 9103				
	Sigma 555				
Chiang, Xiao Yan	**7/26/2005**	**Technician**	**BA 1984 Economics**	**9**	**4**
	1311/1312				
	3510				
	3550				
	CLP-Organic-Prep				
Coleman, Christopher Q.	**11/22/1993**	**Chemist**	**BS 1993 Chemistry w/minor-Mathematics, Sociology**	**16**	**16**
	110.2				
	1311				
	5035				
	524.2				
	8260C				
	CLP-Volatiles				
	CLP-Volatiles-Trace				
	NMAM 5606				
	NMAM 9202				
	NMAM 9205				
	OV-SW-5035				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Di Rienzo, Robert P.	**2/12/1996**	**Vice President Quality Assurance / Information Technology**	**BS 1981 Environmental Toxicology, CQA**	**28**	**13**
	Not Applicable				
Duggan, Melissa A.	**4/9/2007**	**Sample Receiving Technician**		**2**	**2**
	Not Applicable				
Edwards, Meredith D.	**9/20/2004**	**Sample Receipt Technician**	**High School 1994**	**8**	**5**
	Not Applicable				
Edwards, Neil A.	**1/4/1993**	**Technician**	**Student - College**	**16**	**16**
	200.7 3010 3015 3050 3051 6010B 6020A 7470A/245.1 7471A CLP-HG CLP-ICP CLP-ICPMS CLP-ICP-Prep Metals by ICP-MS NMAM 7300 NMAM 7300-T				
Ellsworth, John M.	**1/29/2007**	**Assistant Project Manager**	**BA 1970 Communication**	**2**	**2**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Foote, Penny	**11/18/1991**	**Chemist**	**BS 1994 Chemistry**	**18**	**18**
	1010				
	300.0				
	3060A				
	310.1				
	310.2				
	314.0				
	325.2				
	335.2				
	335.3				
	350.1				
	350.2				
	353.2				
	365.1				
	365.4				
	413.1/9070				
	413.2				
	418.1				
	420.1				
	420.2				
	7.1.2.2				
	7196A				
	9012A/335.4				
	9030A/9034				
	9036				
	9040B/150.1				
	9045C				
	9056				
	9060				
	9065				
	9076				
	9095				
	9251				
	Army 54.1				
	D1125				
	D1426C				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
	D4327				
	DCL GC-ECD				
	DCL Method				
	DCL Thiolamine in Air				
	Dicamba, DCL GC/ECD Method				
	ELLAP Air Analysis ICP				
	ELLAP Paint Analysis ICP				
	IC-EP-26 MOD				
	IW-EP-EOX				
	NMAM 1003				
	NMAM 1008				
	NMAM 1614				
	NMAM 2011				
	NMAM 2016				
	NMAM 2507				
	NMAM 2518				
	NMAM 2533				
	NMAM 3509				
	NMAM 5026				
	NMAM 5034				
	NMAM 5038				
	NMAM 5040				
	NMAM 5503				
	NMAM 5600				
	NMAM 5602				
	NMAM 6004				
	NMAM 6005				
	NMAM 6010				
	NMAM 6011				
	NMAM 6012				
	NMAM 6013				
	NMAM 6013				
	NMAM 6015				
	NMAM 7300				
	NMAM 7600				
	NMAM 7605				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
	NMAM 7903				
	NMAM 7904				
	NMAM 7906				
	OSHA 1008				
	OSHA 44				
	OSHA 57				
	OSHA 71				
	OSHA CSI				
	OSHA ID-107				
	OSHA ID-108				
	OSHA ID-11				
	OSHA ID-110				
	OSHA ID-111				
	OSHA ID-113				
	OSHA ID-126				
	OSHA ID-128SG				
	OSHA ID-180				
	OSHA ID-200				
	OSHA ID-202				
	OSHA ID-211				
	OSHA ID-214				
	OSHA ID-215				
	OSHA PV2055				
	OSHA PV2115				
	SM 214A				
	TO-11A				
	UT04				
Gress, Joseph	**8/27/1990**	**Chemist**	**BS 1989 Chemistry and Graduate Studies – Organic Chemistry**	**19**	**19**
	1311				
	5035				
	524.2				
	8260C				
	CLP-Volatiles				
	CLP-Volatiles-Trace				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Griffiths, Kevin	**10/6/1990**	**Project Manager**	**BS 1978 Chemistry**	**32**	**19**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Hanks, Rosemary H.	**5/31/1989**	**Chemist**	**BS 1973 Botany w/minor – Chemistry**	**20**	**20**

Qualified Methods:

1010
1110
130.2
160.1
160.2
1664A
180.1
305.1
3060A
310.1
310.2
340.2/4500 (f) C
350.1
351.2
353.2
365.1
365.4
410.4
415.1
7.3.3.2
7.3.4.2
7196A
9012A/335.4
9030A/9034
9040B/150.1
9045C
9050/120.1
9060
9066/420.2
9095
CLP-CN
CLP-HG
DCL Method
ELLAP Air Analysis FLAA

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
	ELLAP Dust Analysis FLAA				
	ELLAP Paint Analysis FLAA				
	ELLAP Soil Analysis FLAA				
	HACH 8000				
	IW-DC-KAHN				
	LFO5				
	NMAM 3500				
	NMAM 5026				
	NMAM 6014				
	NMAM 6015				
	NMAM 7401				
	NMAM 7600				
	NMAM 7902				
	OSHA ID-101				
	Section 8.3				
	Sigma 555				
	SM 408D				
	UFO5				
Hansen, Christopher	**4/2/2007**	**Technician**	**BS 2003 Biology w-minor Chemistry**	**6**	**2**
	7470A/245.1				
	7471A				
	CLP-HG-Analysis				
	CLP-HG-Prep				
	CLP-ICP-Prep				
	ELLAP Air Prep ICP				
	ELLAP Dust Prep ICP				
	ELLAP Paint Prep FLAA				
	ELLAP Soil Prep ICP				
	IH-AN-001				
	IH-AN-005				
	IH-AN-021				
	NMAM 6009 MOD				
	NMAM 9103				
	NMAM 9103 MOD				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Hendricks, Reed A.	**6/29/1987**	**Chemist**	**BS 1991 Chemistry with emphasis in Chemical Engineering**	**22**	**22**
	Qualified Methods:				
	1311				
	3510				
	3550				
	3640				
	8270D				
	CLP-Semivolatiles				
	DCL GC-MS				
	NMAM 2501				
	NMAM 2544				
	NMAM 9207 Draft				
	OS-DC-NDMA				
	OSHA 82				
	OSHA CSI				
Hicken, Miles A.	**3/13/1989**	**PC Specialist**	**BS 1987 EE Technology**	**20**	**20**
	Not Applicable				
Holt, Tom	**11/15/2004**	**Technician**	**AS 1981**	**31**	**5**
	3010				
	3015				
	3050				
	3051				
	CLP-ICP-Prep				
	ELLAP Dust Prep ICP				
	ELLAP Paint Prep FLAA				
	ELLAP Paint Prep ICP				
	ELLAP Soil Prep ICP				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Huang, Mei-Qi	**12/10/1990**	**Chemist**	**BS 1963 Medicine**	**19**	**19**
	Qualified Methods:				
	1311				
	3510				
	3520				
	3540				
	3550				
	3580A				
	8015 Soil Extraction				
	8015 Water Extraction				
	8151A Prep				
	8330 Prep				
	8332 Prep				
	CLP-Organic-Prep				
	NMAM 0500				
	NMAM 5040				
	OG-DC-TPHD Prep				
Johnson, Veronica	**7/6/1992**	**Staff Accountant**	**AS 1997 Accounting**	**17**	**17**
	Not Applicable				
Jones, Laurie	**2/25/2008**	**Chemist**		**1**	**1**
	300.0				
	NMAM 7903				
	OSHA ID-111				
	OSHA ID-113				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Kershisnik, John T.	**12/16/1985**	**Chemist**	**BS 1984 Science**	**24**	**24**
	200.7 3005 3010 3015 3050 3051 6010B 6010B 7470A/245.1 7471A 9081 CLP-ICP CLP-ICP-Prep NMAM 7300 NMAM 7300-T SM2340B				
Killpack, Jeff	**2/18/2008**	**Technician**	**Student**	**4**	**1**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Kim, Jason D.	**3/16/2001**	**Chemist**	**BS 1998 Chemistry**	**12**	**8**
	245.5				
	3015				
	3050				
	3051				
	7420				
	7470A/245.1				
	7471A				
	Be MCE and Ghost Wipe hotblock digestion				
	IH-AN-001				
	IH-AN-003				
	IH-AN-004				
	IH-AN-005				
	IH-AN-020				
	NMAM 6009				
	OSHA ID-140				
	OSHA ID-145				
Kuwitzky, Kyle J.	**11/19/2007**	**Technician**		**2**	**2**
	3015				
	3050				
	3051				
	CLP-ICP-PREP				
	ELLAP Air Prep ICP				
	ELLAP Dust Prep ICP				
	ELLAP Soil Prep FLAA				
	IH-AN-021				
	NMAM 6001 Prep				
	NMAM 7500 Prep				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Masoian, Tom	**6/19/1985**	**Research Scientist**	**BS 1986 Chemistry**	**25**	**24**
	Qualified Methods:				
	524.2				
	CLP-Volatiles				
	CLP-Volatiles-Trace				
	T015SIM				
	TO14				
	TO-15				
	TO-17				
McKay, Thomas	**5/4/1998**	**Chemist**	**BS 1997 Zoology**	**11**	**11**
	1120				
	300.0				
	314.0				
	3640				
	6850				
	8082				
	8321				
	8330				
	IC-DC-COOH				
	NMAM 6011				
	NMAM 7903				
	OSHA ID-111				
	OSHA ID-113				
	OSHA ID-214				
Megerdichian, Paul	**5/25/1999**	**Chemist**	**MS 1997 Biochemistry**	**19**	**10**
	365.1				
	NMAM 0500				
	NMAM 0600				
	NMAM 3503				
	NMAM 5524				
	NMAM 7400				
	NMAM 7500				
Olson, Ken R.	**5/2/1986**	**President and CEO**	**JD 1986, BA 1983 Business Management**	**23**	**23**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Olson, Roxanne	**1/19/1998**	**Marketing Coordinator and Assistant Project Manager**	**BA 1991 – Marketing & Finance and Graduate Studies – MBA and Graduate Studies – Educ. Admin.**	**11**	**11**
	Not Applicable				
Ovalle, Ilse	**8/31/2005**	**Technician**		**6**	**4**
	Not Applicable				
Payne, Rory	**9/27/1984**	**Vice President Finance/Administration**	**AAS 1987 Accounting, Marketing, Management, Business Administration**	**25**	**25**
	Not Applicable				
Petersen, Anna Lee	**10/30/2006**	**Technician**	**BS 2006 Botony 1 minor Zoology**	**5**	**2**
	Not Applicable				
Pew, Cristina I.	**8/11/2008**			**1**	**1**
	Not Applicable				
Pope, Paul	**10/6/1998**	**Project Manager**	**MS 1999 Chemistry, BS 1995 Chemistry and Molecular Cell Biology**	**14**	**11**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
Porobic, Svetlana	**9/11/2000**	**Technician**	**BS 1975 Analytical Chemistry**	**25**	**9**

Qualified Methods:

3010
3015
3051
7470A/245.1
7471A
Be MCE and Ghost Wipe hotblock digestion
ELLAP Filter Prep
ELLAP Paint Prep
ELLAP Soil Prep
ELLAP Wipe Prep
IH-AN-001
IH-AN-004 (Wipe)
IH-AN-005 (Paint)
IH-AN-020
NMAM 0500
NMAM 0600
NMAM 7082
NMAM 7082(Mod)
NMAM 9103 mce prep
NMAM 9103 wshdri prep
Sigma 555
Specific Gravity
XX-EP-800

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Potekhin, Mila V.	**12/3/2001**	**Chemist**	**BS 1980 Chemistry**	**29**	**8**
	1311				
	3510				
	3550				
	7580				
	8015B DRO				
	8081A				
	8082				
	8151A				
	CLP-Aroclors				
	CLP-Pesticides				
	DCL GC-ECD				
	DCL Method				
	NMAM 1600				
	NMAM 2005				
	NMAM 2007				
	NMAM 2507				
	NMAM 2543				
	NMAM 5503				
	NMAM 5510				
	NMAM 5600				
	NMAM 5602				
	NMAM 5602				
	NMAM 6602				
	NMAM 7905				
	NON 39				
	OSHA 44				
	OSHA 67				
	UK11				
Potter, Rand	**12/9/1974**	**Project Manager**	**MS 1982 Laboratory Administration, BA 1972 Medical Terminology, AS 1970 Laboratory Science**	**37**	**35**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Quinn, Johnnie L.	**2/27/2006**	**Receptionist**	**Community College**	**3**	**3**
	Not Applicable				
Quintero, Oralia B.	**11/19/2001**	**Assistant Technician**		**8**	**8**
	Not Applicable				
Rawson, Robert M.	**12/11/2007**	**Technician**		**1**	**1**
	7470 Prep				
	CLP-CN-Prep				
	CLP-HG-Prep				
	ELLAP Air Prep FLAA				
	ELLAP Dust Prep FLAA				
	ELLAP Soil Prep FLAA				
	IH-AN-001				
	IH-AN-021				
	NMAM 0500				
	NMAM 0600				
	NMAM 6001 Prep				
	NMAM 6009 Prep				
	NMAM 6010				
	NMAM 6010 Prep				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Reid, Lisa	**10/23/1989**	**Chemist**	**BS 1992 Education**	**20**	**20**
	1010				
	130.2				
	160.1				
	310.1				
	310.2				
	340.2/4500 (f) C				
	350.1				
	353.2				
	365.4				
	40 CFR50 Appendix G				
	415.1				
	7.3.3.2				
	7.3.4.2				
	7041				
	7420				
	7421				
	9030A/9034				
	9040B/150.1				
	9045C				
	9050/120.1				
	9060				
	9095				
	CFR-50 Appendix J				
	CFR50 Appendix J - TSP - PM-10				
	D1125				
	ELLAP Air Analysis FLAA				
	ELLAP Air Analysis ICP				
	ELLAP Air Prep FLAA				
	ELLAP Air Prep ICP				
	ELLAP Dust Analysis FLAA				
	ELLAP Dust Analysis ICP				
	ELLAP Dust Prep FLAA				
	ELLAP Paint Analysis ICP				
	ELLAP Soil Analysis ICP				
	FLAA				

ALS Environmental Employee List

NAME	Hire Date / Title	Education	Experience	
	Qualified Methods:		Industry	DCL
	IH-AN-005 (Paint)			
	KAHN			
	NMAM 0500			
	NMAM 0600			
	NMAM 2539			
	NMAM 3500			
	NMAM 3503			
	NMAM 5026			
	NMAM 6001			
	NMAM 6009			
	NMAM 6010			
	NMAM 6014			
	NMAM 6015			
	NMAM 6700			
	NMAM 7082			
	NMAM 7102			
	NMAM 7105			
	NMAM 7300			
	NMAM 7300-T			
	NMAM 7303			
	NMAM 7401			
	NMAM 7600			
	NMAM 7900			
	NMAM 7901			
	NMAM 7902			
	NMAM 7904			
	OSHA ID-124			
	OSHA S8			
	TO-15			
	TO-17			
Rodriguez, Sheila	**8/28/2008**		**1**	**1**
	Not Applicable			

ALS Environmental Employee List

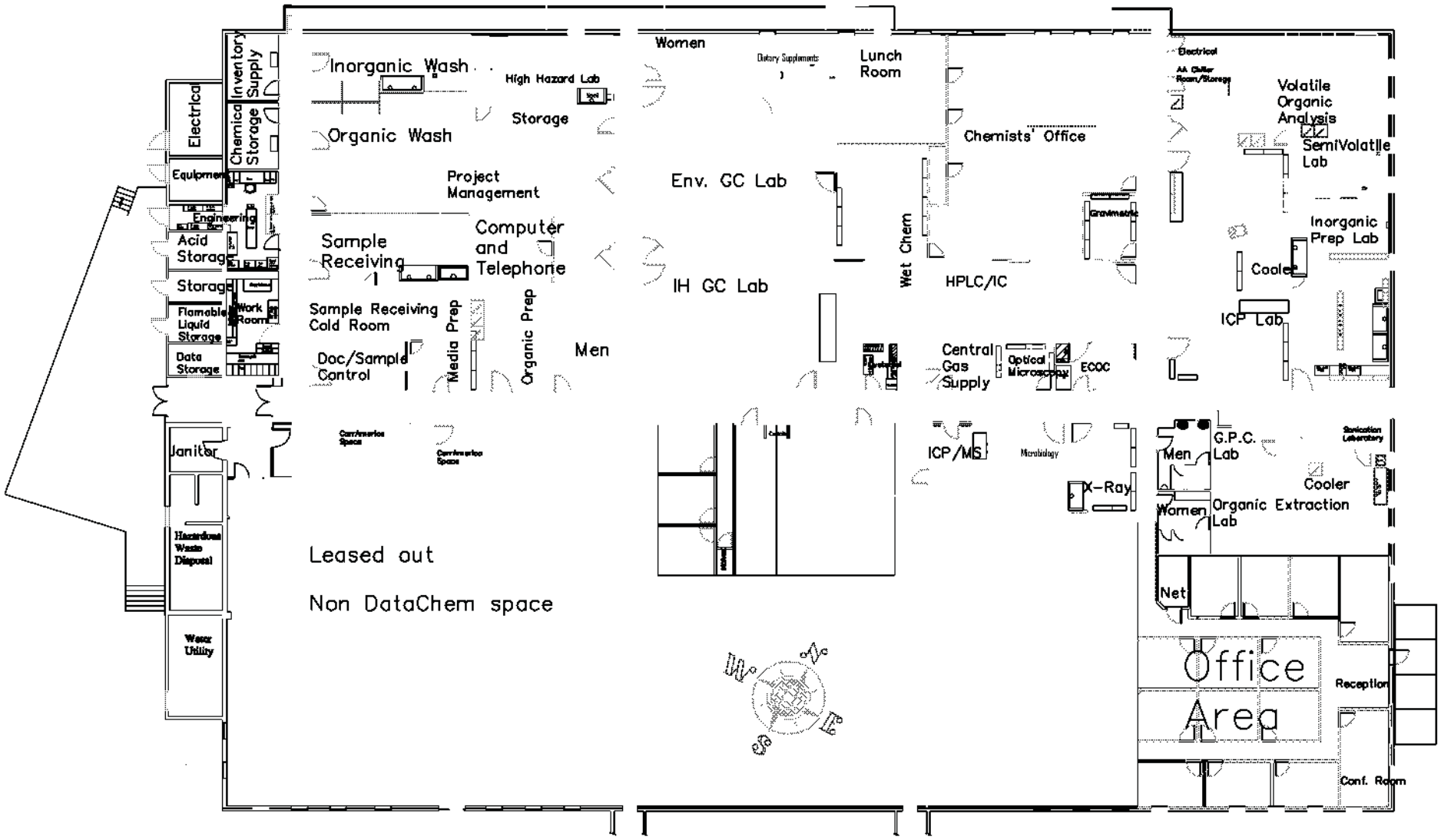
NAME	Hire Date	Title	Education	Experience	
				Industry	DCL
	Qualified Methods:				
Sagers, Steven J.	**11/12/1990**	**Chemist**	**BS 1990 Biology and Chemistry**	**19**	**19**
	1311				
	3510				
	3520				
	3540				
	3550				
	3610				
	3620				
	3640				
	504.1/8011				
	7580				
	8015B				
	8081A				
	8082				
	8151A				
	Akima				
	CAD 13.2				
	CLP-Aroclors				
	CLP-Pesticides				
	DCL GC-ECD				
	DCL GC-SCD				
	DCL GC-TCD				
	NMAM 1600				
	NMAM 2550				
	OSHA CSI				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Sanchez, Joanna	**8/31/1998**	**Chemist**	**BS 1998 Chemistry**	**11**	**7**
	7470A/245.1 7471A CLP-HG ELLAP Air Analysis ICP ELLAP Dust Analysis ICP ELLAP Paint Analysis FLAA ELLAP Paint Analysis ICP ELLAP Soil Analysis ICP NMAM 6009 NMAM 7082 NMAM 7300 NMAM 9103				
Schmidth, Colleen C.	**12/21/2004**	**Receptionist**		**5**	**5**
	Not Applicable				
Shanks, Kathy F.	**9/19/2000**	**Administrative Assistant**	**High School Diploma**	**10**	**10**
	Not Applicable				
Smith, Frank	**7/13/1998**	**Project Manager**	**Courses - Electronic Engineering w/ minor in Psychology, AAS 1989 Medical Equipment Repair Specialist**	**11**	**11**
	Not Applicable				
Stephens, Brent E.	**4/29/1985**	**Vice President Laboratory Director**	**BS 1984 Geology**	**25**	**24**
	Not Applicable				
Stringham, Weston	**10/18/2000**	**Computer Systems Operator**	**AS 2002 Computer Science, Student - Computer Science**	**9**	**9**
	Not Applicable				
Wade, Richard	**11/9/1978**	**Organic Chemistry Manager**	**BS 1976 Chemistry and MBA 2000**	**32**	**31**
	Not Applicable				

ALS Environmental Employee List

NAME	Hire Date	Title	Education	Experience	
	Qualified Methods:			Industry	DCL
Warath, Julie	**12/28/1987**	**Sample Control Team Leader**	**High School**	**22**	**22**
	Not Applicable				
Ward, Jeff	**7/27/1987**	**Inorganic Chemistry Manager**	**BS 1986 Geology**	**23**	**22**
	Not Applicable				
Wilson, Trudy	**7/16/1990**	**Human Resources Manager**	**Studies - Business**	**19**	**19**
	Not Applicable				
Winter, Christopher R.	**12/4/2006**	**Technician**	**1994 High School**	**3**	**3**
	3640				
	7580				
Yang, Bo-Ming	**2/26/2000**	**Technician**	**BA 1989 Music Education**	**15**	**15**
	3540				
	3550				
	3580A				
	8151A				
	CLP-Organic-Prep				


Inorganic Wash
High Hazard Lab
Storage
Organic Wash
Women
Dietary Supplements
Lunch Room
Electrical
AA Chiller Room/Storage
Volatile Organic Analysis
SemiVolatile Lab
Chemists' Office
Project Management
Env. GC Lab
Inorganic Prep Lab
Computer and Telephone
Sample Receiving
Wet Chem
Gravimetric
Cooler
IH GC Lab
HPLC/IC
Sample Receiving Cold Room
Media Prep
Organic Prep
Men
ICP Lab
Doc/Sample Control
Central Gas Supply
Optical Microscopy
ECOC
Electrical
Inventory Supply
Chemical Storage
Equipment
Engineering
Acid Storage
Storage
Flamable Liquid Storage
Work Room
Data Storage
Janitor
Hazardous Waste Disposal
Water Utility
ICP/MS
Microbiology
X-Ray
G.P.C. Lab
Men
Women
Organic Extraction Lab
Cooler
Sonication Laboratory
Net
Office Area
Reception
Conf. Room
Leased out
Non DataChem space
W
N
E
S

ALS Laboratory Group Instrument List

I. EQUIPMENT FOR INORGANIC ANALYSIS

Inductively Coupled Plasma Atomic Emission Spectrophotometer/Mass Spectrometer

Installation Date:	2004	***Vendor Name:***	Thermo Elemental
Instrument ID:	ICPMS02	***Model Number:***	X-5
Location:	Middle South Quad	***Serial Number:***	X0331
Description:	Automated, computer-controlled inductively coupled plasma mass spectrometer		
Software:	PlasmaLab Version 2.3.0.161		
Methods:	EPA 6020, EPA 200.8, ILM05.4		

Installation Date:	1997	***Vendor Name:***	Varian
Instrument ID:	ICPMS01	***Model Number:***	Ultramass 700
Location:	Middle South Quad	***Serial Number:***	EL97052025
Description:	Automated, computer-controlled inductively coupled plasma mass spectrometer		
Software:	WinMass Version 1.1 b54		
Methods:	EPA 6020, EPA 200.8, ILM05.4		

Inductively Coupled Plasma Atomic Emission Spectrophotometers

Installation Date:	2008	***Vendor Name:***	Perkin Elmer
Instrument ID:	ICP09	***Model Number:***	Optima 3000 DV
Location:	East North Quad	***Serial Number:***	069N4092301
Description:	Fully automated, computer-controlled dual view ICP-AES		
Software:	WinLab 32 Version 2.2 SP4		
Methods:	NMAM 7300mod		

Installation Date:	2007	***Vendor Name:***	Thermo-Electron
Instrument ID:	ICP08	***Model Number:***	ICAP Duo 6500
Location:	East North Quad	***Serial Number:***	20074516
Description:	Fully automated, computer-controlled dual view ICP-AES		
Software:	iTeva Version 1.1.0039, Issue 8.1		
Methods:	ILM05.4, EPA 6010, EPA 200.7		

ALS Laboratory Group Instrument List

Installation Date:	2006	***Vendor Name:***	Thermo-Electron
Instrument ID:	ICP07	***Model Number:***	ICAP Duo 6500
Location:	East North Quad	***Serial Number:***	20063201
Description:	Fully automated, computer-controlled dual view ICP-AES		
Software:	iTeva Version 1.1.027		
Methods:	ILM05.4, EPA 6010, EPA 200.7		

Installation Date:	2005	***Vendor Name:***	Perkin Elmer
Instrument ID:	ICP06	***Model Number:***	Optima 3100 XL
Location:	East North Quad	***Serial Number:***	069N9032043
Description:	Fully automated, computer-controlled ICP-AES		
Software:	WinLab 32 Version 2.2 SP4		
Methods:	NMAM 7300		

Installation Date:	1996	***Vendor Name:***	Perkin Elmer
Instrument ID:	ICP01	***Model Number:***	Optima 3000 DV
Location:	East North Quad	***Serial Number:***	069N6011702
Description:	Fully automated, computer-controlled dual view ICP-AES		
Software:	WinLab 32 Version 2.2 SP4		
Methods:	NMAM 7300		

Installation Date:	1996	***Vendor Name:***	Perkin Elmer
Instrument ID:	ICP02	***Model Number:***	Optima 3000 DV
Location:	East North Quad	***Serial Number:***	069N6020502
Description:	Fully automated, computer-controlled dual view ICP-AES		
Software:	WinLab 32 Version 2.2 SP4		
Methods:	NMAM 7300		

Installation Date:	1993	***Vendor Name:***	Thermo Jarrell Ash
Instrument ID:	ICP04	***Model Number:***	ICAP 61E
Location:	West Quad	***Serial Number:***	66982
Description:	Simultaneous ICP-AES equipped with a 0.75-meter spectrometer, simultaneous 41-channel analysis, autosampler, and an NEC 286 Plus data system		
Software:	ThermoSpec Version 6.20.00		
Methods:	EPA 6010B, EPA 200.7		

ALS Laboratory Group Instrument List

Atomic Absorption Spectrophotometers

Installation Date: 2003 ***Vendor Name:*** Varian
Instrument ID: FLAA02 ***Model Number:*** 220-FS
Location: West Quad ***Serial Number:*** EL02106370
Description: Flame AAS
Software: SpectrAA Version 4.10PRO
Methods: NMAM 7082

Installation Date: 1999 ***Vendor Name:*** Perkin Elmer
Instrument ID: AACV01 ***Model Number:*** FIMS-100
Location: East North Quad ***Serial Number:*** 1427
Description: Fully automated AAS flow injection analyzer dedicated to mercury analyses
Software: AAWinLab Version 2.5
Methods: EPA 7470, EPA 7471, NMAM 6009

Installation Date: 1999 ***Vendor Name:*** Varian
Instrument ID: FLAA01 ***Model Number:*** 220-FS
Location: West Quad ***Serial Number:*** EL98067293
Description: Flame AAS equipped with autosampler, autodiluter, VGA Model 77 vapor generation accessory and lamps
Software: SpectrAA Version 4.10PRO
Methods: NMAM 7082

UV-Visible-IR Spectrophotometry Instrumentation

Installation Date: 2006 ***Vendor Name:*** Spectronics
Instrument ID: WET03 ***Model Number:*** Genysis 10
Location: Middle North Quad ***Serial Number:*** SN 2G8J.60001
Description: UV-Visible Spectrophotometer
Software: NA
Methods: NMAM 7600, NMAM 3500, NMAM 6014

ALS Laboratory Group Instrument List

Installation Date: 2004 ***Vendor Name:*** Westco Scientific
Instrument ID: WET01 ***Model Number:*** SmartChem
Location: Middle North Quad ***Serial Number:*** W0402046
Description: Discreet Analyzer equipped with a cadmium reduction column, fully automated and computer controlled
Software: SmartChem Version 122303
Methods: EPA 420.4, EPA 353.3, EPA 7196, EPA 9012/335.4, EPA 350.1, EPA 365.4, EPA 351.2, ILM05.4

Installation Date: 1994 ***Vendor Name:*** Perkin Elmer
Instrument ID: XRAY02 ***Model Number:*** PARAGON 1000
Location: Middle South Quad ***Serial Number:*** 39065
Description: FT-IR Spectrometer
Software: Spectrum Version 2.0
Methods: EPA 413.2

Installation Date: 1993 ***Vendor Name:*** Milton Roy
Instrument ID: WET07 ***Model Number:*** 20D
Location: Middle North Quad ***Serial Number:*** 3325149012
Description: Spectrophotometer
Software: NA
Methods: EPA 410.2

Total Carbon/Total Organic Carbon Analyzers

Installation Date: 1993 ***Vendor Name:*** Dorhmann
Instrument ID: WET04 ***Model Number:*** DC180
Location: Middle North Quad ***Serial Number:*** 9302182
Description: Total Organic Carbon Analyzer
Software: PC-1 Operating and Data Handling System
Methods: EPA 415.1 and EPA 9060

ALS Laboratory Group Instrument List

Installation Date: 1993 ***Vendor Name:*** Leco
Instrument ID: WET05 ***Model Number:*** CHN-1000
Location: Middle North Quad ***Serial Number:*** 3046
Description: Total Carbon Analyzer equipped with autosampler, computer and printer
Software: Serial #3046 Version 1.40
Methods: Lloyd Kahn, TOC (Soil)

Microwave Sample Preparation Systems

Installation Date: 2005 ***Vendor Name:*** CEM
Instrument ID: Mars-Xpress2 ***Model Number:*** Mars-Xpress
Location: East North Quad ***Serial Number:*** MD7763
Description: Microwave Digestion System
Software: NA
Methods: NMAM 7300, NMAM 7082, EPA 3015, EPA 3051

Installation Date: 2005 ***Vendor Name:*** CEM
Instrument ID: Mars-Xpress1 ***Model Number:*** Mars-Xpress
Location: East North Quad ***Serial Number:*** MD7753
Description: Microwave Digestion System
Software: NA
Methods: NMAM 7300, NMAM 7082, EPA 3015, EPA 3051

Installation Date: 1992 ***Vendor Name:*** CEM
Instrument ID: MDS-2100-1 ***Model Number:*** MDS-2100
Location: East North Quad ***Serial Number:*** Z4065
Description: Microwave Digestion System
Software: NA
Methods: NMAM 7300, NMAM 7082, EPA 3015, EPA 3051

Installation Date: 1992 ***Vendor Name:*** CEM
Instrument ID: MDS-2100-2 ***Model Number:*** MDS-2100
Location: East North Quad ***Serial Number:*** Z4077
Description: Microwave Digestion System
Software: NA
Methods: NMAM 7300, NMAM 7082, EPA 3015, EPA 3051

ALS Laboratory Group Instrument List

X-ray Diffraction Instrumentation

Installation Date:	1990	***Vendor Name:***	Siemens
Instrument ID:	XRAY01	***Model Number:***	D5000
Location:	Middle South Quad	***Serial Number:***	001288
Description:	Automated X-Ray Diffractometer equipped with autosampler and Kristalloflex generator		
Software:	Diffrac Plus Version 3.0		
Methods:	NMAM 7500		

Light Microscopes

Installation Date:	1999	***Vendor Name:***	Accuscope
Instrument ID:	Accuscope	***Model Number:***	
Location:	Middle North Quad	***Serial Number:***	None
Description:	Stereo Microscope		
Software:	NA		
Methods:	NMAM 9002		

Installation Date:	1985	***Vendor Name:***	Lietz
Instrument ID:	Laborlux 12	***Model Number:***	Laborlux 12
Location:	Middle North Quad	***Serial Number:***	552283/99356
Description:	Phase Contrast/Cross Polarization Microscope		
Software:	NA		
Methods:	NMAM 9002, NMAM 7400		

Installation Date:	1977	***Vendor Name:***	Leitz
Instrument ID:	Dialux 20	***Model Number:***	Dialux 20
Location:	Middle North Quad	***Serial Number:***	931070
Description:	Phase Contrast/Cross Polarization photomicroscope		
Software:	NA		
Methods:	NMAM 9002, NMAM 7400		

ALS Laboratory Group Instrument List

Installation Date:	1977	***Vendor Name:***	Zeiss
Instrument ID:	14	***Model Number:***	14
Location:	Middle North Quad	***Serial Number:***	470914-9902/44
Description:	Phase Contrast Photomicroscope		
Software:	NA		
Methods:	NMAM 9002, NMAM 7400		

Flash Point Tester

Installation Date:	1990	***Vendor Name:***	Fisher
Instrument ID:	WET06	***Model Number:***	TAG
Location:	East North Quad	***Serial Number:***	1991
Description:	Pensky-Martens Flash Tester		
Software:	NA		
Methods:	EPA 1010		

Specific Ion Electrode and Miscellaneous Meters

Installation Date:	2000	***Vendor Name:***	Orion
Instrument ID:	WET02	***Model Number:***	720A
Location:	Middle North Quad	***Serial Number:***	47286
Description:	pH specific ion electrode system		
Software:	NA		
Methods:	EPA 150.1, EPA 9040 and 9045, EPA 340.2		

Installation Date:	1991	***Vendor Name:***	Orion
Instrument ID:	160	***Model Number:***	160
Location:	Middle North Quad	***Serial Number:***	09050039
Description:	Conductivity Meter		
Software:	NA		
Methods:	EPA 120.1 and EPA 9050		

ALS Laboratory Group Instrument List

Installation Date:	1990	***Vendor Name:***	Orion
Instrument ID:	SA 210	***Model Number:***	SA 210
Location:	Middle North Quad	***Serial Number:***	2426
Description:	pH Meter		
Software:	NA		
Methods:	EPA 150.1, EPA 9040 and 9045		

ALS Laboratory Group Instrument List

II. EQUIPMENT FOR ORGANIC ANALYSIS

Ion Chromatography Instrumentation

Installation Date: 2001 ***Vendor Name:*** Metrohm Peak
Instrument ID: IC05 ***Model Number:*** 761 Compact IC
Location: Middle North Quad ***Serial Number:*** 06158
Description: Ion Chromatograph equipped with conductivity detector, pump, autosampler and Turbochrome Interface
Software: TotalChrom Version 6.2.1.01.104:0104
Methods: EPA 314.0

Installation Date: 2000 ***Vendor Name:*** Dionex
Instrument ID: IC01 ***Model Number:*** IC25
Location: Middle North Quad ***Serial Number:*** 000701170
Description: Ion Chromatograph equipped with conductivity detector, pump, autosampler and Turbochrome Interface
Software: TotalChrom Version 6.2.1.01.104:0104
Methods:

Installation Date: 1993 ***Vendor Name:*** Dionex
Instrument ID: IC04 ***Model Number:*** DX-300
Location: Middle North Quad ***Serial Number:*** 932503
Description: Ion Chromatograph equipped with conductivity detector, advanced gradient pump, autosampler and Turbochrome Interface
Software: TotalChrom Version 6.2.1.01.104:0104
Methods: EPA 300.0

Installation Date: 1992 ***Vendor Name:*** Dionex
Instrument ID: IC03 ***Model Number:*** DX-300
Location: Middle North Quad ***Serial Number:*** 914811
Description: Ion Chromatograph equipped with conductivity detector, advanced gradient pump, autosampler and Turbochrome Interface
Software: TotalChrom Version 6.2.1.01.104:0104
Methods: EPA 300.0

ALS Laboratory Group Instrument List

Installation Date: 1988 ***Vendor Name:*** Dionex
Instrument ID: IC02 ***Model Number:*** 2010i
Location: Middle North Quad ***Serial Number:*** 563907
Description: Ion Chromatograph equipped with conductivity detector, pump, autosampler and Turbochrome Interface
Software: TotalChrom Version 6.2.1.01.104:0104
Methods:

Thermal Optical Analyzers for Elemental and Organic Carbon (Diesel Particulate)

Installation Date: 2006 ***Vendor Name:*** Sunset Laboratorie
Instrument ID: ECOC02 ***Model Number:*** 3
Location: Middle North Quad ***Serial Number:*** 194
Description: Carbon Arosol Analyzer
Software: OCEC INST 234 and OCEC CALC 152
Methods: NMAM 5040

Installation Date: 2006 ***Vendor Name:*** Sunset Laboratorie
Instrument ID: ECOC01 ***Model Number:*** 3
Location: Middle North Quad ***Serial Number:*** 193
Description: Carbon Arosol Analyzer
Software: OCEC INST 234 and OCEC CALC 152
Methods: NMAM 5040

Gas Chromatography

Installation Date: 2009 ***Vendor Name:*** HP
Instrument ID: GCE40 ***Model Number:*** 5890 Series II
Location: Middle North Quad ***Serial Number:*** 3336A53420
Description: Gas Chromatograph with Pulsed Hydrogen Ion Detector (PHID) and Thermal Conductivity Detector (TCD)
Software: Total Chrome Versionn 6.3
Methods: Mine Gases

ALS Laboratory Group Instrument List

Installation Date:	2005	***Vendor Name:***	Agilent
Instrument ID:	GCI37	***Model Number:***	6890
Location:	Middle North Quad	***Serial Number:***	US00002707
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	2005	***Vendor Name:***	Agilent
Instrument ID:	GCI38	***Model Number:***	6890
Location:	Middle North Quad	***Serial Number:***	US00005723
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	GCE20	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3336A56155
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	GCI06	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3336A54741
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	GCE33	***Model Number:***	5890A Series II
Location:	Middle North Quad	***Serial Number:***	3336A56156
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

ALS Laboratory Group Instrument List

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	GCI01	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3336A54742
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1993	***Vendor Name:***	Perkin Elmer
Instrument ID:	GCE24	***Model Number:***	Autosystem
Location:	Middle North Quad	***Serial Number:***	2040301
Description:	Gas Chromatograph with Flame Photometric Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:	7580		

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	GCE21	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3235A44018
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1993	***Vendor Name:***	Perkin Elmer
Instrument ID:	GCE23	***Model Number:***	Autosystem
Location:	Middle North Quad	***Serial Number:***	3041401
Description:	Gas Chromatograph with Flame Photometric Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:	Not Installed		

Installation Date:	1993	***Vendor Name:***	Perkin Elmer
Instrument ID:	GCE25	***Model Number:***	Autosystem
Location:	Middle North Quad	***Serial Number:***	3031103
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:	Not Installed		

ALS Laboratory Group Instrument List

Installation Date:	1993	***Vendor Name:***	Perkin Elmer
Instrument ID:	GCE17	***Model Number:***	Autosystem
Location:	Middle North Quad	***Serial Number:***	3031105
Description:	Gas Chromatograph with Photo Ionization and Flame Ionization Detectors and Headspace autosampler		
Software:	Total Chrom Version 6.3		
Methods:	8015B		

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	GCI12	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3235A46860
Description:	Gas Chromatograph with Flame Ionization Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	GCE26	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	2921A24209
Description:	Gas Chromatograph with Sulfur Cheiluminescence Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	GCE34	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3140A37947
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	GCE27	***Model Number:***	5890A
Location:	Middle North Quad	***Serial Number:***	3223A42224
Description:	Gas Chromatograph with Sulfur Cheiluminescence Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

ALS Laboratory Group Instrument List

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	GCE31	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3126A36708
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	GCI03	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3124A36800
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	GCE30	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	2921A24576
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1991	***Vendor Name:***	HP
Instrument ID:	GCE22	***Model Number:***	5890 Series II
Location:	Middle North Quad	***Serial Number:***	3108A34048
Description:	Gas Chromatograph with Electron Capture Detector and autosampler		
Software:	Total Chrom Version 6.3		
Methods:			

Installation Date:	1990	***Vendor Name:***	Perkin Elmer
Instrument ID:	GCE16	***Model Number:***	Autosystem
Location:	Middle North Quad	***Serial Number:***	3031101
Description:	Gas Chromatograph with Photo Ionization and Flame Ionization Detectors and Tekmar 2000/2016 autosampler		
Software:	Total Chrom Version 6.3		
Methods:	8015B		

ALS Laboratory Group Instrument List

Installation Date: 1990 ***Vendor Name:*** HP
Instrument ID: GCI15 ***Model Number:*** 5890A Series II
Location: Middle North Quad ***Serial Number:*** 3033A32537
Description: Gas Chromatograph with Flame Ionization Detector, Electron Capture Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1990 ***Vendor Name:*** HP
Instrument ID: GCI05 ***Model Number:*** 5890 Series II
Location: Middle North Quad ***Serial Number:*** 3126A36707
Description: Gas Chromatograph with Electron Capture Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1989 ***Vendor Name:*** HP
Instrument ID: GCI02 ***Model Number:*** 5890 Series II
Location: Middle North Quad ***Serial Number:*** 2921A24392
Description: Gas Chromatograph with Flame Ionization Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1989 ***Vendor Name:*** HP
Instrument ID: GCI07 ***Model Number:*** 5890
Location: Middle North Quad ***Serial Number:*** 2843A20146
Description: Gas Chromatograph with Flame Ionization Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1988 ***Vendor Name:*** HP
Instrument ID: GCE18 ***Model Number:*** 5890A
Location: Middle North Quad ***Serial Number:*** 2750A19153
Description: Gas Chromatograph with Electron Capture Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

ALS Laboratory Group Instrument List

Installation Date: 1988 ***Vendor Name:*** HP
Instrument ID: GCE19 ***Model Number:*** 5890A
Location: Middle North Quad ***Serial Number:*** 2843A19954
Description: Gas Chromatograph with Electron Capture Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1988 ***Vendor Name:*** HP
Instrument ID: GCE29 ***Model Number:*** 5890A
Location: Middle North Quad ***Serial Number:*** 2643A10322
Description: Gas Chromatograph with Electron Capture Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Installation Date: 1988 ***Vendor Name:*** HP
Instrument ID: GCI10 ***Model Number:*** 5890 Series II
Location: Middle North Quad ***Serial Number:*** 3303A31862
Description: Gas Chromatograph with Thermal Conductivity Detector and autosampler
Software: Total Chrom Version 6.3
Methods:

Gel Permeation Chromatography

Installation Date: 2006 ***Vendor Name:*** Analytical Bioche
Instrument ID: GPC04 ***Model Number:*** AP2000
Location: East South Quad ***Serial Number:*** F611300174
Description: Gel Permeation Autoprep System with UV detector and autosampler
Software: NA
Methods:

Installation Date: 2006 ***Vendor Name:*** Analytical Bioche
Instrument ID: GPC05 ***Model Number:*** AP2000
Location: East South Quad ***Serial Number:*** F611300175
Description: Gel Permeation Autoprep System with UV detector and autosampler
Software: NA
Methods:

ALS Laboratory Group Instrument List

Installation Date: 2000 ***Vendor Name:*** Analytical Bioche
Instrument ID: GPC03 ***Model Number:*** AP1000
Location: East South Quad ***Serial Number:*** 9441-SI
Description: Gel Permeation Autoprep System with UV detector and autosampler
Software: NA
Methods:

Installation Date: 1998 ***Vendor Name:*** Analytical Bioche
Instrument ID: GPC01 ***Model Number:*** AP1000
Location: East South Quad ***Serial Number:*** 9408-SI
Description: Gel Permeation Autoprep System with UV detector and autosampler
Software: NA
Methods:

Installation Date: 1993 ***Vendor Name:*** Analytical Bioche
Instrument ID: GPC02 ***Model Number:*** AP1000
Location: East South Quad ***Serial Number:*** 9251-SI
Description: Gel Permeation Autoprep System with UV detector and autosampler
Software: NA
Methods:

High Performance Liquid Chromatography

Installation Date: 2002 ***Vendor Name:*** Agilent
Instrument ID: HPLC13 ***Model Number:*** 1100
Location: Middle North Quad ***Serial Number:*** US824002654
Description: High Pressure Liquid Chromatograph with UV Diode Array and Floresence Detection and autosampler
Software: ChemStation for LC Rev. A 09.01 (1206)
Methods:

Installation Date: 2001 ***Vendor Name:*** HP
Instrument ID: HPLC12 ***Model Number:*** 1100
Location: Middle North Quad ***Serial Number:*** US70600692
Description: High Pressure Liquid Chromatograph with UV Diode Array and Floresence Detection and autosampler
Software: ChemStation for LC Rev. A 09.01 (1206)
Methods:

ALS Laboratory Group Instrument List

Installation Date:	1997	***Vendor Name:***	HP
Instrument ID:	HPLC11	***Model Number:***	1100
Location:	Middle North Quad	***Serial Number:***	US53700235
Description:	High Pressure Liquid Chromatograph with UV Detection and autosampler		
Software:	ChemStation for LC Rev. A 09.01 (1206)		
Methods:			

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	HPLC01	***Model Number:***	1050
Location:	Middle North Quad	***Serial Number:***	3405a02923
Description:	High Pressure Liquid Chromatograph with UV Detection and autosampler		
Software:	ChemStation for LC Rev. A 09.01 (1206)		
Methods:	8310		

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	HPLC09	***Model Number:***	1050
Location:	Middle North Quad	***Serial Number:***	3245a01788
Description:	High Pressure Liquid Chromatograph with UV Detection and autosampler		
Software:	ChemStation for LC Rev. A 09.01 (1206)		
Methods:	8330		

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	HPLC03	***Model Number:***	1050
Location:	Middle North Quad	***Serial Number:***	3107a00813
Description:	High Pressure Liquid Chromatograph with UV Detection and autosampler		
Software:	ChemStation for LC Rev. A 09.01_1206)		
Methods:	8330,8332		

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	HPLC08	***Model Number:***	1050
Location:	Middle North Quad	***Serial Number:***	3405a03034
Description:	High Pressure Liquid Chromatograph with UV Detection and autosampler		
Software:	ChemStation for LC Rev. A 09.01 (1206)		
Methods:	8330		

ALS Laboratory Group Instrument List

Installation Date: 1993 ***Vendor Name:*** HP
Instrument ID: HPLC02 ***Model Number:*** 1050
Location: Middle North Quad ***Serial Number:*** 3406a03407
Description: High Pressure Liquid Chromatograph with UV and Floresence Detection and autosampler
Software: ChemStation for LC Rev. A 09.01 (1206)
Methods: Isocyanates

Installation Date: 1993 ***Vendor Name:*** HP
Instrument ID: HPLC04 ***Model Number:*** 1050
Location: Middle North Quad ***Serial Number:*** 3245a01787
Description: High Pressure Liquid Chromatograph with UV Detection and autosampler
Software: ChemStation for LC Rev. A 09.01 (1206)
Methods: 8330

High Performance Liquid Chromatography/Mass Spectrometry

Installation Date: 2007 ***Vendor Name:*** Agilent
Instrument ID: LCMS03 ***Model Number:*** 1200 LC MSD SL
Location: Middle North Quad ***Serial Number:*** US54801209
Description: High Pressure Liquid Chromatograph with Mass Spectrometer Detection and autosampler
Software: ChemStation Rev. B.0301SR1
Methods: R&D, Perchlorate by SW846 6850, Methamphetamine by NMAM 9111 Draft, Explosives and Agent Degradation Products

Installation Date: 2005 ***Vendor Name:*** Agilent
Instrument ID: LCMS02 ***Model Number:*** 1100
Location: Middle North Quad ***Serial Number:*** US230130030
Description: High Pressure Liquid Chromatograph with Mass Spectrometer Detection and autosampler
Software: ChemStation Rev. A 09.03
Methods: Perchlorate by SW846 6850, Methamphetamine by NMAM 9111 Draft, Explosives and Agent Degradation Products

ALS Laboratory Group Instrument List

Installation Date:	2003	***Vendor Name:***	Agilent
Instrument ID:	LCMS01	***Model Number:***	1100
Location:	Middle North Quad	***Serial Number:***	US84100727
Description:	High Pressure Liquid Chromatograph with Mass Spectrometer Detection and autosampler		
Software:	ChemStation Rev. A 09.03		
Methods:	R&D, Perchlorate by SW846 6850, Methamphetamine by NMAM 9111 Draft, Explosives and Agent Degradation Products		

Gas Chromatography/Mass Spectrometry

Installation Date:	2009	***Vendor Name:***	HP
Instrument ID:	5972-C	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3336A57712
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	T017		

Installation Date:	2006	***Vendor Name:***	Agilent
Instrument ID:	5975-B	***Model Number:***	5975-B
Location:	East North Quad	***Serial Number:***	CN10625101
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD Chemstation G3172A Version D.02.00.275		
Methods:	8260B and SOM1.1		

Installation Date:	2006	***Vendor Name:***	Agilent
Instrument ID:	5975-A	***Model Number:***	5975-A
Location:	Middle North Quad	***Serial Number:***	CN60338214
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD Chemstation , G3172A, Version D.02.00.275		
Methods:	8270C and SOM1.1		

ALS Laboratory Group Instrument List

Installation Date:	2002	***Vendor Name:***	Agilent
Instrument ID:	5973-Y	***Model Number:***	5973
Location:	Middle North Quad	***Serial Number:***	US10723199
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:			

Installation Date:	2002	***Vendor Name:***	Agilent
Instrument ID:	5973-Z	***Model Number:***	5973
Location:	East North Quad	***Serial Number:***	US10462027
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 DA Version D.00.01.27		
Methods:			

Installation Date:	1997	***Vendor Name:***	HP
Instrument ID:	5972-X	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3435a02175
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	T017		

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	5972-W	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3434a01791
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	TO15		

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	5971-L	***Model Number:***	5971A
Location:	East North Quad	***Serial Number:***	3284a43426
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1034C Version C.01.05		
Methods:	524.2		

ALS Laboratory Group Instrument List

Installation Date:	1994	***Vendor Name:***	HP
Instrument ID:	5972-U	***Model Number:***	5972A
Location:	Middle North Quad	***Serial Number:***	3341a00983
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:			

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	5972-N	***Model Number:***	5972A
Location:	Middle North Quad	***Serial Number:***	3251a00102
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	8270C		

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	5972-P	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3307a00270
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	8260B		

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	5972-Q	***Model Number:***	5972A
Location:	Middle North Quad	***Serial Number:***	3307a00274
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	8270C		

Installation Date:	1993	***Vendor Name:***	HP
Instrument ID:	5972-R	***Model Number:***	5972A
Location:	Middle North Quad	***Serial Number:***	3329a00503
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	8270C		

ALS Laboratory Group Instrument List

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	5972-O	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3329a0050
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	TO15		

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	5972-S	***Model Number:***	5972A
Location:	East North Quad	***Serial Number:***	3329a00532
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1701 BA Version B.01.00		
Methods:	TO17		

Installation Date:	1992	***Vendor Name:***	HP
Instrument ID:	5971-M	***Model Number:***	5971A
Location:	East North Quad	***Serial Number:***	3234a03897
Description:	Gas Chromatograph with Mass Spectrometer Detector and autosampler		
Software:	MSD ChemStation G 1034C Version C.01.05		
Methods:	8260B/5035		

Specific Ion Electrode and Miscellaneous Meters

Installation Date:	1993	***Vendor Name:***	Corning
Instrument ID:	430	***Model Number:***	430
Location:	East South Quad	***Serial Number:***	007744
Description:	pH Meter		
Software:	NA		
Methods:			

ALS Laboratory Group Instrument List

III. EQUIPMENT FOR MYCOLOGY

Light Microscopes

Installation Date: 2003 ***Vendor Name:*** Accu-scope
Instrument ID: Accu-scope ***Model Number:***
Location: Middle South Quad ***Serial Number:*** 021019
Description: Microscope
Software: NA
Methods:

Installation Date: 2003 ***Vendor Name:*** Ziess
Instrument ID: Axiostar plus ***Model Number:*** Axiostar plus
Location: Middle South Quad ***Serial Number:*** 3108002673
Description: Microscope
Software: NA
Methods:

Installation Date: 2003 ***Vendor Name:*** Ziess
Instrument ID: Axioskop 40 ***Model Number:*** Axioskop 40
Location: Middle South Quad ***Serial Number:*** 3308001212
Description: Microscope
Software: NA
Methods:

Miscellaneous Laboratory Equipment

Installation Date: 2006 ***Vendor Name:*** Biolog
Instrument ID: MYCO01 ***Model Number:*** Biolog
Location: Middle South Quad ***Serial Number:*** E08815
Description: Culture Identification
Software: NA
Methods:

ALS Laboratory Group Instrument List

Installation Date:	2005	***Vendor Name:***	Sorville
Instrument ID:		***Model Number:***	Legend RT
Location:	Middle South Quad	***Serial Number:***	40556341
Description:	Refrigerated Centrifuge		
Software:	NA		
Methods:			

Installation Date:	2004	***Vendor Name:***	VWR
Instrument ID:		***Model Number:***	
Location:	Middle South Quad	***Serial Number:***	
Description:	Incubator		
Software:	NA		
Methods:			

Installation Date:	2004	***Vendor Name:***	LabConco
Instrument ID:		***Model Number:***	
Location:	Middle South Quad	***Serial Number:***	
Description:	Class II Biohazard Hood		
Software:	NA		
Methods:			

Installation Date:	2004	***Vendor Name:***	Tuttnauer
Instrument ID:		***Model Number:***	
Location:	Middle South Quad	***Serial Number:***	
Description:	Table Top Autoclave		
Software:	NA		
Methods:			

Installation Date:	2003	***Vendor Name:***	Bio-Whittaker
Instrument ID:	MYCO02	***Model Number:***	Kinetic-QCL
Location:	Middle South Quad	***Serial Number:***	1512
Description:	Endotoxin		
Software:	Knietic-QCL 1.2		
Methods:			

ALS Laboratory Group Instrument List

IV. EQUIPMENT FOR RADIOLOGICAL ANALYSIS

Radiation Survey Meters

Installation Date: 2002 ***Vendor Name:*** NE Technology
Instrument ID: Electra 1B ***Model Number:*** Electra 1B
Location: West Quad ***Serial Number:*** DP6BD
Description: Rate Meter with probe
Software: NA
Methods:

Installation Date: 1993 ***Vendor Name:*** Ludlum
Instrument ID: 177-1 ***Model Number:*** 177
Location: West Quad ***Serial Number:*** 99646
Description: Contamination Monitor with GM probe
Software: NA
Methods:

Installation Date: 1992 ***Vendor Name:*** Ludlum
Instrument ID: 5 ***Model Number:*** 5
Location: West Quad ***Serial Number:*** 81715
Description: Contamination Monitor with GM probe
Software: NA
Methods:

Installation Date: 1992 ***Vendor Name:*** Ludlum
Instrument ID: 12 ***Model Number:*** 12
Location: West Quad ***Serial Number:*** 79874
Description: Dose Ratemeter
Software: NA
Methods:

Installation Date: 1992 ***Vendor Name:*** Ludlum
Instrument ID: 2929 ***Model Number:*** 2929
Location: West Quad ***Serial Number:*** 105898
Description: Wipe Scaler
Software: NA
Methods:

ALS Laboratory Group Instrument List

V. Miscellaneous Equipment

Electrobalances

Installation Date: 1998 ***Vendor Name:*** Mettler
Instrument ID: GRAV01 ***Model Number:*** MT-5
Location: Grav Lab ***Serial Number:*** 1115500942
Description: Microbalance
Software: Software Wedge for Windows version 1.2
Methods: NMAM 0500/0600

Installation Date: 1992 ***Vendor Name:*** Mettler
Instrument ID: GRAV02 ***Model Number:*** MT-5
Location: Grav Lab ***Serial Number:*** L75248
Description: Microbalance
Software: Software Wedge for Windows version 1.2
Methods: NMAM 0500/0600

Balances

Installation Date: 2003 ***Vendor Name:*** Mettler
Instrument ID: PB303 ***Model Number:*** PB303
Location: Mycology ***Serial Number:*** N69650
Description: Analytical Balance
Software: NA
Methods:

Installation Date: 2003 ***Vendor Name:*** Ohaus
Instrument ID: ARC120 ***Model Number:*** ARC120
Location: Organic Prep ***Serial Number:*** G176-120212065
Description: Analytical Balance
Software: NA
Methods: NA

ALS Laboratory Group Instrument List

Installation Date:	1995	***Vendor Name:***	Mettler
Instrument ID:	AE163-1	***Model Number:***	AE163
Location:	GC IH Lab	***Serial Number:***	C89306
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1994	***Vendor Name:***	Sartorius
Instrument ID:	BP610	***Model Number:***	BP610
Location:	Organic Prep	***Serial Number:***	40604841
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1993	***Vendor Name:***	Mettler
Instrument ID:	AT361	***Model Number:***	AT361
Location:	GC ECD Lab	***Serial Number:***	N43131
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1993	***Vendor Name:***	Mettler
Instrument ID:	AT261O	***Model Number:***	AT261
Location:	HPLC Lab	***Serial Number:***	1112231313
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1993	***Vendor Name:***	Mettler
Instrument ID:	PM200	***Model Number:***	PM200
Location:	GC ECD Lab	***Serial Number:***	N95775
Description:	Analytical Balance		
Software:	NA		
Methods:			

ALS Laboratory Group Instrument List

Installation Date:	1993	***Vendor Name:***	Mettler
Instrument ID:	AT261I	***Model Number:***	AT261
Location:	Wet Lab	***Serial Number:***	45595
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1992	***Vendor Name:***	Sartorius
Instrument ID:	R-200D	***Model Number:***	R-200D
Location:	Metals Prep	***Serial Number:***	40120071
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1992	***Vendor Name:***	Sartorius
Instrument ID:	R-310P	***Model Number:***	R-310P
Location:	GC IH Lab	***Serial Number:***	40019174
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1992	***Vendor Name:***	Sartorius
Instrument ID:	B 310P	***Model Number:***	B 310P
Location:	Asbestos	***Serial Number:***	10803186
Description:	Analytical Balance		
Software:	NA		
Methods:			

Installation Date:	1992	***Vendor Name:***	Sartorius
Instrument ID:	B 120S	***Model Number:***	B 120S
Location:	Grav Lab	***Serial Number:***	40030055
Description:	Analytical Balance		
Software:	NA		
Methods:			

ALS Laboratory Group Instrument List

Installation Date: 1992
Instrument ID: LC-4200
Location: Metals Prep
Description: Analytical Balance
Software: NA
Methods:
Vendor Name: Sartorius
Model Number: LC-4200
Serial Number: 10404701

Installation Date: 1991
Instrument ID: AE163-2
Location: Metals Prep
Description: Analytical Balance
Software: NA
Methods:
Vendor Name: Mettler
Model Number: AE163
Serial Number: B-95868

Installation Date: 1991
Instrument ID: B310S
Location: VOA Lab
Description: Analytical Balance
Software: NA
Methods:
Vendor Name: Sartorius
Model Number: B310S
Serial Number: 40090067

Installation Date: 1990
Instrument ID: 5001
Location: GC/IH Lab
Description: Analytical Balance
Software: NA
Methods:
Vendor Name: Mettler
Model Number: 5001
Serial Number: 2113355984

ALS Laboratory Group Instrument List

VI. Computer Network

Network Servers

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Perlego ***Model Number:*** 600 SC
Location: West Quad ***Serial Number:***
Description: Single CPU, 2.4 Ghz, 512M RAM, 69 GB Storage, Application Server
Software: Windows 2000 Server 5.0.2915 SP4 Build 2195
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Fiscus ***Model Number:*** 1500 SC
Location: West Quad ***Serial Number:***
Description: Dual CPU, 1.3 Ghz, 2G RAM,173 GB Storage, Financial Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Faveo ***Model Number:*** 2500 SC
Location: West Quad ***Serial Number:***
Description: Dual CPU, 933 Mhz, 2.5G RAM, 85 GB Storage, Development Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Spensa ***Model Number:*** 2600
Location: West Quad ***Serial Number:***
Description: Quad CPU, 2.4 Ghz, 2.5G RAM, 173 GB Storage, Database Server
Software: Windows 2000 Server 5.0.2915 SP4 Build 2195
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Porta ***Model Number:*** 2400
Location: West Quad ***Serial Number:***
Description: Dual CPU, 933 Mhz, 1G RAM, 69 GB Storage, VPN Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

ALS Laboratory Group Instrument List

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Turbo ***Model Number:*** 1800
Location: West Quad ***Serial Number:***
Description: Quad CPU, 3.3 Ghz, 4G RAM, 478 GB Storage, Chromatography Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Spensa1 ***Model Number:*** 1800
Location: West Quad ***Serial Number:***
Description: Quad CPU, 3.4 Ghz, 4G RAM, 478 GB Storage, Database Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell OptiPlex
Instrument ID: Eminus ***Model Number:*** GX 260
Location: West Quad ***Serial Number:***
Description: Single CPU, 533 Mhz, 256MB RAM, 38 GB Storage, Remote Access Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Emitto ***Model Number:*** 1800
Location: West Quad ***Serial Number:***
Description: Quad CPU, 3.4 Ghz, 8G RAM, 478 GB Storage, E-Mail Server
Software: Windows 2003 X 64 Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Dominus ***Model Number:*** 2400
Location: West Quad ***Serial Number:***
Description: Dual CPU, 933 Mhz, 512MB RAM, 173 GB Storage, Domain Controller
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

ALS Laboratory Group Instrument List

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Limbus ***Model Number:*** 2600
Location: West Quad ***Serial Number:***
Description: Dual CPU, 2.6 Ghz, 1G RAM, 1.7 TB Storage, Backup Server
Software: Windows 2000 Server 5.0.2915 SP4 Build 2195
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Firmus ***Model Number:*** 2400
Location: West Quad ***Serial Number:***
Description: Dual CPU, 533 Mhz, 1G RAM, 51 GB Storage, Backup Domain Controller
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Imago ***Model Number:*** 2800
Location: West Quad ***Serial Number:***
Description: Quad CPU, 2.8 Ghz, 2G RAM, 560 GB Storage, LIMS Server
Software: Windows 2000 Server 5.0.2915 SP4 Build 2195
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Xenos ***Model Number:*** 1800
Location: West Quad ***Serial Number:***
Description: Quad CPU, 3.4 Ghz, 4G RAM, 576 GB Storage, File Server
Software: Windows 2003 Standard Edition 5.2.3790 SP2 Build 3790
Methods:

Installation Date: ***Vendor Name:*** Dell Power Edge
Instrument ID: Cuprum ***Model Number:*** 2400
Location: West Quad ***Serial Number:***
Description: Dual CPU, 866 Mhz, 1G RAM, 34 GB Storage, LIMS Server
Software: Windows 2000 Server 5.0.2915 SP4 Build 2195
Methods:

ALS Laboratory Group Instrument List

Cisco Switches

Installation Date:		***Vendor Name:***	Cisco Switches
Instrument ID:		***Model Number:***	Catalyst 3750
Location:	West Quad	***Serial Number:***	

Description: The Cisco® Catalyst® 3750 Series is an innovative line of multilayer Fast Ethernet and Gigabit Ethernet switches featuring Cisco StackWise™ technology that allows customers to build a unified, highly resilient switching system—one switch at a time.

Software: NA

Methods:

Installation Date:		***Vendor Name:***	Cisco Switches
Instrument ID:		***Model Number:***	Catalyst 3750
Location:	West Quad	***Serial Number:***	

Description: The Cisco® Catalyst® 3750 Series is an innovative line of multilayer Fast Ethernet and Gigabit Ethernet switches featuring Cisco StackWise™ technology that allows customers to build a unified, highly resilient switching system—one switch at a time.

Software: NA

Methods:

Installation Date:		***Vendor Name:***	Cisco Switches
Instrument ID:		***Model Number:***	Catalyst 3750
Location:	West Quad	***Serial Number:***	

Description: The Cisco® Catalyst® 3750 Series is an innovative line of multilayer Fast Ethernet and Gigabit Ethernet switches featuring Cisco StackWise™ technology that allows customers to build a unified, highly resilient switching system—one switch at a time.

Software: NA

Methods:

ALS Laboratory Group Instrument List

Installation Date: ***Vendor Name:*** Cisco Switches
Instrument ID: ***Model Number:*** Catalyst 2590
Location: East South Quad ***Serial Number:***
Description: The Cisco Catalyst 2950 Series Switch is a fixed-configuration, stackable standalone switch that provides wire-speed Fast Ethernet and Gigabit Ethernet connectivity.
Software: NA
Methods:

Installation Date: ***Vendor Name:*** Cisco Switches
Instrument ID: ***Model Number:*** Catalyst 2590
Location: East South Quad ***Serial Number:***
Description: The Cisco Catalyst 2950 Series Switch is a fixed-configuration, stackable standalone switch that provides wire-speed Fast Ethernet and Gigabit Ethernet connectivity.
Software: NA
Methods:

Installation Date: ***Vendor Name:*** Cisco Switches
Instrument ID: ***Model Number:*** Catalyst 2590
Location: West Quad ***Serial Number:***
Description: The Cisco Catalyst 2950 Series Switch is a fixed-configuration, stackable standalone switch that provides wire-speed Fast Ethernet and Gigabit Ethernet connectivity.
Software: NA
Methods:

DEC Servers

Installation Date: 1994 ***Vendor Name:*** Digtal Equipment
Instrument ID: Aurum ***Model Number:*** DEC 2100
Location: West Quad ***Serial Number:***
Description: 4/200 Alpha system equipped with 4 CPU's, 576 Mb memory 14 Gb disk storage.
Software: NA
Methods:

ALS Laboratory Group Instrument List

Installation Date: 1994 ***Vendor Name:*** Digtal Equipment
Instrument ID: Protos ***Model Number:*** DEC 3000 - M300
Location: West Quad ***Serial Number:***
Description: 128 Mb memory, 4Gb disk storage.
Software: NA
Methods:

Installation Date: 1993 ***Vendor Name:*** Digtal Equipment
Instrument ID: Woozle ***Model Number:*** MicroVAX 3100-9
Location: West Quad ***Serial Number:***
Description: 64 Mb memory, 2 Gb disk storage, 96 Mb cartridge tape drive
Software: NA
Methods:

Installation Date: 1991 ***Vendor Name:*** Digtal Equipment
Instrument ID: Tigger ***Model Number:*** VAX 4000–500 sy
Location: West Quad ***Serial Number:***
Description: 256 Mb memory, 5G disk storage, and 300 Mb
Software: NA
Methods:

Installation Date: ***Vendor Name:*** Digtal Equipment
Instrument ID: Krypto ***Model Number:*** Alpha Servers 400
Location: West Quad ***Serial Number:***
Description:
Software: NA
Methods:

Installation Date: ***Vendor Name:*** Digtal Equipment
Instrument ID: Krammer ***Model Number:*** Alpha Servers 400
Location: West Quad ***Serial Number:***
Description:
Software: NA
Methods:

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
120.1/9050	Specific Conductance	Check accuracy of cell constant	Daily, prior to analysis	Follow manufacture's instructions	Follow manufacture's instructions to clean electrode
		Check Standard	5%	± 20% of target	1) Rerun 2) Clean system 3) Recalibrate
150.1/9040/9045	pH	3 point calibration	Daily, prior to analysis	ICV within limits	1) Clean system 2) Recalibrate
		ICV	After initial calibration	± 0.05 pH units from initial calibration value	Recalibrate
		LCS	5%	± 0.1 pH units from target value	1) Recalibrate 2) Rerun all samples
		CCV	10% plus at end of run	± 0.05 pH units from target value	1) Rerun 2) Clean System 3) Rerun smples to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
200.7 (ICP)	Metals, Total and Dissolved	Laboratory mixed standard calibration	Daily prior to analyses		
		Calibration blank	After initial calibration and continuing calibration	<3 x Detection Limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
		ICP interference check	Run at beginning of daily run, after 8 hours and at end of run	80-120% of true value for EPA check sample elements	Recalibrate
		Initial calibration check	After calibration	±5% of true value	Recalibrate
		Continuing calibration verification standard	After ICV, 10% plus end of run	±5% of true value	1) Rerun 2) Recalibrate
200.8 (ICP/MS)	Metals, Total and Dissolved	Laboratory mixed standard calibration	Daily prior to analyses		
		Calibration blank	After initial calibration and continuing calibration	<3 x Detection Limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
		Interference check	Run at beginning of daily run, after 8 hours and at end of run	80-120% of true value for EPA check sample elements	Recalibrate if appropriate
		Initial calibration check	After calibration	±5% of true value	Recalibrate
		Continuing calibration verification standard	After ICV, 10% plus end of run	±5% of true value	1) Rerun 2) Recalibrate if appropriate

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
300.0 (IC)	Fluoride, Chloride, Bromide, Sulfate, Nitrate, Nitrite, ortho-Phosphate	Minimum four points	Initially and as required	r≥0.995	1) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	Daily	< ½ PQL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
310.2 (TAA)	Alkalinity	Minimum three points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	after ICV &CCV	<3 x Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
314.0 (IC)	Perchlorate	Minimum six points	Initially and as required	r 0.995	1) Repeat calibration
		Initial Calibration Verification	After Initial Calibration	± 10% of true value	1) Check Calculations 2) Re-prepare and re-analyze 3) Recalibrate
		Continuing Calibration verification standards	10% of field samples plus at end of run	± 15% of true value	1)Correct Problem 2) Recalibrate
		- MRL Check Standard	Before daily analysis of samples	± 25%	3) Rerun samples back to last compliant CCV
		- Initial Calibration Check Standard	Before daily analysis of samples	± 25%	
		Calibration Blank (LRB)	Before daily analysis of samples	< ½ PQL	1) Rerun 2) Clean System
		Instrument Performance Check (IPC)	Initial Injection daily	± 20% of true value	1) Re-prepare and re-analyze 2) Recalibrate 3) Repeat MCT Study

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
340.2/4500F	Fluoride	Minimum seven points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±15% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	10% plus end of run	±15% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After ICV and CCV	Absolute value < RL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
350.1	Ammonia-Nitrogen	Minimum four points	Daily, prior to analysis	r 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±10% or true value	1) Check calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After ICV and CCVs	<3 x Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
351.2	Total Kjedahl Nitrogen	Minimum six points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±15% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	10% plus end of run	±15% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After each ICV and CCV	Absolute value < RL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
353.2 (TAA)	Nitrate+Nitrate-Nitrogen	Minimum four points	Daily, prior to analysis	r 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After ICV and CCVs	<3 x Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
364.4~~1~~	Total Phosphorus	Minimum four points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After ICV and CCVs	<3 x Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
365.1 or 365.2~~4~~	Ortho-Phosphate	Minimum six points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±15% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	10% plus end of run	±15% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After each ICV and CCV	Absolute value < RL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
415.1/9060 (TOC)	Total Organic Carbon	Minimum two points	Daily, prior to analyses	ICV within limits	1) Check Calculation 2) Recalibrate
		Initial calibration verification	After initial calibration	±20% of true value	1) Check Calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
524.2	Volatile Organics 25 mL unless known high level Drinking Water	Tune instrument using BFB	Every 12 hours	Refer to method (SW846)	1) Retune instrument 2) Repeat BFB analysis
		Minimum five points	Initially and as required	RF <= 30%, RF > 30% Use Linear or Quadratic fit	1) Evaluate system 2) Repeat calibration if appropriate
		Calibration Verification	Every 12 hours	%RSD <= 20%	1) Evaluate system 2) Repeat calibration 3) Rerun all samples to last compliant CCV
6010B (ICP)	Metals, Total and Dissolved	Laboratory mixed standard calibration	Daily prior to analyses		
		Calibration blank	After initial calibration and continuing calibration	<3 x Detection Limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
		ICP interference check	Run at beginning of daily run, after 8 hours and at end of run	80-120% of true value for EPA check sample elements	Recalibrate
		Initial calibration check	After calibration	±10% of true value	Recalibrate
		Continuing calibration verification standard	After ICV, 10% plus end of run	±10% of true value	1) Rerun 2) Recalibrate

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
6020A(ICP/MS)	Metals, Total and Dissolved	Laboratory mixed standard calibration	Daily prior to analyses		
		Calibration blank	After initial calibration and continuing calibration	<3 x Detection Limit	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
		Interference check	Run at beginning of daily run, after 8 hours and at end of run	80-120% of true value for EPA check sample elements	Recalibrate if appropriate
		Initial calibration check	After calibration	±10% of true value	Recalibrate
		Continuing calibration verification standard	After ICV, 10% plus end of run	±10% of true value	1) Rerun 2) Recalibrate if appropriate
7196A (TAA)	Hexavalent Chromium	Minimum three points	Daily prior to analyses	r 0.995 for instruments that give r value	Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check Calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After initial calibration and continuing calibrations	<3 x Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last CCB

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
7421 (GFAA) 7060 (GFAA) 7740 (GFAA)	Pb As Se	Minimum three points, five for mercury	Daily prior to analyses	r 0.995	Recalibrate
7470A/7471A (CVAA) GFAA Methods	Hg Tl Ag	Initial calibration verification	After initial calibration	±10%	1) Check Calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	± 10% for GFAA ± 20% for CVAA	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration Blank	After ICV and CCV Every 12 hours	< 3X Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last CCB
7580	White Phosphorus	Minimum six points	Initially and as required	r 0.990	Recalibrate
		Calibration Verification	After Initial Calibration, after every ten samples and at end of run.	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV

Method [RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~ Quality Control	Frequency	Acceptance Criteria	Corrective Action
8015B (GC/FID)	Total Petroleum Hydrocarbons-Gasoline	Minimum five points	Initially and as required	RSD ≤25% or r .990	Recalibrate
		Initial Calibration Verification	After Initial Calibration	± 25%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Every ten samples and at the end of the analysis Beginning of analysis if initial calibration is not run	± 25%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV
8015B (GC/FID)	Total Petroleum Hydrocarbons-Diesel	Minimum five points	Initially and as required	r .990	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Every ten samples and at the end of the analysis Beginning of analysis if initial calibration is not run	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
8081A (GC/ECD)	Organochlorine Pesticides	Minimum five points	Initially and as required	r 0.990 or %RSD for RF 20%	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Daily, before sample analyses and every 12 hours	±15% ~~average of all analytes~~	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV
8082 (GC/ECD)	PCBs	Minimum five points PCB1016 and 1260	Initially and as required	r 0.990 or %RSD for RF 20%	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Daily, before sample analyses and every 12 hours	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
8151A (GC/ECD)	Chlorinated Herbicides	Minimum five points	Initially and as required	r 0.995 or %RSDfor RF ≤20%	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Daily, before sample analyses and after analysis	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
8260B (GC/MS)	Volatile Organics 5mL purge	Tune instrument using BFB	Every 12 hours	Refer to method (SW846)	1) Retune instrument 2) Repeat BFB analysis
		Minimum five points	Initially and as required	%RSD for CCCs<30%, Avg. RF>0.30 (2 compounds) and >0.1 (3 compounds), also ave. %RSD<15% for all spiked analytes	1) Evaluate system 2) Repeat calibration if appropriate
		Calib. Verif. Std: Calibration check compounds (CCC)	Every 12 hours	%RSD for CCCs<20%	1) Evaluate system 2) Repeat calibration
		System Performance Check Compounds (SPCC)	Every 12 hours	Avg. RF>0.30 (2 compounds) and >0.1 (3 compounds)	1) Evaluate system 2) Repeat calibration
8270C (GC/MS)	Semivolatile Organics	Check of instrument tuning criteria using DFTPP	Every 12 hours	Refer to method (SW846)	1) Retune instrument 2) Repeat DFTPP analysis
		Minimum five points	Initially and as required	%RSD for CCCs<30% Avg. RF>0.050 SPCCs	1) Evaluate system 2) Recalibrate if appropriate
		Calibration Verification Standard	Every 12 hours	RF>0.050 for SPCCs % Difference<20% for CCCs	1) Evaluate system 2) Repeat calibration check 3) Recalibrate if appropriate

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
8310 (HPLC)	Polynuclear Aromatic Hydrocarbons	Minimum five points	Initially and as required	r 0.995 or %RSD for RF<20%	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Daily, before sample analyses Every ten samples and at end	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV
8330/8332	Nitroaromatics	Minimum five points	Initially and as required	r 0.995 or %RSD for RF<20%	Recalibrate
		Initial Calibration Verification	After Initial Calibration	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate
		Continuing calibration check standard	Daily, before sample analyses Every ten samples and at end	±15%	1) Evaluate system 2) Reanalyze 3) Recalibrate 4) Rerun all samples to last compliant CCV

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
9012A (Colorimeter)	Cyanide	8-point calibration	Daily, prior to analysis	r 0.995 ±10% of true value	Recalibrate
		Initial calibration verification	After initial calibration	±15% of true value	1) Check Calculations 2) Recalibrate
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After ICVs and CCVs	< 3X Detection limit	1) Rerun 2) Clean system 3) Rerun samples back to last CCB
9030/9034	Sulfide	Cal Check Standard	5%	~~± 25% of true value~~Within DCL Performance Limits	1) Check Calculations 2) Rerun 3) redigest and rerun all associated samples.

Method[RPD1] [RPD2] ~~(Instrument)~~	Parameter	~~Calibration~~Quality Control	Frequency	Acceptance Criteria	Corrective Action
HACH	Chemical Oxygen Demand (COD)	Minimum five points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	10% plus end of run	±10% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After each ICV and CCV	Absolute value < RL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank
9066/420.2~~1~~	Total Phenols	Minimum six points	Daily, prior to analysis	R 0.995 for instruments that give r value	1) Check calculations 2) Repeat calibration
		Initial calibration verification	After initial calibration	±10% of true value	1) Check calculations 2) Repeat calibration
		Continuing calibration verification standard	After every 10~~5~~ samples plus end of run	±15% of true value	1) Correct Problem 2) Recalibrate 3) Rerun samples back to last compliant CCV
		Calibration blank	After each ICV and CCV	Absolute value < RL	1) Rerun 2) Clean system 3) Rerun samples back to last clean blank

SAMPLE PRESERVATION, CONTAINERS, AND HOLD TIMES

					Holding Time (Days)	
Analysis	**Matrix**	**Method**	**Sample Size/Container**	**Preservative[1]**	**From Sampling**	**From Extraction**
INORGANICS						
Acidity	W/WW	305.1	500 mL/P	Cool, 4°C	14	
Alkalinity	W/WW	310.1/310.2	500 mL/P	Cool, 4°C	14	
Ammonia	W/WW	350.1	500 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Anions	W/WW S/SW	300.0 300.0 Mod	500 mL/P 4 oz/G	Cool, 4°C	28 (2 for NO_3, NO_2 & PO_4)	
Chemical Oxygen Demand (COD)	W/WW	COD/HACH	500 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Color	W	110.2	250 mL/P	Cool, 4°C	2	
Conductivity	W/WW S/SW	120.1 9050A	500 mL/P 4 oz/G	Cool, 4°C	28	
Corrosivity	W/WW S/SW	1110	250 mL/P 4 oz/P	NA	7 7	
Cyanide	W/WW S/SW	335.4 9010A/9012A	1L/P 4 oz/P	NaOH, pH>12 Cool, 4°C	14 14	
Fluoride	W/WW	340.2	500 mL/P	NA	28	
Hexavalent Chromium	W/WW S/SW	7196A	500 mL/P 4 oz/P/G	Cool, 4°C	1 28	1
Ignitability	W/WW S/SW	1010	500 mL/G 4 oz/G	None	7	
Mercury	W/WW S/SW	245.1/245.5 7470A/7471A	250mL/P/G 4 oz/P/G	HNO_3, pH<2	28 28	
Metals ICP/AA	W/WW S/SW	200 Series 6010B/6020	500 mL/P 4 oz/P/G	HNO_3 pH<2	180 180	
Nitrate	W/WW	353.2	250 mL/P	Cool, 4°C	2	
Nitrate + Nitrite	W/WW	353.2	250 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Nitrite	W/WW	353.2 Mod	125 mL/P	Cool, 4°C	2	
Odor	W/WW	140.1	500 mL/G	Cool, 4°C	1	
Oil & Grease	W/WW S/SW	413.2 9071A	1 L/AG 8 oz/AG	Cool, 4°C H_2SO_4 pH<2	28 28	
Organoacids (IMPA,MPA, etc.)	W/WW S/SW	UT04 LT04	2 x 1L/AG 8 oz/AG	Cool, 4°C	40 40	

					Holding Time (Days)	
Analysis	**Matrix**	**Method**	**Sample Size/Container**	**Preservative[1]**	**From Sampling**	**From Extraction**
ortho-Phosphate	W/WW	365.1	125 mL/P	Cool, 4°C Filter Immediately	2	
Perchlorate	W/WW S/SW	DCL SOP	500 mL/P 4 oz/AG	Cool, 4°C	28 28	
pH	W/WW S/SW	150.1 9040B/9045C	500mL/P 4 0z/P/G	Cool, 4°C	ASAP ASAP	
Phenolics	W/WW	420.2 9066	1 L/AG 8 oz/AG	Cool, 4°C H_2SO_4 pH<2	1 28	
Reactive Cyanide	W/WW S/SW	7.3.3.2	500 mL/P 4 oz/P/G	Cool, 4°C Dark	7 7	
Reactive Sulfide	W/WW S/SW	7.3.4.2	500 mL/P 4 oz/P/G	Cool, 4°C Dark	7 7	
Sulfide	W/WW S/SW	376.1 9030B	500 mL/P 4 oz/P/G	Cool, 4°C pH>9 NaOH, ZnOAc	7 7	
Total Kjeldahl Nitrogen	W/WW	351.2	1 L/P	Cool, 4°C H_2SO_4 pH<2	28	
Total Dissolved Solids	W/WW	160.1	500 mL/P	Cool, 4°C	7	
Total Organic Carbon (TOC)	W/WW S/SW	415.1 9060	250 mL/AG 4 oz/AG	Cool, 4°C H_2SO_4 pH<2	28 28	
Total Phosphorus	W/WW	365.4	125 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Total Recoverable Petroleum Hydro-carbons (TRPH)	W/WW	418.1	1 L/AG	Cool, 4°C H_2SO_4 pH<2	28	
Total Settleable Solids	W/WW	160.1	500 mL/P	Cool, 4°C	2	
Total Solids Moisture	W/WW S/SW	160.3	500 mL/P 4 oz/G	Cool, 4°C	7 7	
Total Suspended Solids	W/WW	160.2	500 mL/P	Cool, 4°C	7	
Total Volatile Solids	W/WW	160.4	250 mL/P	Cool, 4°C	7	
Turbidity	W/WW	180.1	250 mL/P	Cool, 4°C	2	

Analysis	Matrix	Method	Sample Size/Container	Preservative[1]	Holding Time (Days) From Sampling	Holding Time (Days) From Extraction
ORGANICS						
BTEX	W/WW S/SW	8260B	2 x 40 mL/AG 4 oz/AG	Cool, 4°C, HCl pH<2	14 14	
DIMP/DMMP	W/WW S/SW	DCL SOP	2 x 1L/AG 8 oz/AG	Cool, 4°C	7 7	— 40
Dioxins/Furans (7)	W/WW S/SW	8280/8290	2 x 1 L/AG 8 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 30	40 45
Explosives	W/WW S/SW	8330	2 x 1 L/AG 8 oz/AG	Cool, 4°C, Dark 0.008% $Na_2S_2O_3$	7 14	40 40
Formaldehyde	W/WW S/SW	8315	2 x 1 L/AG 4 oz/AG	Cool, 4°C Dark	3 3	3 3
Herbicides	W/WW S/SW	8151A	2 x 1 L/AG 8 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 14	40 40
NDMA	W/WW S/SW	UM34 and DCL SOP	2 x 1 L/AG 8 oz/AG	Cool, 4°C	7 14	40 40
Nitroglycerin/PETN	W/WW S/SW	8332	2 x 1 L/AG 8 oz/AG	Cool, 4°C	7 14	40 40
Organochlorine Pesticides	W/WW S/SW	8081	2 x 1 L/AG 8 oz/AG	Cool, 4°C, pH 5-9 0.008% $Na_2S_2O_3$	7 14	40 40
Organophosphorus Pesticides (7)	W/WW S/SW	8141A	2 x 1 L/AG 8 oz/AG	Cool, 4°C, pH 5-9 0.008% $Na_2S_2O_3$	7 14	40 40
Organosulfur Compounds	W/WW S/SW	AAA9 LL05	2 x 1 L/AG 8 oz/AG	Cool, 4°C	7 7	40 40
PCBs	W/WW	8082	2 x 1 L/AG 8 oz/AG	Cool, 4°C	7 14	40 40
Polynuclear Aromatics (PAHs)	W/WW S/SW	8270C 8310	2 x 1 L/AG 8 oz/AG	Cool, 4°C, Dark 0.008% $Na_2S_2O_3$	7 14	40 40
Semivolatile Organics	W/WW S/SW	8270C	2 x 1 L/AG 8 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 14	40 40
TCLP Metals	W/WW S/SW	1311	1 L/P	NA	180	
TCLP Semivolatiles, Pesticides, & Herbicides	W/WW S/SW	1311	3 X 1L/AG 8 oz/AG	Cool, 4°C	14 (leach) 7 (extraction)	40
TCLP Volatiles	W/WW S/SW	1311	3 X 40mL/AG 8 oz/AG	Cool, 4°C	14 (leach) 14 (analyze)	
Thiodiglycol	W/WW S/SW	UL09 LL9	2 x 1 L/AG 8 oz/AG	Cool, 4°C	40 7	— 40

					Holding Time (Days)	
Analysis	Matrix	Method	Sample Size/Container	Preservative [1]	From Sampling	From Extraction
TPH—Gas	W/WW S/SW	8015B	2 X 40 mL/AG 4 oz/P	Cool, 4°C HCl, pH<2	14 14	
TPH - Diesel	W/WW S/SW	8015B	1 L/AG 4 oz/AG	Cool, 4°C	14 14	40 40
Volatile Organics	W/WW	524.2	2 x 40 mL/AG	Cool, 4°C Dechlorination then HCl, pH<2 No Head-space	14	
Volatile Organics	W/WW S/SW	8260B	2 x 40 mL/AG 4 oz/AG	Cool, 4°C HCl, pH<2, No Head-space	14 14	
MISCELLANEOUS						
Asbestos (7)	W	100.1	1 L/P	Cool, 4°C	2	
Asbestos (7)	W/W	100.1	1 L/P	Cool, 4°C	None	

Abbreviations used are as follows:

Matrix		Container		Preservatives	
W	Water	P	Plastic (HDPE)	NaOH	Sodium Hydroxide
WW	Waste Water	AG	Amber Glass	HCl	Hydrochloric Acid
S	Soil/Sediment	G	Glass	HNO_3	Nitric Acid
SW	Solid Waste			H_2SO_4	Sulfuric Acid
				$Na_2S_2O_4$	Sodium Thiosulfate

[1] Chemical Preservative on W/WW matrix only.

NOTES:
1. Sample preservation should be performed during sample collection.
2. Soil samples can be collected in either glass jars or stainless steel liners with both ends sealed with Teflon® paper and plastic caps.
3. Extraction hold times are from the date of sampling, and analysis hold times are from the date of extraction.
4. If analyzing for dissolved metals, the sample shall be field-filtered through a 0.45-µm filter immediately (within 15 minutes) after sample collection and prior to preservation.
5. Provide twice the number of containers listed when matrix spike, matrix duplicate, and matrix spike duplicate analyses are requested for the sample. Minimum frequency is one per 20 field samples.
6. This table includes the requirements of the U. S. Environmental Protection Agency, as published in the *Code of Federal Regulations,* Volume 49, Number 209, 40 CFR 136 dated October 26, 1984, page 43260 and SW846 Chapter 2 Table 2-36 Revision 3, December 1996.
7. DataChem does not perform these analyses and subcontracts this work, with client approval, to certified vendors.

ALS DataChem
Field Chain-of-Custody Record

Appendix 14.9
Version 1
Effective Date 8-31-09

Client Name & Address:	Project No.:	Preservation Code	Sample Matrix Code	Sample for Matrix QC	Analyses Requested								No. of Containers	Matrix Codes: W) Water B) Bulk L) Liquid F) Filter S) Soil G) Wipe C) Solid M) Media Preservation Codes: 1) Cool to 4°C 2) HCl to pH<2, 4°C 3) H_2SO_4 to pH<2, 4°C 4) HNO_3 to pH<2, 4°C 5) NaOH to pH>9, 12, 4°C 6) ZnOAc/NaOH to pH>9, 4°C
	Project Name:													
Phone:														
FAX:	Sampler: *(Signature)*													
e-mail:														

Field Sample Number	Site ID	Date	Time	Depth	DCL Sample Number												Remarks

Possible Hazard Identification
☐ Non-Hazard ☐ Skin Irritant ☐ Rad
☐ Flammable ☐ Poison ☐ Unknown

Sample Disposal
☐ Return to Client ☐ Archive for _____ Months
☐ Disposal by Lab
(a fee may be assessed if samples are retained longer than 3 months)

Requested Turn Around Time
☐ 48 Hours (Rush) ☐ 7 Days ☐ 21 Days
☐ 72 Hours (Rush) ☐ 14 Days ☐ Other
(Rush is email or fax data unless previously approved)

Carrier/Airbill #:

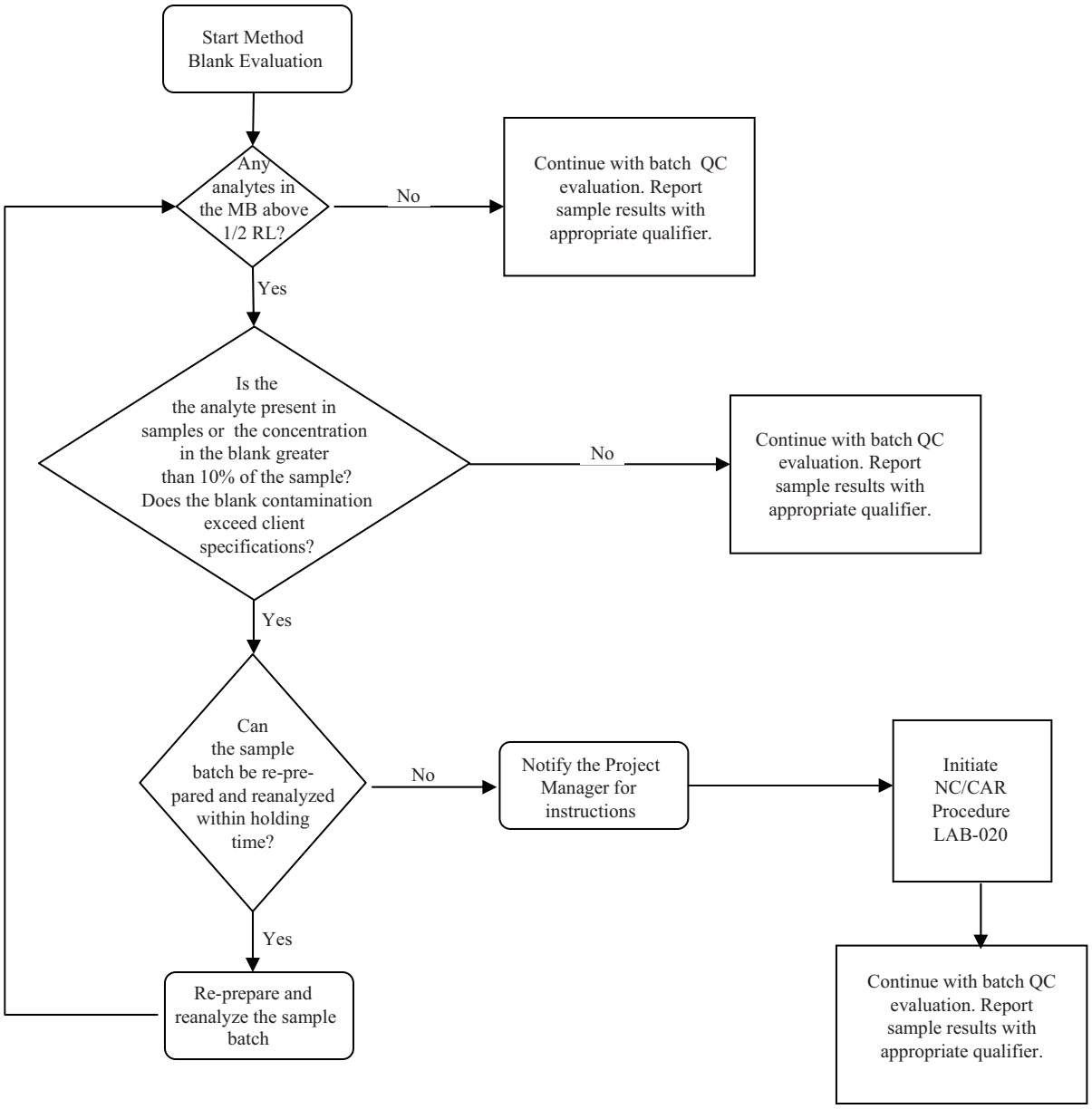
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time
Relinquished by: *(Signature)*	Received by: *(Signature)*	Date	Time

Shipped to:

ALS DataChem
960 West LeVoy Drive
Salt Lake City, UT 84123
Phone: (800) 356-9135
Phone: (801) 266-7700
FAX: (801) 268-9992
www.datachem.com

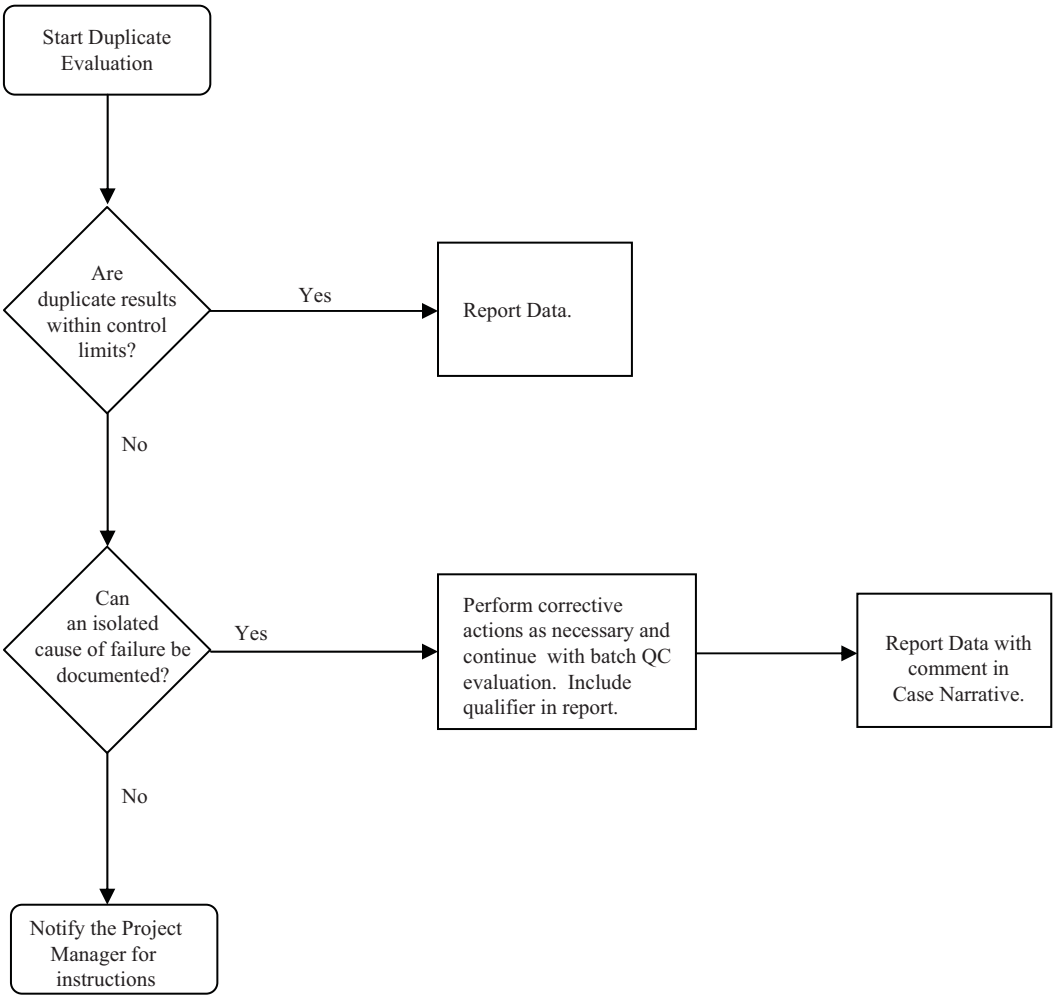
Appendix 14.10
Version 1
Effective Date 8-31-09

Method Blank Acceptability



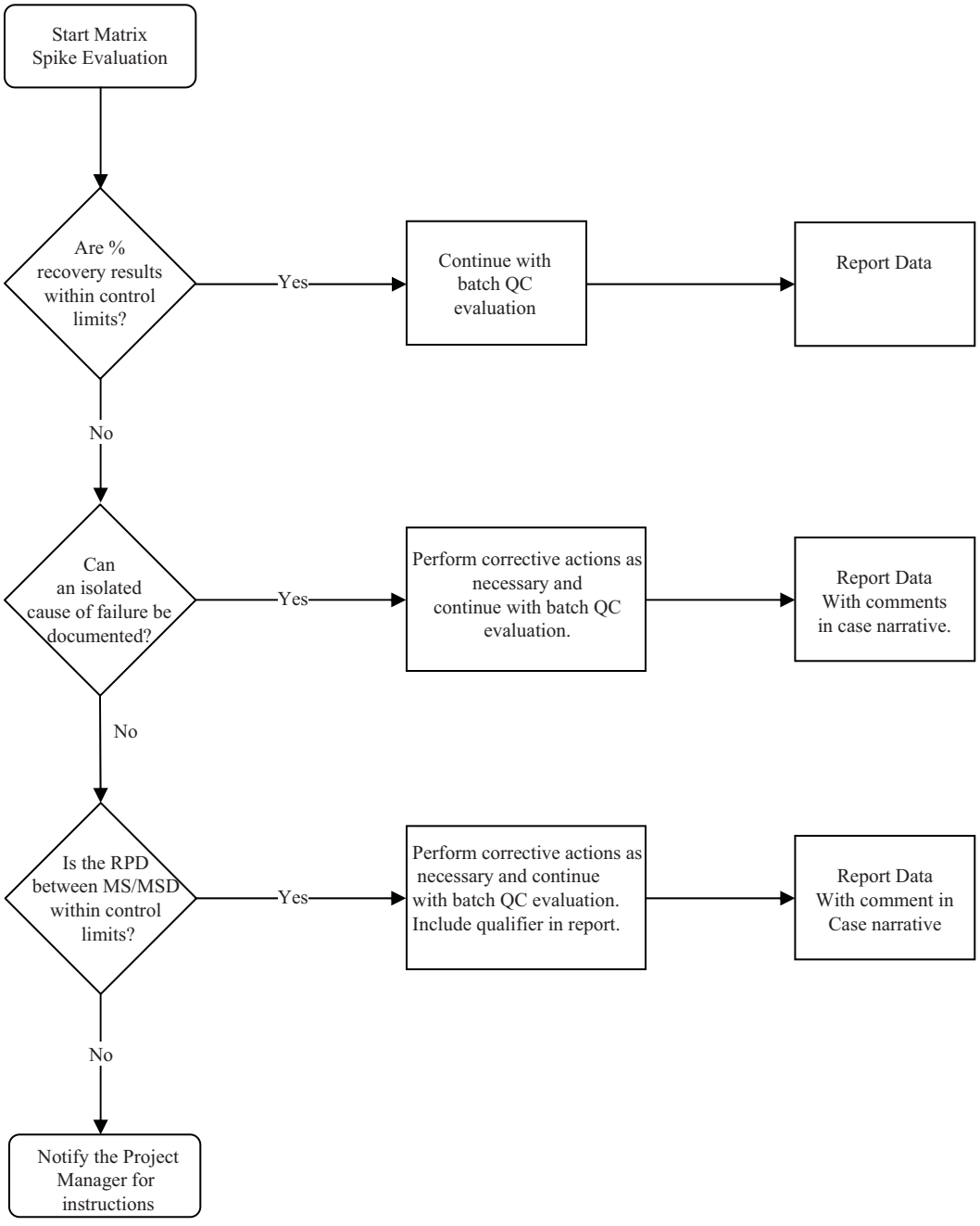
Appendix 14.10
Version 1
Effective Date 8-31-09

Duplicate Acceptability



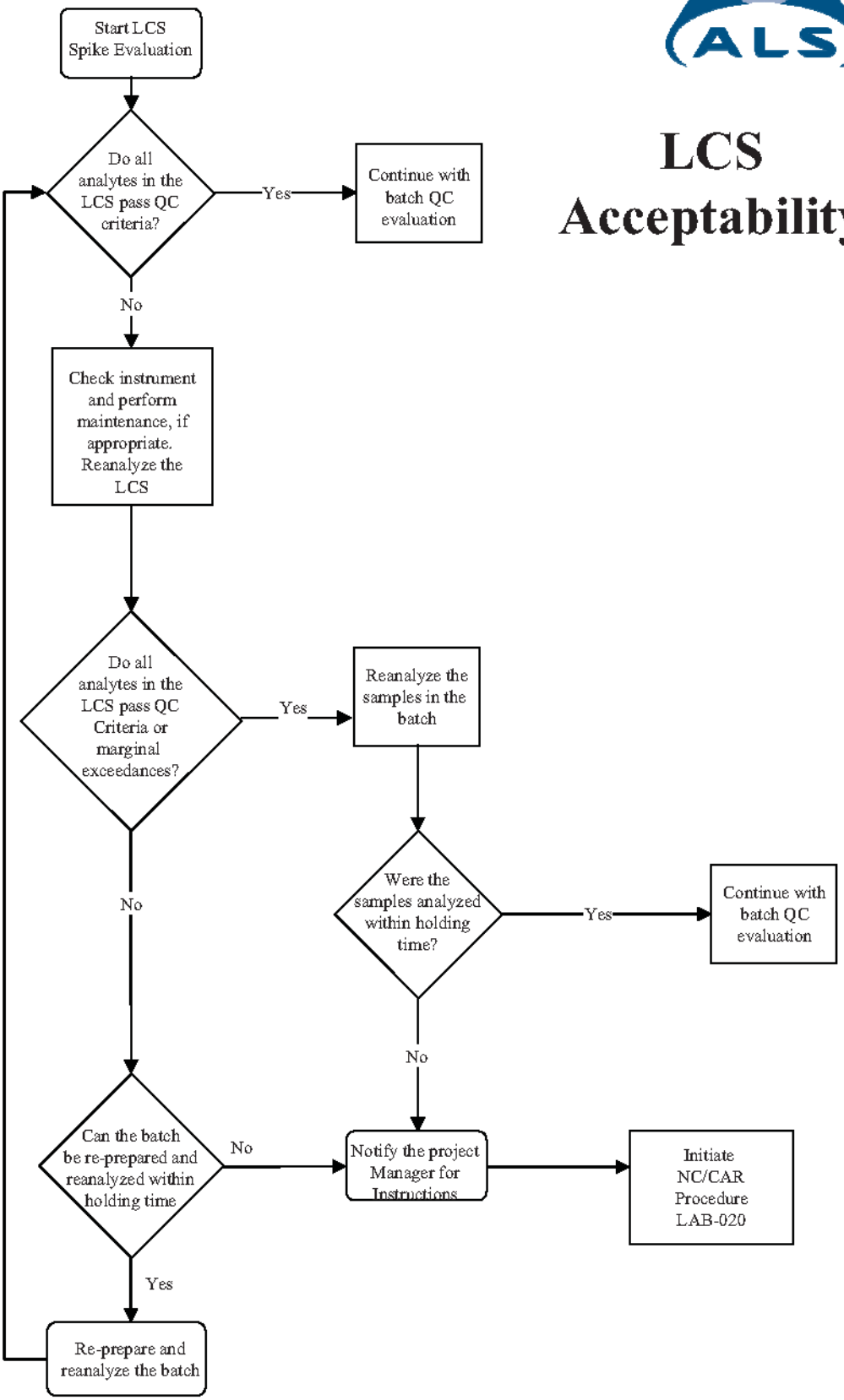
Appendix 14.10
Version 1
Effective Date 8-31-09

Matrix Spike Acceptability

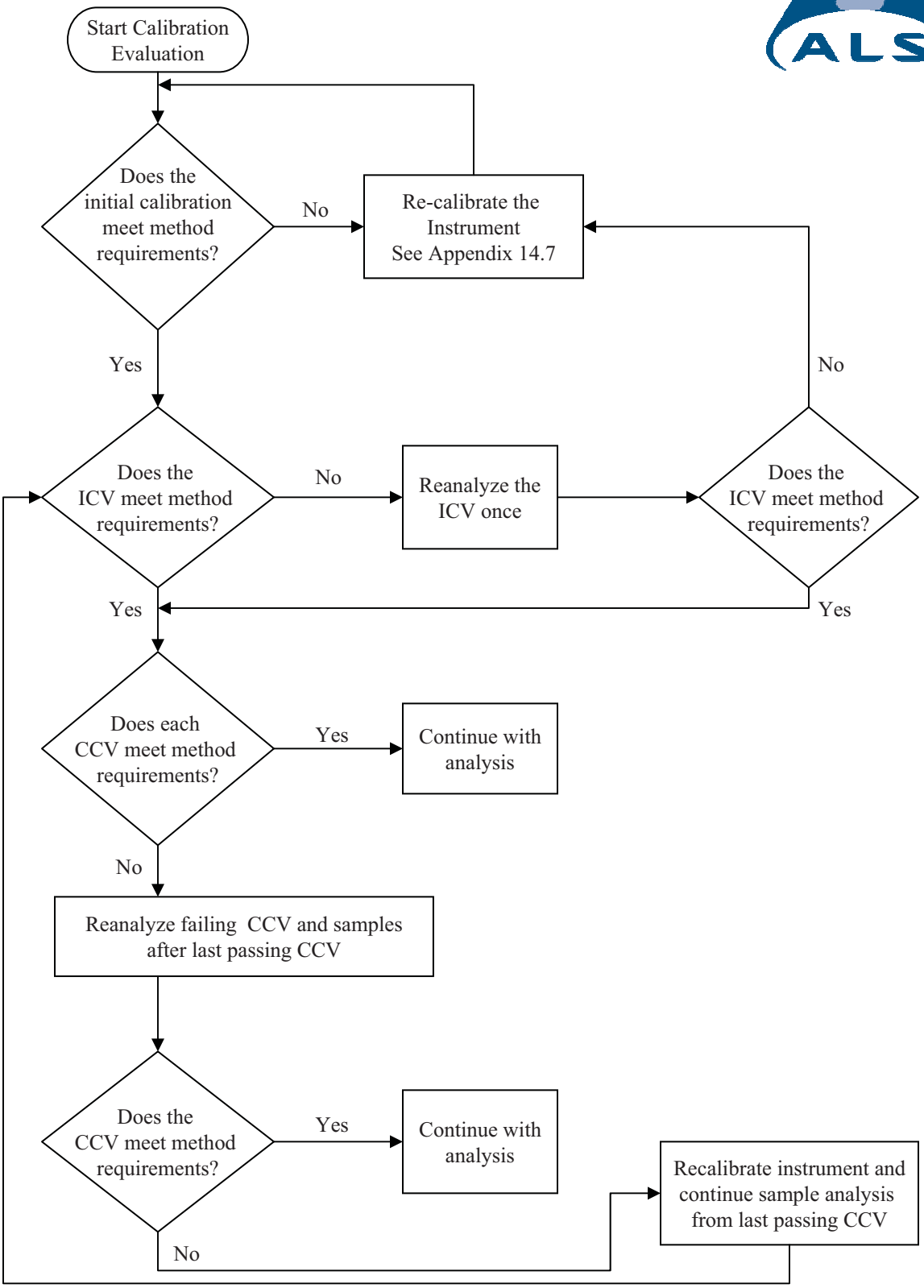


Appendix 14.10
Version 1
Effective Date 8-31-09

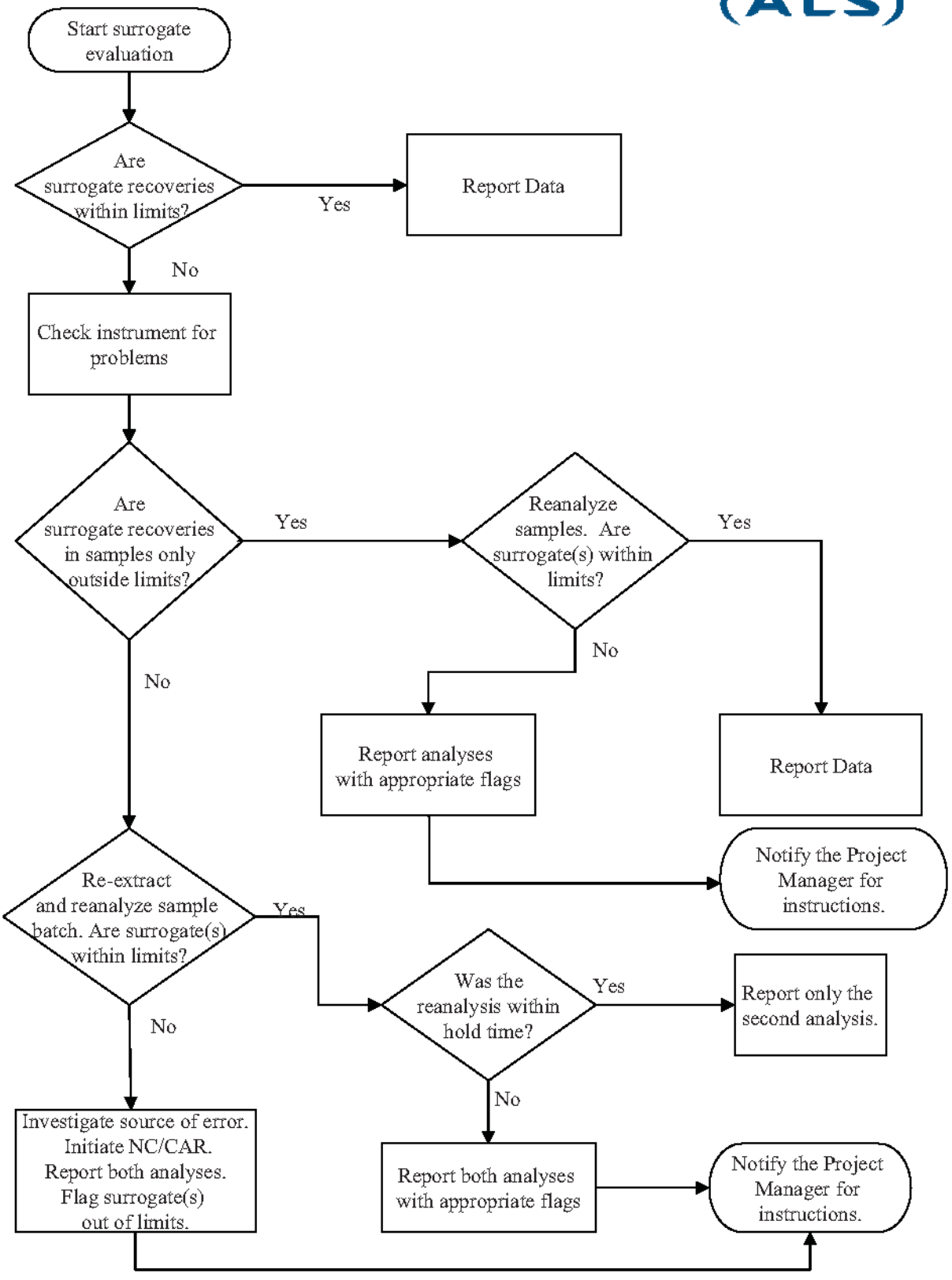
LCS Acceptability



Calibration Acceptablity



Surrogate Acceptability



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SOP	NAME	Location	Revision	Date Revised	Date Reviewed
Agilent 5890	5890, and 5890A Series II Instrument Manuals	GC/GCMS Labs	0	5/28/2009	5/28/2009
Agilent 6890	6890 GC Systems Manuals	IH GC Lab	0	5/28/2009	5/28/2009
Agilent GC/MS	5972, 5973, 5795 GC/MS Systems	GC/MS Labs	0	5/28/2009	5/28/2009
Agilent HPLC	1050 and 1100 Instrument Manuals	HPLC/IC Lab	0	5/28/2009	5/28/2009
ALS On-Line	ALS On-Line Controlled Documents and Spredsheets Used by the Laboratory from both Internal and External Sources	ALS Online	0	1/26/2007	4/8/2009
Appendix 14.1	Accreditations and Certifications	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.10	Batch QC and Corrective Action Flowcharts	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.11	Master List of Documents	ALS Online	2	9/8/2009	9/8/2009
Appendix 14.12	Definitions and Terms	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.13	Analytical Services Provided by ALS Laboratory Group	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.14	Historical Control LimitLCS and Surrogate	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.15	Method Detection and Reporting Limits	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.16	Marginal Exceedances	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.17	ALS Maintained Control Limits	ALS Online	1	8/31/2009	8/31/2009
Appendix 14.18	DoD QSM Requirements 4.1	ALS Online	1	8/31/2009	8/31/2009

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
Appendix 14.2	Organization Chart		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.3	Key Personnel		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.4	ALS Staff Summary		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.5	Facility Floor Plan		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.6	Equipment List		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.7	Summary of Calibration and Corrective Action Procedures		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.8	Sample Preservation and Holding Times		ALS Online	1	8/31/2009	8/31/2009
Appendix 14.9	Chain-of-Custody		ALS Online	1	8/31/2009	8/31/2009
CHP	Safety Manual and Chemical Hygiene Plan	X	ALS Online	4	5/30/2008	5/30/2008
CVAA	CVAA Vendor Instrument Manual		Metals Lab	0	2/22/2000	6/11/2009
Dionex	DX-300 and 2010i Instrument Manuals		HPLC/IC Lab	0	5/28/2009	5/28/2009
DoD QSM 4.1	DoD QSM 4.1 Quality Systems Manual		ALS Online	4.1	8/25/2009	8/25/2009
DRO-SW-8015B	Determination of Diesel Range Organics by EPA 8015B	X	ALS Online	3	2/6/2008	8/7/2008
EA-DC-002	Processed Sample Storage & Disposal Control		ALS Online	12	4/13/2009	4/13/2009
EA-DC-006	Handling & Disposal of Radioactive Waste		ALS Online	5	12/10/2002	6/11/2009

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
EA-DC-008	Monitoring of Areas and Personnel for Radioactive Contamination		ALS Online	4	11/1/2002	6/11/2009
Geneysis 10	Thermo Spectronic Operators Manual		Wet Chemistry Lab	0	1/1/2007	5/28/2009
GPC 1000	Autoprep 1000 Operating Manual V2		GPC Lab	0	5/28/2009	5/28/2009
GPC 2000	Autoprep 2000 Software V3		GPC Lab	0	5/28/2009	5/28/2009
GRO-SW-8015B	Determination of Gasoline Range Organics by EPA 8015B	X	ALS Online	0	1/15/2005	7/31/2008
HP 7673	Autosampler Manual		GC Env Lab	0	5/28/2009	5/28/2009
IC-EP-300.0	Determination of Inorganic Anions in Water and Soil by Ion Chromatorgaphy (300.0 and 9056)		ALS Online	12	5/1/2009	5/1/2009
IC-EP-305.1	Titrimetric Determination of Acidity		ALS Online	0	8/16/2000	10/30/2008
IC-EP-310.1	Determination of Alkalinity in Water by the titration method		ALS Online	1	5/2/2002	10/30/2008
IC-EP-5.4-CN	Total Cyanide Analysis and Reporting for EPA-CLLP Statement of Work ILM05.4		ALS Online	0	11/16/2007	4/16/2009
ICP/MS	ICP/MS Vendor Instrument Manual		ICP/MS Lab	0	2/22/2000	5/30/2009
ICP1	ITEV Help Version 1.2.0.34		ICP Lab	0	5/28/2009	5/28/2009
ICP2	Window Help Version 5.06.2195.6001		ICP Labs	0	5/28/2009	5/28/2009

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
IC-SW-7196A/30	Alkaline Digestion and Colorimetric Determination of Hexavalent Chromium in Soils, Sediments, Sludges or Solid Wastes		ALS Online	0	8/8/2003	10/30/2008
IH-AN-014	Analysis of Volatile Organic Compounds in Ambient Air Using SilcoCan Passivated Canisters by EPA Method TO-15		ALS Online	5	1/7/2008	3/27/2009
IH-AN-015	Analysis of Volatile Organic Compounds by Thermal Desorption Gas Chromatography/Mass Spectrometry (GC/MS) by Modified Method TO-17		ALS Online	3	1/7/2008	3/27/2009
IHQAP	Industrial Hygiene Chemistry Quality Assurance Plan		ALS Online	16	9/1/2009	9/1/2009
IP-CW-200.7	Determination of Metals and Trace Elements by Inductively Coupled Plasma-Atomic Emmision Spectroscopy Using EPA Method 200.7		ALS Online	4	1/5/2009	1/5/2009
IP-CW-200.8	Determination of Metals and Trace Elements Using Inductively Coupled Plasma-Mass Spectrometry by EPA Method 200.8	X	ALS Online	2	7/3/2002	8/6/2008
IP-EP-5.4-ICP	ICP Metals Analysis and Reporting for EPA-CLP Statement of Work ILM05.4		ALS Online	0	11/16/2007	12/19/2008
IP-EP-5.4-ICPMS	ICP-MS Metals Analysis and Reporting for EPA-CLP Statement of Work ILM05.4	X	ALS Online	0	11/16/2007	8/6/2008

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
IP-SW-6010B	Determination of Trace Metals in Solution by Inductively Coupled Plasma-Atomic Emission Spectroscopy	X	ALS Online	6	2/16/2005	9/4/2008
IP-SW-6020	Determination of Trace Metals in Solution by EPA Method 6020	X	ALS Online	7	5/15/2007	8/6/2008
IS-DC-BIOTA	Microwave-Assisted Acid Digestion of Biota Samples for Analysis by Atomic Spectroscopy	X	ALS Online	2	2/15/2002	1/29/2008
IS-EP-5.4-ICP-P	Sample Preparation for ICP Metals Analysis for EPA-CLP Statement of Work ILM05.4		ALS Online	1	2/20/2009	2/20/2009
ISO 17025:1999	General requirements for the competence of testing and calibration laboratories		ALS Online	0	1/1/1999	8/25/2009
ISO 17025:2005	General requirements for the competence of testing and calibration laboratories		ALS Online	0	1/1/2005	8/25/2009
IS-SW-3005	Acid Digestion of Waters for Total Recoverable or Dissolved Metals for AA or ICP	X	ALS Online	7	4/15/2003	7/30/2008
IS-SW-3010	Acid Digestion of Aqueous Samples and Extracts for Total Metals for AA or ICP	X	ALS Online	9	4/15/2003	7/30/2008
IS-SW-3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts		ALS Online	9	1/26/2009	1/26/2009
IS-SW-3050	Acid Digestion of Sediments, Sludges, and Soils for Analysis by AA or ICP Spect.	X	ALS Online	9	5/11/2005	7/30/2008
IS-SW-3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils		ALS Online	9	1/26/2009	1/26/2009

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
IT-EP-5.4-HG	COLD VAPOR ATOMIC ABSORPTION MERCURY ANALYSIS AND REPORTING FOR ILM05.4		ALS Online	0	11/16/2007	12/19/2009
IT-SW-7420	Determination of Lead in Water and Soil by Flame Atomic Absorption Spectroscopy	X	ALS Online	4	4/15/2003	12/10/2007
IT-SW-7470	Determination of Mercury in Liquid Waste by the Manual Cold-Vapor Tech.		ALS Online	17	7/6/2009	7/6/2009
IT-SW-7471	Det. of Mercury in Solid or Semi-Solid Waste by the Manual Cold-Vapor Tech.		ALS Online	16	8/6/2007	12/19/2008
IT-SW-9081	Determination of Cation-Exchange Capacity of Soils (Sodium Acetate)	X	ALS Online	3	6/28/2002	1/29/2008
IW-DC-COD-HA	Determination of Chemical Oxygen Demand in Water by Colorimetry		ALS Online	3	1/5/2009	2/25/2009
IW-DC-KAHN	Determination of Total Organic Carbon in Soil by Modified Lloyd Kahn Method		ALS Online	3	7/28/1998	4/21/2009
IW-EP-120.1	Determination of Electrical Conductivity of Water (120.1 and 9050)		ALS Online	3	11/22/2004	4/16/2009
IW-EP-160.1	Determination of Total Dissolved Solids in Water by the Gravimetric Technique		ALS Online	5	4/6/2001	4/16/2009
IW-EP-160.2	The Determination of Total Suspended Solids in Water by the Gravimetric Technique		ALS Online	3	11/15/2002	4/16/2009
IW-EP-1664	Oil and Grease as n-Hexane Extractable Material (HEM) by Solid Phase Extraction		ALS Online	3	12/15/2008	12/15/2008

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IW-EP-340.2	Determination of Fluoride in Water by Ion Selective Electrodes	ALS Online	2	11/15/2002	2/25/2009
IW-SM-2130B	Determination of Turbidity in Water by the Nephelometric Method	ALS Online	2	1/26/2009	1/26/2009
IW-SW-1010	Determination of Ignitability of Liquids by the Pensky-Martens Closed-Cup Method	ALS Online	6	5/20/2005	5/7/2009
IW-SW-1110	Determination of Corrosivity Toward Steel in Nonaqueous Liquids	ALS Online	4	11/15/2002	5/7/2009
IW-SW-7.3.3.2	Test Method to Determine Hydrogen Cyanide Released from Wastes	ALS Online	6	12/15/2008	4/16/2009
IW-SW-7.3.4.2	Test Method to Determine Hydrogen Sulfide Released from Wastes	ALS Online	6	12/15/2008	4/16/2009
IW-SW-9030/903	Determination of Total Acid-Soluble Sulfide in Aqueous, Soil, Solid Waste Materials, or Effluents by Titration (9030B/9034)	ALS Online	5	2/20/2009	4/16/2009
IW-SW-9040B	Determination of pH of Water by the Electrometric Method	ALS Online	4	4/6/2001	4/16/2009
IW-SW-9045C	Determination of pH of Soil and Waste by the Electrometric Method	ALS Online	5	4/6/2001	4/16/2009
IW-SW-9060	Determination of Total Organic Carbon in Water by the Combustion or Oxidation Tech.	ALS Online	6	1/12/2007	4/21/2009
IW-SW-9095	Paint Filter Liquids Test	ALS Online	4	6/26/2002	4/16/2009

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LAB-001	Laboratory Ethics and Data Integrity	ALS Online	6	2/1/2009	2/1/2009
LAB-002	Preventative Maintenance for Analytical Instrumentation	ALS Online	3	11/3/2005	6/11/2009
LAB-003	Labeling of Standards, Solutions, and Reagents	ALS Online	7	10/24/2008	10/24/2008
LAB-004	Hazardous Waste Handling and Disposal	ALS Online	3	10/31/2005	6/11/2009
LAB-005	General Laboratory Safety and Chemical Hygiene	ALS Online	0	9/5/2000	6/11/2009
LAB-006	Training	ALS Online	6	11/1/2006	6/11/2009
LAB-007	Record of Training	ALS Online	3	5/24/2002	6/11/2009
LAB-008	Procurement Controls for Purchased Materials and Services	ALS Online	2	2/29/2008	6/11/2009
LAB-009	Security for Laboratory Facility and Samples	ALS Online	0	11/1/2001	6/11/2009
LAB-010	Refrigeration Units	ALS Online	2	1/15/2005	6/11/2009
LAB-011	Glassware Cleaning for Inorganic Chemistry	ALS Online	1	1/27/2006	6/11/2009
LAB-011SP	Glassware Cleaning for Inorganic Chemistry (Spanish Version)	ALS Online	0	8/30/2005	6/11/2009
LAB-012	Glassware Cleaning for Organic Analysis	ALS Online	0	12/11/2001	6/11/2009
LAB-012sp	Glassware Washing for Organic Chemistry (Spanish Version)	ALS Online	0	12/11/2001	6/11/2009
LAB-013	Archives X	ALS Online	1	9/1/2004	7/29/2008

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LAB-014	Wipe Sampling of Laboratory Work Surfaces for Lead		ALS Online	1	8/13/2004	6/11/2009
LAB-015	Balances		ALS Online	2	3/6/2009	3/6/2009
LAB-016	Calibration Verification of Pipettors		ALS Online	2	10/12/2007	6/11/2009
LAB-017	Handling Chemical Carcinogens		ALS Online	1	4/15/2003	6/11/2009
LAB-018	Calibration of Thermometers		ALS Online	0	2/18/2002	6/11/2009
LAB-019	Production and Verification of ASTM Type II Quality water		ALS Online	0	12/3/2001	6/11/2009
LAB-020	NonConformance/Corrective Action Procedures	X	ALS Online	3	9/2/2008	9/2/2008
LAB-021	Document Control	X	ALS Online	2	2/27/2007	7/29/2008
LAB-022	Estimation of Uncertainty of Measurements		ALS Online	1	5/1/2005	6/11/2009
LAB-023	Client Communication		ALS Online	8	6/12/2009	6/12/2009
LAB-024	Calculation of Method Detection Limit		ALS Online	1	1/1/2009	1/1/2009
LAB-025	Voluntary Repirator Program		ALS Online	0	11/5/2002	6/11/2009
LAB-026	Management Review		ALS Online	5	3/9/2009	3/9/2009
LAB-027	Internal Assessments and Audits		ALS Online	6	9/1/2009	9/1/2009
LAB-030	Documentation: Maintaining Instrument Records, Notebooks, and Logbooks		ALS Online	2	7/1/2009	7/1/2009

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SOP	NAME	Location	Revision	Date Revised	Date Reviewed
Lab-031	Documentation of Modified Methods and Validation of Permanently Modified and New Analytical Methods	ALS Online	1	11/19/2007	6/11/2009
LAB-032	Manual Integration on GC,HPLC,IC, LC/MS and GC/MS Data Systems	ALS Online	1	11/16/2007	6/11/2009
LAB-101	Computer Software Testing	ALS Online	1	4/1/2009	4/1/2009
LAB-103	Computer Software Control	ALS Online	1	4/1/2009	4/1/2009
LAB-105	Network Systems and Security	ALS Online	1	5/28/2003	6/11/2009
LAB-106	LIMS Raw Data	ALS Online	1	7/16/2007	6/11/2009
Lab-108	Management of Electronic Data Deliverables (EDD)	ALS Online	0	6/15/2006	6/11/2009
Lab-109	Software Change Control	ALS Online	0	6/15/2006	6/11/2009
Lab-110	New or Refurbished Computer Installation	ALS Online	0	4/11/2008	6/11/2009
LC/MS	Instrument Software Help	LC/MS Lab	0	5/28/2009	5/28/2009
LC/MS-CLO4	The Determination of Perchlorate in Water, Soil and Biota by Liquid Chromatography / Mass Spectrometry	ALS Online	5	2/15/2008	12/16/2008
LC-MS-AgentDe	The Determination of Agent Degradation Products in Water and Soil by Liquid Chromatography/Mass Spectrometry X	ALS Online	0	7/7/2008	7/7/2008

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Metrohm Peak	761 Instrument Manual		HPLC/IC Lab	0	5/28/2009	5/28/2009
Microwave	Microwave Vendor Instrument Manual		Metals Lab	0	2/22/2000	6/11/2009
MSDS #1	Material Safety Data Sheets - Binder #1		ICP Lab - West Wall - South Door Cabinet	0	3/27/2009	3/27/2009
MSDS #2	Materail Safety Data Sheets - Binder #2		HPLC Lab - East Wall Cabinet	0	3/27/2009	3/27/2009
NELAC 2003	NELAC 2003 Quality Systems		ALS Online	0	8/25/2009	8/25/2009
OE-EP-SOM	Organic Sample Preparation for EPA-CLP SOW SOM01.2	X	ALS Online	1	7/1/2008	7/1/2008
OE-SW-1311	Toxicity Characteristics Leaching Procedure		ALS Online	9	7/1/2009	7/1/2009
OE-SW-1312	Synthetic Precipitation Leaching Procedure		ALS Online	2	7/1/2009	7/1/2009
OE-SW-3510	Separatory Funnel Liquid-Liquid Extraction	X	ALS Online	10	5/1/2005	9/4/2008
OE-SW-3520	Continuous Liquid-Liquid Extraction	X	ALS Online	4	1/8/2008	8/1/2008
OE-SW-3540	Soxhlet Extraction	X	ALS Online	4	4/15/2003	8/1/2008
OE-SW-3550	Sonication Extraction	X	ALS Online	11	1/8/2008	9/4/2008
OE-SW-3580A	Waste Dilution	X	ALS Online	2	6/26/2002	8/1/2008
OE-SW-3640	Gel Permeation Chromatography for SW846 Methods		ALS Online	7	11/1/2008	11/1/2008

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SOP	NAME		Location	Revision	Date Revised	Date Reviewed
OL-SW-8330	The Determination of Explosives by EPA Method 8330		ALS Online	15	12/15/2008	12/15/2008
OL-SW-8332	HPCL Analysis of Nitroglycerin and PETN by EPA Method 8332	X	ALS Online	7	4/15/2003	8/7/2008
OP-EP-SOM-AR	ANALYSIS, DATA PROCESSING AND REPORTING OF SAMPLES FOR AROCLORS ACCORDING TO EPA-CLP SOW SOM01.2		ALS Online	2	2/6/2009	2/6/2009
OP-EP-SOM-Pest	Analysis, Data Processing and Reporting of Samples for Pesticides According to EPA-CLP SOM01.2		ALS Online	0	11/21/2007	10/30/2008
OP-SW-7580	Analytical Determination of White Phosphorus (P4) using EPA Method 7580		ALS Online	6	8/10/2009	8/10/2009
OP-SW-8081	Analytical Determination of Organochlorine Pesticides Using Revision 1 of EPA Method 8081A		ALS Online	10	2/1/2009	2/1/2009
OP-SW-8082	Analytical Determination of Polychlorinated Biphenyls (PCBs)		ALS Online	7	3/1/2005	10/31/2008
OP-SW-8150C	Preparation of Diazomethane Solutions	X	ALS Online	3	5/1/2003	6/20/2008
OP-SW-8151A	Analytical Determination of Herbicides Using EPA Method 8151A	X	ALS Online	7	5/23/2007	6/20/2008
OS-DC-001	Basic Instrument Operation for the Analysis of Semivolatile Organic Compounds		ALS Online	2	8/3/1998	6/11/2009

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OS-DC-002	Preventative Maintenance for HP 5971 and 5972 MSD & 5890 Gas Chromatograph		ALS Online	1	8/3/1998	6/11/2009
OS-EP-SOM	ANALYSIS OF SAMPLES FOR SEMIVOLATILE ORGANIC COMPOUNDS ACCORDING TO EPA-CLP STATEMENT OF WORK SOM01.2	X	ALS Online	0	11/16/2007	8/8/2008
OS-SW-8270D	Analysis of Semivolatile Organic Compounds by EPA Method 8270D		ALS Online	0	3/1/2008	6/4/2009
OS-SW-DIOXA	Analysis of 1,4-Dioxane by EPA Method 8270C	X	ALS Online	0	5/21/2004	7/30/2008
OS-SW-PAH/SI	Analysis of Polynuclear Aromatic Hydrocarbons by GC/MS Single Ion Monitoring	X	ALS Online	2	4/15/2003	7/30/2008
OV-DC-002	Preventative Maintenance for HP 5971 & 5972 Mass Selective Detectors & 5890 for GC/MS VOA		ALS Online	1	7/30/1998	6/11/2009
OV-DCL-Methan	Analytical Determination of Methane, Ethane and Ethene in Water	X	ALS Online	0	9/1/2003	1/29/2008
OV-EP-SOM-Lo	LOW/MEDIUM VOLATILE ANALYSIS BY EPA-CLP SOM01.2	X	ALS Online	1	7/1/2008	7/1/2008
OV-EP-SOM-Tra	TRACE VOLATILE ANALYSIS: PROCEDURES FOR ANALYSIS, DATA PROCESSING, AND REPORTING ACCORDING TO EPA-CLP SOW SOM01.2	X	ALS Online	1	7/1/2008	7/1/2008

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OV-SW-5035	Closed System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste by EPA Method 5035		ALS Online	4	7/13/2009	7/13/2009
OV-SW-524.2	Capillary Column Analysis by Volatile Organic Compounds in Water		ALS Online	6	12/15/2008	12/15/2008
OV-SW-8260C	Analysis of Volatile Organic Compounds by EPA Method 8260C		ALS Online	1	12/1/2008	12/1/2008
QA-EP-001	Review of CLP Organic Data	X	ALS Online	7	6/12/2008	6/12/2008
QAPP	Quality Assurance Program Plan		ALS Online	13	9/1/2009	9/1/2009
QC-DC-001	Establishing, Monitoring and Updating Control Limits		ALS Online	8	1/1/2009	1/1/2009
QD-EP-1400	Data Management and Handling - Data Systems and Software	X	ALS Online	6	7/1/2008	7/1/2008
QS-DC-001	Sample Receipt and Logging		ALS Online	14	10/2/2006	12/16/2008
QS-DC-003	Sample Splitting		ALS Online	2	5/12/2000	12/16/2008
QS-DC-005	Sampling Media, Handling, and Preservation of Environmental Samples		ALS Online	4	11/21/2001	12/16/2008
QS-EP-100	EPA Sample Receipt and Logging	X	ALS Online	7	7/1/2008	7/1/2008
RRO-SW-8015B	Determination of Residual Range Organics by EPA 8015B	X	ALS Online	0	1/15/2005	5/1/2007
RSP	Radiation Safety Procedures		ALS Online	8	3/15/2001	10/29/2008

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SC-001	Smart Chem Instrument Instructions and Methods from Manufacturer	Wet Chemistry Lab	0	2/5/2009	2/5/2009
SC-EP-310.2	Determination of Alkalinity in Aqueous Samples by Discrete Analyzer (EPA Method 310.2)	ALS Online	0	1/12/2007	10/30/2008
SC-EP-350.1	Determination of Ammonia in Aqueous Samples and Soild Extracts by Discrete Analyzer	ALS Online	2	1/11/2007	4/16/2009
SC-EP-351.2	Determination of Total Kjeldahl Nitrogen (TKN) in Aqueous Samples and Soil Extracts by Discrete Analyzer	ALS Online	2	12/15/2008	4/16/2009
SC-EP-353.2	Determination of Nitrate + Nitrite as Nitrogen Using the Discrete Analyzer	ALS Online	2	1/11/2007	4/16/2009
SC-EP-365.1	Determination of Orthophosphate in Aqueous Samples and Soil Extracts by Discrete Analyzer	ALS Online	2	2/9/2009	4/16/2009
SC-EP-365.4	Determination of Total Phosphorus in Aqueous Samples and Soil Extracts by Discrete Analyzer	ALS Online	1	11/16/2007	4/16/2009
SC-EP-375.4	Determination of Sulfate in Aqueous Samples and Soil Extracts by Discrete Analyzer	ALS Online	0	2/20/2009	2/20/2009
SC-SW-7196	Determination of Heaxavalent Chromium in Aqueous Samples and Soil Extracts by Discrete Analyzer	ALS Online	3	8/13/2007	10/30/2008
SC-SW-9012	Determination of Total Cyanide in Water and Soil by Discrete Analyzer (9012A and 335.4)	ALS Online	3	1/5/2009	4/16/2009

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SC-SW-9066	Determination of Phenolics in Aqueous Samples by Discrete Analyzer (EPA Methods 9066 and 420.4)		ALS Online	0	1/12/2007	10/30/2008
Training Guide A	Acid Base pH Chemistry		ALS Online	0	10/5/2001	6/11/2009
Training Guide C	Fundamentals of Chromatography Data Systems		ALS Online	0	10/5/2001	6/11/2009
Training Guide G	Gas Chromatography		ALS Online	0	10/5/2001	6/11/2009
Training Guide H	HPLC Troubleshooting		ALS Online	0	10/5/2001	6/11/2009
Training Guide I	ICP/MS		ALS Online	0	10/5/2001	6/11/2009
Training Guide M	Mass Spectrometry		ALS Online	0	10/5/2001	6/11/2009
Training Records	Training and Document Control Database		Network Drive	2	9/18/2006	6/11/2009
WA-DC-002	Acceptance Criteria for Samples Processed under the DataChem Radioactive Materials License		ALS Online	2	5/10/2002	6/11/2009
XX-DC-006	Chain-of-Custody and Laboratory Tracking	X	ALS Online	6	12/1/2002	4/1/2008
XX-DC-011	Preparation and Review of SOP Documents		ALS Online	10	1/1/2009	1/1/2009
XX-DC-018	Evaluation of Quality Control Data		ALS Online	5	1/1/2009	1/1/2009
XX-DC-019	Standards Purity, Preparation, Traceability and Verification		ALS Online	6	4/1/2004	6/11/2009
XX-DC-020	Deliverable and Data Package Preparation and Review		ALS Online	7	1/1/2009	1/1/2009

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XX-DC-023	Peer Review		ALS Online	4	1/1/2009	1/1/2009
XX-DC-025	Sub-Sampling for Soils and Sediments		ALS Online	1	5/23/2007	6/9/2009
XX-EP-200	Sample Storage and Security		ALS Online	6	10/25/2006	6/11/2009
XX-EP-700	Data Control Systems - Calibration	X	ALS Online	4	7/1/2008	7/1/2008
XX-EP-800	Solids/Moisture Determination	X	ALS Online	5	11/16/2007	1/29/2008
XX-EP-900	Document Control and Data Package Preparation for EPA CLP Contracts	X	ALS Online	6	7/1/2008	7/29/2008

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APPENDIX A - GLOSSARY

Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: the process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority: the Territorial, State, or federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation (NELAC)[1.5.2.3]

Accrediting Authority Review Board (AARB): five voting members from Federal and State Accrediting Authorities and one non-voting member from USEPA, appointed by the NELAP Director, in consultation with the NELAC Board of Directors, for the purposes stated in 1.6.3.e. (NELAC) [1.6.3]

Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Assessor Body: the organization that actually executes the accreditation process, i.e., receives and reviews accreditation applications, reviews QA documents, reviews proficiency testing results, performs on-site assessments, etc., whether EPA, the State, or contracted private party. (NELAC)

Analyst: the designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Applicant Laboratory or **Applicant:** the laboratory or organization applying for NELAP accreditation. (NELAC)

Assessment: the evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of NELAC). (NELAC)

Assessment Criteria: the measures established by NELAC and applied in establishing the extent to which an applicant is in conformance with NELAC requirements. (NELAC)

Assessment Team: the group of people authorized to perform the on-site inspection and proficiency testing data evaluation required to establish whether an applicant meets the criteria for NELAP accreditation. (NELAC)

Assessor: one who performs on-site assessments of accrediting authorities and laboratories' capability and capacity for meeting NELAC requirements by examining the records and other physical evidence for each one of the tests for which accreditation has been requested. (NELAC)

Audit: a systematic evaluation to determine the conformance to quantitative *and qualitative* specifications of some operational function or activity. (EPA-QAD)

Batch: environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. Blanks include:

Equipment Blank: a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (NELAC)

Field Blank: blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)

Instrument Blank: a clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Method Blank: a sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Reagent Blank: (method reagent blank): a sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Blind Sample: a sub-sample for analysis with a composition known to the submitter. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibration: to determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter, instrument, or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method: a defined technical procedure for performing a calibration. (NELAC)

Calibration Standard: a substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

Chain of Custody Form: record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC)

Clean Air Act: the enabling legislation in 42 U.S.C. 7401 *et seq.*, Public Law 91-604, 84 Stat. 1676 Pub. L. 95-95, 91 Stat., 685 and Pub. L. 95-190, 91 Stat., 1399, as amended, empowering EPA to promulgate air quality standards, monitor and to enforce them. (NELAC)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA/Superfund): the enabling legislation in 42 U.S.C. 9601-9675 *et seq*., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), 42 U.S.C. 9601*et seq.*, to eliminate the health and environmental threats posed by hazardous waste sites. (NELAC)

Confidential Business Information (CBI): information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. NELAC and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

Second column confirmation
Alternate wavelength
Derivatization
Mass spectral interpretation
Alternative detectors or
Additional cleanup procedures.
(NELAC)

Conformance: an affirmative indication or judgement that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Contributor: a participant in NELAC who is not a Voting Member. Contributors include representatives of laboratories, manufacturers, industry, business, consumers, academia, laboratory associations, laboratory accreditation associations, counties, municipalities, and other political subdivisions, other federal and state officials not engaged in environmental activities, and other persons who are interested in the objectives and activities of NELAC. (NELAC)[Art III, Const]

Corrective Action: the action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: a qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction: the process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency: an unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Delegate: any environmental official of the States or the Federal government not sitting in the House of Representatives, who is eligible to vote in the House of Delegates. (NELAC)

Demonstration of Capability: a procedure to establish the ability of the analyst to generate acceptable accuracy. (NELAC)

Denial: to refuse to accredit in total or in part a laboratory applying for initial accreditation or resubmission of initial application. (NELAC)[4.4.1]

Detection Limit: the lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Document Control: the act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Environmental Laboratory Advisory Board (ELAB): a Federal Advisory Committee, with members appointed by EPA and composed of a balance of non-state, non-federal representatives, from the environmental laboratory community, and chaired by an ELAB member. (NELAC)[1.6.2]

Environmental Monitoring Management Council (EMMC): an EPA Committee consisting of EPA managers and scientists, organized into a Policy Council, a Steering Group, *ad hoc* Panels, and work groups addressing specific objectives, established to address EPA-wide monitoring issues. (NELAC)

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA): the enabling legislation under 7 U.S.C. 135 *et seq.,* as amended, that empowers the EPA to register insecticides, fungicides, and rodenticides. (NELAC)

Federal Water Pollution Control Act (Clean Water Act, CWA): the enabling legislation under 33 U.S.C. 1251 *et seq.*, Public Law 92-50086 Stat. 816, that empowers EPA to set discharge limitations, write discharge permits, monitor, and bring enforcement action for non-compliance. (NELAC)

[effective July 1, 2001[
Field of Accreditation: (previously Field of Testing) NELAC's approach to accrediting laboratories by matrix, technology/method and analyte/analyte group. Laboratories requesting accreditation for a matrix-technology/method-analyte/analyte group combination or for an updated/improved method are required to submit only that portion of the accreditation process not previously addressed (see NELAC, section 1.8 ff). (NELAC)

Field of Proficiency Testing: NELAC's approach to offering proficiency testing by matrix, technology, and analyte/analyte group.

Finding: an assessment conclusion that identifies a condition having a significant effect on an item or activity. An assessment finding is normally a deficiency and is normally accompanied by specific examples of the observed condition. (NELAC)

Governmental Laboratory: as used in these standards, a laboratory owned by a Federal, state, or tribal government; includes government-owned contractor-operated laboratories. (NELAC).

Holding Times (Maximum Allowable Holding Times): the maximum times that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136)

Inspection: an activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ASQC E4-1994)

Interim Accreditation: temporary accreditation status for a laboratory that has met all accreditation criteria except for a pending on-site assessment which has been delayed for reasons beyond the control of the laboratory. (NELAC)

Internal Standard: a known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. (NELAC)

International System of Units (SI): the coherent system of units adopted and recommended by the General Conference on Weights and Measures. (CCGPM) (VIM 1.12)

Laboratory: a body that calibrates and/or tests. (ISO 25)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC)

Laboratory Duplicate: aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Legal Chain of Custody Protocols: procedures employed to record the possession of samples from the time of sampling until analysis and are performed at the special request of the client. These protocols include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples by the laboratory. **In addition, these protocols document all handling of the samples within the laboratory**. (NELAC)

Manager (however named): the individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Matrix: the substrate of a test sample.

Field of Accreditation Matrix: these matrix definitions shall be used when accrediting a laboratory (see Field of Accreditation).

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source.

Non-Potable Water: any aqueous sample excluded from the definition of Drinking Water matrix. Includes surface water, groundwater, effluents, water treatment chemicals, and TCLP or other extracts.

Solid and Chemical Materials: includes soils, sediments, sludges, products and by-products of an industrial process that results in a matrix not previously defined.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Air and Emissions: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device. (NELAC)

Quality System Matrix: These matrix definitions are an expansion of the field of accreditation matrices and shall be used for purposes of batch and quality control requirements (see Appendix D of Chapter 5). These matrix distinctions shall be used:

Aqueous: any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: any aqueous sample that has been designated a potable or potential potable water source.

Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-aqueous Liquid: any organic liquid with <15% settleable solids.

Biological Tissue: any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

Air and Emissions: whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter, or other device. (NELAC)

Matrix Spike (spiked sample or fortified sample): a sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of Target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

May: denotes permitted action, but not required action. (NELAC)

Method: 1. see Test Method. 2. Logical sequence of operations, described generically, used in the performance of measurements. (VIM 2.4)

Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Mobile Laboratory: A portable enclosed structure with necessary and appropriate accommodation and environmental conditions as described in Chapter 5, within which testing is performed by analysts. Examples include but are not limited to trailers, vans, and skid-mounted structures configured to house testing equipment and personnel.

Must: denotes a requirement that must be met. (Random House College Dictionary)

National Accreditation Database: the publicly accessible database listing the accreditation status of all laboratories participating in NELAP. (NELAC)

National Institute of Standards and Technology (NIST): an agency of the US Department of Commerce's Technology Administration that is working with EPA, States, NELAC, and other public and commercial entities to establish a system under which private sector companies and interested States can be accredited by NIST to provide NIST-traceable proficiency testing (PT) to those laboratories testing drinking water and wastewater. (NIST)

National Environmental Laboratory Accreditation Conference (NELAC): a voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP): the overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

National Voluntary Laboratory Accreditation Program (NVLAP): a program administered by NIST that is used by providers of proficiency testing to gain accreditation for all compounds/matrices for which NVLAP accreditation is available, and for which the provider intends to provide NELAP PT samples. (NELAC)

Negative Control: measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

NELAC Standards: the plan of procedures for consistently evaluating and documenting the ability of laboratories performing environmental measurements to meet nationally defined standards established by the National Environmental Laboratory Accreditation Conference. (NELAC)

NELAP Recognition: the determination by the NELAP Director that an accrediting authority meets the requirements of the NELAP and is authorized to grant NELAP accreditation to laboratories. (NELAC)

Non-governmental Laboratory: any laboratory not meeting the definition of the governmental laboratory. (NELAC)

Performance Audit: the routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): a set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting measurement processes which will meet those needs in a cost-effective manner. (NELAC)

Positive Control: measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision: the degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Primary Accrediting Authority: the agency or department designated at the Territory, State or Federal level as the recognized authority with responsibility and accountability for granting NELAC accreditation for a specified field of testing. (NELAC)[1.5.2.3]

Procedure: Specified way to carry out an activity or a process. Procedures can be documented or not. (ISO 9000: 2000 and Note1)

Proficiency Testing: a means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC)[2.1]

Proficiency Testing Oversight Body/Proficiency Testing Provider Accreditor (PTOB/PTPA): an organization with technical expertise, administrative capacity and financial resources sufficient to implement and operate a national program of PT provider evaluation and oversight that meets the responsibilities and requirements established by NELAC standards. (NELAC)

Proficiency Testing Program: the aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Testing Study Provider: any person, private party, or government entity that meets stringent criteria to produce and distribute NELAC PT samples, evaluate study results against published performance criteria and report the results to the laboratories, primary accrediting authorities, PTOB/PTPA, and NELAP. (NELAC)

Proficiency Test Sample (PT): a sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Protocol: a detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA-QAD)

Quality Assurance: an integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance [Project] Plan (QAPP): a formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual: a document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: a structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ASQC E-41994)

Quantitation Limits: levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported at a specified degree of confidence . (NELAC)

Range: the difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data: any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

[effective July 1, 2001[
Recognition: previously known as reciprocity. The mutual agreement of two or more parties (i.e., States) to accept each other's findings regarding the ability of environmental testing laboratories in meeting NELAC standards. (NELAC)[1.5.3]

Reference Material: a material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30-2.1)

Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.08)

Reference Toxicant: the toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results (see Chapter 5, Appendix D, section 2.1f). (NELAC)

Replicate Analyses: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Requirement: denotes a mandatory specification; often designated by the term "shall". (NELAC)

Resource Conservation and Recovery Act (RCRA): the enabling legislation under 42 USC 321 *et seq.* (1976), that gives EPA the authority to control hazardous waste from the "cradle-to-grave", including its generation, transportation, treatment, storage, and disposal. (NELAC)

Revocation: the total or partial withdrawal of a laboratory's accreditation by the accrediting authority. (NELAC)[4.4.3]

Safe Drinking Water Act (SDWA): the enabling legislation, 42 USC 300f *et seq.* (1974), (Public Law 93-523), that requires the EPA to protect the quality of drinking water in the U.S. by setting maximum allowable contaminant levels, monitoring, and enforcing violations. (NELAC)

Sample Tracking: procedures employed to record the possession of the samples from the time of sampling until analysis, reporting, and archiving. These procedures include the use of a Chain of Custody Form that documents the collection, transport, and receipt of compliance samples to the laboratory. In addition, access to the laboratory is limited and controlled to protect the integrity of the samples. (NELAC)

Secondary Accrediting Authority: the Territorial, State or federal agency that grants NELAC accreditation to laboratories, based upon their accreditation by a NELAP-recognized Primary Accrediting Authority. See also **Recognition** and **Primary Accrediting Authority**. (NELAC)[1.5.2.3]

Selectivity: (Analytical chemistry) the capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Shall: denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (ANSI)

Should: denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (ANSI)

Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. (NELAC)

Standard: the document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedures (SOPs): a written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Statistical Minimum Significant Difference (SMSD): the minimum difference between the control and a test concentration that is statistically significant; a measure of test sensitivity or power. The power of a test depends in part on the number of replicates per concentration, the significance level selected, e.g., 0.05, and the type of statistical analysis. If the variability remains constant, the sensitivity of the test increases as the number of replicates is increased. (NELAC)

Supervisor (however named): the individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (QAMS)

Suspension: temporary removal of a laboratory's accreditation for a defined period of time, which shall not exceed six months, to allow the laboratory time to correct deficiencies or area of non-compliance with the NELAC standards. (NELAC)[4.4.2]

Technical Director: individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Technology: a specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Test: a technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method: an adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP or published by a recognized authority. (NELAC)

Testing Laboratory: a laboratory that performs tests. (ISO/IEC Guide 2-12.4)

Test Sensitivity/Power: the minimum significant difference (MSD) between the control and test concentration that is statistically significant. It is dependent on the number of replicates per concentration, the selected significance level, and the type of statistical analysis (see Chapter 5, Appendix D, section 2.4.a). (NELAC)

Tolerance Chart: A chart in which the plotted quality control data is assessed via a tolerance level (e.g. +/- 10% of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. +/- 3 sigma) (applies to radiobioassay laboratories). (ANSI)

Toxic Substances Control Act (TSCA): the enabling legislation in 15 USC 2601 *et seq.*, (1976), that provides for testing, regulating, and screening all chemicals produced or imported into the United States for possible toxic effects prior to commercial manufacture. (NELAC)

Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM-6.12)

United States Environmental Protection Agency (EPA): the federal governmental agency with responsibility for protecting public health and safeguarding and improving the natural environment (i.e., the air, water, and land) upon which human life depends. (US-EPA)

Validation: the confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

Verification: confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Voting Member: officials in the employ of the Government of the United States, and the States, the Territories, the Possessions of the United States, or the District of Columbia and who are actively engaged in environmental regulatory programs or accreditation of environmental laboratories. (NELAC)

Work Cell: a well-defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

Sources:

40CFR Part 136

American Society for Quality Control (ASQC), Definitions of Environmental Quality Assurance Terms, 1996

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ANSI/ASQC E4, 1994

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International Vocabulary of Basic and General Terms in Metrology (VIM): 1984. Issued by BIPM, IEC, ISO and OIML

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National Environmental Laboratory Accreditation Conference (NELAC), July 1998 Standards

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US EPA Quality Assurance Management Section (QAMS), Glossary of Terms of Quality Assurance Terms, 8/31/92 and 12/6/95

US EPA Quality Assurance Division (QAD)

Webster's New World Dictionary of the American Language

APPENDIX B - GLOSSARY

The following definitions are used in the text of Quality Systems. In writing this document, the following hierarchy of definition references were used: ISO 8402, ANSI/ASQC E-4, EPA's Quality Assurance Division Glossary of Terms, and finally definitions developed by NELAC. The source of each definition, unless otherwise identified, is the Quality Systems Committee.

Quality Systems Definitions: The Quality Systems Committee is the NELAC-appointed group that created and continues to modify NELAP Chapter 5 (Quality Systems). Terms not included in the NELAC Glossary, but defined by DoD, are included in gray text boxes throughout this Appendix.

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory. In the context of the National Environmental Laboratory Accreditation Program (NELAP), this process is a voluntary one. (NELAC)

Accrediting Authority: The Territorial, State, or Federal agency having responsibility and accountability for environmental laboratory accreditation and which grants accreditation. (NELAC) [1.5.2.3]

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Aliquot: A discrete, measured, representative portion of a sample taken for analysis. (Team, EPA QAD Glossary)

Analysis Duplicate: The second measurement of the target analyte(s) performed on a single sample or sample preparation.

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality. (NELAC)

Analyte: The specific chemicals or components for which a sample is analyzed; may be a group of chemicals that belong to the same chemical family, and which are analyzed together. (EPA Risk Assessment Guide for Superfund; OSHA Glossary)

Analytical Detection Limit: The smallest amount of an analyte that can be distinguished in a sample by a given measurement procedure throughout a given (e.g., 0.95) confidence interval. (Applicable only to radiochemistry)

Analytical Reagent (AR) Grade: Designation for the high purity of certain chemical reagents and solvents given by the American Chemical Society. (Quality Systems)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of NELAC). (NELAC)

Audit: A systematic evaluation to determine the conformance to quantitative and qualitative specifications of some operational function or activity. (EPA-QAD)

Batch: Environmental samples, which are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one to 20 environmental samples of the same NELAC-defined matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be 24 hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. (NELAC Quality Systems Committee)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Blind Sample: A sub-sample for analysis with a composition known to the submitter. The analyst/ laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process. (NELAC)

Calibration: To determine, by measurement or comparison with a standard, the correct value of each scale reading on a meter or other device. The levels of the applied calibration standard should bracket the range of planned or expected sample measurements. (NELAC)

Calibration Curve: The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (NELAC)

Calibration Method: A defined technical procedure for performing a calibration. (NELAC)

Calibration Standard: A substance or reference material used to calibrate an instrument. (QAMS)

Certified Reference Material (CRM): A reference material one or more of whose property values are certified by a technically valid procedure, accompanied by or traceable to a certificate or other documentation which is issued by a certifying body. (ISO Guide 30 - 2.2)

Chain of Custody Form: A record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; collector; time of collection; preservation; and requested analyses. (NELAC)

Chemical: Any element, compound, or mixture of elements and/or compounds. Frequently, chemical substances are classified by the CAS rules of nomenclature for the purposes of identification for a hazard evaluation. (OSHA Glossary)

Client: The party that has agreed to pay the bill for services rendered by the laboratory, and with whom the laboratory has a contractual relationship for that project. For a laboratory, this is typically the prime contractor who originally hires the laboratory for the project, and who signs the contract as the receiver of services and resulting data. In cases where the laboratory has a direct contractual relationship with DoD, the client shall be the Government's authorized contracting officer. The contracting officer, as the client, shall consult with the Government's authorized technical representative when dealing with laboratory technical issues. It is understood that typically other "Clients" are present at other levels of the project, but they may be removed from the day-to-day decision-making (for example, installation representatives, service center representatives, various other Government officials). Specific circumstances may require the direct notification of these other clients, in addition to the prime contractor or DoD representative; these circumstances shall be included as part of specific project requirements. (Team)

Compound: A unique combination of chemical elements, existing in combination to form a single chemical entity. (Team)

Component: A single chemical entity, such as an element or compound. Multiple components may compose one analyte. (OSHA Glossary, Team)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions compromised samples are not analyzed. If emergency situations require analysis, the results must be appropriately qualified. (NELAC)

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to:

- Second column confirmation;
- Alternate wavelength;
- Derivatization;
- Mass spectral interpretation;
- Alternative detectors; or
- Additional cleanup procedures. (NELAC)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ ASQC E4-1994)

Consensus Standards: A protocol established by a recognized authority (for example, American Society for Testing and Materials [ASTM], American National Standards Institute [ANSI], or the Institute for Electrical and Electronic Engineers [IEEE]).

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data are of acceptable quality (i.e., that they meet specified acceptance criteria). (NELAC)

Data Reduction: The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useable form. (EPA-QAD)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Definitive Data: Data that are generated using rigorous analytical methods, such as approved EPA reference methods. Data are analyte-specific, with confirmation of analyte identity and concentration. Methods produce tangible raw data in the form of paper printouts or electronic files. Data shall satisfy QA/QC requirements. For data to be definitive, either analytical or total measurement error shall be determined and documented. (Data Quality Objectives Process for Superfund)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate acceptable accuracy. (NELAC)

Desorption Efficiency: The mass of target analyte recovered from sampling media, usually a sorbent tube, divided by the mass of target analyte spiked on to the sampling media expressed as a percentage. Sample target analyte masses are usually adjusted for the desorption efficiency. (NELAC)

Detection Limit: The lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value. See Method Detection Limit. (NELAC)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA- QAD)

Environmental Program: An organized effort that assesses environmental concerns and leads to the collection of data, either in the field or through laboratory analysis. (Variation on EPA QAD Glossary for Terms: Environmentally related measurement, environmental sample)

Holding Times (Maximum Allowable Holding Times): The maximum times that samples may be held prior to analysis and still be considered valid or not compromised. (40 CFR Part 136)

Holding Times (DoD Clarification): The time elapsed from the time of sampling to the time of extraction or analysis, as appropriate.

Inspection: An activity such as measuring, examining, testing, or gauging one or more characteristics of an entity and comparing the results with specified requirements in order to establish whether conformance is achieved for each characteristic. (ANSI/ ASQC E4-1994)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. (NELAC)

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Key Staff: At a minimum, the following managerial and supervisory staff (however named) – executive staff (for example, Chief Executive Officer, Chief Operating Officer, laboratory director, technical director); technical directors/supervisors (for example, section supervisors for organics and inorganics); quality assurance systems directors/supervisors (for example, QA officer, quality auditors); and support systems directors/supervisors (for example, information systems supervisor, purchasing director, project manager).

Laboratory: A body that calibrates and/or tests. (ISO 25)

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system. (NELAC).

Laboratory Duplicate: Aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently. (NELAC)

Limit of Detection (LOD): The lowest concentration level that can be determined by a single analysis and with a defined level of confidence to be statistically different from a blank. See also Method Detection

Limit, Detection Limit, and Quantitation Limit (Analytical Chemistry, 55, p. 2217, December 1983, modified)

Manager (however named): The individual designated as being responsible for the overall operation, all personnel, and the physical plant of the environmental laboratory. A supervisor may report to the manager. In some cases, the supervisor and the manager may be the same individual. (NELAC)

Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

- Aqueous: Any aqueous sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.
- Drinking Water: Any aqueous sample that has been designated a potable or potential potable water source.
- Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.
- Non-aqueous Liquid: Any organic liquid with <15% settleable solids.
- Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
- Solids: Includes soils, sediments, sludges and other matrices with > 15% settleable solids.
- Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.
- Air: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbent tube, impinger solution, filter or other device. (NELAC)

Matrix Spike (spiked sample or fortified sample): A sample prepared by adding a known mass of target analyte to a specified amount of matrix sample for which an independent estimate of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency. (QAMS)

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision of the recovery for each analyte. (QAMS)

May: Denotes permitted action, but not required action. (NELAC)

Media: Material that supports the growth of a microbiological culture.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses. (NELAC)

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136 Appendix B)

Must: Denotes a requirement that must be met. (Random House College Dictionary)

National Accreditation Database: The publicly accessible database listing the accreditation status of all laboratories participating in NELAP. (NELAC)

National Environmental Laboratory Accreditation Conference (NELAC): A voluntary organization of State and Federal environmental officials and interest groups purposed primarily to establish mutually acceptable standards for accrediting environmental laboratories. A subset of NELAP. (NELAC)

National Environmental Laboratory Accreditation Program (NELAP): The overall National Environmental Laboratory Accreditation Program of which NELAC is a part. (NELAC)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results. (NELAC)

Nonconformance: An indication or judgment that a product or service has not met the requirements of the relevant specifications, contract or regulation; also the state of failing to meet the requirements.

Objective Evidence: Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measures, or tests that can be verified. (ASQC)

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory. (NELAC)

Performance Based Measurement System (PBMS): A set of processes wherein the data quality needs, mandates or limitations of a program or project are specified and serve as criteria for selecting appropriate test methods to meet those needs in a cost-effective manner. (NELAC)

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects. (NELAC)

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (NELAC)

Preservation: Refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample. (NELAC)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (NELAC) [2.1]

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (NELAC)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the analyst and is provided to test whether the analyst/laboratory can produce analytical results within specified acceptance criteria. (QAMS)

Protocol: A detailed written procedure for field and/or laboratory operation (e.g., sampling, analysis) which must be strictly followed. (EPA- QAD)

Pure Reagent Water: Shall be water (defined by national or international standard) in which no target analytes or interferences are detected as required by the analytical method. (NELAC)

Quality Assurance: An integrated system of activities involving planning, quality control, quality assessment, reporting and quality improvement to ensure that a product or service meets defined standards of quality with a stated level of confidence. (QAMS)

Quality Assurance (Project) Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EPA-QAD)

Quality Control: The overall system of technical activities whose purpose is to measure and control the quality of a product or service so that it meets the needs of users. (QAMS)

Quality Control Sample: An uncontaminated sample matrix with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system. (EPA-QAD)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (NELAC)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC. (ANSI/ ASQC E-41994)

Quantitation Limits: Levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported at a specific degree of confidence. (NELAC)

Quantitation Limits (DoD Clarification): The value at which an instrument can accurately measure an analyte at a specific concentration (i.e., a specific numeric concentration can be quantified). These points are established by the upper and lower limits of the calibration range.

Range: The difference between the minimum and the maximum of a set of values. (EPA-QAD)

Raw Data: Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study. Raw data may include photography, microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted. (EPA-QAD)

Reagent Blank (method reagent blank): A sample consisting of reagent(s), without the target analyte or sample matrix, introduced into the analytical procedure at the appropriate point and carried through all subsequent steps to determine the contribution of the reagents and of the involved analytical steps. (QAMS)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions. (EPA-QAD)

Reference Material: A material or substance one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (ISO Guide 30- 2.1)

Reference Method: A method of known and documented accuracy and precision issued by an organization recognized as competent to do so. (NELAC)

Reference Standard: A standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived. (VIM-6.08)

Reference Toxicant: The toxicant used in performing toxicity tests to indicate the sensitivity of a test organism and to demonstrate the laboratory's ability to perform the test correctly and obtain consistent results (see Chapter 5, Appendix D, Section 2.1.f). (NELAC)

Replicate Analyses: The measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval. (NELAC)

Reporting Limit: A data value specified by the client based on sensitivity requirements from project-specific action levels. If initially set by the client below the laboratory's lower quantitation limit, method modification is required or the client will be required to accept the laboratory's lower quantitation limit as the lowest technically valid value that can be provided by the laboratory. For methods that require only one standard and a blank, a low-level check standard shall be required to establish the lower quantitation limit. The reporting limit shall be no lower than this value. Note: There may be numbers reported to the client that are below the reporting limit. These numbers must be flagged appropriately. When the analysis demonstrates a non-detect at the MDL, the data shall be flagged with a "U." The value reported to the client is the MDL, adjusted by any dilution factor used in the analysis. When an analyte is detected between the lower quantitation limit and the MDL, the data shall be flagged with a "J." The value reported is an estimation.

Requirement: Denotes a mandatory specification; often designated by the term "shall". (NELAC)

Sample: Portion of material collected for chemical analysis, identified by a single, unique alphanumeric code. A sample may consist of portions in multiple containers, if a single sample is submitted for multiple or repetitive analysis.

Sampling Media: Material used to collect and concentrate the target analytes(s) during air sampling such as solid sorbents, filters, or impinger solutions.

Selectivity: (Analytical chemistry) The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. (EPA-QAD)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (NELAC)

Shall: Denotes a requirement that is mandatory whenever the criterion for conformance with the specification requires that there be no deviation. This does not prohibit the use of alternative approaches or methods for implementing the specification so long as the requirement is fulfilled. (ANSI)

Should: Denotes a guideline or recommendation whenever noncompliance with the specification is permissible. (ANSI)

Spike: A known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes. (NELAC)

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of NELAC and meets the approval requirements of NELAC procedures and policies. (ASQC)

Standard Operating Procedure (SOP): A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed and which is accepted as the method for performing certain routine or repetitive tasks. (QAMS)

Standardized Reference Material (SRM): A certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method. (EPA-QAD)

Supervisor (however named): The individual(s) designated as being responsible for a particular area or category of scientific analysis. This responsibility includes direct day-to-day supervision of technical employees, supply and instrument adequacy and upkeep, quality assurance/quality control duties and ascertaining that technical employees have the required balance of education, training and experience to perform the required analyses. (NELAC)

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Target Analytes: Identified on a list of project-specific analytes for which laboratory analysis is required or on a list of analytes found in Appendix DoD-C, if no project-specific analytes are provided.

Technical Director: Individual(s) who has overall responsibility for the technical operation of the environmental testing laboratory. (NELAC)

Test: A technical operation that consists of the determination of one or more characteristics or performance of a given product, material, equipment, organism, physical phenomenon, process or service according to a specified procedure. The result of a test is normally recorded in a document sometimes called a test report or a test certificate. (ISO/IEC Guide 2-12.1, amended)

Test Method: An adoption of a scientific technique for a specific measurement problem, as documented in a laboratory SOP. (NELAC)

Testing Laboratory: Laboratory that performs tests. (ISO/ IEC Guide 2 - 12.4)

Test Sensitivity/Power: The minimum significant difference (MSD) between the control and test concentration that is statistically significant. It is dependent on the number of replicates per concentration, the selected significance level, and the type of statistical analysis (see Chapter 5, Appendix D, Section 2.4.a). (NELAC)

Tolerance Chart: A chart in which the plotted quality control data is assessed via a tolerance level (e.g. +/- 10% of a mean) based on the precision level judged acceptable to meet overall quality/data use requirements instead of a statistical acceptance criteria (e.g. +/- 3 sigma) (applies to radiobioassay laboratories). (ANSI)

Traceability: The property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons. (VIM - 6.12)

Tune – An injected standard required by the method as a check on instrument performance for mass spectrometry.

Validation: The process of substantiating specified performance criteria. (EPA- QAD)

Verification: Confirmation by examination and provision of evidence that specified requirements have been met. (NELAC)

NOTE: In connection with the management of measuring equipment, verification provides a means for checking that the deviations between values indicated by a measuring instrument and corresponding known values of a measured quantity are consistently smaller than the maximum allowable error defined in a standard, regulation or specification peculiar to the management of the measuring equipment.

The result of verification leads to a decision either to restore in service, to perform adjustment, to repair, to downgrade, or to declare obsolete. In all cases, it is required that a written trace of the verification performed shall be kept on the measuring instrument's individual record.

Work Cell: A well defined group of analysts that together perform the method analysis. The members of the group and their specific functions within the work cell must be fully documented. (NELAC)

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A

A&I: Alternative and Innovative (Wastewater Treatment System)

AA: Accountable Area; Adverse Action; Advices of Allowance; Assistant Administrator; Associate Administrator; Atomic Absorption

AAEE: American Academy of Environmental Engineers

AANWR: Alaskan Arctic National Wildlife Refuge

AAP: Asbestos Action Program

AAPCO: American Association of Pesticide Control Officials

AARC: Alliance for Acid Rain Control

ABEL: EPA's computer model for analyzing a violator's ability to pay a civil penalty.

ABES: Alliance for Balanced Environmental Solutions

AC: Actual Commitment. Advisory Circular

A&C: Abatement and Control

ACA: American Conservation Association

ACBM: Asbestos-Containing Building Material

ACE: Alliance for Clean Energy

ACE: Any Credible Evidence

ACEEE: American Council for an Energy Efficient Economy

ACFM: Actual Cubic Feet Per Minute

ACL: Alternate Concentration Limit. Analytical Chemistry Laboratory

ACM: Asbestos-Containing Material

ACP: Agriculture Control Program (Water Quality Management); ACP: Air Carcinogen Policy

ACQUIRE: Aquatic Information Retrieval

ACQR: Air Quality Control Region

ACS: American Chemical Society

ACT: Action

ACTS: Asbestos Contractor Tracking System

ACWA: American Clean Water Association

ACWM: Asbestos-Containing Waste Material

ADABA: Acceptable Data Base

ADB: Applications Data Base

ADI: Acceptable Daily Intake

ADP: AHERA Designated Person; Automated Data Processing

ADQ: Audits of Data Quality

ADR: Alternate Dispute Resolution

ADSS: Air Data Screening System

ADT: Average Daily Traffic

AEA: Atomic Energy Act

AEC: Associate Enforcement Counsels

AEE: Alliance for Environmental Education

AEERL: Air and Energy Engineering Research Laboratory

AEM: Acoustic Emission Monitoring

AERE: Association of Environmental and Resource Economists

AES: Auger Electron Spectrometry

AFA: American Forestry Association

AFCA: Area Fuel Consumption Allocation

AFCEE: Air Force Center for Environmental Excellence

AFS: AIRS Facility Subsystem

AFUG: AIRS Facility Users Group

AH: Allowance Holders

AHERA: Asbestos Hazard Emergency Response Act

AHU: Air Handling Unit

AI: Active Ingredient

AIC: Active to Inert Conversion

AICUZ: Air Installation Compatible Use Zones

AID: Agency for International Development

AIHC: American Industrial Health Council

AIP: Auto Ignition Point

AIRMON: Atmospheric Integrated Research Monitoring Network

AIRS: Aerometric Information Retrieval System

AL: Acceptable Level

ALA: Delta-Aminolevulinic Acid

ALA-O: Delta-Aminolevulinic Acid Dehydrates

ALAPO: Association of Local Air Pollution Control Officers

ALARA: As Low As Reasonably Achievable

ALC: Application Limiting Constituent

ALJ: Administrative Law Judge

ALMS: Atomic Line Molecular Spectroscopy

ALR: Action Leakage Rate

AMBIENS: Atmospheric Mass Balance of Industrially Emitted and Natural Sulfur

AMOS: Air Management Oversight System

AMPS: Automatic Mapping and Planning System

AMSA: Association of Metropolitan Sewer Agencies

ANC: Acid Neutralizing Capacity

ANPR: Advance Notice of Proposed Rulemaking

ANRHRD: Air, Noise, & Radiation Health Research Division/ORD

ANSS: American Nature Study Society

AOAC: Association of Official Analytical Chemists

AOC: Abnormal Operating Conditions

AOD: Argon-Oxygen Decarbonization

AOML: Atlantic Oceanographic and Meteorological Laboratory

AP: Accounting Point

APA: Administrative Procedures Act

APCA: Air Pollution Control Association

APCD: Air Pollution Control District

APDS: Automated Procurement Documentation System

APHA: American Public Health Association

APRAC: Urban Diffusion Model for Carbon Monoxide from Motor Vehicle Traffic

APTI: Air Pollution Training Institute

APWA: American Public Works Association

AQ-7: Non-reactive Pollutant Modelling

AQCCT: Air-Quality Criteria and Control Techniques

AQCP: Air Quality Control Program

AQCR: Air-Quality Control Region

AQD: Air-Quality Digest

AQDHS: Air-Quality Data Handling System

AQDM: Air-Quality Display Model

AQMA: Air-Quality Maintenance Area

AQMD: Air Quality Management District

AQMP: Air-Quality Maintenance Plan; Air-Quality Management Plan

AQSM: Air-Quality Simulation Model

AQTAD: Air-Quality Technical Assistance Demonstration

AR: Administrative Record

A&R: Air and Radiation

ARA: Assistant Regional Administrator; Associate Regional Administrator

ARAC: Acid Rain Advisory Committee

ARAR: Applicable or Relevant and Appropriate Standards, Limitations, Criteria, and Requirements

ARB: Air Resources Board

ARC: Agency Ranking Committee

ARCC: American Rivers Conservation Council

ARCS: Alternative Remedial Contract Strategy

ARG: American Resources Group

ARIP: Accidental Release Information Program

ARL: Air Resources Laboratory

ARM: Air Resources Management

ARNEWS: Acid Rain National Early Warning Systems

ARO: Alternate Regulatory Option

ARRP: Acid Rain Research Program

ARRPA: Air Resources Regional Pollution Assessment Model

ARS: Agricultural Research Service

ARZ: Auto Restricted Zone

AS: Area Source

ASC: Area Source Category

ASDWA: Association of State Drinking Water Administrators

ASHAA: Asbestos in Schools Hazard Abatement Act

ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASIWCPA: Association of State and Interstate Water Pollution Control Administrators

ASMDHS: Airshed Model Data Handling System

ASRL: Atmospheric Sciences Research Laboratory

AST: Advanced Secondary (Wastewater) Treatment

ASTHO: Association of State and Territorial Health Officers

ASTM: American Society for Testing and Materials

ASTSWMO: Association of State and Territorial Solid Waste Management Officials

AT: Advanced Treatment. Alpha Track Detection

ATERIS: Air Toxics Exposure and Risk Information System

ATS: Action Tracking System; Allowance Tracking System

ATSDR: Agency for Toxic Substances and Disease Registry

ATTF: Air Toxics Task Force

AUSM: Advanced Utility Simulation Model

A/WPR: Air/Water Pollution Report

AWRA: American Water Resources Association

AWT: Advanced Wastewater Treatment

AWWA: American Water Works Association

AWWARF: American Water Works Association Research Foundation.

B

BAA: Board of Assistance Appeals

BAC: Bioremediation Action Committee; Biotechnology Advisory Committee

BACM: Best Available Control Measures

BACT: Best Available Control Technology

BADT: Best Available Demonstrated Technology

BAF: Bioaccumulation Factor

BaP: Benzo(a)Pyrene

BAP: Benefits Analysis Program

BART: Best Available Retrofit Technology

BASIS: Battelle's Automated Search Information System

BAT: Best Available Technology

BATEA: Best Available Treatment Economically Achievable

BCT: Best Control Technology

BCPCT: Best Conventional Pollutant Control Technology

BDAT: Best Demonstrated Achievable Technology

BDCT: Best Demonstrated Control Technology

BDT: Best Demonstrated Technology

BEJ: Best Engineering Judgement. Best Expert Judgment

BF: Bonafide Notice of Intent to Manufacture or Import (IMD/OTS)

BID: Background Information Document. Buoyancy Induced Dispersion

BIOPLUME: Model to Predict the Maximum Extent of Existing Plumes

BMP: Best Management Practice(s)

BMR: Baseline Monitoring Report

BO: Budget Obligations

BOA: Basic Ordering Agreement (Contracts)

BOD: Biochemical Oxygen Demand. Biological Oxygen Demand

BOF: Basic Oxygen Furnace

BOP: Basic Oxygen Process

BOPF: Basic Oxygen Process Furnace

BOYSNC: Beginning of Year Significant Non-Compliers

BP: Boiling Point

BPJ: Best Professional Judgment

BPT: Best Practicable Technology. Pest Practicable Treatment

BPWTT: Best Practical Wastewater Treatment Technology

BRI: Building-Related Illness

BRS: Bibliographic Retrieval Service

BSI: British Standards Institute

BSO: Benzene Soluble Organics

BTZ: Below the Treatment Zone

BUN: Blood Urea Nitrogen

C

CA: Citizen Act. Competition Advocate. Cooperative Agreements. Corrective Action

CAA: Clean Air Act; Compliance Assurance Agreement

CAAA: Clean Air Act Amendments

CAER: Community Awareness and Emergency Response

CAFE: Corporate Average Fuel Economy

CAFO: Concentrated Animal Feedlot; Consent Agreement/Final Order

CAG: Carcinogenic Assessment Group

CAIR: Comprehensive Assessment of Information Rule

CALINE: California Line Source Model

CAM: Compliance Assurance Monitoring rule; Compliance Assurance Monitoring

CAMP: Continuous Air Monitoring Program

CAN: Common Account Number

CAO: Corrective Action Order

CAP: Corrective Action Plan. Cost Allocation Procedure. Criteria Air Pollutant

CAPMoN: Canadian Air and Precipitation Monitoring Network

CAR: Corrective Action Report

CAS: Center for Automotive Safety; Chemical Abstract Service

CASAC: Clean Air Scientific Advisory Committee

CASLP: Conference on Alternative State and Local Practices

CASTNet: Clean Air Status and Trends Network

CATS: Corrective Action Tracking System

CAU: Carbon Adsorption Unit; Command Arithmetic Unit

CB: Continuous Bubbler

CBA: Chesapeake Bay Agreement. Cost Benefit Analysis

CBD: Central Business District

CBEP: Community Based Environmental Project

CBI: Compliance Biomonitoring Inspection; Confidential Business Information

CBOD: Carbonaceous Biochemical Oxygen Demand

CBP: Chesapeake Bay Program; County Business Patterns

CCA: Competition in Contracting Act

CCAA: Canadian Clean Air Act

CCAP: Center for Clean Air Policy; Climate Change Action Plan

CCEA: Conventional Combustion Environmental Assessment

CCHW: Citizens Clearinghouse for Hazardous Wastes

CCID: Confidential Chemicals Identification System

CCMS/NATO: Committee on Challenges of a Modern Society/North Atlantic Treaty Organization

CCP: Composite Correction Plan

CC/RTS: Chemical Collection/ Request Tracking System

CCTP: Clean Coal Technology Program

CD: Climatological Data

CDB: Consolidated Data Base

CDBA: Central Data Base Administrator

CDBG: Community Development Block Grant

CDD: Chlorinated dibenzo-p-dioxin

CDF: Chlorinated dibenzofuran

CDHS: Comprehensive Data Handling System

CDI: Case Development Inspection

CDM: Climatological Dispersion Model; Comprehensive Data Management

CDMQC: Climatological Dispersion Model with Calibration and Source Contribution

CDNS: Climatological Data National Summary

CDP: Census Designated Places

CDS: Compliance Data System

CE: Categorical Exclusion. Conditionally Exempt Generator

CEA: Cooperative Enforcement Agreement; Cost and Economic Assessment

CEAT: Contractor Evidence Audit Team

CEARC: Canadian Environmental Assessment Research Council

CEB: Chemical Element Balance

CEC: Commission for Environmental Cooperation

CECATS: CSB Existing Chemicals Assessment Tracking System

CEE: Center for Environmental Education

CEEM: Center for Energy and Environmental Management

CEI: Compliance Evaluation Inspection

CELRF: Canadian Environmental Law Research Foundation

CEM: Continuous Emission Monitoring

CEMS: Continuous Emission Monitoring System

CEPA: Canadian Environmental Protection Act

CEPP: Chemical Emergency Preparedness Plan

CEQ: Council on Environmental Quality

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act (1980)

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System

CERT: Certificate of Eligibility

CESQG: Conditionally Exempt Small Quantity Generator

CEST: Community Environmental Service Teams

CF: Conservation Foundation

CFC: Chlorofluorocarbons

CFM: Chlorofluoromethanes

CFR: Code of Federal Regulations

CHABA: Committee on Hearing and Bio-Acoustics

CHAMP: Community Health Air Monitoring Program

CHEMNET: Chemical Industry Emergency Mutual Aid Network

CHESS: Community Health and Environmental Surveillance System

CHIP: Chemical Hazard Information Profiles

CI: Compression Ignition. Confidence Interval

CIAQ: Council on Indoor Air Quality

CIBL: Convective Internal Boundary Layer

CICA: Competition in Contracting Act

CICIS: Chemicals in Commerce Information System

CIDRS: Cascade Impactor Data Reduction System

CIMI: Committee on Integrity and Management Improvement

CIS: Chemical Information System. Contracts Information System

CKD: Cement Kiln Dust

CKRC: Cement Kiln Recycling Coalition

CLC: Capacity Limiting Constituents

CLEANS: Clinical Laboratory for Evaluation and Assessment of Toxic Substances

CLEVER: Clinical Laboratory for Evaluation and Validation of Epidemiologic Research

CLF: Conservation Law Foundation

CLI: Consumer Labelling Initiative

CLIPS: Chemical List Index and Processing System

CLP: Contract Laboratory Program

CM: Corrective Measure

CMA: Chemical Manufacturers Association

CMB: Chemical Mass Balance

CME: Comprehensive Monitoring Evaluation

CMEL: Comprehensive Monitoring Evaluation Log

CMEP: Critical Mass Energy Project

CNG: Compressedd Natural Gas

COCO: Contractor-Owned/ Contractor-Operated

COD: Chemical Oxygen Demand

COH: Coefficient Of Haze

CPDA: Chemical Producers and Distributor Association

CPF: Carcinogenic Potency Factor

CPO: Certified Project Officer

CQA: Construction Quality Assurance

CR: Continuous Radon Monitoring

CROP: Consolidated Rules of Practice

CRP: Child-Resistant Packaging; Conservation Reserve Program

CRR: Center for Renewable Resources

CRSTER: Single Source Dispersion Model

CSCT: Committee for Site Characterization

CSGWPP: Comprehensive State Ground Water Protection Program

CSI: Common Sense Initiative; Compliance Sampling Inspection

CSIN: Chemical Substances Information Network

CSMA: Chemical Specialties Manufacturers Association

CSO: Combined Sewer Overflow

CSPA: Council of State Planning Agencies

CSRL: Center for the Study of Responsive Law

CTARC: Chemical Testing and Assessment Research Commission

CTG: Control Techniques Guidelines

CTSA: Cleaner TechnologiesSubstitutess Assessment

CV: Chemical Vocabulary

CVS: Constant Volume Sampler

CW: Continuous working-level monitoring

CWA: Clean Water Act (aka FWPCA)

CWAP: Clean Water Action Project

CWTC: Chemical Waste Transportation Council

CZMA: Coastal Zone Management Act

CZARA: Coastal Zone Management Act Reauthorization Amendments

D

DAPSS: Document and Personnel Security System (IMD)

DBP: Disinfection By-Product

DCI: Data Call-In

DCO: Delayed Compliance Order

DCO: Document Control Officer

DDT: DichloroDiphenylTrichloroethane

DERs: Data Evaluation Records

DES: Diethylstilbesterol

DfE: Design for the Environment

DI: Diagnostic Inspection

DMR: Discharge Monitoring Report

DNA: Deoxyribonucleic acid

DNAPL: Dense Non-Aqueous Phase Liquid

DO: Dissolved Oxygen

DOW: Defenders Of Wildlife

DPA: Deepwater Ports Act

DPD: Method of Measuring Chlorine Residual in Water

DQO: Data Quality Objective

DRE: Destruction and Removal Efficiency

DRES: Dietary Risk Evaluation System

DRMS: Defense Reutilization and Marketing Service

DRR: Data Review Record

DS: Dichotomous Sampler

DSAP: Data Self Auditing Program

DSCF: Dry Standard Cubic Feet

DSCM: Dry Standard Cubic Meter

DSS: Decision Support System; Domestic Sewage Study

DT: Detectors (radon) damaged or lost; Detention Time

DU: Decision Unit. Ducks Unlimited; Dobson Unit

DUC: Decision Unit Coordinator

DWEL: Drinking Water Equivalent Level

DWS: Drinking Water Standard

DWSRF: Drinking Water State Revolving Fund

E

EA: Endangerment Assessment; Enforcement Agreement; Environmental Action; Environmental

Assessment;. Environmental Audit

EAF: Electric Arc Furnaces

EAG: Exposure Assessment Group

EAP: Environmental Action Plan

EAR: Environmental Auditing Roundtable

EASI: Environmental Alliance for Senior Involvement

EB: Emissions Balancing

EC: Emulsifiable Concentrate; Environment Canada; Effective Concentration

ECA: Economic Community for Africa

ECAP: Employee Counselling and Assistance Program

ECD: Electron Capture Detector

ECHH: Electro-Catalytic Hyper-Heaters

ECL: Environmental Chemical Laboratory

ECOS: Environmental Council of the States

ECR: Enforcement Case Review

ECRA: Economic Cleanup Responsibility Act

ED: Effective Dose

EDA: Emergency Declaration Area

EDB: Ethylene Dibromide

EDC: Ethylene Dichloride

EDD: Enforcement Decision Document

EDF: Environmental Defense Fund

EDRS: Enforcement Document Retrieval System

EDS: Electronic Data System; Energy Data System

EDTA: Ethylene Diamine Triacetic Acid

EDX: Electronic Data Exchange

EDZ: Emission Density Zoning

EEA: Energy and Environmental Analysis

EECs: Estimated Environmental Concentrations

EER: Excess Emission Report

EERL: Eastern Environmental Radiation Laboratory

EERU: Environmental Emergency Response Unit

EESI: Environment and Energy Study Institute

EESL: Environmental Ecological and Support Laboratory

EETFC: Environmental Effects, Transport, and Fate Committee

EF: Emission Factor

EFO: Equivalent Field Office

EFTC: European Fluorocarbon Technical Committee

EGR: Exhaust Gas Recirculation

EH: Redox Potential

EHC: Environmental Health Committee

EHS: Extremely Hazardous Substance

EI: Emissions Inventory

EIA: Environmental Impact Assessment. Economic Impact Assessment

EIL: Environmental Impairment Liability

EIR: Endangerment Information Report; Environmental Impact Report

EIS: Environmental Impact Statement; Environmental Inventory System

EIS/AS: Emissions Inventory System/Area Source

EIS/PS: Emissions Inventory System/Point Source

EKMA: Empirical Kinetic Modeling Approach

EL: Exposure Level

ELI: Environmental Law Institute

ELR: Environmental Law Reporter

EM: Electromagnetic Conductivity

EMAP: Environmental Mapping and Assessment Program

EMAS: Enforcement Management and Accountability System

EMR: Environmental Management Report

EMS: Enforcement Management System

EMSL: Environmental Monitoring Support Systems Laboratory

EMTS: Environmental Monitoring Testing Site; Exposure Monitoring Test Site

EnPA: Environmental Performance Agreement

EO: Ethylene Oxide

EOC: Emergency Operating Center

EOF: Emergency Operations Facility (RTP)

EOP: End Of Pipe

EOT: Emergency Operations Team

EP: Earth Protectors; Environmental Profile; End-use Product; Experimental Product; Extraction Procedure

EPAA: Environmental Programs Assistance Act

EPAAR: EPA Acquisition Regulations

EPCA: Energy Policy and Conservation Act

EPACT: Environmental Policy Act

EPACASR: EPA Chemical Activities Status Report

EPCRA: Emergency Planning and Community Right to Know Act

EPD: Emergency Planning District

EPI: Environmental Policy Institute

EPIC: Environmental Photographic Interpretation Center

EPNL: Effective Perceived Noise Level

EPRI: Electric Power Research Institute

EPTC: Extraction Procedure Toxicity Characteristic

EQIP: Environmental Quality Incentives Program

ER: Ecosystem Restoration; Electrical Resistivity

ERA: Economic Regulatory Agency

ERAMS: Environmental Radiation Ambient Monitoring System

ERC: Emergency Response Commission. Emissions Reduction Credit, Environmental Research Center

ERCS: Emergency Response Cleanup Services

ERDA: Energy Research and Development Administration

ERD&DAA: Environmental Research, Development and Demonstration Authorization Act

ERL: Environmental Research Laboratory

ERNS: Emergency Response Notification System

ERP: Enforcement Response Policy

ERT: Emergency Response Team

ERTAQ: ERT Air Quality Model

ES: Enforcement Strategy

ESA: Endangered Species Act. Environmentally Sensitive Area

ESC: Endangered Species Committee

ESCA: Electron Spectroscopy for Chemical Analysis

ESCAP: Economic and Social Commission for Asia and the Pacific

ESECA: Energy Supply and Environmental Coordination Act

ESH: Environmental Safety and Health

ESP: Electrostatic Precipitators

ET: Emissions Trading

ETI: Environmental Technology Initiative

ETP: Emissions Trading Policy

ETS: Emissions Tracking System; Environmental Tobacco Smoke

ETV: Environmental Technology Verification Program

EUP: End-Use Product; Experimental Use Permit

EWCC: Environmental Workforce Coordinating Committee

EXAMS: Exposure Analysis Modeling System

ExEx: Expected Exceedance

F

FACA: Federal Advisory Committee Act

FAN: Fixed Account Number

FATES: FIFRA and TSCA Enforcement System

FBC: Fluidized Bed Combustion

FCC: Fluid Catalytic Converter

FCCC: Framework Convention on Climate Change

FCCU: Fluid Catalytic Cracking Unit

FCO: Federal Coordinating Officer (in disaster areas); Forms Control Officer

FDF: Fundamentally Different Factors

FDL: Final Determination Letter

FDO: Fee Determination Official

FE: Fugitive Emissions

FEDS: Federal Energy Data System

FEFx: Forced Expiratory Flow

FEIS: Fugitive Emissions Information System

FEL: Frank Effect Level

FEPCA: Federal Environmental Pesticide Control Act; enacted as amendments to FIFRA.

FERC: Federal Energy Regulatory Commission

FES: Factor Evaluation System

FEV: Forced Expiratory Volume

FEV1: Forced Expiratory Volume--one second; Front End Volatility Index

FF: Federal Facilities

FFAR: Fuel and Fuel Additive Registration

FFDCA: Federal Food, Drug, and Cosmetic Act

FFF: Firm Financial Facility

FFFSG: Fossil-Fuel-Fired Steam Generator

FFIS: Federal Facilities Information System

FFP: Firm Fixed Price

FGD: Flue-Gas Desulfurization

FID: Flame Ionization Detector

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act

FIM: Friable Insulation Material

FINDS: Facility Index System

FIP: Final Implementation Plan

FIPS: Federal Information Procedures System

FIT: Field Investigation Team

FLETC: Federal Law Enforcement Training Center

FLM: Federal Land Manager

FLP: Flash Point

FLPMA: Federal Land Policy and Management Act

FMAP: Financial Management Assistance Project

F/M: Food to Microorganism Ratio

FML: Flexible Membrane Liner

FMP: Facility Management Plan

FMP: Financial Management Plan

FMS: Financial Management System

FMVCP: Federal Motor Vehicle Control Program

FOE: Friends Of the Earth

FOIA: Freedom Of Information Act

FOISD: Fiber Optic Isolated Spherical Dipole Antenna

FONSI: Finding Of No Significant Impact

FORAST: Forest Response to Anthropogenic Stress

FP: Fine Particulate

FPA: Federal Pesticide Act

FPAS: Foreign Purchase Acknowledgement Statements

FPD: Flame Photometric Detector

FPEIS: Fine Particulate Emissions Information System

FPM: Federal Personnel Manual

FPPA: Federal Pollution Prevention Act

FPR: Federal Procurement Regulation

FPRS: Federal Program Resources Statement; Formal Planning and Supporting System

FQPA: Food Quality Protection Act

FR: Federal Register. Final Rulemaking

FRA: Federal Register Act

FREDS: Flexible Regional Emissions Data System

FRES: Forest Range Environmental Study

FRM: Federal Reference Methods

FRN: Federal Register Notice. Final Rulemaking Notice

FRS: Formal Reporting System

FS: Feasibility Study

FSA: Food Security Act

FSS: Facility Status Sheet; Federal Supply Schedule

FTP: Federal Test Procedure (for motor vehicles)

FTS: File Transfer Service

FTTS: FIFRA/TSCA Tracking System

FUA: Fuel Use Act

FURS: Federal Underground Injection Control Reporting System

FVMP: Federal Visibility Monitoring Program

FWCA: Fish and Wildlife Coordination Act

FWPCA: Federal Water Pollution and Control Act (aka CWA). Federal Water Pollution and Control Administration

G

GAAP: Generally Accepted Accounting Principles

GAC: Granular Activated Carbon

GACT: Granular Activated Carbon Treatment

GAW: Global Atmospheric Watch

GCC: Global Climate Convention

GC/MS: Gas Chromatograph/ Mass Spectograph

GCVTC: Grand Canyon Visibility Transport Commission

GCWR: Gross Combination Weight Rating

GDE: Generic Data Exemption

GEI: Geographic Enforcement Initiative

GEMI: Global Environmental Management Initiative

GEMS: Global Environmental Monitoring System; Graphical Exposure Modeling System

GEP: Good Engineering Practice

GFF: Glass Fiber Filter

GFO: Grant Funding Order

GFP: Government-Furnished Property

GICS: Grant Information and Control System

GIS: Geographic Information Systems; Global Indexing System

GLC: Gas Liquid Chromatography

GLERL: Great Lakes Environmental Research Laboratory

GLNPO: Great Lakes National Program Office

GLP: Good Laboratory Practices

GLWQA: Great Lakes Water Quality Agreement

GMCC: Global Monitoring for Climatic Change

G/MI: Grams per mile

GOCO: Government-Owned/ Contractor-Operated

GOGO: Government-Owned/ Government-Operated

GOP: General Operating Procedures

GOPO: Government-Owned/ Privately-Operated

GPAD: Gallons-per-acre per-day

GPG: Grams-per-Gallon

GPR: Ground-Penetrating Radar

GPS: Groundwater Protection Strategy

GR: Grab Radon Sampling

GRAS: Generally Recognized as Safe

GRCDA: Government Refuse Collection and Disposal Association

GRGL: Groundwater Residue Guidance Level

GT: Gas Turbine

GTN: Global Trend Network

GTR: Government Transportation Request

GVP: Gasoline Vapor Pressure

GVW: Gross Vehicle Weight

GVWR: Gross Vehicle Weight Rating

GW: Grab Working-Level Sampling. Groundwater

GWDR: Ground Water Disinfection Rule

GWM: Groundwater Monitoring

GWP: Global Warming Potential

GWPC: Ground Water Protection Council

GWPS: Groundwater Protection Standard; Groundwater Protection Strategy

H

HA: Health Advisory

HAD: Health Assessment Document

HAP: Hazardous Air Pollutant

HAPEMS: Hazardous Air Pollutant Enforcement Management System

HAPPS: Hazardous Air Pollutant Prioritization System

HATREMS: Hazardous and Trace Emissions System

HAZMAT: Hazardous Materials

HAZOP: Hazard and Operability Study

HBFC: Hydrobromofluorocarbon

HC: Hazardous Constituents; Hydrocarbon

HCCPD: Hexachlorocyclo-pentadiene

HCFC: Hydrochlorofluorocarbon

HCP: Hypothermal Coal Process

HDD: Heavy-Duty Diesel

HDDT: Heavy-duty Diesel Truck

HDDV: Heavy-Duty Diesel Vehicle

HDE: Heavy-Duty Engine

HDG: Heavy-Duty Gasoline-Powered Vehicle

HDGT: Heavy-Duty Gasoline Truck

HDGV: Heavy-Duty Gasoline Vehicle

HDPE: High Density Polyethylene

HDT: Highest Dose Tested in a study. Heavy-Duty Truck

HDV: Heavy-Duty Vehicle

HEAL: Human Exposure Assessment Location

HECC: House Energy and Commerce Committee

HEI: Health Effects Institute

HEM: Human Exposure Modeling

HEPA: High-Efficiency Particulate Air

HEPA: Highly Efficient Particulate Air Filter

HERS: Hyperion Energy Recovery System

HFC: Hydrofluorocarbon

HHDDV: Heavy Heavy-Duty Diesel Vehicle

HHE: Human Health and the Environment

HHV: Higher Heating Value

HI: Hazard Index

HI-VOL: High-Volume Sampler

HIWAY: A Line Source Model for Gaseous Pollutants

HLRW: High Level Radioactive Waste

HMIS: Hazardous Materials Information System

HMS: Highway Mobile Source

HMTA: Hazardous Materials Transportation Act

HMTR: Hazardous Materials Transportation Regulations

HOC: Halogenated Organic Carbons

HON: Hazardous Organic NESHAP

HOV: High-Occupancy Vehicle

HP: Horse Power

HPLC: High-Performance Liquid Chromatography

HPMS: Highway Performance Monitoring System

HPV: High Priority Violator

HQCDO: Headquarters Case Development Officer

HRS: Hazardous Ranking System

HRUP: High-Risk Urban Problem

HSDB: Hazardous Substance Data Base

HSL: Hazardous Substance List

HSWA: Hazardous and Solid Waste Amendments

HT: Hypothermally Treated

HTP: High Temperature and Pressure

HVAC: Heating, Ventilation, and Air-Conditioning system

HVIO: High Volume Industrial Organics

HW: Hazardous Waste

HWDMS: Hazardous Waste Data Management System

HWGTF: Hazardous Waste Groundwater Task Force; Hazardous Waste Groundwater Test Facility

HWIR: Hazardous Waste Identification Rule

HWLT: Hazardous Waste Land Treatment

HWM: Hazardous Waste Management

HWRTF: Hazardous Waste Restrictions Task Force

HWTC: Hazardous Waste Treatment Council

I

I/A: Innovative/Alternative

IA: Interagency Agreement

IAAC: Interagency Assessment Advisory Committee

IADN: Integrated Atmospheric Deposition Network

IAG: Interagency Agreement

IAP: Incentive Awards Program. Indoor Air Pollution

IAQ: Indoor Air Quality

IARC: International Agency for Research on Cancer

IATDB: Interim Air Toxics Data Base

IBSIN: Innovations in Building Sustainable Industries

IBT: Industrial Biotest Laboratory

IC: Internal Combustion

ICAIR: Interdisciplinary Planning and Information Research

ICAP: Inductively Coupled Argon Plasma

ICB: Information Collection Budget

ICBN: International Commission on the Biological Effects of Noise

ICCP: International Climate Change Partnership

ICE: Industrial Combustion Emissions Model. Internal Combustion Engine

ICP: Inductively Coupled Plasma

ICR: Information Collection Request

ICRE: Ignitability, Corrosivity, Reactivity, Extraction

ICRP: International Commission on Radiological Protection

ICRU: International Commission of Radiological Units and Measurements

ICS: Incident Command System. Institute for Chemical Studies; Intermittent Control Strategies.; Intermittent Control System

ICWM: Institute for Chemical Waste Management

IDLH: Immediately Dangerous to Life and Health

IEB: International Environment Bureau

IEMP: Integrated Environmental Management Project

IES: Institute for Environmental Studies

IFB: Invitation for Bid

IFCAM: Industrial Fuel Choice Analysis Model

IFCS: International Forum on Chemical Safety

IFIS: Industry File Information System

IFMS: Integrated Financial Management System

IFPP: Industrial Fugitive Process Particulate

IGCC: Integrated Gasification Combined Cycle

IGCI: Industrial Gas Cleaning Institute

IIS: Inflationary Impact Statement

IINERT: In-Place Inactivation and Natural Restoration Technologies

IJC: International Joint Commission (on Great Lakes)

I/M: Inspection/Maintenance

IMM: Intersection Midblock Model

IMPACT: Integrated Model of Plumes and Atmosphere in Complex Terrain

IMPROVE: Interagency Monitoring of Protected Visual Environment

INPUFF: Gaussian Puff Dispersion Model

INT: Intermittent

IOB: Iron Ore Beneficiation

IOU: Input/Output Unit

IPCS: International Program on Chemical Safety

IP: Inhalable Particles

IPM: Inhalable Particulate Matter. Integrated Pest Management

IPP: Implementation Planning Program. Integrated Plotting Package; Inter-media Priority Pollutant (document); Independent Power Producer

IPCC: Intergovernmental Panel on Climate Change

IPM: Integrated Pest Management

IRG: Interagency Review Group

IRLG: Interagency Regulatory Liaison Group (Composed of EPA, CPSC, FDA, and OSHA)

IRIS: Instructional Resources Information System. Integrated Risk Information System

IRM: Intermediate Remedial Measures

IRMC: Inter-Regulatory Risk Management Council

IRP: Installation Restoration Program

IRPTC: International Register of Potentially Toxic Chemicals

IRR: Institute of Resource Recovery

IRS: International Referral Systems

IS: Interim Status

ISAM: Indexed Sequential File Access Method

ISC: Industrial Source Complex

ISCL: Interim Status Compliance Letter

ISCLT: Industrial Source Complex Long Term Model

ISCST: Industrial Source Complex Short Term Model

ISD: Interim Status Document

ISE: Ion-specific electrode

ISMAP: Indirect Source Model for Air Pollution

ISO: International Organization for Standardization

ISPF: (IBM) Interactive System Productivity Facility

ISS: Interim Status Standards

ITC:Innovative Technology Council

ITC: Interagency Testing Committee

ITRC: Interstate Technology Regulatory Coordination

ITRD: Innovative Treatment Remediation Demonstration

IUP: Intended Use Plan

IUR: Inventory Update Rule

IWC: In-Stream Waste Concentration

IWS: Ionizing Wet Scrubber

J

JAPCA: Journal of Air Pollution Control Association

JCL: Job Control Language

JEC: Joint Economic Committee

JECFA: Joint Expert Committee of Food Additives

JEIOG: Joint Emissions Inventory Oversight Group

JLC: Justification for Limited Competition

JMPR: Joint Meeting on Pesticide Residues

JNCP: Justification for Non-Competitive Procurement

JOFOC: Justification for Other Than Full and Open Competition

JPA: Joint Permitting Agreement

JSD: Jackson Structured Design

JSP: Jackson Structured Programming

JTU: Jackson Turbidity Unit

L

LAA: Lead Agency Attorney

LADD: Lifetime Average Daily Dose; Lowest Acceptable Daily Dose

LAER: Lowest Achievable Emission Rate

LAI: Laboratory Audit Inspection

LAMP: Lake Acidification Mitigation Project

LC: Lethal Concentration. Liquid Chromatography

LCA: Life Cycle Assessment

LCD: Local Climatological Data

LCL: Lower Control Limit

LCM: Life Cycle Management

LCRS: Leachate Collection and Removal System

LD: Land Disposal. Light Duty

LD L0: The lowest dosage of a toxic substance that kills test organisms.

LDC: London Dumping Convention

LDCRS: Leachate Detection, Collection, and Removal System

LDD: Light-Duty Diesel

LDDT: Light-Duty Diesel Truck

LDDV: Light-Duty Diesel Vehicle

LDGT: Light-Duty Gasoline Truck

LDIP: Laboratory Data Integrity Program

LDR: Land Disposal Restrictions

LDRTF: Land Disposal Restrictions Task Force

LDS: Leak Detection System

LDT: Lowest Dose Tested. Light-Duty Truck

LDV: Light-Duty Vehicle

LEL: Lowest Effect Level. Lower Explosive Limit

LEP: Laboratory Evaluation Program

LEPC: Local Emergency Planning Committee

LERC: Local Emergency Response Committee

LEV: Low Emissions Vehicle

LFG: Landfill Gas

LFL: Lower Flammability Limit

LGR: Local Governments Reimbursement Program

LHDDV: Light Heavy-Duty Diesel Vehicle

LI: Langelier Index

LIDAR: Light Detection and Ranging

LIMB: Limestone-Injection Multi-Stage Burner

LLRW: Low Level Radioactive Waste

LMFBR: Liquid Metal Fast Breeder Reactor

LMOP: Landfill Methane Outreach Program

LNAPL: Light Non-Aqueous Phase Liquid

LOAEL: Lowest-Observed-Adverse-Effect-Level

LOD: Limit of Detection

LQER: Lesser Quantity Emission Rates

LQG: Large Quantity Generator

LRTAP: Long Range Transboundary Air Pollution

LUIS: Label Use Information System

M

MAC: Mobile Air Conditioner

MAPSIM: Mesoscale Air Pollution Simulation Model

MATC: Maximum Acceptable Toxic Concentration

MBAS: Methylene-Blue-Active Substances

MCL: Maximum Contaminant Level

MCLG: Maximum Contaminant Level Goal

MCS: Multiple Chemical Sensitivity

MDL: Method Detection Limit

MEC: Model Energy Code

MEI: Maximally (or most) Exposed Individual

MEP: Multiple Extraction Procedure

MHDDV: Medium Heavy-Duty Diesel Vehicle

MOBILE5A: Mobile Source Emission Factor Model

MOE: Margin Of Exposure

MOS: Margin of Safety

MP: Manufacturing-use Product; Melting Point

MPCA: Microbial Pest Control Agent

MPI: Maximum Permitted Intake

MPN: Maximum Possible Number

MPWC: Multiprocess Wet Cleaning

MRF: Materials Recovery Facility

MRID: Master Record Identification number

MRL: Maximum-Residue Limit (Pesticide Tolerance)

MSW: Municipal Solid Waste

MTD: Maximum Tolerated Dose

MUP: Manufacturing-Use Product

MUTA: Mutagenicity

MWC: Machine Wet Cleaning

N

NAA: Nonattainment Area

NAAEC: North American Agreement on Environmental Cooperation

NAAQS: National Ambient Air Quality Standards

NACA: National Agricultural Chemicals Association

NACEPT: National Advisory Council for Environmental Policy and Technology

NADP/NTN: National Atmospheric Deposition Program/National Trends Network

NAMS: National Air Monitoring Stations

NAPAP: National Acid Precipitation Assessment Program

NAPL: Non-Aqueous Phase Liquid

NAPS: National Air Pollution Surveillance

NARA: National Agrichemical Retailers Association

NARSTO: North American Research Strategy for Tropospheric Ozone

NAS: National Academy of Sciences

NASDA: National Association of State Departments of Agriculture

NCAMP: National Coalition Against the Misuse of Pesticides

NCEPI: National Center for Environmental Publications and Information

NCWS: Non-Community Water System

NEDS: National Emissions Data System

NEPI: National Environmental Policy Institute

NEPPS: National Environmental Performance Partnership System

NESHAP: National Emission Standard for Hazardous Air Pollutants

NIEHS: National Institute for Environmental Health Sciences

NETA: National Environmental Training Association

NFRAP: No Further Remedial Action Planned

NICT: National Incident Coordination Team

NIOSH: National Institute of Occupational Safety and Health

NIPDWR: National Interim Primary Drinking Water Regulations

NISAC: National Industrial Security Advisory Committee

NMHC: Nonmethane Hydrocarbons

NMOC: Non-Methane Organic Component

NMVOC: Non-methane Volatile Organic Chemicals

NO: Nitric Oxide

NOA: Notice of Arrival

NOAA: National Oceanographic and Atmospheric Agency

NOAC: Nature of Action Code

NOAEL: No Observable Adverse Effect Level

NOEL: No Observable Effect Level

NOIC: Notice of Intent to Cancel

NOIS: Notice of Intent to Suspend

N2O: Nitrous Oxide

NOx: Nitrogen Oxides

NORM: Naturally Occurring Radioactive Material

NPCA: National Pest Control Association>

NPDES: National Pollutant Discharge Elimination System

NPHAP: National Pesticide Hazard Assessment Program

NPIRS: National Pesticide Information Retrieval System

NPTN: National Pesticide Telecommunications Network

NRD: Natural Resource Damage

NRDC: Natural Resources Defense Council

NSDWR: National Secondary Drinking Water Regulations

NSEC: National System for Emergency Coordination

NSEP: National System for Emergency Preparedness

NSPS: New Source Performance Standards

NSR: New Source Review

NTI: National Toxics Inventory

NTIS: National Technical Information Service

NTNCWS: Non-Transient Non-Community Water System

NTP: National Toxicology Program

NTU: Nephlometric Turbidity Unit

O

O3: Ozone

OCD: Offshore and Coastal Dispersion

ODP: Ozone-Depleting Potential

ODS: Ozone-Depleting Substances

OECD: Organization for Economic Cooperation and Development

OF: Optional Form

OLTS: On Line Tracking System

O&M: Operations and Maintenance

ORM: Other Regulated Material

ORP: Oxidation-Reduction Potential

OTAG: Ozone Transport Assessment Group

OTC: Ozone Transport Commission

OTR: Ozone Transport Region

P

P2: Pollution Prevention

PAG: Pesticide Assignment Guidelines

PAH: Polynuclear Aromatic Hydrocarbons

PAI: Performance Audit Inspection (CWA); Pure Active Ingredient compound

PAM: Pesticide Analytical Manual

PAMS: Photochemical Assessment Monitoring Stations

PAT: Permit Assistance Team (RCRA)

PATS: Pesticide Action Tracking System; Pesticides Analytical Transport Solution

Pb: Lead

PBA: Preliminary Benefit Analysis (BEAD)

PCA: Principle Component Analysis

PCB: Polychlorinated Biphenyl

PCE: Perchloroethylene

PCM: Phase Contrast Microscopy

PCN: Policy Criteria Notice

PCO: Pest Control Operator

PCSD: President's Council on Sustainable Development

PDCI: Product Data Call-In

PFC: Perfluorated Carbon

PFCRA: Program Fraud Civil Remedies Act

PHC: Principal Hazardous Constituent

PHI: Pre-Harvest Interval

PHSA: Public Health Service Act

PI: Preliminary Injunction. Program Information

PIC: Products of Incomplete Combustion

PIGS: Pesticides in Groundwater Strategy

PIMS: Pesticide Incident Monitoring System

PIN: Pesticide Information Network

PIN: Procurement Information Notice

PIP: Public Involvement Program

PIPQUIC: Program Integration Project Queries Used in Interactive Command

PIRG: Public Interest Research Group

PIRT: Pretreatment Implementation Review Task Force

PIT: Permit Improvement Team

PITS: Project Information Tracking System

PLIRRA: Pollution Liability Insurance and Risk Retention Act

PLM: Polarized Light Microscopy

PLUVUE: Plume Visibility Model

PM: Particulate Matter

PMAS: Photochemical Assessment Monitoring Stations

PM2.5: Particulate Matter Smaller than 2.5 Micrometers in Diameter

PM10: Particulate Matter (nominally 10m and less)

PM15: Particulate Matter (nominally 15m and less)

PMEL: Pacific Marine Environmental Laboratory

PMN: Premanufacture Notification

PMNF: Premanufacture Notification Form

PMR: Pollutant Mass Rate

PMR: Proportionate Mortality Ratio

PMRS: Performance Management and Recognition System

PMS: Program Management System

PNA: Polynuclear Aromatic Hydrocarbons

PO: Project Officer

POC: Point Of Compliance

POE: Point Of Exposure

POGO: Privately-Owned/ Government-Operated

POHC: Principal Organic Hazardous Constituent

POI: Point Of Interception

POLREP:Pollution Report

POM: Particulate Organic Matter. Polycyclic Organic Matter

POP: Persistent Organic Pollutant

POR: Program of Requirements

POTW: Publicly Owned Treatment Works

POV: Privately Owned Vehicle

PP: Program Planning

PPA: Planned Program Accomplishment

PPB: Parts Per Billion

PPE: Personal Protective Equipment

PPG: Performance Partnership Grant

PPIC: Pesticide Programs Information Center

PPIS: Pesticide Product Information System; Pollution Prevention Incentives for States

PPMAP: Power Planning Modeling Application Procedure

PPM/PPB: Parts per million/ parts per billion

PPSP: Power Plant Siting Program

PPT: Parts Per Trillion

PPTH: Parts Per Thousand

PQUA: Preliminary Quantitative Usage Analysis

PR: Pesticide Regulation Notice; Preliminary Review

PRA: Paperwork Reduction Act; Planned Regulatory Action

PRATS: Pesticides Regulatory Action Tracking System

PRC: Planning Research Corporation

PRI: Periodic Reinvestigation

PRM: Prevention Reference Manuals

PRN: Pesticide Registration Notice

PRP: Potentially Responsible Party

PRZM : Pesticide Root Zone Model

PS: Point Source

PSAM: Point Source Ambient Monitoring

PSC: Program Site Coordinator

PSD: Prevention of Significant Deterioration

PSES: Pretreatment Standards for Existing Sources

PSI: Pollutant Standards Index; Pounds Per Square Inch; Pressure Per Square Inch

PSIG: Pressure Per Square Inch Gauge

PSM: Point Source Monitoring

PSNS: Pretreatment Standards for New Sources

PSU: Primary Sampling Unit

PTDIS: Single Stack Meteorological Model in EPA UNAMAP Series

PTE: Potential to Emit

PTFE: Polytetrafluoroethylene (Teflon)

PTMAX: Single Stack Meteorological Model in EPA UNAMAP series

PTPLU: Point Source Gaussian Diffusion Model

PUC: Public Utility Commission

PV: Project Verification

PVC: Polyvinyl Chloride

PWB: Printed Wiring Board

PWS: Public Water Supply/ System

PWSS: Public Water Supply System

Q

QAC: Quality Assurance Coordinator

QA/QC: Quality Assistance/ Quality Control

QAMIS: Quality Assurance Management and Information System

QAO: Quality Assurance Officer

QAPP: Quality Assurance Program (or Project) Plan

QAT: Quality Action Team

QBTU: Quadrillion British Thermal Units

QC: Quality Control

QCA: Quiet Communities Act

QCI: Quality Control Index

QCP: Quiet Community Program

QL: Quantification Limit

QNCR: Quarterly Noncompliance Report

QUA: Qualitative Use Assessment

QUIPE: Quarterly Update for Inspector in Pesticide Enforcement

R

RA: Reasonable Alternative; Regulatory Alternatives; Regulatory Analysis; Remedial Action; Resource Allocation; Risk Analysis; Risk Assessment

RAATS: RCRA Administrate Action Tracking System

RAC: Radiation Advisory Committee. Raw Agricultural Commodity; Regional Asbestos Coordinator. Response Action Coordinator

RACM: Reasonably Available Control Measures

RACT: Reasonably Available Control Technology

RAD: Radiation Adsorbed Dose (unit of measurement of radiation absorbed by humans)

RADM: Random Walk Advection and Dispersion Model; Regional Acid Deposition Model

RAM: Urban Air Quality Model for Point and Area Source in EPA UNAMAP Series

RAMP: Rural Abandoned Mine Program

RAMS: Regional Air Monitoring System

RAP: Radon Action Program; Registration Assessment Panel; Remedial Accomplishment Plan; Response Action Plan

RAPS: Regional Air Pollution Study

RARG: Regulatory Analysis Review Group

RAS: Routine Analytical Service

RAT: Relative Accuracy Test

RB: Request for Bid

RBAC: Re-use Business Assistance Center

RBC: Red Blood Cell

RC: Responsibility Center

RCC: Radiation Coordinating Council

RCDO: Regional Case Development Officer

RCO: Regional Compliance Officer

RCP: Research Centers Program

RCRA: Resource Conservation and Recovery Act

RCRIS: Resource Conservation and Recovery Information System

RD/RA: Remedial Design/ Remedial Action

R&D: Research and Development

RD&D: Research, Development and Demonstration

RDF: Refuse-Derived Fuel

RDNA: Recombinant DNA

RDU: Regional Decision Units

RDV: Reference Dose Values

RE: Reasonable Efforts; Reportable Event

REAP: Regional Enforcement Activities Plan

REE: Rare Earth Elements

REEP: Review of Environmental Effects of Pollutants

RECLAIM: Regional Clean Air Initiatives Marker

RED: Reregistration Eligibility Decision Document

REDA: Recycling Economic Development Advocate

ReFIT: Reinvention for Innovative Technologies

REI: Restricted Entry Interval

REM: (Roentgen Equivalent Man)

REM/FIT: Remedial/Field Investigation Team

REMS: RCRA Enforcement Management System

REP: Reasonable Efforts Program

REPS: Regional Emissions Projection System

RESOLVE: Center for Environmental Conflict Resolution

RF: Response Factor

RFA: Regulatory Flexibility Act

RFB: Request for Bid

RfC: Reference Concentration

RFD: Reference Dose Values

RFI: Remedial Field Investigation

RFP: Reasonable Further Programs. Request for Proposal

RHRS: Revised Hazard Ranking System

RI: Reconnaissance Inspection

RI: Remedial Investigation

RIA: Regulatory Impact Analysis; Regulatory Impact Assessment

RIC: Radon Information Center

RICC: Retirement Information and Counseling Center

RICO: Racketeer Influenced and Corrupt Organizations Act

RI/FS: Remedial Information/ Feasibility Study

RIM: Regulatory Interpretation Memorandum

RIN: Regulatory Identifier Number

RIP: RCRA Implementation Plan

RISC: Regulatory Information Service Center

RJE: Remote Job Entry

RLL: Rapid and Large Leakage (Rate)

RMCL: Recommended Maximum Contaminant Level (this phrase being discontinued in favor of MCLG)

RMDHS: Regional Model Data Handling System

RMIS: Resources Management Information System

RNA: Ribonucleic Acid

ROADCHEM: Roadway Version that Includes Chemical Reactions of BI, NO_2, and O_3

ROADWAY: A Model to Predict Pollutant Concentrations Near a Roadway

ROC: Record Of Communication

RODS: Records Of Decision System

ROG: Reactive Organic Gases

ROLLBACK: A Proportional Reduction Model

ROM: Regional Oxidant Model

ROMCOE: Rocky Mountain Center on Environment

ROP: Rate of Progress; Regional Oversight Policy

ROPA: Record Of Procurement Action

ROSA: Regional Ozone Study Area

RP: Radon Progeny Integrated Sampling. Respirable Particulates. Responsible Party

RPAR: Rebuttable Presumption Against Registration

RPM: Reactive Plume Model. Remedial Project Manager

RQ: Reportable Quantities

RRC: Regional Response Center

RRT: Regional Response Team; Requisite Remedial Technology

RS: Registration Standard

RSCC: Regional Sample Control Center

RSD: Risk-Specific Dose

RSE: Removal Site Evaluation

RTCM: Reasonable Transportation Control Measure

RTDF: Remediation Technologies Development Forum

RTDM: Rough Terrain Diffusion Model

RTECS: Registry of Toxic Effects of Chemical Substances

RTM: Regional Transport Model

RTP: Research Triangle Park

RUP: Restricted Use Pesticide

RVP: Reid Vapor Pressure

RWC: Residential Wood Combustion

S

S&A: Sampling and Analysis. Surveillance and Analysis

SAB: Science Advisory Board

SAC: Suspended and Cancelled Pesticides

SAEWG: Standing Air Emissions Work Group

SAIC: Special-Agents-In-Charge

SAIP: Systems Acquisition and Implementation Program

SAMI: Southern Appalachian Mountains Initiative

SAMWG: Standing Air Monitoring Work Group

SANE: Sulfur and Nitrogen Emissions

SANSS: Structure and Nomenclature Search System

SAP: Scientific Advisory Panel

SAR: Start Action Request. Structural Activity Relationship (of a qualitative assessment)

SARA: Superfund Amendments and Reauthorization Act of 1986

SAROAD: Storage and Retrieval Of Aerometric Data

SAS: Special Analytical Service. Statistical Analysis System

SASS: Source Assessment Sampling System

SAV: Submerged Aquatic Vegetation

SBC: Single Breath Cannister

SC: Sierra Club

SCAP: Superfund Consolidated Accomplishments Plan

SCBA: Self-Contained Breathing Apparatus

SCC: Source Classification Code

SCD/SWDC: Soil or Soil and Water Conservation District

SCFM: Standard Cubic Feet Per Minute

SCLDF: Sierra Club Legal Defense Fund

SCR: Selective Catalytic Reduction

SCRAM: State Consolidated RCRA Authorization Manual

SCRC: Superfund Community Relations Coordinator

SCS: Supplementary Control Strategy/System

SCSA: Soil Conservation Society of America

SCSP: Storm and Combined Sewer Program

SCW: Supercritical Water Oxidation

SDC: Systems Decision Plan

SDWA: Safe Drinking Water Act

SDWIS: Safe Drinking Water Information System

SBS: Sick Building Syndrome

SEA: State Enforcement Agreement

SEA: State/EPA Agreement

SEAM: Surface, Environment, and Mining

SEAS: Strategic Environmental Assessment System

SEDS: State Energy Data System

SEGIP: State Environmental Goals and Improvement Project

SEIA: Socioeconomic Impact Analysis

SEM: Standard Error of the Means

SEP: Standard Evaluation Procedures

SEP: Supplementary Environmental Project

SEPWC: Senate Environment and Public Works Committee

SERC: State Emergency Planning Commission

SES: Secondary Emissions Standard

SETAC: Society for Environmental Toxicology and Chemistry

SETS: Site Enforcement Tracking System

SF: Standard Form. Superfund

SFA: Spectral Flame Analyzers

SFDS: Sanitary Facility Data System

SFFAS: Superfund Financial Assessment System

SFIREG: State FIFRA Issues Research and Evaluation Group

SFS: State Funding Study

SHORTZ: Short Term Terrain Model

SHWL: Seasonal High Water Level

SI: International System of Units. Site Inspection. Surveillance Index. Spark Ignition

SIC: Standard Industrial Classification

SICEA: Steel Industry Compliance Extension Act

SIMS: Secondary Ion-Mass Spectrometry

SIP: State Implementation Plan

SITE: Superfund Innovative Technology Evaluation

SLAMS: State/Local Air Monitoring Station

SLN: Special Local Need

SLSM: Simple Line Source Model

SMART: Simple Maintenance of ARTS

SMCL: Secondary Maximum Contaminant Level

SMCRA: Surface Mining Control and Reclamation Act

SME: Subject Matter Expert

SMO: Sample Management Office

SMOA: Superfund Memorandum of Agreement

SMP: State Management Plan

SMR: Standardized Mortality Ratio

SMSA: Standard Metropolitan Statistical Area

SNA: System Network Architecture

SNAAQS: Secondary National Ambient Air Quality Standards

SNAP: Significant New Alternatives Project; Significant Noncompliance Action Program

SNARL: Suggested No Adverse Response Level

SNC: Significant Noncompliers

SNUR: Significant New Use Rule

SO: Sulfur Dioxide

SOC: Synthetic Organic Chemicals

SOCMI: Synthetic Organic Chemicals Manufacturing Industry

SOFC: Solid Oxide Fuel Cell

SOTDAT: Source Test Data

SOW: Scope Of Work

SPAR: Status of Permit Application Report

SPCC: Spill Prevention, Containment, and Countermeasure

SPE: Secondary Particulate Emissions

SPF: Structured Programming Facility

SPI: Strategic Planning Initiative

SPLMD: Soil-pore Liquid Monitoring Device

SPMS: Strategic Planning and Management System; Special Purpose Monitoring Stations

SPOC: Single Point Of Contact

SPS: State Permit System

SPSS: Statistical Package for the Social Sciences

SPUR: Software Package for Unique Reports

SQBE: Small Quantity Burner Exemption

SQG: Small Quantity Generator

SR: Special Review

SRAP: Superfund Remedial Accomplishment Plan

SRC: Solvent-Refined Coal

SRF: State Revolving Fund

SRM: Standard Reference Method

SRP: Special Review Procedure

SRR: Second Round Review. Submission Review Record

SRTS: Service Request Tracking System

SS: Settleable Solids. Superfund Surcharge. Suspended Solids

SSA: Sole Source Aquifer

SSAC: Soil Site Assimilated Capacity

SSC: State Superfund Contracts

SSD: Standards Support Document

SSEIS: Standard Support and Environmental Impact Statement;. Stationary Source Emissions and Inventory System.

SSI: Size Selective Inlet

SSMS: Spark Source Mass Spectrometry

SSO: Sanitary Sewer Overflow; Source Selection Official

SSRP: Source Reduction Review Project

SSTS: Section Seven Tracking System

SSURO: Stop Sale, Use and Removal Order

STALAPCO: State and Local Air-Pollution Control Officials

STAPPA: State and Territorial Air Pollution

STAR: Stability Wind Rose. State Acid Rain Projects

STARS: Strategic Targeted Activities for Results System

STEL: Short Term Exposure Limit

STEM: Scanning Transmission-Electron Microscope

STN: Scientific and Technical Information Network

STORET: Storage and Retrieval of Water-Related Data

STP: Sewage Treatment Plant. Standard Temperature and Pressure

STTF: Small Town Task Force (EPA)

SUP: Standard Unit of Processing

SURE: Sulfate Regional Experiment Program

SV: Sampling Visit; Significant Violater

SW: Slow Wave

SWAP: Source Water Assessment Program

SWARF: Waste from Metal Grinding Process

SWC: Settlement With Conditions

SWDA: Solid Waste Disposal Act

SWIE: Southern Waste Information Exchange

SWMU: Solid Waste Management Unit

SWPA: Source Water Protection Area

SWQPPP: Source Water Quality Protection Partnership Petitions

SWTR: Surface Water Treatment Rule

SYSOP: Systems Operator

T

TAD: Technical Assistance Document

TAG: Technical Assistance Grant

TALMS: Tunable Atomic Line Molecular Spectroscopy

TAMS: Toxic Air Monitoring System

TAMTAC: Toxic Air Monitoring System Advisory Committee

TAP: Technical Assistance Program

TAPDS: Toxic Air Pollutant Data System

TAS: Tolerance Assessment System

TBT: Tributyltin

TC: Target Concentration. Technical Center. Toxicity Characteristics. Toxic Concentration:

TCDD: Dioxin (Tetrachlorodibenzo-p-dioxin)

TCDF: Tetrachlorodi-benzofurans

TCE: Trichloroethylene

TCF: Total Chlorine Free

TCLP: Total Concentrate Leachate Procedure. Toxicity Characteristic Leachate Procedure

TCM: Transportation Control Measure

TCP: Transportation Control Plan; Trichloropropane;

TCRI: Toxic Chemical Release Inventory

TD: Toxic Dose

TDS: Total Dissolved Solids

TEAM: Total Exposure Assessment Model

TEC: Technical Evaluation Committee

TED: Turtle Excluder Devices

TEG: Tetraethylene Glycol

TEGD: Technical Enforcement Guidance Document

TEL: Tetraethyl Lead

TEM: Texas Episodic Model

TEP: Typical End-use Product. Technical Evaluation Panel

TERA: TSCA Environmental Release Application

TES: Technical Enforcement Support

TEXIN: Texas Intersection Air Quality Model

TGO: Total Gross Output

TGAI: Technical Grade of the Active Ingredient

TGP: Technical Grade Product

THC: Total Hydrocarbons

THM: Trihalomethane

TI: Temporary Intermittent

TI: Therapeutic Index

TIBL: Thermal Internal Boundary Layer

TIC: Technical Information Coordinator. Tentatively Identified Compounds

TIM: Technical Information Manager

TIP: Technical Information Package

TIP: Transportation Improvement Program

TIS: Tolerance Index System

TISE: Take It Somewhere Else

TITC: Toxic Substance Control Act Interagency Testing Committee

TLV: Threshold Limit Value

TLV-C: TLV-Ceiling

TLV-STEL: TLV-Short Term Exposure Limit

TLV-TWA: TLV-Time Weighted Average

TMDL: Total Maximum Daily Limit; Total Maximum Daily Load

TMRC: Theoretical Maximum Residue Contribution

TNCWS: Transient Non-Community Water System

TNT: Trinitrotoluene

TO: Task Order

TOA: Trace Organic Analysis

TOC: Total Organic Carbon/ Compound

TOX: Tetradichloroxylene

TP: Technical Product; Total Particulates

TPC: Testing Priorities Committee

TPI: Technical Proposal Instructions

TPQ: Threshold Planning Quantity

TPSIS: Transportation Planning Support Information System

TPTH: Triphenyltinhydroxide

TPY: Tons Per Year

TQM: Total Quality Management

T-R: Transformer-Rectifier

TRC: Technical Review Committee

TRD: Technical Review Document

TRI: Toxic Release Inventory

TRIP: Toxic Release Inventory Program

TRIS: Toxic Chemical Release Inventory System

TRLN: Triangle Research Library Network

TRO: Temporary Restraining Order

TSA: Technical Systems Audit

TSCA: Toxic Substances Control Act

TSCATS: TSCA Test Submissions Database

TSCC: Toxic Substances Coordinating Committee

TSD: Technical Support Document

TSDF: Treatment, Storage, and Disposal Facility

TSDG: Toxic Substances Dialogue Group

TSI: Thermal System Insulation

TSM: Transportation System Management

TSO: Time Sharing Option

TSP: Total Suspended Particulates

TSS: Total Suspended (non-filterable) Solids

TTFA: Target Transformation Factor Analysis

TTHM: Total Trihalomethane

TTN: Technology Transfer Network

TTO: Total Toxic Organics

TTY: Teletypewriter

TVA: Tennessee Valley Authority

TVOC: Total Volatile Organic Compounds

TWA: Time Weighted Average

TWS: Transient Water System

TZ: Treatment Zone

U

UAC: User Advisory Committee

UAM: Urban Airshed Model

UAO: Unilateral Administrative Order

UAPSP: Utility Acid Precipitation Study Program

UAQI: Uniform Air Quality Index

UARG: Utility Air Regulatory Group

UCC: Ultra Clean Coal

UCCI: Urea-Formaldehyde Foam Insulation

UCL: Upper Control Limit

UDMH: Unsymmetrical Dimethyl Hydrazine

UEL: Upper Explosive Limit

UF: Uncertainty Factor

UFL: Upper Flammability Limit

ug/m3: Micrograms Per Cubic Meter

UIC: Underground Injection Control

ULEV: Ultra Low Emission Vehicles

UMTRCA: Uranium Mill Tailings Radiation Control Act

UNAMAP: Users' Network for Applied Modeling of Air Pollution

UNECE: United Nations Economic Commission for Europe

UNEP: United Nations Environment Program

USC: Unified Soil Classification

USDA: United States Department of Agriculture

USDW: Underground Sources of Drinking Water

USFS: United States Forest Service

UST: Underground Storage Tank

UTM: Universal Transverse Mercator

UTP: Urban Transportation Planning

UV: Ultraviolet

UVA, UVB, UVC: Ultraviolet Radiation Bands

UZM: Unsaturated Zone Monitoring

V

VALLEY: Meteorological Model to Calculate Concentrations on Elevated Terrain

VCM: Vinyl Chloride Monomer

VCP: Voluntary Cleanup Program

VE: Visual Emissions

VEO: Visible Emission Observation

VHS: Vertical and Horizontal Spread Model

VHT: Vehicle-Hours of Travel

VISTTA: Visibility Impairment from Sulfur Transformation and Transport in the Atmosphere

VKT: Vehicle Kilometers Traveled

VMT: Vehicle Miles Traveled

VOC: Volatile Organic Compounds

VOS: Vehicle Operating Survey

VOST: Volatile Organic Sampling Train

VP: Vapor Pressure

VSD: Virtually Safe Dose

VSI: Visual Site Inspection

VSS: Volatile Suspended Solids

W

WA: Work Assignment

WADTF: Western Atmospheric Deposition Task Force

WAP: Waste Analysis Plan

WAVE: Water Alliances for Environmental Efficiency

WB: Wet Bulb

WCED: World Commission on Environment and Development

WDROP: Distribution Register of Organic Pollutants in Water

WENDB: Water Enforcement National Data Base

WERL: Water Engineering Research Laboratory

WET: Whole Effluent Toxicity test

WHO: World Health Organization

WHP: Wellhead Protection Program

WHPA: Wellhead Protection Area

WHWT: Water and Hazardous Waste Team

WICEM: World Industry Conference on Environmental Management

WL: Warning Letter; Working Level (radon measurement)

WLA/TMDL: Wasteload Allocation/Total Maximum Daily Load

WLM: Working Level Months

WMO: World Meteorological Organization

WP: Wettable Powder

WPCF: Water Pollution Control Federation

WQS: Water Quality Standard

WRC: Water Resources Council

WRDA: Water Resources Development Act

WRI: World Resources Institute

WS: Work Status

WSF: Water Soluble Fraction

WSRA: Wild and Scenic Rivers Act

WSTB: Water Sciences and Technology Board

WSTP: Wastewater Sewage Treatment Plant

WWEMA: Waste and Wastewater Equipment Manufacturers Association

WWF: World Wildlife Fund

WWTP: Wastewater Treatment Plant

WWTU: Wastewater Treatment Unit

Z

ZEV: Zero Emissions Vehicle

ZHE: Zero Headspace Extractor

ZOI: Zone Of Incorporation

ZRL: Zero Risk Level

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DATA CHEM LABORATORIES, INC.

Industrial Hygiene Services & Fees

Mycology Services & Fees

Dietary Supplement Information

Environmental Offerings

For up-to-date
Service & Fee
Information
visit
www.datachem.com

There are several ways to locate information within this guide:

- **Click on any of the items in the Tables of Contents to be taken directly to the referring page.**
- **Click on the main headings to be taken to that section's Table of Contents.**
- **While holding the CTRL key hit the 'F' key, this will bring up the find feature in Acrobat. Type in the term you're looking for to bring up a list of associated pages.**

If you have difficulty locating a particular item please contact our Project Managers at 1-800-356-9135 or email us at info@datachem.com

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DataChem Laboratories, Inc.
Industiral Hygiene Fee Schedule, Dietary Supplements Information & Environmental Offerings

Effective May 1, 2008

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TEST CATALOG & FEE SCHEDULE
INDUSTRIAL HYGIENE
EFFECTIVE MAY 1, 2008

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♦ *Direct analysis of air samples collected in SUMMA canisters or Tedlar bags*

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Qualifications and Accreditations

DataChem Laboratories, Inc. (DCL) in Salt Lake City, Utah is AIHA accredited for the specified Field(s) of Testing as documented by the scope of accreditation. These fields include the following:

- **AIHA Accreditation (No. 17)**
  Industrial Hygiene Program
  Environmental Lead Program (Paint, Soil, Dust, Air)

- Participation in:
  - AIHA Proficiency Analytical Testing (PAT) Programs
    - Industrial Hygiene
    - Metals, Silica, Asbestos/Fibers, Organic Compounds
    - Beryllium (BEPAT)
    - Lead (ELPAT)
    - Paint, Soil, Dust, Air
  - AIHA Bulk Asbestos Analysis Program

- **NIOSH** Contract Laboratory for 32 years **(1974—2006)**

Description of Services

DataChem Laboratories, Inc. (DCL) is pleased to offer an extensive array of Industrial Hygiene analyses. Specific analytical tests are listed in this catalog. Lists of tests are presented in two sections. The first section provides details pertinent to prominent types of industrial hygiene analyses (e.g., asbestos, silica, metals, particulate). The second section lists NIOSH and OSHA methods numerically. An alphabetical list by analyte is also included. Volume discounts are available depending on the scope of the project. Please call a member of our staff for additional information.

When preparing samples for analysis, please note that many analyses require a three sample minimum fee to cover the costs of method setup. Please inquire as to which analyses require this minimum.

RUSH SERVICES

Turn Around Time	Surcharge
Next Working Day	100%
Three Working Days	50%

Prior notification to confirm rush analysis capacity is requested

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MICROBIOLOGICAL SERVICES

AEROBIOLOGY

NON-VIABLE FUNGAL SPORE ANALYSIS

Fungal Spore Trap Spore and Pollen COUNT (Allergenco-D, Micro-5, etc.)	Test Code	3 Days	1 Day
Fungal Spore Genus Identification and Numeration; Mycelial Fragment and Pollen COUNT	AC1	$35	$70
Fungal Spore Genus Identification and Numeration; Mycelial Fragment, Pollen, Total Fiber, and Skin Cell COUNT	AC2	$45	$70

VIABLE FUNGAL ANALYSIS

Impactor Plate GENUS Classification and Count (MEA, PDA, SABDEX, etc.)*	Test Code	7-10 Days
Xerophilic or Thermophilic Fungi ID and Total Plate Count (GENUS ID)	VA1	$35
Impactor Plate SPECIES Classification and Count (MEA, PDA, SABDEX, etc.)*	**Test Code**	**7-10 Days**
Xerophilic or Thermophilic Fungi ID and Total Plate Count (SPECIES ID)	VA2	$65 Dominant Species Only ($135 up to five Species (+) $17 additional Species)

* Other Media Type available: See Media Available from DataChem Laboratories, Inc. section of catalog.

VIABLE BACTERIAL ANALYSIS

Impactor Plate GRAM STAIN Classification and Count (TSA, 5% SBA, etc.)	Test Code	2-3 Days
Heterotrophic or Thermophilic Bacteria GRAM STAIN and Total Plate Count	VA3	$35
Impactor Plate SPECIES Classification and Count (TSA, 5% SBA, etc.)	**Test Code**	**Species 5-7 Days**
Heterotrophic or Thermophilic Bacteria SPECIES ID and Total Plate Count	VA4	$70 Dominant species only (+) Gram Stain ID; $20 each additional species

Note: Many additional specialty media and analyses are available, call 1-800-356-9135 for more information

ENVIRONMENTAL MYCOLOGY

SURFACE FUNGAL ANALYSIS

Fungal Culture ID and Quantification (Liquid, Swab, bulk)	Test Code	Species ID 7-10 Days	
Fungal **SPECIES ID** and Quantification (Xerophilic or Thermophilic)	FC1	$65 Dominant species only ($135 up to five species (+) $17 each additional species	
Fungal Screen Percent ESTIMATE (Swab, Tape-Lift, Bio-Tape, Bulk)	**Test Code**	**3 Days**	**1 Day**
Fungal **GENUS** Identification Screen and % **ESTIMATE**	SB1	$30	$60
Bulk Dust Fungal Spore COUNT	**Test Code**	**3 Days**	**1 Day**
Fungal Spore **GENUS** Identification; Mycelial Fragment and Pollen (counts per gram)	BD1	$45	$70

ENVIRONMENTAL BACTERIOLOGY

WATER BACTERIAL ANALYSIS

Water Analysis by Membrane Filtration (m-HPC, TSA, 5% SBA, etc)	Test Code	2 Days
Heterotrophic or Thermophilic Bacteria **COLONY PLATE COUNT**	EM1	$30
Heterotrophic or Thermophilic Bacteria **GRAM STAIN ID** and Total Plate Count	EM2	$45
Heterotrophic or Thermophilic Bacteria **SPECIES ID** and Total Plate Count	EM3	$75 Dominant Species only (+) Gram ID; ($20 each additional species)

E.COLI AND TOTAL COLIFORM ANALYSIS

PRESENCE or ABSENCE of E. coli (+) Total Coliform (liquid, swab)	Test Code	2 Days
(USEPA: 40 CFR Part 141) Accepted Method	CF1	$25
QUANTITATIVE Analysis of E. coli (+) Total Coliform (liquid, swab)	**Test Code**	**3 Days**
USEPA: 40 CFR Part 141) Accepted Method	CF2	$55

BIOLOGICAL ACTIVITY REACTION TEST (BART)

Environmental Corrosive Bacterial (liquid, swab)	Test Code	10 Days
Iron Related Bacteria (IRB) for microbiological influenced corrosion	MA1	$25
Sulfate Reducing Bacteria; (NPDWR) EPA Accepted	MA2	$25
Blue-Green Micro-Algae	MA3	$25
Fluorescent Pseudomonas; (NPDWR) EPA Accepted	MA4	$25
Denitrifying Bacteria	MA5	$25

COMMERCIAL MICROBIOLOGY

MICROBIAL TOXIN ANALYSIS

Gram Negative Bacterial LAL ENDOTOXIN Assay (liquid, swab, bulk)	Test Code	7 Days
Endotoxin Units/mL	SA1	1-3 samples $140/sample >3 samples $95/sample
Fungi AFLATOXIN Assay (liquid, swab, bulk)	**Test Code**	**7 Days**
Aflatoxin Micrograms/mL	SA2	1-3 samples $155/sample >3 samples $97/sample

STANDARD PLATE COUNT

Water Analysis by Membrane Filtration (m-HPC, TSA, 5% SBA, etc)	Test Code	2 Days
Heterotrophic or Thermophilic Bacteria **COLONY PLATE COUNT**	SM1	$30
Heterotrophic or Thermophilic Bacteria **GRAM STAIN ID** and Total Plate Count	SM2	$45
Heterotrophic or Thermophilic Bacteria **SPECIES ID** and Total Plate Count	SM3	$75 Dominant Species only (+) Gram ID; ($20 each additional species)

BACTERIA ID ANALYSIS

Enteric Bacteria ID and Quantification (liquid, swab, bulk)	Test Code	2 Days
Salmonella—CFU/mL or Gram	EC1	$70
Shigella—CFU/mL or Gram	EC2	$70
E.coli—CFU/mL or Gram	EC3	$65
Enterobacter—CFU/mL or Gram	EC4	$70
(Panel of all 4)		$240

BACTERIA ID ANALYSIS (CONT.)

Aerobic Bacteria ID and Quantification (liquid, swab, bulk)	Test Code	2 Days
Staphylococcus aureus—CFU/mL or Gram	AB1	$70
Pseudomonas aeruginosa—CFU/mL or Gram	AB2	$70

OTHER PRODUCT SPECIFIC TESTING

Listeria Qualitative Screen	Test Code	2 Days
Listeria QUALITATIVE Screen (minimum 3 samples)	LQ3	$170
> 3 samples		$140/sample

DataChem Laboratories, Inc. performs USP methods and tailored microbial analytical services—PLEASE CALL FOR PRICING.

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COMMON INDUSTRIAL HYGIENE ANALYSES

ACIDS (INORGANIC)

Analyte	Method	Instrument	Medium	Fee($)
Inorganic Acids (Full Panel)	NIOSH 7903	IC	Silica Gel Tube (SKC 226-10-03)	140
Inorganic Acids (Select Analytes)	NIOSH 7903	IC	Silica Gel Tube (SKC 226-10-03)	50/20*

Inorganic Acids as Anions Analyte List:

Bromide ion (Br^-) Fluoride ion (F^-) Phosphate ion (PO_4^{3-})
Chloride ion (Cl^-) Nitrate ion (NO_3^-) Sulfate ion (SO_4^{2-})

ALDEHYDES

Analyte	Method	Instrument	Medium	Fee($)
Aldehydes (Full Panel listed below)	NIOSH 2539 (Mod)	GC-FID	XAD-2 Tube (SKC 226-118)	175
Aldehydes (Select Analytes from list)	NIOSH 2539 (Mod)	GC-FID	XAD-2 Tube (SKC 226-118)	60/20*

Analyte List:

Acetaldehyde	Formaldehyde	Isovaleraldehyde
Acrolein	Heptanal	Propionaldehyde
Butyraldehyde	Hexanal	Valeraldehyde

AMINES

Analyte	Method	Instrument	Medium	Fee($)
Amine Compounds (an extensive list of amines with derivatization)	Call for method	GC-MS	Wipes, Air, Liquids, Solids	Call for quote
Morpholine	DCL SOP	GC-MS	Water or Air	175
Ethanolamine, Diethanolamine, Triethanolamine	NIOSH 3509 (Draft)	IC	Impinger	120/45
Dimethylamine Ethylamine Methylamine Diethylamine	OSHA 34 OSHA 36 OSHA 40 OSHA 41	HPLC (NBD Chloride Derivative)	XAD-7 SKC 226-96	150 75/25
Diethylenediamine (piperazine), Ethylenediamine (EDA), Diethylenetriamine (DETA), Triethylene tetramine (TETA)	OSHA 60	HPLC (NITC Derivative)	XAD-2 SKC 226-30-18	150 75/25
Diphenylamine, Isopropylaniline	OSHA 78	HPLC	GFF SKC 225-9004	100 75/25

*First analyte on a sample/each additional analyte on same sample

ANTINEOPLASTIC AND CHEMOTHERAPY DRUGS

Analyte	Method	Instrument	Medium	Fee($)
Select compounds of interest from the list below:	DCL SOP	LC-MS or GC-MS	Wipe (cotton gauze)	200/75
	DCL SOP	LC-MS or GC-MS	Air samples collected on filters or OVS7	200/75

Compound List:

Cisplatin	Fluorouracil	Methchlorethamine
Cyclophosphamide	Ifosfamide	Methotrexate
Floxuridine	Irinotecan	Mitoxantrone

For additional compounds contact DataChem Laboratories, Inc. at 1-800-356-9135.

ASBESTOS/TOTAL FIBERS

Analyte	Method	Instrument	Medium	TAT	Fee($)
Bulk Asbestos	NIOSH 9002	PLM	Bulk	Five Working Days	25
Bulk Asbestos	NIOSH 9002	PLM	Bulk	Next Working Day	35
Asbestos in Soil	NIOSH 9002	PLM	Soil	Five Working Days	50
Asbestos in Air	NIOSH 7400	PCM	MCE Filter	Five Working Days	15
Asbestos in Air	NIOSH 7400	PCM	MCE Filter	Next Working Day	25

* First analyte on a sample/additional analyte on same sample

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DIESEL PARTICULATE (ELEMENTAL CARBON)

Analyte	Method	Instrument	Medium	Fee($)
Elemental Carbon	NIOSH 5040	OC-EC	Treated Quartz Fiber Filter	45
Elemental Carbon (Acid treatment for removal of carbonaceous material)	NIOSH 5040	OC-EC	Treated Quartz Fiber Filter	110

FIXED GASES

Analyte	Method	Instrument	Medium	Fee($)
Fixed Gases	DCL	GC-PDHID	SUMMA/SilcoCan canister	250
			SUMMA/SilcoCan canister seven calendar day rental	40
			SUMMA/SilcoCan Regulator seven calendar day rental	40
Single Analyte/ Additional Analyte	DCL	GC-PDHID	SUMMA/SilcoCan canister	120/45*

Analyte List:

Carbon Monoxide	Hydrogen	Nitrogen
Carbon Dioxide	Methane	Oxygen

GRAVIMETRIC

Analyte	Method	Instrument	Medium	Fee($)
Total Dust	NIOSH 0500	Microbalance	PVC, 5µm, Preweighed	10
Respirable Dust	NIOSH 0600	Microbalance	PVC, 5µm, Preweighed	10
PM 10	40 CFR 50 APP B	Microbalance	QFF, 8"x10", Preweighed	20
Coal Tar Pitch Volatiles	OSHA 58	Microbalance	PTFE, 2µm	75
Benzene Solubles	NIOSH 5042	Microbalance	PTFE, 2µm, Preweighed	85
Metalworking Fluids	NIOSH 5524	Microbalance	PTFE, 2µm, Preweighed	60

* First analyte on a sample/additional analyte on same sample

Note: Tare weighed PVC and PTFE filters (2- or 3-piece cassettes) are available from DCL; the standard cost is $5.00 per cassette. For gravimetric determinations, DCL recommends that tare weights and post-collection weights be determined using the same microbalance. DCL also recommends that filters be utilized within six months of their tare weight determination.

INDOOR AIR QUALITY (VOCs)

Analyte	Method	Instrument	Medium	Fee($)
Volatile Organics	EPA TO-15	GC-MS	SUMMA/SilcoCan canister	250
			SUMMA/SilcoCan canister seven calendar day rental	40
			SUMMA/SilcoCan Regulator seven calendar day rental	40
Volatile Organics[1]	EPA TO-17 (Mod) Semi-quantitative	GC-MS	Supelco Carbotrap 300 Tube	250
			Supelco Carbotrap 300 Tube seven calendar day rental	40
Volatile Organics[2] (Passive Monitoring)	EPA TO-17 (Mod) Semi-quantitative	GC-MS	Ultra Passive Sampler SKC 590-100	250

Analyte List for EPA TO-15,17:(Mod):

Acetone	Chloroform	cis-1,2-Dichloroethene	Hexachloro-1,3-butadiene	Toluene
Benzene	Chloromethane	trans-1,2-Dichloroethene	n-Hexane	1,2,4-Trichlorobenzene
Benzyl chloride	Cyclohexane	1,2-Dichloropropane	2-Hexanone	1,1,1-Trichloroethane
Bromodichloromethane	Dibromochloromethane	cis-1,3-Dichlorpropene	Methyl t-butyl ether	1,1,2-Trichloroethane
Bromoform	1,2-Dibromoethane	trans-1,3-Dichloropropene	4-Methyl-2-pentanone	Trichloroethene
Bromomethane	m-Dichlorobenzene	Ethyl acetate	Methylene chloride	1,2,4-Trimethylbenzene
1,3-Butadiene	o-Dichlorobenzene	Ethyl benzene	Propene	1,3,5-Trimethylbenzene
2-Butanone	p-Dichlorobenzene	4-Ethyl toluene	Styrene	Vinyl acetate
Carbon disulfide	Dichlorodifluoromethane	Freon 11	1,1,2,2-Tetrachloroethane	Vinyl chloride
Carbon tetrachloride	1,1-Dichloroethane	Freon 113	Tetrachloroethene	m/p-Xylene
Chlorobenzene	1,2-Dichloroethane	Freon 114	Tetrahydrofuran	o-Xylene
Chloroethane	1,1-Dichloroethene	Heptane		

[1] In addition to the compounds listed above, a National Institute of Standards and Technology (NIST) database search will be performed and significant TICs (Tentatively Identified Compounds) will be reported from a library of over 75,000 compounds. Contact DCL customer service for more information.

[2] Sampling rates for passive monitors not determined for all compounds

LEAD AND BERYLLIUM

Analyte	Method	Instrument	Medium	Fee($)
Lead	NIOSH 7082	FLAA	MCE Cassette	15
Lead	DCL	FLAA	Paint, Swipe, Bulk	15
Lead	40 CFR 50 APP G	FLAA	8 X 10 Glass Fiber Filter	45
Beryllium	NIOSH 7102	FLAA	MCE Cassette, Swipe	25
Beryllium	NIOSH 7300/7303	ICP	MCE Cassette, Swipe	45

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LIGHT HYDROCARBONS

Analyte	Method	Instrument	Medium	Fee($)
Light Hydrocarbons (Full Panel)	DCL	GC-PDHID	Tedlar Air Bag or Summa	200
Single Analyte/ Additional Analyte	DCL	GC-PDHID	Tedlar Air Bag or Summa	50/25*

Analyte List for Light Hydrocarbons by pulsed discharged hydrogen ion detector:

Methane	Ethylene	Propane	n-Butane	n-Pentane
Ethane	Acetylene	Propylene	iso-Butane	iso-Pentane

METALS

Analyte	Method	Instrument	Medium	Fee($)
Metals Panel A (15 Metals)	NIOSH 7300/7303 (Mod)	ICP	MCE Cassette, Swipe, Bulk	95
Metals Panel B (27 Metals, full list)	NIOSH 7300/7303 (Mod)	ICP	MCE Cassette, Swipe, Bulk	115
Metals Panel C (5 Metals, low detection levels)	NIOSH 7300/7303 (Mod)	ICP	MCE Cassette, Swipe, Bulk	95
Metals Panel D (8 Metals, welding fume specific)	NIOSH 7300/7303 (Mod)	ICP	MCE Cassette, Swipe, Bulk	95
Specific Metals from full list (Panel B)	NIOSH 7300/7303 (Mod)	ICP	MCE Cassette, Swipe, Bulk	45/20*
Metals	DCL	ICP-MS	Whole Blood, Urine, Plasma	Call for Quote

Panel A—Analyte list NIOSH 7300/7303(Mod):

Aluminum	Cadmium	Copper	Manganese	Silver
Arsenic	Calcium	Iron	Nickel	Sodium
Beryllium	Chromium	Lead	Selenium	Zinc

Panel B—Analyte list NIOSH 7300/7303(Mod):

Aluminum	Cobalt	Manganese	Silver	Yttrium
Arsenic	Copper	Molybdenum	Sodium	Zinc
Beryllium	Iron	Nickel	Tellurium	Zirconium
Cadmium	Lead	Phosphorus	Thallium	
Calcium	Lithium	Platinum	Titanium	
Chromium	Magnesium	Selenium	Vanadium	

Panel C—Trace metal analyte list NIOSH 7300/7303(Mod):

Arsenic	Cadmium	Lead	Selenium	Thallium

Panel D—Welding fumes analyte list NIOSH 7300/7303(Mod):

Cadmium	Copper	Manganese	Silver
Chromium	Iron	Nickel	Zinc

Note: Additional fee may be charged for unusual mediums. Please call 1-800-356-9135 for information about recommended media types.

* First analyte on a sample/each additional analyte on same sample.

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Methamphetamine, Illicit Drugs and Related Compounds

Option	Analyte	Method	Instrument	Medium	Fee($)	Fee($)
1	Methamphetamine (only)	NIOSH 9111 Draft	LC-MS	Cotton Gauze	45 4 day TAT	90 2 day TAT
2	Quantitation of the following five drugs: Methamphetamine, Amphetamine, Ephedrine, MDMA (ecstasy) and Pseudoephedrine	NIOSH 9106 or 9109	GC-MS	Cotton Gauze	125 10 day TAT	Quote Other TAT
3	Option # 2 above with LSD, PCP or Cocaine added	NIOSH 9106 Mod	GC-MS	Cotton Gauze	125 (0ption #2 price) + 50 per analyte 10 day TAT	Quote Other TAT
4	Quantitative analysis: (Select compounds of interest from the list below)	NIOSH 9109	GC-MS	Cotton Gauze	100/30 10 day TAT	Quote Other TAT
5	Custom quantitation of individual Compounds listed below using the deuterated analog as internal standard	NIOSH 9106 or 9109	GC-MS	Cotton Gauze	150/50 10 day TAT	Quote Other TAT
6	Unknown illicit drug identification	DCL	GC/MS	Powders, liquids, wipes	500 14 day TAT	Quote Other TAT

Analyte List :

Amphetamine	Codeine	LSD	4-Methylaminorex
Acetaminophen	Dextromethorphan	MBDB	Morphine
6-Acetyl morphine	Diazepam	MDA (ecstasy analog)	N-Ethyl amphetamine
Aminorex	Diphenhydramine	MDEA (ecstasy analog)	N,N-Dimethyltryptamine
Atropine	Ecgonine, methyl ester	MDMA (ecstasy)	Norephedrine (Phenyl propanol amine)
Barbituates	Ephedrine	Melatonin	Norspseudoephedrine
BDB	Fenfluramine	Meperidine	Oxazepam
Benzyl piperazine	Fentanyl	Mescaline	Oxycodone
4-Bromo-2, 5-DMPEA	Flunitrazepam	Methadone	Phencyclidine (PCP)
Caffeine	Heroin	Methamphetamine	Phenethylamine
Cathine (norpseudoephedrine)	Hydrocodone	Methaqualone	Phentermine
Cathinone	Hydromorphone	Methcathinone	Pseudoephedrine
Chlorpheniramine	Ketamine	Methoxyamphetamine, 4-(PMMA)	Tramadol
Cocaine	Lidocaine	Methyl phenidate (Ritalin)	Trifluoromethylphenyl piperazine

Marijuana & Cocaine Identification

Analyte	Method	Instrument	Medium	Fee($)
THC (active drug)	DCL SOP	LC-MS	Bulk Plant Material	75 5 day TAT
Cocaine	DCL SOP	LC-MS	Wipes	75 3 day TAT

* First analyte on a sample/each additional analyte on same sample..

MINE GASES

Analyte	Method	Instrument	Medium	Fee($)
Mine Gases	DCL	GC-PDHID	SUMMA/SilcoCan canister; Tedlar bag; Vacutain tube	320
	SUMMA/SilcoCan canister seven calendar day rental			40
	SSUMMA/SilcoCan Regulator seven calendar day rental			40
Single Analyte/ Additional Analyte	DCL	GC-PDHID	SUMMA/SilcoCan canister	120/45*

Analyte List:

Carbon Monoxide	Nitrogen	Ethane	Propane	iso-Butane
Carbon Dioxide	Oxygen	Ethylene	Propylene	n-Pentane
Hydrogen	Methane	Acetylene	n-Butane	iso-Pentane

PESTICIDES & HERBICIDES

Option	Analyte	Method	Instrument	TAT	Fee($)
1	Pesticides and Herbicides by GC/ECD	NIOSH 5600 or 5602	GC-ECD	7 days	100/30*
2	Pesticides and Herbicides by GC/MS	NIOSH 5600 or NIOSH 5605 (Draft)	GC/MS	7 days	100/35*
3	Pesticides by HPLC	NIOSH 5601	HPLC	7 days	100/30*
4	Pesticides and Herbicides by LC/MS	NIOSH 5601 (Mod)	LC/MS	7 days	130/90*

Please select compounds of interest and associated air methodology from Pesticide Table on next three pages.
Price listed above is per analyte. Groups of analytes may be analyzed at a reduced cost. Please inquire for comparable wipe methods. For any pesticide not listed, call 1-800-356-9135 for more information.

DCL Sampling Recommendations: Unless otherwise specified in the method, DCL recommends for most pesticide and herbicide air sampling, use of SKC 226-58 OVS-2 tube. Sample at 0.1 to 1 liter/minute for up to 8 hours. For wipe samples use pre-cleaned cotton gauze moistened with 100% isopropanol.

Analyte	Method	Instrument	TAT	Fee($)
Comprehensive Pesticide Screen (semi-quantitative)	DCL Method on SKC 226-58	GC-MS	14 days	500
Comprehensive Herbicide Screen (semi-quantitative)	DCL Method on SKC 226-58	GC-MS	14 days	500

Note: Comprehensive Pesticide Screen: The classes of pesticides that have a reasonable expectation of being detected by this procedure are organophosphorus, organochlorine, pyrethroid, imidazole and triazole fungicides, and most organonitrogen pesticides. Pesticides and fungicides that cannot be detected by this procedure include inorganics (arsenic and tin compounds), dithiocarbamates (maneb, mancozeb, etc.), and most carbamate insecticides. For these classes of compounds, refer to methods listed above or call for quote.

Note: Comprehensive Herbicide Screen: The classes of pesticides that have a reasonable expectation of being detected by this procedure are nitro- and chlorinated phenols (e.g., trichlorophenol, pentachlorophenol, dinoseb), most benzoic acid herbicides (e.g.' dicamba), and phenoxyacetic acid and related herbicides and their esters (e.g., 2,4-D, 2,4-DB, 2,4,5-T, dichlorprop, MCPA, mecoprop, Silvex, etc.), triazenes (atrazine, propazine, simazine), bromacil, many N-arylcarbamates, and many more. Herbicides that cannot be detected by this procedure include inorganics (arsenic compounds), glyphosate (Roundup™), quaternary amines (paraquat and diquat), sulfonylureas, and most substituted ureas. For these classes of compounds, refer to methods listed above or call for quote.

* First analyte on a sample/additional analyte on same sample

PESTICIDES & HERBICIDES LIST

	PESTICIDE	AIR METHODS GC-MS	GC-ECD	LC-MS HPLC	Notes
1	Abamectin			LC-MS	MM(870)
2	Acephate	5604	5604		
3	Acetochlor	5605	5600	5601	
4	Acifluorfen	5605	5600	5601	ME
5	Alachlor	5605	5600	5601	
6	Aldicarb			5601	
7	Aldoxycarb			5601	
8	Aldrin	5605	5600		
9	Allethrin	5605	5600	5601	
10	Ametryn	5605		5601	
11	Amitraz	DCL		5601	
12	Amitrole	DCL			TMS
13	Ancymidol	DCL		5601	TMS
14	Asulam	DCL		5601	TMS
15	Atrazine	5605	5600	5601	
16	Azadirachtin			LC-MS	MM(721)
17	Azinphos methyl	5605	5600	5601	
18	Azoxystrobin			5601	
19	Benalaxyl	5605		5601	
20	Bendiocarb			5601	
21	Benfluralin	5605	5600	5601	
22	Benomyl			5601	
23	Bensulfuron methyl			5601	
24	Bensulide	DCL		5601	TMS
25	Bentazon	5605		5601	ME
26	Benzthiazuron			5601	
27	BHC	5605	5600		
28	Bifenthrin	5605	5600	5601	QFF
29	Bioallethrin	5605	5600	5601	
30	Bioresmethrin	5605		5601	
31	Biphenyl	5605		5601	
32	Brodifacoum			5601	QFF
33	Bromacil	5605	5600	5601	ME
34	Bromadiolone			5601	QFF
35	Bromophos	5605	5600	5601	
36	Bromophos ethyl	5605	5600	5601	
37	Bromopropylate	DCL		5601	TMS
38	Bromoxynil	5605	5600	5601	ME
39	Bromoxynyl octanoate	5605	5600	5601	
40	Bronopol	DCL			TMS
41	Buprofezin	5605		5601	
42	Butralin	5605	5600	5601	
43	Butylate	5605			
44	Captan	5605	5600	5601	
45	Carbaryl			5601	
46	Carbendazim			5601	
47	Carbofuran			5601	
48	Carbosulfan	5605		5601	
49	Carboxin	5605		5601	
50	Chlorbenside	5605	5600	5601	
51	Chlordane	5605	5600		
52	Chlorethoxyfos	5605	5600		
53	Chlorfenapyr	5605	5600	5601	
54	Chlorflurenol	DCL		5601	TMS
55	Chlorimuron ethyl			5601	
56	Chlorobenzilate	DCL		5601	TMS
57	Chloroneb	5605	5600	5601	
58	Chlorophacinone			5601	QFF
59	Chloropicrin	5605	5600		
60	Chlorothalonil	5605	5600	5601	
61	Chlorpropham	5605	5600	5601	
62	Chlorpyrifos	5605	5600	5601	
63	Chlorpyrifos methyl	5605	5600	5601	
64	Chlorsulfuron			5601	
65	Clethodim	5605		5601	ME
66	Clofentezine	5605	5600	5601	
67	Clomazone	5605	5600	5601	
68	Clopyralid	5605	5600	5601	ME
69	Coumaphos	5605	5600	5601	
70	Cyanazine	5605	5600	5601	
71	Cyanophos	5605	5600	5601	
72	Cybutryne	5605		5601	
73	Cyclanilide	5605	5600	5601	ME
74	Cycloate	5605			
75	Cyfluthrin	5605	5600	5601	QFF
76	Cyhalothrin, lambda-	5605	5600	5601	QFF
77	Cypermethrin	5605	5600	5601	QFF
78	Cyphenothrin	5605	5600	5601	QFF
79	Cyproconazole	5605	5600	5601	
80	Cypromazine	DCL		5601	
81	2,4-D	5605	5600	5601	ME
82	Dacthal	5605	5600	5601	
83	Dazomet	5605			
84	2,4-DB	5605	5600	5601	ME
85	DDD	5605	5600		
86	DDE	5605	5600		
87	DDT	5605	5600		
88	DEF	5605			
89	Deltamethrin	5605	5600	5601	QFF
90	Desmedipham			5601	
91	Diazinon	5605	5600	5601	
92	Dicamba	5605	5600	5601	ME
93	Dichlobenil	5605	5600	5601	
94	Dichlorprop	5605	5600	5601	ME
95	Dichlorvos	5605	5600		
96	Diclofop methyl	5605	5600	5601	
97	Dicloran	DCL	5600	5601	TMS
98	Dicofol	DCL		5601	TMS
99	Dicrotophos	5605	5600	5601	
100	Dieldrin	5605	5600		
101	Dienochlor	5605	5600		
102	Difenzoquat			5601	QFF
103	Diflubenzuron			5601	
104	Diflufenzopyr			5601	
105	Dimethenamid	5605	5600	5601	
106	Dimethoate	5605	5600		
107	Diniconazole	5605	5600	5601	
108	Dinocap	5605	5600	5601	
109	Dinoseb	5605	5600	5601	ME
110	Diphacinone			5601	QFF
111	Diquat dibromide			5601	QFF
112	Disulfoton	5605			
113	Dithianon	5605	5600	5601	
114	Dithiopyr	5605	5600	5601	
115	Diuron			5601	
116	Dodine	DCL			TMS
117	Endosulfan sulfate	5605	5600		
118	Endosulfan, alpha-	5605	5600		
119	Endosulfan, beta-	5605	5600		
120	Endothall	5605			ME

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PESTICIDES & HERBICIDES LIST (CONT.)

	PESTICIDE	AIR METHODS GC-MS	GC-ECD	LC-MS HPLC	Notes		PESTICIDE	AIR METHODS GC-MS	GC-ECD	LC-MS HPLC	Notes
121	Endrin	5605	5600			181	Imidacloprid	DCL		5601	TMS
122	EPTC	5605				182	Iprodione	DCL		5601	TMS
123	Esfenvalerate	5605	5600	5601	QFF	183	Isazophos methyl	5605	5600	5601	
124	Ethalfluralin	5605	5600	5601		184	Isodrin	5605	5600		
125	Ethephon	DCL			ME;TMS	185	Isoproturon			5601	
126	Ethion	5605	5600			186	Isoxaben	5605		5601	
127	Ethofumasate	5605		5601		187	Kinoprene	5605	5600		
128	Ethoprop	5605				188	Lactofen	5605	5600	5601	
129	Ethoxyquin	DCL		5601	TMS	189	Lindane	5605	5600		
130	Fenamiphos	5605		5601		190	Linuron			5601	
131	Fenarimol	DCL		5601	TMS	191	Malathion	5605	5600		
132	Fenbuconazole	5605	5600	5601		192	Maleic Hydrazide	DCL			TMS
133	Fenbutatin oxide	DCL		5601	QFF	193	Mancozeb			3600	Red
134	Fenitrothion	5605	5600	5601		194	Maneb			3600	Red
135	Fenoxaprop ethyl	5605	5600	5601		195	MCPA	5605	5600	5601	ME
136	Fenoxycarb	5605		5601		196	MCPB	5605	5600	5601	ME
137	Fenpropathrin	5605	5600	5601		197	Mecoprop	5605	5600	5601	ME
138	Fensulfothion	5605	5600	5601		198	Mefenoxam	5605		5601	
139	Fenthion	5605		5601		199	Mefluidide	5605	5600	5601	ME
140	Fenvalerate	5605	5600	5601	QFF	200	Mepiquat chloride	DCL		5601	QFF;Pyr
141	Ferbam			3600	Red	201	Mercaptobenzothiazole	5605		5601	
142	Fipronil	5605	5600	5601		202	Metalaxyl	5605		5601	
143	Fipronil sulfone	5605	5600	5601	TBP	203	Metam			3600	
144	Fipronil sulfide	5605	5600	5601	TBP	204	Methabenzthiazuron			5601	
145	Flamprop isopropyl	5605	5600	5601		205	Methamidophos	5605			
146	Flamprop methyl	5605	5600	5601		206	Methidathion	5605		5601	
147	Fluazifop-p-butyl	5605	5600	5601		207	Methiocarb			5601	
148	Fludioxonil	5605	5600	5601		208	Methomyl			5601	
149	Flumetralin	5605	5600	5601		209	Methoprene	5605	5600		
150	Flumetsulam	DCL		5601		210	Methoxychlor	5605	5600		
151	Flumiclorac-pentyl	5605	5600	5601		211	Methyl parathion	5605	5600	5601	
152	Fluometuron			5601		212	Metolachlor	5605	5600	5601	
153	Fluridone	DCL		5601		213	Metribuzin	5605		5601	
154	Flutolail	5605	5600	5601		214	Metsulfuron methyl			5601	
155	Fluvalinate	5605	5600	5601	QFF	215	MGK 264	5605			
156	Folpet	5605	5600	5601		216	MGK 326	5605		5601	
157	Fomesafen sodium	5605	5600	5601		217	Mirex	5605	5600		
158	Fonofos	5605				218	Molinate	5605			
159	Formetanante			5601		219	Monuron			5601	
160	Fosamine ammonium	9206			QFF	220	Myclobutanil	5605	5600	5601	
161	Fuvalinate, tau-	5605	5600	5601	QFF	221	Nabam			3600	
162	Gluphosinate ammonium	9206			QFF	222	Naled	5605	5600		
163	Glyphosate	9206			QFF	223	Naphthyloxyacetic acid	5605		5601	ME
164	Glyphosine	9206			QFF	224	Napropamide	5605		5601	
165	Halofenozide	5605	5600	5601		225	Naptalam	DCL		5601	ME;TMS
166	Halosulfuron			5601		226	Neburon			5601	
167	Heptachlor	5605	5600			227	Niclosamide	5605	5600	5601	ME
168	Heptachlor epoxide	5605	5600			228	Nicosulfuron			5601	
169	Hexaconazole	5605	5600	5601		229	Norflurazon	5605	5600	5601	
170	Hexaflumuron			5601		230	Omethoate	5605			
171	Hexazinone	5605		5601		231	Oryzalin	DCL		5601	TMS
172	Hexythiazox			5601		232	Oxadiazon	5605	5600	5601	
173	Hydramethylnon (Amdro)			5601		233	Oxadixyl	5605		5601	
174	Hymexazol	DCL		5601	TMS	234	Oxamyl			5601	
175	Imazalil	5605	5600	5601		235	Oxycarboxin	5605		5601	
176	Imazamethabenz-methyl	5605	5600	5601	ME	236	Oxydemeton methyl	5605			
177	Imazapic	5605	5600	5601	ME	237	Oxyfluorfen	5605	5600	5601	
178	Imazapyr	5605		5601	ME	238	Oxytetracycline			LC-MS	MM(497)
179	Imazaquin	5605		5601	ME	239	Oxythioquinox	5605		5601	
180	Imazethapyr	5605	5600	5601	ME	240	Paclobutrazol	5605	5600	5601	

PESTICIDES & HERBICIDES LIST (CONT.)

	PESTICIDE	AIR METHODS GC-MS	GC-ECD	LC-MS HPLC	Notes
241	Paraquat			5601	QFF
242	Parathion	5605	5600	5601	
243	PCNB	5605	5600	5601	
244	Pebulate	5605			
245	Pendimethalin	5605	5600	5601	
246	Pentachlorophenol	5605	5600	5601	ME
247	Permethrin	5605	5600	5601	
248	Perthane	5605	5600		
249	Phenmedipham			5601	
250	Phenothrin, d-	5605		5601	
251	Phenthoate	5605		5601	
252	Phenylphenol, o-	DCL		5601	TMS
253	Phorate	5605			
254	Phosalone	5605	5600	5601	
255	Phosfolan	5605			
256	Phosmet	5605	5600	5601	
257	Phosphamidon	5605	5600	5601	
258	Phostebupirim	5605	5600	5601	
259	Picloram	5605	5600	5601	ME
260	Pindone (Pival)	DCL		5601	TMS
261	Piperalin	5605	5600	5601	
262	Piperonyl butoxide	5605			
263	Pirimicarb			5601	
264	Pirimiphos methyl	5605		5601	
265	Pirimisulfuron-methyl			5601	
266	Prallethrin	5605	5600	5601	
267	Prodiamine	DCL		5601	
268	Profenofos	5605	5600	5601	
269	Prometon	5605		5601	
270	Prometryn	5605		5601	
271	Pronamide	5605	5600	5601	
272	Propachlor	5605	5600	5601	
273	Propamocarb	DCL			TMS
274	Propanil	5605	5600	5601	
275	Propargite	5605		5601	
276	Propazine	5605	5600	5601	
277	Propetamphos	5605	5600		
278	Propiconazole	5605	5600	5601	
279	Propoxur			5601	
280	Prosulfuron			5601	
281	Pyraclofos	5605	5600	5601	
282	Pyrazon	DCL		5601	TMS
283	Pyrazophos	5605		5601	
284	Pyrazoxyfen	5605	5600	5601	
285	Pyrethrum	5605	5600	5601	
286	Pyridaben	5605	5600	5601	
287	Pyridate	5605	5600	5601	
288	Pyrithiobac-sodium	5605	5600	5601	ME
289	Pyrproxyfen	5605		5601	
290	Quinalphos	5605		5601	
291	Quinclorac	5605	5600	5601	ME
292	Quinolinol, 8-	DCL		5601	TMS
293	Quizalofop ethyl	5605	5600	5601	
294	Resmethrin	5605		5601	
295	Rimsulfuron			5601	
296	Ronnel	5605	5600	5601	
297	Rotenone	5605		5601	
298	Sethoxydim	5605		5601	ME
299	Siduron			5601	
300	Silvex	5605	5600	5601	ME
301	Simazine	5605	5600	5601	
302	Simetryn	5605		5601	
303	Spinosad			LC-MS	MM(740)
304	Sulfentrazone	5605	5600	5601	ME;TMS
305	Sulfometuron methyl			5601	
306	Sulfotepp	5605			
307	Sulprofos	5605		5601	
308	2,4,5-T	5605	5600	5601	ME
309	TCMTB	5605		5601	
310	Tebuconazole	5605	5600	5601	
311	Tebuthiuron			5601	
312	Tecnazene	5605	5600	5601	
313	Tefluthrin	5605	5600	5601	
314	Temephos	5605		5601	QFF
315	Terbacil	5605		5601	
316	Terbufos	5605			
317	Terbuthylazine	5605	5600	5601	
318	Terbutryn	5605		5601	
319	Terrazole	5605	5600	5601	
320	Tetrachlorvinphos	5605	5600	5601	
321	Tetramethrin	5605	5600	5601	
322	Thiabendazole	DCL		5601	TMS
323	Thiadiazuron			5601	
324	Thifensulfuron-methyl			5601	
325	Thiobencarb	5605	5600	5601	
326	Thiodicarb			5601	
327	Thiophanate-methyl			5601	
328	Thiram			3600	Red
329	Toxaphene	5605	5600		
330	Tralomethrin	5605	5600	5601	
331	Triadimefon	5605	5600	5601	
332	Triadimenol	DCL		5601	TMS
333	Triallate	5605			
334	Triasulfuron			5601	
335	Triazophos	5605		5601	
336	Tribenuron-methyl			5601	
337	Trichlorfon	5605	5600		
338	Trichloronate	5605	5600	5601	
339	Trichlorophenol, 2,4,6-	5605	5600	5601	ME
340	Triclopyr	5605	5600	5601	ME
341	Triflumizole	5605	5600	5601	
342	Triflumuron			5601	
343	Trifluralin	5605	5600	5601	
344	Triflusulfuron-methyl			5601	
345	Triforine	DCL			
346	Trinexapac-ethyl	DCL		5601	ME;TMS
347	Troysan KK-108A	5605		5601	
348	Ttriphenyltin hydroxide	DCL			
349	Uniconizole-P	5605	5600	5601	
350	Vernolate	5605			
351	Vinclozolin	5605	5600	5601	
352	Warfarin	5605		5601	ME
353	Zectran			5601	
354	Zineb			3600	Red
355	Ziram			3600	Red

Notes:
ME = Methylation of acidic groups necessary for GC
MM = Macromolecule (approx. molecular weight)
Pyr = Pyrolysis injection technique for GC-MS.
QFF = For air sampling, use Quartz Fiber Filter.
Red = Need to keep sample under reducing conditions.
TBP = Toxic breakdown products.
TMS = Trimethylsilylation of polar groups necessary for GC.

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POLYCHLORINATED BIPHENYLS (PCBs)

Analyte	Method	Instrumentation	Medium Types	Fee ($)
PCBs	NIOSH 5503 (Mod)	GC-ECD	Wipe, Filter, Florisil Tube Oil, Bulk	80

Analyte List:

Aroclor 1016	Aroclor 1232	Aroclor 1248	Aroclor 1260
Aroclor 1221	Aroclor 1242	Aroclor 1254	

POLYNUCLEAR AROMATIC HYDROCARBONS (PAHs)

Analyte	Method	Instrumentation	Medium	Fee ($)
PAHs	NIOSH 5528 (Draft)[3]	GC-MS	OVS, XAD-7[4] SKC 226-57	80/35*;230†
PAHs	NIOSH 5506 (Mod)	HPLC-UV	SKC 226-30-04[5] + Prefilter (PTFE)	80/35*;230†
PAHs	OSHA 58 (Mod)	HPLC-UV	PTFE Filter, 2µm	80/35*;230†
PAHs	EPA TO-13	GC-MS	SKC 226-131 (PUF Sampler)	325†

Analyte List:

Acenaphthene	Benzo[b]fluoranthene	Chrysene	Indeno[1,2,3-cd]pyrene
Acenaphthylene	Benzo[k]fluoranthene	Dibenz[a,h]anthracene	Naphthalene
Anthracene	Benzo[g,h,i]perylene	Fluoranthene	Phenanthrene
Benz[a]anthracene	Benzo[a]pyrene	Fluorene	Pyrene

SILICA (Crystalline)

Analyte	Method	Instrument	Medium	Fee($)
Quartz[6]	NIOSH 7500 (Mod)	XRD	PVC, 5µm	45
Quartz,[6] Cristobalite	NIOSH 7500 (Mod)	XRD	PVC, 5µm	55
Quartz,[6] Cristobalite, Tridymite	NIOSH 7500 (Mod)	XRD	PVC, 5µm	65
Quartz	NIOSH 7500 (Mod)	XRD	Bulk Material	100
Quartz, Cristobalite	NIOSH 7500 (Mod)	XRD	Bulk Material	110
Quartz, Cristobalite, Tridymite	NIOSH 7500 (Mod)	XRD	Bulk Material	120

* First analyte on a sample/additional analyte on same sample
† Fee for complete panel
3 Improved NIOSH method for collection and analysis
4 Validation studies demonstrate excellent retention and no breakthrough for listed PAH compounds
5 Not recommended for naphthalene or other low molecular weight PAH
6 Total weight measurement should also be requested to calculate OSHA PEL

SOLVENT PANEL— LOW LEVEL INDOOR AIR QUALITY

Analyte	Method	Instrument	Medium	Fee($)
Quantitative Analysis of all Compounds listed below	DCL SOP	GC-MS	Charcoal 226-01 or 3M 3500 Passive Monitor	110
First Analyte/ Additional Analyte	DCL SOP	GC-MS	Charcoal 226-01 or 3M 3500 Passive Monitor	35/15*

Analyte List:

Benzene
n-butyl alcohol
n-butyl acetate
2-ethoxyethanol acetate
Chlorobenzene
Chloroform
Cumene (isopropyl benzene)
Cyclohexane
Cyclohexene
1,3-dichlorobenzene
1,2-dichlorobenzene
1,4-dichlorobenzene
1,2-dichloroethane
Ethylbenzene
n-hexane
Methyl ethyl ketone (MEK)
Methyl isobutyl ketone
Naphthalene
n-octane
2-pentanone
n-propyl acetate
Styrene
1,1,1-trichloroethane
1,1,2-trichloroethane
Tetrachloroethene
Tetrahydrofuran
Toluene
Trichloroethene
Total methyl styrenes
Total xylenes

Note: Analysis is performed by mass spectrometry which ensures positive identification. Full calibration provides quantitative results for all compounds listed above. Identification of unknown compounds not listed is available at an additional charge of $10 per compound. Contact DCL customer service for more information.

SULFUR GASES

Analyte	Method	Instrument	Medium	Fee($)
Organosulfur Compounds (Full List)	DCL	GC-SCD	Tedlar Air Bag or SUMMA Canister	320
Organosulfur Compounds (Specific Analytes) Choose from list below:	DCL	GC-SCD	Tedlar Air Bag or SUMMA Canister	100/50*
SO_2	DCL	GC-SCD	Tedlar Air Bag or SUMMA Canister	100

Analyte List:

n-Butyl mercaptan
t-Butyl mercaptan
Carbon disulfide
Carbonyl sulfide
Diethyl sulfide
Dimethyl sulfide
Dimethyl disulfide
Ethyl Mercaptan
Hydrogen sulfide
Isopropyl mercaptan
Methyl mercaptan
n-Propyl mercaptan
Tetrahydrothiophene
Thiophene

* First analyte on a sample/each additional analyte on same sample.

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EPA Toxic Organic Methods

Analyte	Method	Instrument	Medium	Fee($)
Pesticides & PCBs (High Volume)	EPA TO-4	GC-ECD or MS	SKC PUF Cartridge	200
Pesticides & PCBs (Low Volume)	EPA TO-10A	GC-ECD	SKC PUF Cartridge	300
PAHs	EPA TO-13	GC-MS	SKC PUF Cartridge	225
Volatiles (SUMMA/Silco Canisters)	EPA TO-15	GC-MS	SUMMA/SilcoCan Canister	250
Volatiles (Carbotrap Tubes)	EPA TO-17 (Mod) Semi-quantitative	GC-MS	Supelco Carbotrap 300 Tube	250

Vapor Intrusion

Analyte	Method	Instrument	Medium	Fee($)
Volatiles (Selected List)	TO-15	GC-MS SIM	Tedlar Air Bag or SUMMA Canister	320

NOTES

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NIOSH 4TH EDITION METHODS

NIOSH National Institute for Occupational Safety and Health

Fourth Edition NIOSH Method	Analytes(s)	Instrument	Sample Medium	Fee ($)*
0500	Dust, total	GRAV	PVC, 5µm, Preweighed	10
0600	Dust, respirable	GRAV	PVC, 5µm, Preweighed	10
1000	Allyl chloride	GC-FID	SKC 226-01	75
1001	Methyl chloride	GC-FID	SKC 226-09	90
1002	Chloroprene	GC-FID	SKC 226-01	90
1003	Halogenated hydrocarbons	GC-FID	SKC 226-01	50/15*
1004	Dichloroethyl ether	GC-FID	SKC 226-01	75
1005	Methylene chloride	GC-FID	SKC 226-01 (2)	50
1006	Fluorotrichloromethane	GC-FID	SKC 226-09	75
1007	Vinyl chloride	GC-FID	SKC 226-01 (2)	90
1008	Ethylene dibromide	GC-ECD	SKC 226-01 GWS	75
1010	Epichlorohydrin	GC-FID	SKC 226-01	75
1011	Ethyl bromide	GC-FID	SKC 226-01	75
1012	Difluorodibromomethane	GC-FID	SKC 226-01 (2)	75
1013	Propylene dichloride	GC-FID	SKC 226-81A	75
1014	Methyl iodide	GC-FID	SKC 226-01	75
1015	Vinylidene chloride	GC-FID	SKC 226-01	90
1016	Tetrachlorodifluoroethane	GC-FID	SKC 226-01	75
1017	Bromotrifluoromethane	GC-FID	SKC 226-09	75
1018	Dichlorodifluoromethane	GC-FID	SKC 226-01	90
1019	1,1,2,2-Tetrachloroethane	GC-FID	SKC 226-81A	75
1020	1,1,2-Trichloro-1,2,2-trifluoroethane	GC-FID	SKC 226-01	75
1022	Trichloroethylene	GC-FID	SKC 226-01	50
1024	1,3-Butadiene	GC-FID	SKC 226-37	75
1025	1-bromopropane/ 2-bromopropane	GC-FID	SKC 266-01 or 226-121	75/25*
1026	p-Chlorobenzotrifluoride	GC-FID	SKC 226-01	75
1300	Ketones I	GC-FID	SKC 226-01	50/15*
1301	Ketones II	GC-FID	SKC 226-01	50/15*
1302 (Mod)	n-Methyl-2-pyrrolidinone	GC-MS	SKC 226-01	60
1400	Alcohols I	GC-FID	SKC 226-01	50/15*
1401	Alcohols II	GC-FID	SKC 226-01	50/15*
1402	Alcohols III	GC-FID	SKC 226-01	50/15*
1403	Alcohols IV	GC-FID	SKC 226-01	50/15*
1450	Esters I	GC-FID	SKC 226-01	50/15*
1451	Methyl cellosolve acetate	GC-FID	SKC 226-01	60
1452	Ethyl formate	GC-FID	SKC 226-01	60
1453	Vinyl acetate	GC-FID	ORBO 92 Tube	60
1454	Isopropyl acetate	GC-FID	SKC 226-01	60
1457	Ethyl acetate	GC-FID	SKC 226-01	60
1458	Methyl acetate	GC-FID	SKC 226-01	60
1459	Methyl acrylate	GC-FID	SKC 226-01	60
1460	Isopropyl Acetate	GC-FID	SKC 226-01	75
1500	Hydrocarbons	GC-FID	SKC 226-01	50/15*
1501	Aromatic hydrocarbons	GC-FID	SKC 226-01	50/15*
1550	Naphthas	GC-FID	SKC 226-01	50
1551	Turpentine	GC-FID	SKC 226-01	50
1601	1,1-Dichloro-1-nitroethane	GC-FID	SKC 226-81A	75
1602	Dioxane	GC-FID	SKC 226-01	50
1603	Acetic acid	GC-FID	SKC 226-01	100

* First analyte on a sample/additional analyte on same sample

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Fourth Edition NIOSH Method	Analytes(s)	Instrument	Sample Medium	Fee ($)*
1604	Acrylonitrile	GC-FID	SKC 226-01	50
1606	Acetonitrile	GC-FID	SKC 226-09	50
1608	Glycidol	GC-FID	SKC 226-01	75
1609	Tetrahydrofuran	GC-FID	SKC 226-01	50
1610	Ethyl ether	GC-FID	SKC 226-01	50
1611	Methylal	GC-FID	SKC 226-01	75
1612	Propylene oxide	GC-FID	SKC 226-01	90
1613 (Mod)	Pyridine	GC-MS	SKC 226-01	75
1614	Ethylene oxide	GC-ECD	SKC 226-81A	150
1615	Methyl tert-butyl ether	GC-FID	SKC 226-37	50
1616	n-Butyl glycidyl ether	GC-FID	SKC 226-01	75
1618	Isopropyl ether	GC-FID	SKC 226-01	75
1622 (Draft)	Carbon Disulfide	GC-SCD	SKC 226-01/226-44	80
2000	Methanol	GC-FID	SKC 226-51	50
2002 (Mod)	Aromatic amines modified	LC-MS	SKC 226-10	Call for quote
2003	1,1,2,2-Tetrabromoethane	GC-MSD	SKC 226-10	75
2004 (Mod)	Dimethyl acetamide	GC-FID	SKC 226-10	75
2005	Nitrobenzene	GC-FID	SKC 226-10	75
2007	Aminoethanol compounds I	GC-FID	SKC 226-10-04	120/45*
2010 (Mod)	Aliphatic amines modified	LC-MS	SKC 226-10	Call for quote
2011	Formic acid	IC	226-10-03/Prefilter (PTFE)	75
2014	p-Chlorophenol	HPLC-UV	SKC 226-10	80
2016	Formaldehyde	HPLC-UV	SKC 226-119 DNPH	110
2018	Aliphatic Aldehydes	HPLC-UV	SKC 226-119 DNPH	110/35*
2500	Methyl ethyl ketone	GC-FID	SKC 226-81A/226-121	50
2505	Furfuryl alcohol	GC-FID	SKC 226-115	50
2507	Nitroglycerin & EGDN	GC-ECD	SKC 226-35-03	75/25*
2508	Isophorone	GC-FID	SKC 226-81A	60
2510	I-Octanethiol	GC-SCD	SKC 226-35-03	60
2513	Ethylene chlorohydrin	GC-FID	SKC 226-81A	75
2514	Anisidine	HPLC-UV	SKC 226-30-05	80
2516	Dichlorofluoromethane	GC-FID	SKC 226-09 (2)/226-25	90
2517	Pentachloroethane	GC-ECD	SKC 226-59-04	75
2518	Hexachlorocyclopentadiene	GC-ECD	SKC 226-116 (2)	95
2519	Ethyl chloride	GC-FID	SKC 226-25	90
2521	Methyl cyclohexanone	GC-FID	SKC 226-115	75
2522	Nitrosamine	GC-MS	Thermosorb/N	250
2523	1,3-Cyclopentadiene	GC-FID	Chromosorb 104 tube	75
2524	Dimethyl Sulfate	GC-MS or GC-SCD	SKC 226-114	90
2526	Nitroethane	GC-FID	SKC 226-30-02	75
2527	Nitromethane	GC-FID	SKC 226-111A	75
2528	2-Nitropropane	GC-FID	SKC 226-110	75
2530	Diphenyl (biphenyl)	GC-FID	SKC 226-35-01	60
2532	Glutaraldehyde	HPLC-UV	SKC 226-119	90
2533 (Mod)	Tetraethyl Lead/Tetramethyl Lead	GC-MS	SKC 226-30-04/226-30-06	90/35*
2536	Valeraldehyde	GC-FID	SKC 226-118	60
2537	Methyl methacrylate	GC-FID	SKC 226-30-06	50
2538	Acetaldehyde	GC-FID	SKC 226-27	60
2539	Aldehyde screen	GC-FID	SKC 226-118 (2-hydroxy methyl) piperdine (Panel of 9 compounds)	60/20* $175 (pg 6)
2540	Ethylenediamine	HPLC-UV	SKC 226-30-18	120
2541	Formaldehyde	GC-FID	SKC 226-118	60
2543	Hexachlorobutadiene	GC-ECD	SKC 226-30-04	75

* First analyte on a sample/additional analyte on same sample

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Fourth Edition	Analytes(s)	Instrument	Sample Medium	Fee ($)*
2544 (Mod)	Nicotine	GC-MS	SKC 226-30-04	75
2545	Allyl glycidyl ether	GC-FID	SKC 226-35-03	75
2546	Cresols/ Phenols	GC-FID	SKC 226-95	75/35*
2552	Methyl Acrylate	GC-FID	SKC 226-121	75/20*
2553	Ketones II	GC-FID	SKC 226-121	75/20*
2554	Glycol Ethers	GC-FID	SKC 226-81A	50/15*
2555	Ketones I	GC-FID	SKC 226-121	75/20*
2556	Isophorone	GC-FID	SKC 226-93	75
2557	Diacetyl/Acetoin	GC-FID	SKC 226-121	90/25*
2558	Acetoin	GC-FID	SKC 226-121	90
2559	Decabromodiphenyl Oxide	HPLC-UV	Quartz fiber filter	120
3500	Formaldehyde	VIS	Impinger	50
3503	Hydrazine	VIS	Impinger	130
3507	Acetaldehyde	HPLC-UV	Impinger	90
3509	Aminoethanol compounds II	IC	Impinger	120/45*
3512	Maleic anhydride	HPLC-UV	Impinger	125
3513 (Mod)	Tetranitromethane	GC-MS	Impinger	75
5000	Carbon black	GRAV	PVC, 5µm, Preweighed	10
5001	2,4-D & 2,4,5-T	HPLC-UV	Glass fiber filter, 1µm	125/35*
5002	Warfarin	HPLC-UV	PTFE filter, 1µm	80
5003	Paraquat	HPLC-UV	PTFE filter, 1µm	80
5004	Hydroquinone	HPLC-UV	MCE filter, .8µm	80
5005	Thiram	HPLC-UV	PTFE filter, 1µm	80
5008	Pyrethrum	HPLC-UV	Glass fiber filter, 1µm	80
5009	Benzoyl peroxide	HPLC-UV	MCE filter, .8µm	80
5010	Bromoxynil	HPLC-UV	PTFE filter, 2µm	80/30*
5012 (Mod)	EPN	GC-MS	Glass fiber filter, 1µm	80
5014	Chlorinated terphenyl	GC-ECD	Glass fiber filter, 1µm	80
5016	Strychnine	HPLC	Glass fiber filter, 1µm	80
5017 (Mod)	Dibutyl phosphate	GC-MS	PTFE filter, 1µm	80
5020	Dibutyl phthalate/Di(2-ethylhexyl)phthalate	GC-FID	MCE filter, .8µm	60/20*
5021	o-Terphenyl	GC-FID	PTFE filter, 2µm	60
5026	Oil mist, mineral (A bulk sample must be submitted with filters)	IR	MCE filter, .8µm	100
5027	Ribavirin	HPLC-UV	Glass fiber filter, 1µm	135
5029	4,4-Methylenedianiline (MDA)	HPLC-UV	SKC 225-9004	80
5030	Cyanuric acid	HPLC-UV	PVC, 5µm, Preweighed	160
5031	Aspartame	HPLC-UV	PTFE filter, 1µm	135
5033	p-Nitroaniline	HPLC	MCE filter, .8µm	80
5034 (Mod)	Tributyl phosphate	GC-MS	MCE filter, .8µm	80
5039	Chlorinated camphene (Toxaphene)	GC-ECD	MCE filter, .8µm	80
5040	Elemental carbon	OC-EC	Quartz fiber filter	45
5042	Benzene solubles & Total weight	GRAV	PTFE, 2µm, Preweighed	85
5044	Estrogenic / Hormone Compounds	HPLC	PTFE Filter	125
5502	Aldrin & Lindane	GC-ECD	Impinger	80/35*
5503 (Mod)	Polychlorinated biphenyls	GC-ECD	226-39/Prefilter (GFF)	80
5506 (Mod)	Polynuclear aromatic hydrocarbons (PAH)	HPLC-UV	226-30-04/Prefilter (PTFE)	80/35* (Panel – $230) (pg15)
5509	Benzidine & 3,3-Dichlorobenzidine	HPLC-UV	Glass fiber filter, 1µm	80/35*
5510	Chlordane	GC-ECD	226-107/Prefilter (MCE)	80
5512	Pentachlorophenol	HPLC-UV	Impinger	80
5514 (Mod)	Demeton	GC-MS	MCE filter, 2µm	80
5519	Endrin	GC-ECD	MCE filter, .8µm	80
5522	HDI, 2,4-TDI, 2,6-TDI, MDI	HPLC-UV	Impinger	135/45*

* First analyte on a sample/additional analyte on same sample

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Formulation NIOSH Method	Analytes(s)	Instrument	Sample Medium	Fee ($)*
5523	Glycols	GC-FID	SKC 226-57	75/35*
5524	Metal working fluids	GRAV	PTFE, 2µm, Preweighed	60
5525	Isocyanates, Total (MAP)	HPLC	PTFE or Impinger	275
5528 (Draft)	Polynuclear Aromatic Hydrocarbons (PAH)	GC-MS SIM	SKC 226-57, OVS (XAD-7)	80/35* (Panel—$230) (pg15)
5600	Organophosphorus pesticides	GC-ECD	SKC 226-58	100/50* (Panel – $350) (pg11)
5601	Pesticides	HPLC	SKC 226-58 OVS2	(pg11)
5602	Organochlorine pesticides	GC-ECD	SKC 226-58	100/50* (Panel – $350) (pg11)
6001(Mod)	Arsine	ICP	SKC 226-01	90
6004	Sulfur dioxide/Sulfate	IC	SKC 225-9005	60/20*
6005	Iodine	IC	SKC 226-67	75
6007(Mod)	Nickel Carbonyl	ICP	ORBO 304	90
6009	Mercury	CVAA	SKC 226-17-1A	60
6010	Hydrogen cyanide	VIS	SKC 226-28	50
6011	Chlorine & Bromine	IC	SKC 225-9006	100/50*
6012	Sulfuryl Fluoride	IC	SKC 226-16	90
6013	Hydrogen Sulfide	IC	226-09/Prefilter (PTFE)	75
6014	Nitric oxide & Nitrogen dioxide	VIS	SKC 226-40	75/30*
6015	Ammonia	VIS	SKC 226-10-06	50
7013(Mod)	Aluminum compounds as Al	ICP	MCE filter, .8µm	45
7029 (Mod)	Copper, or other metals (Dust/Fume)	ICP	MCE filter, .8µm	45/25*/25¥
7082	Lead	FLAA	MCE filter, .8µm	15
7300	Metals	ICP	MCE filter, .8µm (Complete panel of 27 elements – $115) (pg9)	45/20*
7303	Metals	ICP	MCE filter, .8 um	45/20*
7400	Total Fibers	PCM	SKC 225-321A	15
7401	Alkaline dust	TITRA	PTFE filter, 1µm	80
7500	Silica (crystalline)	XRD	PVC filter, 5µm	(pg15)
7504	Vanadium Pentoxide	XRD	PVC filter, 5µm	55
7600	Hexavalent chromium	VIS	PVC filter, 5µm	60
7605	Hexavalent chromium	HPLC-UV	PVC filter, 5µm	80
7607 (Draft)	Chloramine Compounds	IC	Silica gel/filter cassette	150
7901(Mod)	Arsenic Trioxide	ICP	SKC 225-9005	75
7902	Fluorides, particulate and gaseous	ISE	SKC 225-9001	50/20*
7903	Inorganic acids	IC	SKC 226-10-03 (Complete panel of 6 analytes – $140) (pg6)	50/20*
7904(Mod)	Cyanides, particulate and gaseous	VIS	MCE filter, .8µm/impinger	60/20*
7905 (Mod)	Phosphorus	GC-MS	SKC 226-35-03	80
8003	Lead in urine or blood	FLAA	Urine or blood	40
8310(Mod)	Metals in urine	ICP-MS	Urine	60
9002	Asbestos bulk	PLM	Bulk material	25
9102	Metals on wipe	ICP	Wipe	45/20*
9103	Mercury on wipe	CVAA	Wipe	60
9106 (Draft)	Methamphetamine, Amphetamine, Ephedrine, MDMA and Pseudoephedrine	GC-MS	Cotton Gauze	(pg10)
9109 (Draft)	Methamphetamine, Amphetamine, Ephedrine, MDMA and Pseudoephedrine	GC-MS	Cotton Gauze	(pg10)
9111 (Draft)	Methamphetamine only	LC-MS	Cotton Gauze	(pg10)
9201	Pesticide Surface Residues	GC-ECD	SKC 226-58 OVS2	Call for quote
9202	Pesticide Surface Residues	LC-MS	SKC 226-58 OVS2	Call for quote

* First analyte on a sample/additional analyte on same sample
¥ Separation of soluble / insoluble fraction

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OSHA METHODS

OSHA Method	Analytes(s)	Instrument	Sample Medium	Fee ($)*
01	Cyclohexanone	GC-FID	SKC 226-110	50
02	Ethylene dibromide	GC-ECD	SKC 226-01	75
03	Ethylene dichloride	GC-ECD	SKC 226-01 GWS	75
05	Chloroform	GC-FID	SKC 226-01	50
07	Organic vapors	GC-FID	SKC 226-01	50/15*
08	Vinyl bromide	GC-FID	SKC 226-01	90
09	Styrene	GC-FID	SKC 226-01	50
10	Chloromethyl methyl ether (CMME)	GC-ECD	Impinger	90
11	1,1,2-Trichloroethane	GC-FID	SKC 226-01	50
12	Benzene	GC-FID	SKC 226-01	50
14	1,1,1-Trichloroethane	GC-FID	SKC 226-01	50
19	Vinylidene chloride	GC-FID	SKC 226-01	90
24	Methylenebis-(o-chloroaniline) (MOCA)	HPLC-UV	Impinger	80
25	Maleic anhydride	HPLC-UV	SKC 226-30-07/226-30	200
28	Acrylic acid	HPLC-UV	SKC 226-30-08 (2)	80
29	Enflurane & Halothane	GC-FID	SKC 226-01 (2)	90
32	Phenol & Cresol	HPLC-UV	SKC 226-95	80
34	Dimethylamine	HPLC	SKC 226-96	75
35	Naphthalene	GC-FID	SKC 226-110	80
36	Ethylamine	HPLC	SKC-226-96	75
37	Acrylonitrile	GC-FID	SKC 226-01	75
39	Pentachlorophenol	HPLC-UV	SKC 226-97 (2)	125
40	Methylamine	HPLC	SKC 226-96	75
41	Diethylamine	HPLC	SKC 226-96	75
42	HDI, 2,4-TDI, 2,6-TDI	HPLC-UV	SKC 225-9002	80/35*
42	Isophorone diisocyanate	HPLC-UV	SKC 225-9002	120
43	EGDN & Nitroglycerin	HPLC-UV	SKC 226-35-03	80/35*
44	2,4-DNT, 2,6-DNT, 2,4,6-TNT	GC-ECD	SKC 226-56	80/35*
45	2,3,5,6-Tetrachlorophenol	HPLC-UV	SKC 226-97 (2)	125
46	1-Nitropropane	GC-FID	SKC 226-93	75
47	Methylene bis-phenyl diisocyanate (MDI)	HPLC-UV	SKC 225-9002	80
50	Ethylene oxide	GC-ECD	SKC 226-81A	150
51	Vinyl acetate	GC-FID	ORBO 92 Tube	60
53	Methyl cellosolve	GC-FID	SKC 226-01	50/15*
54	Methyl isocyanate	HPLC-UV	ORBO 657	80
55	MCA & ECA	HPLC-UV	SKC 226-98	80/35*
57	4,4-Methylenedianiline (MDA)	GC-ECD	SKC 225-9004	90
58 (Mod)	Coal tar pitch volatiles	GRAV	PTFE, 2µm	75
	(PAH Analysis: Panel)	HPLC	PTFE, 2µm	$230 (pg15)
59	Methylene chloride	GC-FID	SKC 226-09-02	50
60	Diethylenediamine (piperazine), Ethylenediamine (EDA), Diethylentriamine (DETA), Triethylenetetramine (TETA)	HPLC	SKC 226-30-18	75/25*
62 (Mod)	Chlorpyrifos, Diazinon, Malathion	GC-ECD	SKC 226-30-16	80/35*
63	Carbaryl (Sevin)	HPLC-UV	SKC 226-30-16	80
64	Glutaraldehyde	HPLC-UV	SKC 225-9003	90

* First analyte on a sample/additional analyte on same sample

OSHA Method	Analyte(s)	Instrument	Sample Medium	Fee ($)*
67	Chlordane	GC-ECD	SKC 226-30-16	80
69	Acetone	GC-FID	SKC 226-121	50
70	Pyrethrum	GC-ECD	SKC 226-30-16	80
71	MOCA, o-Dianisidine, o-Tolidine	GC-ECD	SKC 225-9004	90/35*
72	Furfural	GC-FID	SKC 226-81A	75
73	o,m,p-Toluidine	GC-ECD	SKC 225-9004	90
75	Vinyl chloride	GC-FID	ORBO 92 Tube	90
76	Chloroacetaldehyde	GC-ECD	SKC 226-15 GWS	90
78	Diphenylamine, Isopropylamine	HPLC	GFF SKC 225-9004	75/25*
79	2-Methoxyethanol, 2-Ethoxyethanol	GC-FID	SKC 226-01	50/15*
80	Methylene chloride	GC-FID	SKC 226-121	50
81	Crotonaldehyde	HPLC	SKC 225-9019	90
83	2-Butoxyethanol	GC-FID	SKC 226-01	50
84	2-Butanone	GC-FID	SKC 226-121	50
85	Valeraldehyde	HPLC-UV	SKC 225-9020	90
86	Maleic anhydride	HPLC-UV	SKC 225-9021	125
87	Phenylene Diamine	HPLC-UV	SKC 225-9004	100/35*
89	Divinyl benzene, Styrene	GC-FID	SKC 226-73	65/20*
90	Phthalic anhydride	HPLC-UV	Glass fiber filter (treated)	80
91	Methyl alcohol	GC-FID	SKC 226-82 (2)	50
95	Ethylene thiourea	HPLC-UV	Glass fiber filter, 1µm	160
98	Trimellitic anhydride (TMA)	HPLC-UV	Glass fiber filter (treated)	160
100	Ethyl alcohol	GC-FID	SKC 226-82 (2)	50
104	Phthalates	GC-FID	SKC 226-56	80/35*
106	Desflurane	GC-FID	SKC 226-81A	90
108	Hydrazine	HPLC-UV	SKC 225-9012	80
109	Isopropyl Alcohol	GC/FID	SKC 226-82(2)	60
1003	Phosphine	ICP	SKC 225-9018	65
1008	Hydrogen Sulfide	IC	SKC 226-177	150
ID 006	Hydrogen peroxide	VIS	Impinger	75
ID 104	Sulfur dioxide	IC	Impinger	60
ID 108	Bromine	IC	Impinger	60
ID 111	Phosphoric acid	IC	MCE filter, .8µm	60
ID 112	Formic acid	IC	Impinger	75
ID 113	Sulfuric acid	IC	MCE filter, .8µm	60
ID 125G	Metals	ICP	MCE filter, .8µm (Full Panel – $115)	45/20* (pg9)
ID 142	Quartz & Cristobalite	XRD	PVC filter, 5µm $55	(pg15)
ID 145	Mercury, particulate	CVAA	MCE filter, .8µm	60
ID 165SG	Acid mist	IC	SKC 226-10-03	60/20*
ID 186SG	Formic Acid	IC	Impinger	75
ID 196	Carbon black	GRAV	PVC, 5µm, Preweighed	75
ID 200	Sulfur dioxide	IC	SKC 226-80	60
ID 202	Chlorine dioxide	IC	Impinger	80
ID 206	Solder metals	ICP	MCE filter, .8µm	45/20*
ID 211	Sodium Azide (Gaseous/ Particulate)	IC-UV	226-55/Prefilter (PVC)	80/80*
ID 214	Ozone	IC	SKC 225-9014	80
ID 215	Hexavalent Chromium	HPLC	PVC filter, 5µm	80
PV2063	Cypermethrin	GC-ECD	SKC 226-30-16	120
PV2079	Aniline	GC-FID	SKC 226-98	120**
PV2110	Piperonyl Butoxide	HPLC	SKC 226-58 OVS2	175

* First analyte on a sample/additional analyte on same sample
** Three sample minimum required

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ALPHABETICAL LIST BY ANALYSIS

Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
Acetaldehyde	NIOSH 2538	GC-FID	SKC 226-27	60
Acetaldehyde	NIOSH 3507	HPLC-UV	Impinger	90
Acetic acid	NIOSH 1603	GC-FID	SKC 226-01	100
Acetoin	NIOSH 2558	GC-FID	SKC 226-121	90
Acetone	OSHA 69	GC-FID	SKC 226-121	50
Acetonitrile	NIOSH 1606	GC-FID	SKC 226-09	50
Acid mist	OSHA ID 165/SG	IC	SKC 226-10-03	60/20*
Acids (Inorganic)	NIOSH 7903	IC	SKC 226-10-03	(pg6)
Acrylic acid	OSHA 28	HPLC-UV	SKC 226-30-08 (2)	80
Acrylonitrile	NIOSH 1604	GC-FID	SKC 226-01	50
Acrylonitrile	OSHA 37	GC-FID	SKC 226-01	75
Alcohols I	NIOSH 1400	GC-FID	SKC 226-01	50/15*
Alcohols II	NIOSH 1401	GC-FID	SKC 226-01	50/15*
Alcohols III	NIOSH 1402	GC-FID	SKC 226-01	50/15*
Alcohols IV	NIOSH 1403	GC-FID	SKC 226-01	50/15*
Aldehyde screen	NIOSH 2539 (Mod)	GC-FID	SKC 226-118 (Panel of 9 compounds – 175) (See p. 5)	60/20*
Aldrin & Lindane	NIOSH 5502	GC-ECD	Impinger	80/35*
Aliphatic Aldehydes	NIOSH 2018	HPLC-UV	226-119	110/35*
Aliphatic Amines	NIOSH 2010 (Mod)	LC-MS	SKC 226-10	Call for quote
Alkaline dust	NIOSH 7401	TITRA	PTFE filter, 1µm	80
Allyl chloride	NIOSH 1000	GC-FID	SKC 226-01	75
Allyl glycidyl ether	NIOSH 2545	GC-FID	SKC 226-35-03	75
Aluminum compounds as Al	NIOSH 7013 (Mod)	ICP	MCE filter, .8µm	45
Amines, Ethanolamine, Diethanolamine, Triethanolamine	NIOSH 3509 (Draft)	IC	Impinger	120/45*
Amines, Screen	DCL Method	LC-MS	SKC 226-10	200
Aminoethanol compounds II	NIOSH 3509	IC	Impinger	120/45*
Ammonia	NIOSH 6015	VIS	SKC 226-10-06	50
Aniline	OSHA PV 2079	GC/MS	SKC 226-53	90
Anisidine	NIOSH 2514	HPLC-UV	SKC 226-30-05	80
Aromatic Amines	NIOSH 2002 (Mod)	LC-MS	SKC 226-10	120
Aromatic hydrocarbons	NIOSH 1501	GC-FID	SKC 226-01	50/15*
Arsenic Trioxide	NIOSH 7901 (Mod)	ICP	SKC 225-9005	75
Arsine	NIOSH 6001 (Mod)	ICP	SKC 226-01	90
Asbestos (air)	NIOSH 7400	PCM	MCE filter	15
Asbestos (bulk)	NIOSH 9002	PLM	Bulk material	25
Aspartame	NIOSH 5031	HPLC-UV	PTFE filter, 1µm	135
Benzene	OSHA 12	GC-FID	SKC 226-01	50
Benzene Solubles & Total Weight	NIOSH 5042	GRAV	PTFE, 2µm, Preweighed	85
Benzidine & 3,3-Dichlorobenzidine	NIOSH 5509	HPLC-UV	Glass fiber filter, 1µm	80/35*
Benzoyl peroxide	NIOSH 5009	HPLC	MCE filter, .8µm	80
Bifenthrin	DCL	GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	120/35*
Bromine	OSHA ID 108	IC	Impinger	60
1– Bromopropane/ 2-bromopropane	NIOSH 1025	GC-FID	226-01 or 226-121	75/25*
Bromotrifluoromethane	NIOSH 1017	GC-FID	SKC 226-09	375
Bromoxynil	NIOSH 5010	HPLC-UV	PTFE filter, 2µm	80/30*
1,3-Butadiene	NIOSH 1024	GC-FID	SKC 226-37	75
2-Butanone (MEK)	OSHA 84	GC-FID	SKC 226-121	50

* First analyte on a sample/additional analyte on same sample

Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
2-Butoxyethanol	OSHA 83	GC-FID	SKC 226-01	50
n-Butyl glycidyl ether	NIOSH 1616	GC-FID	SKC 226-01	75
Butyric Acid	OSHA CSI	GC-FID	226-15	75
Carbaryl (Sevin)	OSHA 63	HPLC-UV	SKC 226-30-16	80
Carbon black	NIOSH 5000	GRAV	PVC, 5µm, Preweighed	10
Carbon black	OSHA ID 196	GRAV	PVC, 5µm, Preweighed	75
Carbon disulfide	NIOSH 1622 (Draft)	GC-SCD	SKC 226-01/226-44	80
Chloramines	NIOSH 7607	IC	Silica gel/filter cassette	145
Chlordane	NIOSH 5510	GC-ECD	226-107/Prefilter (MCE)	80
Chlordane	OSHA 67	GC-ECD	SKC 226-30-16	80
Chlorinated camphene (Toxaphene)	NIOSH 5039	GC-ECD	MCE filter, .8µm	80
Chlorinated terphenyl	NIOSH 5014	GC-ECD	Glass fiber filter, 1µm	80
Chlorine & Bromine	NIOSH 6011	IC	SKC 225-9006	100/50*
Chlorine dioxide	OSHA ID 202	IC	Impinger	80
Chloroacetaldehyde	OSHA 76	GC-ECD	SKC 226-15 GWS	90
p-Chlorobenzotrifluoride	NIOSH 1026	GC-FID	SKC 226-01	75
Chloroform	OSHA 05	GC-FID	SKC 226-01	50
Chloromethyl methyl ether (CMME)	OSHA 10	GC-ECD	Impinger	90
p-Chlorophenol	NIOSH 2014	HPLC-UV	SKC 226-10	80
Chloroprene	NIOSH 1002	GC-FID	SKC 226-01	90
Chlorothalonil	DCL	GC-MS	SKC 226-58 OVS2 or cotton gauze wipe	120
Chlorpyrifos, Diazinon, Malathion	OSHA 62	GC-ECD	SKC 226-30-16	80/35*
Coal tar pitch volatiles	OSHA 58	GRAV	PTFE filter, 2µm	75
(PAH Analysis: Panel)		HPLC	PTFE filter, 2µm See p. 12)	230
Copper (Fumes/Dust/Soluble/Insoluble/etc.))	NIOSH 7029 (Mod)	ICP	MCE filter, .8µm	45/25/25
Cresols/ Phenols	NIOSH 2546	GC-FID	SKC 226-95	75/35*
Crotonaldehyde	OSHA 81	HPLC-UV	SKC 225-9019	90
Cyanides, particulate and gaseous	NIOSH 7904 (Mod)	VIS	Filter + Impinger	60/20*
Cyanuric acid	NIOSH 5030	HPLC-UV	PVC, 5µm, Preweighed	160
Cyclohexanone	OSHA 01	GC-FID	SKC 226-110	50
1,3-Cyclopentadiene	NIOSH 2523	GC-FID	Chromosorb 104 tube	75
Cyfluthrin	DCL	GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	120/35*
Cypermethrin	OSHA PV2063	GC-ECD	226-30-16	100
2,4-D & 2,4,5-T	NIOSH 5001	HPLC-UV	Glass fiber filter, 1µm	125/35*
2,4-DNT, 2,6-DNT, 2,4,6-TNT	OSHA 44 (Mod)	GC-ECD	SKC 226-56	80/35*
Decabromodiphenyl Oxide	NIOSH 2559	HPLC-UV	Quartz fiber filter	120
Deltamethrin	DCL	GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	120/35*
Demeton	NIOSH 5514 (Mod)	GC-MS	MCE filter, 2µm	80
Desflurane	OSHA 106	GC-FID	SKC 226-81A	90
Diacetyl/Acetoin	NIOSH 2557	GC-FID	SKC 226-121	90
Dibutyl phosphate	NIOSH 5017 (Mod)	GC-MS	PTFE filter, 1µm	80
Dibutyl phthalate & Di(2-ethylhexyl phthalate	NIOSH 5020	GC-FID	MCE filter, .8µm	60/20*
1,1-Dichloro-1-nitroethane	NIOSH 1601	GC-FID	SKC 226-81A	75
Dichlorodifluoromethane	NIOSH 1018	GC-FID	SKC 226-01	90
Dichloroethyl ether	NIOSH 1004	GC-FID	SKC 226-01	75
Dichlorofluoromethane	NIOSH 2516	GC-FID	SKC 226-09 (2)/226-25	90
Diesel Particulate	NIOSH 5040	OC-EC	Quartz fiber filter	(pg7)
Diethylamine	OSHA 41	HPLC	SKC-226-96	75
Diethylenediamine (piperazine)	OSHA 60	HPLC	SKC 226-30-18	75/25*

* First analyte on a sample/additional analyte on same sample

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Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
Diethylentriamine (DETA)	OSHA 60	HPLC	SKC 226-30-18	75/25*
Difluorodibromomethane	NIOSH 1012	GC-FID	SKC 226-01 (2)	75
Dimethyl acetamide	NIOSH 2004	GC-MS	SKC 226-10	75
Dimethyl Sulfate	NIOSH 2524	GC-SCD or GC-MS	SKC 226-114	90
Dimethylamine	OSHA 34	HPLC	SKC 226-96	75
Dioxane	NIOSH 1602	GC-FID	SKC 226-01	50
Diphenyl (Biphenyl)	NIOSH 2530	GC-FID	SKC 226-35-01	60
Diphenylamine, Isopropylamine	OSHA 78	HPLC	GFF SKC 225-9004	75/25*
Divinyl benzene, Styrene	OSHA 89	GC-FID	SKC 226-73	65/20*
Dust, respirable	NIOSH 0600	GRAV	PVC, 5µm, Preweighed	10
Dust, total	NIOSH 0500	GRAV	PVC, 5µm, Preweighed	10
EGDN & Nitroglycerin	OSHA 43	HPLC-UV	SKC 226-35-03	80/35*
Elemental Carbon	NIOSH 5040	OC-EC	Quartz fiber filter	45
Endrin	NIOSH 5519	GC-ECD	MCE filter, .8µm	80
Enflurane & Halothane	OSHA 29	GC-FID	SKC 226-01 (2)	90
Epichlorohydrin	NIOSH 1010	GC-FID	SKC 226-01	75
EPN	NIOSH 5012(Mod)	GC-MS	Glass fiber filter, 1µm	80
Esters I	NIOSH 1450	GC-FID	SKC 226-01	50/15*
Estrogenic Hormones	NIOSH 5044	HPLC	PTFE Filter	125
Ethanolamine	OSHA PV2111	HPLC	SKC 226-96	120
Ethyl acetate	NIOSH 1457	GC-FID	SKC 226-01	60
Ethyl alcohol	OSHA 100	GC-FID	SKC 226-82 (2)	50
Ethyl bromide	NIOSH 1011	GC-FID	SKC 226-01	75
Ethyl chloride	NIOSH 2519	GC-FID	SKC 226-25	90
Ethyl ether	NIOSH 1610	GC-FID	SKC 226-01	50
Ethyl formate	NIOSH 1452	GC-FID	SKC 226-01	60
Ethylamine	OSHA 36	GC-FID	SKC-226-110	80
Ethylene chlorohydrin	NIOSH 2513	GC-FID	SKC 226-81A	75
Ethylene diamine (EDA)	OSHA 60	HPLC	SKC 226-30-18	75/25*
Ethylene dibromide	NIOSH 1008	GC-ECD	SKC 226-01 GWS	75
Ethylene dibromide	OSHA 02	GC-ECD	SKC 226-01	75
Ethylene dichloride	OSHA 03	GC-ECD	SKC 226-01 GWS	75
Ethylenediamine	NIOSH 2540 or OSHA 60	HPLC-UV	SKC 226-30-04	120
Ethylene oxide	NIOSH 1614	GC-ECD	SKC 226-81A	150
Ethylene oxide	OSHA 50	GC-ECD	SKC 226-81A	150
Ethylene thiourea	OSHA 95	HPLC-UV	Glass fiber filter, 1µm	160
Fenthion	DCL	GC-MS	SKC 226-58 OVS2 or cotton gauze wipe	180/35*
Fipronil	DCL	GC-MS/GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	(See p.10)
Fixed Gases	DCL	GC-TCD & GC-FID	Tedlar Bag / SUMMA	Call for quote
Fluorides, particulate and gaseous	NIOSH 7902	ISE	SKC 225-9001	50/20*
Fluorotrichloromethane	NIOSH 1006	GC-FID	SKC 226-09	75
Formaldehyde	NIOSH 2016	HPLC-UV	SKC 226-119	110
Formaldehyde	NIOSH 2016(Mod)	HPLC-UV	Passive monitor DNPH treated	110
Formaldehyde	NIOSH 2541	GC-FID	SKC 226-118 (2-hydroxy methyl) piperdine	60

* First analyte on a sample/additional analyte on same sample

Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
Formaldehyde	NIOSH 3500	VIS	Impinger/3M 3721/ SKC 526-100, 526-200, 526-201	50
Formic acid	NIOSH 2011	IC	226-10-03/Prefilter (PTFE)	75
Formic acid	OSHA ID 112	IC	Impinger	75
Furfural	OSHA 72	GC-FID	SKC 226-81A	75
Furfuryl alcohol	NIOSH 2505	GC-FID	SKC 226-115	50
Glutaraldehyde	NIOSH 2532	HPLC-UV	SKC 226-119	90
Glutaraldehyde	OSHA 64	HPLC-UV	SKC 225-9003	90
Glycidol	NIOSH 1608	GC-FID	SKC 226-01	75
Glycol Ethers	NIOSH 2554	GC-FID	SKC 226-81A	50/15*
Glycols	NIOSH 5523	GC-FID	SKC 226-57	75/35*
Glyphosate	DCL	GC-ECD	Quartz fiber filter	100
Halogenated hydrocarbons	NIOSH 1003	GC-FID	SKC 226/01	50/15*
HDI, 2,4-TDI, 2,6-TDI	OSHA 42	HPLC-UV	SKC 225-9002	80/35*
HDI, 2,4-TDI, 2,6-TDI, MDI	NIOSH 5522	HPLC-UV	Impinger	135/45*
Hexachlorobutadiene	NIOSH 2543	GC-ECD	SKC 226-30-04	75
Hexachlorocyclopentadiene	NIOSH 2518	GC-ECD	SKC 226-116 (2)	95
Hexavalent chromium	NIOSH 7600	VIS	PVC filter, 5µm	60
Hexavalent chromium	NIOSH 7605	HPLC	PVC filter, 5µm	80
Hexavalent chromium	OSHA ID 215	HPLC	PVC filter, 5µm	125
Hydrazine	NIOSH 3503	VIS	Impinger	130
Hydrazine	OSHA 108	HPLC-UV	SKC 225-9012	80
Hydrocarbons	NIOSH 1500	GC-FID	SKC 226-01	50/15*
Hydrocarbons	NIOSH 1500	GC-FID	3M 3500 POVM	50/15*
Hydrocarbons (light)	DCL	GC-FID	SUMMA or Tedlar bag	(pg9)
Hydrogen cyanide	NIOSH 6010	VIS	SKC 226-28	50
Hydrogen peroxide	OSHA ID 006	VIS	Impinger	75
Hydrogen Sulfide	NIOSH 6013	IC	226-09/Prefilter (PTFE)	75
Hydrogen Sulfide	OSHA 1008	IC	SKC 226-177	150
Hydroquinone	NIOSH 5004	HPLC-UV	MCE filter, .8µm	80
Imidacloprid	DCL	HPLC	SKC 226-58 OVS2 or cotton gauze wipe	180
Inorganic acids	NIOSH 7903	IC	SKC 226-10-03 (Complete panel of 6 analytes – 140)	50/20* (pg6)
Iodine	NIOSH 6005	IC	SKC 226-67	75
Isocyanates, Total (MAP)	NIOSH 5525	HPLC	PTFE or Impinger	275
Isophorone	NIOSH 2508	GC-FID	SKC 226-81A	60
Isophorone	NIOSH 2556	GC-FID	SKC226-93	75
Isophorone diisocyanate (IPDI)	OSHA 42	HPLC	SKC 225-9002	120
Isopropyl alcohol	OSHA 109	GC-FID	SKC 226-82 (2)	60
Isopropyl acetate	NIOSH 1454	GC-FID	SKC 226-01	60
Isopropyl Acetate	NIOSH 1460	GC-FID	SKC 226-01	75
Isopropyl ether	NIOSH 1618	GC-FID	SKC 226-01	75
Ketones I	NIOSH 1300	GC-FID	SKC 226-01	50/15*
Ketones II	NIOSH 1301	GC-FID	SKC 226-01	50/15*
Ketones I	NIOSH 2555	GC-FID	SKC 226-121	75/20*
Ketones II	NIOSH 2553	GC-FID	SKC 226-121	75/20*
Lead	NIOSH 7082	FLAA	MCE filter, .8µm	15
Lead	40CFR50APPG	FLAA	GFF, 8x10	45
Lead in urine or blood	NIOSH 8003 (mod)	ICP-MS	Urine or blood	60
Maleic anhydride	NIOSH 3512	HPLC-UV	Impinger	125
Maleic anhydride	OSHA 25	HPLC-UV	SKC 226-30-07	125
Maleic anhydride	OSHA 86	HPLC-UV	SKC 225-9021	125
Marijuana (Identified)	DCL	LC-MS	Bulk plant material	75

* First analyte on a sample/additional analyte on same sample

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Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
MCA & ECA	OSHA 55	HPLC-UV	SKC 226-98	80/35*
Mercury	NIOSH 6009	CVAA	SKC 226-17-1A	60
Mercury, particulate	OSHA ID 145	CVAA	MCE filter, .8µm	60
Mercury on wipe	NIOSH 9103	CVAA	Wipe	60
Metals	NIOSH 7300	ICP	MCE filter, .8µm	45/20*
			(Complete panel of 27 elements – 115) (pg9)	
Metals	OSHA ID 125	ICP	MCE filter, .8µm	45/20*
			(Complete panel of 27 elements – 115) (pg9)	
Metals	NIOSH 7303 (Mod)	ICP	MCE filter, .8um	45/20*
Metals on wipe	NIOSH 9102	ICP	Wipe	45/20*
Metals in urine	NIOSH 8310 (Mod)	ICP-MS	Urine	60
Metal working fluids	NIOSH 5524	GRAV	PTFE, 2µm, Preweighed	60
Methamphetamine Only	NIOSH 9111 (Draft)	LC-MS	Cotton Gauze	(pg10)
Methamphetamine and other compounds	NIOSH 9106 or NIOSH 9109	GC-MS	Cotton Gauze	(pg10)
Methanol	NIOSH 2000	GC-FID	SKC 226-51	50
2-Methoxyethanol, 2-Ethoxyethanol	OSHA 79	GC-FID	SKC 226-01	50/15*
n-Methyl-2-pyrrolidinone	NIOSH 1302 (Mod)	GC-MS	SKC 226-01	60
Methyl acetate	NIOSH 1458	GC-FID	SKC 226-01	60
Methyl acrylate	NIOSH 1459	GC-FID	SKC 226-01	60
Methyl acrylate	NIOSH 2552	GC-FID	SKC 226-121	75/20*
Methyl alcohol	OSHA 91	GC-FID	SKC 226-82 (2)	50
Methyl cellosolve	OSHA 53	GC-FID	SKC 226-01	50/15*
Methyl cellosolve acetate	NIOSH 1451	GC-FID	SKC 226-01	60
Methyl chloride	NIOSH 1001	GC-FID	SKC 226-09	90
Methyl cyclohexanone	NIOSH 2521	GC-FID	SKC 226-115	75
Methyl ethyl ketone	NIOSH 2500	GC-FID	SKC 226-81A/226-121	50
Methyl iodide	NIOSH 1014	GC-FID	SKC 226-01	75
Methyl isocyanate	OSHA 54	HPLC-UV	ORBO 657	80
Methyl methacrylate	NIOSH 2537	GC-FID	SKC 226-30-06	50
Methyl methacrylate	OSHA 94	GC-FID	SKC 226-73	75
Methyl tert-butyl ether	NIOSH 1615	GC-FID	SKC 226-37	50
Methylal	NIOSH 1611	GC-FID	SKC 226-01	75
Methylamine	OSHA 40	HPLC	SKC-226-96	75
Methylene bisphenyl disocyanate (MDI)	OSHA 47	HPLC-UV	SKC 225-9002	80
Methylene chloride	NIOSH 1005	GC-FID	SKC 226-01 (2)	50
Methylene chloride	OSHA 59	GC-FID	SKC 226-09-02	50
Methylene chloride	OSHA 80	GC-FID	SKC 226-121	50
Methylenebis-(o-chloroaniline) (MOCA)	OSHA 24	HPLC	Impinger	80
4,4- Methylenedianiline (MDA)	OSHA 57	GC-ECD	SKC 225-9004	90
4,4- Methylenedianiline (MDA)	NIOSH 5029	HPLC-UV	SKC 225-9004	80
MOCA, o-Dianisidine, o-Tolidine	OSHA 71	GC-ECD	SKC 225-9004	90/35*
Naphthalene	OSHA 35	GC-FID	SKC 226-110	80
Naphthas	NIOSH 1550	GC-FID	SKC 226-01	50
Nickel Carbonyl	NIOSH 6007(Mod)	ICP	ORBO 304	60
Nicotine	NIOSH 2544 (Mod)	GC-MS	SKC 226-30-04	75
Nitric oxide & Nitrogen dioxide	NIOSH 6014	VIS	SKC 226-40	75/30*
p-Nitroaniline	NIOSH 5033	HPLC-UV	MCE filter, .8µm	80
Nitrobenzene	NIOSH 2005	GC-FID	SKC 226-10	75
Nitroethane	NIOSH 2526	GC-FID	SKC 226-30-02	75
Nitroglycerin & EGDN	NIOSH 2507	GC-ECD	SKC 226-35-03	75
Nitromethane	NIOSH 2527	GC-FID	SKC 226-111A	75
1-Nitropropane	OSHA 46	GC-FID	SKC 226-93	75

* First analyte on a sample/additional analyte on same sample

Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
2-Nitropropane	NIOSH 2528	GC-FID	SKC 226-110	75
I-Octanethiol	NIOSH 2510	GC-SCD	SKC 226-81A	60
Oil mist, mineral (bulk sample must be submitted with filters)	NIOSH 5026	IR	MCE filter, .8µm	Call for quote
Organic vapors	OSHA 07	GC-FID	SKC 226-01	50/15*
Organochlorine Pesticides	NIOSH 5600	GC-ECD	SKC 226-58	100/50* (pg11)
Organophosphorus Pesticides	NIOSH 5600	GC-ECD	SKC 226-58	100/50* (pg11)
Organosulfur Compounds	DCL	GC-SCD	SUMMA or Tedlar bag	(pg16)
Ozone	OSHA ID 214	IC	SKC 225-9014	80
Paraquat	NIOSH 5003	HPLC-UV	PTFE filter, 1µm	80
Pentachloroethane	NIOSH 2517	GC-ECD	SKC 226-59-04	75
Pentachlorophenol	NIOSH 5512	HPLC-UV	Impinger	80
Pentachlorophenol	OSHA 39	HPLC-UV	SKC 226-97 (2)	125
Permethrin	DCL	GC-MS/GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	(pg11)
Pesticides	EPA TO-10A	GC-ECD	SKC PUF Cartridge	(pg17)
Pesticide Surface Residues	NIOSH 9201	GC-ECD	SKC 226-58 OVS2	Call for quote
Pesticide Surface Residues	NIOSH 9202	LC-MS	SKC 226-58 OVS2	Call for quote
Piperonyl Butoxide	OSHA PV 2110	HPLC	SKC 226-58 OVS2	175
Phalates	OSHA 104	GC-FID	SKC 226-56	80/35*
Phthalic anhydride	OSHA 90	HPLC-UV	Glass fiber filter (treated)	80
Phenol & Cresol	OSHA 32	HPLC-UV	SKC 226-95	80
Phenylene Diamine	OSHA 87	HPLC-UV	SKC 225-9004	100/35*
Phosgene	NON 40	GC-MS	SKC-226-153	150
Phosphine	OSHA 1003	ICP	SKC 225-9018	65
Phosphoric acid	OSHA ID 111	IC	MCE filter, .8µm	60
Phosphorus	NIOSH 7905 (Mod)	GC-FPD	SKC 226-35-03	80
Phthalic anhydride	OSHA 90	HPLC-UV	Glass fiber filter (treated)	80
Polychlorinated biphenyls (PCBs)	NIOSH 5503	GC-ECD	226-39/Prefilter (GFF)	80
Polynuclear aromatic hydrocarbons (PAH)	NIOSH 5506 (Mod)	HPLC	226-30-04/Prefilter (PTFE) (Panel – 230)	80/35* (pg15)
Polynuclear aromatic hydrocarbons (PAH)	NIOSH 5528 (Draft)	GC-MS SIM	SKC 226-57 OVS (XAD-7) (Panel – 230)	80/35* (pg15)
Propylene dichloride	NIOSH 1013	GC-FID	SKC 226-81A	75
Propylene oxide	NIOSH 1612	GC-FID	SKC 226-01	90
Pyrethrum	NIOSH 5008	HPLC-UV	Glass fiber filter, 1µm	80
Pyrethrum	OSHA 70	GC-ECD	SKC 226-30-16	80
Pyridine	NIOSH 1613	GC-MS	SKC 226-01	75
Quartz & Cristobalite	OSHA ID 142	XRD	PVC filter, 5µm	(pg15) 65
Ribavirin	NIOSH 5027	HPLC-UV	Glass fiber filter, 1µm	135
Silica (Crystalline)	NIOSH 7500 (Mod)	XRD	PVC filter, 5µm	(pg15)
Sodium Azide (Gaseous/ Particulate)	OSHA ID 211	IC-UV	226-55/Prefilter (PVC)	80/25*
Solder metals	OSHA ID 206	ICP	MCE filter, .8µm	45/20*
Strychnine	NIOSH 5016	HPLC-UV	Glass fiber filter, 1µm	80
Styrene	OSHA 09	GC-FID	SKC 226-01	50
Sulfur dioxide	OSHA ID 104	IC	Impinger	60
Sulfur dioxide	OSHA ID 200	IC	SKC 226-80	60
Sulfur dioxide/Sulfate	NIOSH 6004	IC	SKC 225-9005	60/20*
Sulfur Gases (14)	DCL Method	GC-SCD	SUMMA or Tedlar bag	(pg16)
Sulfuric acid	OSHA ID 113	IC	MCE filter, .8µm	60
Sulfuryl Fluoride	NIOSH 6012	IC	SKC 226-16	90

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Analyte(s)	Method	Instrument	Sample Medium	Fee ($)*
Temephos	DCL	GC-MS/GC-ECD	SKC 226-58 OVS2 or cotton gauze wipe	(pg11)
o-Terphenyl	NIOSH 5021	GC-FID	PTFE filter, 2µm	60
1,1,2,2-Tetrabromoethane	NIOSH 2003	GC-FID	SKC 226-10	75
Tetrachlorodifluoroethane	NIOSH 1016	GC-FID	SKC 226-01	75
1,1,2,2-Tetrachloroethane	NIOSH 1019	GC-FID	SKC 226-81A	75
2,3,5,6-Tetrachlorophenol	OSHA 45	HPLC-UV	SKC 226-97 (2)	125
Tetraethyl Lead/ Tetramethyl Lead	NIOSH 2533 (Mod)	GC-MS	SKC 226-30-04/226-30-06	90/35*
Tetrahydrofuran	NIOSH 1609	GC-FID	SKC 226-01	50
Tetranitromethane	NIOSH 3513 (Mod)	GC-MS	Impinger	75
THC (marijuana identification)	DCL	LC-MS	Bulk plant material	75
Thiram	NIOSH 5005	HPLC-UV	PTFE filter, 1µm	80
o,m,p-Toluidine	OSHA 73	GC-ECD	SKC 225-9004	90
Total fibers	NIOSH 7400	PCM	SKC 225-321A	15
Toxic Organic Compounds	EPA TO-10A	GC-ECD	SKG Cartridges	(pg17)
Tributyl phosphate	NIOSH 5034 (Mod)	GC-MS	MCE filter, .8µm	80
1,1,2-Trichloro-1,2,2-trifluoroethane	NIOSH 1020	GC-FID	SKC 226-01	75
1,1,2-Trichloroethane	OSHA 11	GC-FID	SKC 226-01	50
1,1,1-Trichloroethane	OSHA 14	GC-FID	SKC 226-01	50
Trichloroethylene	NIOSH 1022	GC-FID	SKC 226-01	50
Triethylene tetramine (TETA)	OSHA 60	HPLC	SKC 226-30-18	75/25*
Trimellitic anhydride (TMA)	OSHA 98	HPLC-UV	Glass fiber filter (treated)	160
Turpentine	NIOSH 1551	GC-FID	SKC 226-01	50
Valeraldehyde	NIOSH 2536	GC-FID	SKC 226-118	60
Valeraldehyde	OSHA 85	HPLC-UV	SKC 225-9020	90
Vanadium Pentoxide	NIOSH 7504	XRD	PVC filter, 5µm	55
Vapor Intrusion	TO-15	GC-MS	Tedlar bag or SUMMA Can	250
Vinyl acetate	NIOSH 1453	GC-FID	ORBO 92 Tube	60
Vinyl acetate	OSHA 51	GC-FID	ORBO 92 Tube	60
Vinyl bromide	OSHA 08	GC-FID	SKC 226-01	90
Vinyl chloride	NIOSH 1007	GC-FID	SKC 226-01 (2)	90
Vinyl chloride	OSHA 75	GC-FID	ORBO 92 Tube	90
Vinylidene chloride	NIOSH 1015	GC-FID	SKC 226-01	90
Vinylidene chloride	OSHA 19	GC-FID	SKC 226-01	90
Warfarin	NIOSH 5002	HPLC-UV	PTFE filter, 1µm	80

* First analyte on a sample/additional analyte on same sample

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Media Available from DataChem Laboratories, Inc.

SKC Sorbent Tubes

(All Media is subject to availability and may require a minimum order)

NOTE: If large or 3-stage media collection tubes are selected, the cost of associated analysis doubles.

Tube Number (SKC)	Description	Treated	Sorbent (mg)	Cost ($)
226-01	Charcoal tube	No	50/100	1.50
226-01 GWS	Charcoal tube, Glass wool separator	No	50/100	1.50
226-09	Charcoal tube	No	200/400	1.50
226-09-02	Charcoal tube	No	350/350/350	4.00
226-10	Silica gel tube	No	75/150	1.50
226-10-03	Silica gel tube (Specially Cleaned)	Yes	200/400	2.00
226-10-04	Silica gel tube	No	150/300	3.00
226-10-06	Silica gel tube (Sulfuric acid)	Yes	100/200	3.00
226-15 GWS	Silica gel tube, Glass wool separator	No	260/520	3.00
226-17-1A	Anasorb C300 (Comparable to Hopcalite)	No	200	2.50
226-25	Charcoal (two tubes)	No	200 and 400	4.00
226-27	XAD-2 (2-Hydroxymethyl piperidine)	Yes	225/450	4.00
226-28	Soda Lime	No	200/600	4.00
226-30-02	XAD-2 (two tubes)	No	300 and 600	6.00
226-30-04	XAD-2 tube	No	50/100	2.00
226-30-05	XAD-2 tube	No	75/150	3.00
226-30-06	XAD-2 tube	No	200/400	4.00
226-30-07	XAD-2 tube (p-Anisidine)	Yes	50/100	6.00
226-30-08	Anasorb 708	No	100	4.00
226-30-16	OVS (XAD-2, GFF)	Yes	140/270	10.00
226-35-01	Tenax® tube	No	10/20	5.00
226-35-03	Tenax tube	No	50/100	5.00
226-37	Charcoal (2 tubes)	No	200 and 400	3.00
226-39	Florisil tube	No	50/100	2.00

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SKC SORBENT TUBES

(All Media is subject to availability and may require a minimum order)

NOTE: If large or 3-stage media collection tubes are selected, the cost of associated analysis doubles.

TUBE NUMBER (SKC)	DESCRIPTION	TREATED	SORBENT (MG)	COST ($)
226-40	Molecular Sieve (2 tubes and oxidizer)	Yes	400	10.00
226-44	Drying tube	No	250	2.00
226-51	Silica gel tube	No	50/100	2.00
226-56	OVS (Tenax, GFF) tube	No	70/140	17.50
226-57	OVS (XAD-7, GFF) tube	No	100/200	12.50
226-58	OVS (XAD-2, QFF) tube	No	140/270	13.50
226-59-04	Porapak-R	No	35/70	3.00
226-67	Charcoal tube (Potassium Hydroxide)	Yes	50/100	2.00
226-73	Charcoal tube (t-Butylcatechol)	Yes	50/100	2.50
226-80	Anasorb 747 (Potassim Hydroxide)	Yes	50/100	2.50
226-81A	Anasorb 747 tube	No	70/140	2.00
226-82	Anasorb 747 (2 tubes)	No	200 and 400	4.00
226-93	XAD-4 tube	No	40/80	2.00
226-94	XAD-7/ORBO 657 (Treated)	No	30/60	4.00
226-95	XAD-7	No	50/100	2.00
226-96	XAD-7 (Plus NBD Chloride)	Yes	50/100	3.00
226-97	XAD-7 (2 tubes + 1 specially cleaned tube)	No	175	8.00
226-98	XAD-7 (Phosphoric acid)	Yes	40/80	2.00
226-107	Chromosorb-102	No	50/100	3.00
226-110	Chromosorb-106	No	50/100	5.00
226-111A	Chromosorb-106	No	300/600	15.00
226-114	Porapak-P	No	50/100	4.50
226-115	Porapak-Q	No	75/150	3.50
226-116	Porapak-T (2 tubes)	No	25 and 75	9.50
226-117	XAD-2 tube	Yes	75/150	3.00
226-118	XAD-2 tube	Yes	60/120	3.00
226-119	Silica gel tube	Yes	150/300	3.50
226-121	Anasorb-CMS	No	75/150	3.50
226-177	Silica gel (silver nitrate-treated)	Yes		22.00

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SKC Industrial Hygiene Filters (Assembled)

(All Media is subject to availability and may require a minimum order)

Filter No. (SKC)	Description (Material, Pore Size, Cassette Type)	Treated	Size (mm)	Cost ($)
225-321A	Mixed cellulose ester, 0.8 µm, black polypropylene cassette	No	25	2.00
225-502	MCE, (*matched weight*), 5.0 µm, 2-piece	No	37	6.00
225-503	MCE, (*matched weight*), 5.0 µm, 3-piece	No	37	6.00
225-9001	MCE, (sodium carbonate)	Yes	37	6.50
225-9002	Glass fiber, (1-(2-pyridyl) piperazine)	Yes	37	7.00
225-9003	Glass fiber, 2 filters, (2,4-DNPH)	Yes	37	7.00
225-9004	Glass fiber, (H_2SO_4)	Yes	37	5.00
225-9005	MCE, cellulose, (sodium carbonate)	Yes	37	8.50
225-9006	Cleaned silver membrane filter, black polypropylene cassette	Yes	25	32.00
225-9014	Glass fiber, 2 filters, nitrite impregnated	Yes	37	8.00
225-9018	Glass filter & polyester filter (Mercuric chloride treatment on polyester only)	Yes	37	16.00
225-9019	Glass fiber, 2 filters, (phosphoric acid & 2,4-dinitrophenylhydrazine)	Yes	37	10.00
225-9020	Glass fiber, 3 filters, (phosphoric acid & 2,4-dinitrophenylhydrazine)	Yes	37	10.00
225-9021	Glass fiber, (veratrylamine)	Yes	37	8.00
225-9501	Air-O-Cell Sampling Cassette	No	37	7.50

Industrial Hygiene Filters (Assembled at DataChem)

(All Media is subject to availability and may require a minimum order)

Filter Material	Description (Pore Size, Cassette Type)	Preweighed	Size (mm)	Cost ($)
PVC	5.0 µm, 2-piece	No	37	3.00
PVC	5.0 µm, 3-piece	No	37	3.00
PVC	5.0 µm, 2-piece	Yes	37	5.00
PVC	5.0 µm, 3-piece	Yes	37	5.00
PTFE	1.0 µm, 2-piece	No	37	3.00
PTFE	1.0 µm, 3-piece	No	37	3.00
PTFE	2.0 µm, 2-piece	No	37	3.00
PTFE	2.0 µm, 3-piece	No	37	3.00
PTFE	2.0 µm, 2-piece	Yes	37	5.00
PTFE	2.0 µm, 3-piece	Yes	37	5.00
MCE	0.8 µm, 2-piece	No	37	3.00
MCE	0.8 µm, 3-piece	No	37	3.00
QFF	No pore size, heat-treated, 2-piece	No	37	3.00
QFF	No pore size, heat-treated, 3-piece	No	37	3.00
GFF	1.0 µm, (binder-free, type AE), 2-piece	No	37	3.00
GFF	1.0 µm, (binder-free, type AE), 3-piece	No	37	3.00

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MICROBIOLOGY SAMPLING MEDIA

(All Media is subject to availability and may require a minimum order)

	DESCRIPTION	COST ($)
	Bio-Tape™ Surface Sampler Bio-Tape™ provides a standardized sampling method for the determination of possible mold, microbial, bioaerosol, and inorganic dust contamination.	1.00
	Bio-Cassette™ Impactor and Agar BioCassette is a single-use, disposable sampler that combines an impactor and a petri dish containing malt extract agar into one unit.	15.00
	Air-O-Cell™ Air Sampling Cassette The Air-O-Cell sampling cassette is specifically designed for the rapid collection and analysis of a wide range of airborne aerosols.	7.00
	Sterile Surface Swabs The Surface Swab is ideal for determining the relative degree and type of biological contamination in an area.	1.00
	Malt Extract Agar 85mm diameter sterile plastic petri dish with malt extract agar.	3.00
	Potato Dextrose Agar 85mm diameter sterile plastic petri dish with potato dextrose agar.	2.00
	Tryptic Soy Agar 85mm diameter sterile plastic petri dish with tryptic soy agar.	1.50
	Cellulose Agar 85mm diameter sterile plastic petri dish with cellulose agar.	1.50
	Czapek Agar 85mm diameter sterile plastic petri dish with Czapek agar.	1.50
	Corn Meal Agar 85mm diameter sterile plastic petri dish with corn meal agar.	3.00

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MISCELLANEOUS MEDIA

(All Media is subject to availability and may require a minimum order)

DESCRIPTION		TREATED	SIZE	COST
	SKC 232-01 Tedlar air bag	NO	1 L	10.00
	SKC 232-03 Tedlar air bag	NO	3 L	12.00
	SKC 232-05 Tedlar air bag	NO	5 L	14.00
	3M 3500 POVM	NO	NA	12.00
	3M 3520 POVM (2-stage)	NO	NA	15.00
	3M 3721 Formaldehyde POVM	YES	NA	15.00
	3M 3551 Ethylene oxide POVM	NO	NA	18.00
	Methylene Chloride extracted cotton gauze with amber glass container	YES	10 cm^2	10.00
	Ghost wipes	NO	10 WIPES	4.00
	SUMMA canister (7 day rental)	¾	6 L	40.00
	Flow regulator valve for SUMMA canister (7 day rental)	—	—	40.00
	Supelco Carbotrap 300 tube	YES	¾	40.00

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Sampling Pump Rentals

Industrial Hygiene Sampling Pumps





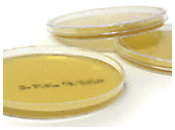
EACH KIT INCLUDES:

- (1) Personal Sampling Pump 5 to 4000 ml/min flow range
- (1) Field Rotameter , 5 feet of PVC Tubing
- (1) Low flow adapter for sampling in the 5 to 800 ml/min flow range
- (1) Sampling Tube Holder and/or Sampling Cassette Holder

RENTAL PRICE:

- $15 per day/per pump**

Microbial Sampling Pumps





TWO PUMP SAMPLING KIT RENTAL:

- (2) Sampling pumps with maximum air volume of 45 liters/minute
- (1) Field Calibration Rotameter with range of 5 – 30 liters/minute
- (1) Stand, 10 feet of PVC Tubing and (1) Carrying Case.
- $30 per day

SINGLE PUMP RENTAL:

- (1) Sampling pump with maximum air volume of 45 liters/minute
- (1) Field Rotameter , 5 feet of PVC Tubing
- $15 per day/per pump**

Note: For large projects pump rental may be included at no additional charge.
Please contact a DCL representative for further information.

(If shipping is required, a $15 fee is applied for FedEx overnight delivery)

** Additional fees may be applied for non-return or damaged equipment.

LEGEND OF ACRONYMS

AIHA	American Industrial Hygiene Association
BEPAT	Beryllium Proficiency Analytical Testing
CFR	Code of Federal Regulations
CMA	Corn Meal Agar
CVAA	Cold Vapor Atomic Absorption
DCL	DataChem Laboratories, Inc.
OC-EC	Elemental Carbons-Organic Carbons
ELPAT	Lead Proficiency Analytical Testing
EMPAT	Environmental Mold Proficiency Analytical Testing
EPA	Environmental Protection Agency
FLAA	Flame Atomic Absorption
GC-ECD	Gas Chromatography-Electron Capture Detector
GC-FID	Gas Chromatography-Flame Ionization Detector
GC-FPD	Gas Chromatography-Flame Photometric Detector
GC-MS	Gas Chromatography-Mass Spectrometry
GC-NPD	Gas Chromatography-Nitrogen Phosphorus Detector
GC-SCD	Gas Chromatography-Sulfur Chemiluminescence Detector
GC-TCD	Gas Chromatography-Thermal Coupled Detector
GFF	Glass Fiber Filter
GRAV	Gravimetric
HPLC	High Performance Liquid Chromatography
HPLC-UV	High Performance Liquid Chromatography-Ultraviolet
IC	Ion Chromatography
ICP	Inductively Coupled Plasma
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
IR	Infrared Spectrophotometry
IRB	Iron Related Bacteria
ISE	Ion Specific Electrode
LAL	Limulus Amebocyte Lysate
LC-MS	Liquid Chromatography-Mass Spectrometry
MCE	Mixed Cellulose Ester
MEA	Malt Extract Agar
mg/m^3	Milligrams/cubic meter
MVOC	Microbial Volatile Organic Compound
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards & Technology
NIOSH	NIOSH Manual of Analytical Methods
NPDWR	National Primary Drinking Water Regulations
OSHA	Occupational Safety and Health Act
OVS	OSHA Versatile Sampler
PAHs	Polynuclear Aromatic Hydrocarbons
PAT	Proficiency Analytical Testing
PCBs	Polychlorinated Biphenyls
PCM	Phase Contrast Microscopy
PDA	Potato Dextrose Agar
PEL	Permissible Exposure Limit
PLM	Polarized Light Microscopy
POVM	Passive Organic Vapor Monitor
ppb	Parts per billion
ppm	Parts per million
PTFE	Poly-tetra-fluoro-ethylene
PUF	Poly-urethane foam
PVC	Poly-vinyl chloride
SIM	Selected Ion Monitoring
TICs	Tentatively Identified Compounds
TITRA	Titration
TSA	Tryptic Soy Agar
VIS	Visible Absorption Spectrophotometry
XRD	X-ray Diffraction
$\mu g/m^3$	Micrograms/cubic meter
µg/sample	Micrograms/sample

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DIETARY SUPPLEMENTS INFORMATION

EFFECTIVE MAY 1, 2008

DataChem is ISO 17025 compliant and a proud member of United Natural Products Alliance (UNPA), a trade association of dietary supplement related companies committed to safety, science and quality. DataChem provides testing for active ingredients as well as inert materials in the final product. DataChem especially offers dietary supplement analyses for pesticides, herbicides, microbial, residual contaminants, as well as a wide range of adulterant compounds. The following list gives a sampling of the kinds of analyses that DataChem is bringing online over the next few months.

- Amino Acids and Related Compounds Analysis
- Artificial Sweetners Analysis
- Biochemicals and Functional Nutrients Analysis
- Botanicals
- Contaminants
- Lipids (Fat) Analysis
- Microbial Analysis
- Minerals and Metals Analysis
- Pharmaceuticals Analysis
- Preservatives Analysis
- Prohormones and Steroids Analysis
- Sugars and Sugar Alcohols Analysis
- Supplement Labeling Analysis
- Vitamins Analysis

Current information can always be found on DataChem's website at www.datachem.com

Please contact Jason Kim at 1-800-356-9135 for your dietary supplement analytical service needs and quotes.

NOTES

DataChem Laboratories, Inc.

Analytical Offerings

Environmental

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Qualifications and Accreditations

DCL is a NELAC accredited laboratory providing environmental analytical services to government and private clientele such as the EPA, Departments of Defense and Energy, and numerous environmental engineering firms. In supporting environmental investigation and monitoring programs, DCL performs a full range of organic and inorganic analyses using SW-846 and EPA methodologies on a wide range of sample matrices including groundwater, surface water, wastewater, soil, sludge, and hazardous waste.

- Our certifications / validations include:
  - U.S. Army Corps of Engineers
  - Department of the Navy
  - Department of Energy (DOE)
  - Air Force Center for Environmental Excellence (AFCEE)
  - NELAP
  - Various state certifications

- Programs we participate in:
  - Environmental Protection Agency (EPA-CLP)
  - Water Pollution (NELAP)
  - Water Supply (NELAP)
  - Soil (NELAP)

Description of Services

DataChem Laboratories, Inc. (DCL) is pleased to offer an extensive array of Environmental analyses. Specific analytical tests are listed in this catalog. Lists of tests are presented in two sections. The first section provides details pertinent to prominent types of environmental analyses (Specialty Analysis, TCLP and Hazardous Waste Characterization and EPA CLP). The second section lists analysis alphabetically by subject and then numerically by method. Please call a member of our staff for additional information.

RUSH SERVICES

Turn Around Time	Surcharge
Next Working Day	100%-150%
Three Working Days	50%-75%

Prior notification to confirm rush analysis capacity is requested

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SPECIALTY ANALYSIS

	Method
PERCHLORATE	
Perchlorate in Vegetation	DCL SOP
Perchlorate Analysis by LC-MS	EPA 6850
WHITE PHOSPHORUS	SW 7580
METHANE / ETHANE / ETHENE [1]	DCL SOP
EXPLOSIVES / NITROAROMATICS	
Explosives	SW 8321
Explosives (14 Compounds)	EPA 8330
Nitroglycerine/PETN	EPA 8332
Nitrocellulose	USAEC
NDMA (N-NITROSODIMETHYLAMINE)	
NDMA by GC/MS-SIM	DCL SOP
CHEMICAL AGENT BREAKDOWN PRODUCTS BY LC-MS	
DIMP/DMMP	DCL SOP
Organoacids (EMPA, IMPA, MPA, FAA)	DCL SOP
Organosulfur Compounds by GC-MS	8270D
Thiodiglycol	DCL SOP
POLYNUCLEAR AROMATIC HYDROCARBONS	
PAHs by GC-MS	EPA 8270D
PAHs by GC-MS SIM, Low	8270D/SIM

Note: Footnotes appear on Page E-11

TCLP AND HAZARDOUS WASTE CHARACTERIZATION

	Method
TCLP ANALYSIS	
Complete TCLP Analysis	
Itemized TCLP Analysis Pricing:	
TCLP Leaching:	EPA 1311
Metals/Non-Volatile Organics	
ZHE (Volatiles)	
SPLP Leaching:	EPA 1312
California WET Extraction	Title 22
Leachate Analysis:	
Volatiles (10 COMPOUNDS)	SW 8260C
Semivolatiles (12 COMPOUNDS)	SW 8270D
Pesticides (7 COMPOUNDS)	SW 8081A
Herbicides (2 COMPOUNDS)	SW 8151A
ICP Metals (7 ELEMENTS)	SW 6010B
Mercury (1 ELEMENT)	SW 7470A
HAZARDOUS WASTE CHARACTERIZATION	
Ignitability	SW 1010/1030/7.1.2.1
Corrosivity	SW 9040B/9045C
Reactivity	
Reactive Cyanide	SW-846 Chap. 7.3.3.2
Reactive Sulfide	SW-846 Chap. 7.3.4.2
Paint Filter Liquids	SW 9095A

Note: Footnotes appear on Page E-11

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EPA CLP ANALYSIS

	SOW	*Technique*
CLP ORGANICS		
Volatiles		
Volatiles	EPA SOM*	P&T GC-MS
Volatiles, Trace	EPA SOM*	P&T GC-MS
Volatiles, SIM	EPA SOM*	P&T GC-MS
Semivolatiles		
Semivolatiles	EPA SOM*	GC-MS
Semivolatiles, SIM	EPA SOM*	GC-MS
1,4-Dioxane	EPA SOM*	GC-MS
Pesticides		
Pesticides	EPA SOM*	GC-ECD
Aroclors		
Aroclors	EPA SOM*	GC-ECD
CLP INORGANICS		
Metals (ICP/ICP-MS + Hg)	EPA ILM*	ICP/ICP-MS/CVAA
Mercury	EPA ILM*	CVAA
Cyanide	EPA ILM*	AutoAnalyzer

Note: Footnotes appear on Page E-11

SCHEDULE OF SERVICES ARRANGED BY ANALYTICAL SUBJECT

INORGANIC ANALYSES

Parameter	*Method*	*Technique*
Metals Panels		
TAL Metals (23 metals)	SW 6010B + 7470A/7471B	ICP-CVAA
TAL Metals (23 metals)	CLP ILM*	ICP-AES/ICP-MS/CVAA
Appendix IX (17 metals)	SW 6010B + 7470A/7471B	ICP-CVAA
RCRA Metals (8 metals)	SW 6010B + 7470A/7471B	ICP-CVAA
TCLP Metals (8 metals)	SW 1311/6010B + 7470A	1311/ICP-CVAA
California CAM 17 (17 metals)	SW 6010B + 7470A/7471B	ICP-CVAA
ICP Metals		
ICP Metals (26 metals)	SW 6010B	ICP
ICP Metals (23 metals)	EPA 200.7	ICP
Single Metal	SW 6010B	ICP
Additional Metals	SW 6010B	ICP
Boron	SW 6010B	ICP
Silicon	SW 6010B	ICP
ICP-MS Metals [5]		
Standard Metals List (20 metals)	EPA 200.8	ICP-MS
Standard Metals List (22 metals)	SW 6020A	ICP-MS
Single Metal	SW 6020A	ICP-MS
Additional Metals	SW 6020A	ICP-MS
Mercury		
Mercury in Water	EPA 245.1	CVAA
Mercury in Water	SW 7470A	CVAA
Mercury in Soil/Sediment	SW 7471B	CVAA
Mercury in Sediment	EPA 245.5	CVAA
Hexavalent Chromium [6]		
Hexavalent Chromium	SW 7196A	Colorimetry

GENERAL INORGANICS

Parameter	*Method*	*Technique*
Acidity	EPA 305.1	Titration
Alkalinity	EPA 310.1	Titration
Alkalinity	EPA 310.2	AutoAnalyzer
Alkalinity (as CO_3, HCO_3, OH)	EPA 310.2	AutoAnalyzer
Ammonia Nitrogen	EPA 350.1	AutoAnalyzer
(with distillation)	EPA 350.1	AutoAnalyzer
Anions [5]		
Complete Scan	EPA 300.0	Ion Chromatography
Single Anion	EPA 300.0	Ion Chromatography
Additional Anions	EPA 300.0	Ion Chromatography

Note: Footnotes appear on Page E-11

GENERAL INORGANICS, CON'T.

Parameter	*Method*	*Technique*
Asbestos	NIOSH 9002	PLM
Asbestos [6]	EPA 100.1	TEM
Cation Exchange Capacity	SW 9081	ICP
Chemical Oxygen Demand	410.2 HACH Kits	Colorimetry
Color	EPA 110.2	Visual
Conductivity	EPA 120.1	Conductivity Meter
Corrosivity		
Corrosivity in Water	SW 9040	Electrode
Corrosivity in Soil	SW 9045	Electrode
NACE	SW 1110	Gravimetric
Cyanide		
EPA-CLP	CLP ILM05.4	AutoAnalyzer
Reactive	EPA 7.3.3.2	Colorimetry
Total	EPA 335.4	AutoAnalyzer/UV
Total	SW 9012A	AutoAnalyzer/UV
Weak and Dissociable	SM 4500-CN I	AutoAnalyzer/UV
Fluoride	EPA 340.2	Electrode
Hardness (as $CaCO_3$)	EPA 130.2	Titrimetric
Hardness (as $CaCO_3$) [7]	SM 2340B/6010B/200.7	Calculation (ICP)
Hexavalent Chromium [4]	SW 7196A	Colorimetry
Ignitability	SW 1010	Pensky-Martin
Ignitability	SW 1030	Flame
IMPA, MPA	USAEC	Ion Chromatography
%Moisture / %Solids Determination	ASTM D-2216	Gravimetric
Nitrocellulose	USAEC	Colorimetry
Nitrogen as N		
Ammonia	EPA 350.1	AutoAnalyzer
Nitrate	EPA 353.2	AutoAnalyzer
Nitrate/Nitrite	EPA 353.2	AutoAnalyzer
Nitrite	EPA 353.2 Mod	AutoAnalyzer
Total Kjeldahl	EPA 351.2	AutoAnalyzer
Odor	EPA 140.1	Olfactory
Oil & Grease	EPA 1664A	Gravimetric
Organoacids	DCL SOP	Ion Chromatography
Paint Filter Liquids	SW 9095A	Paint Filter
Perchlorate	EPA 6850	LC/MS
pH in Water	EPA 150.1	Electrode
pH in Water	SW 9040B	Electrode
pH in Soil	SW 9045C	Electrode
Phenolics [8]	EPA 420.4	AutoAnalyzer
Phenolics	SW 9066	AutoAnalyzer
Phosphorus		
Ortho	EPA 365.1	AutoAnalyzer
Total	EPA 365.4	AutoAnalyzer
White Phosphorus	SW 7580	GC/FPD
Reactive Cyanide	EPA 7.3.3.2	AutoAnalyzer
Reactive Sulfide	EPA 7.3.4.2	Colorimetry
Solids		
Total Dissolved	EPA 160.1	Gravimetric
Total Suspended	EPA 160.2	Gravimetric
Total	EPA 160.3	Gravimetric
Total Volatile	EPA 160.4	Oven/Gravimetric
Total Settleable	EPA 160.5	Volumetric

Note: Footnotes appear on Page E-11

GENERAL INORGANICS CON'T.

Parameter	*Method*	*Technique*
Specific Conductance	EPA 120.1 or 9050A	Conductivity Meter
Sulfate	EPA 375.2	Colorimetry
Sulfide		
Reactive	EPA 7.3.4.2	Colorimetry
Total	EPA 376.1	Titration
Sulfides	SW 9030B	Distillation/Titration
Total Kjeldahl Nitrogen	EPA 351.2	AutoAnalyzer
Total Organic Carbon (dup)	EPA 415.1	Oxidation/IR
Total Organic Carbon (quad)	SW 9060	IR Analyzer
Total Organic Carbon	Lloyd Kahn	Combustion/IR Carbon Analyzer
Turbidity	EPA 180.1	Nephelometer

ORGANIC ANALYSIS

Parameter	*Method*	*Technique*
Volatile Organics		
Volatiles	SW 5030/8260C	GC/MS
Volatiles, Closed System P&T for Soils	SW 5035/8260C	GC/MS
Volatiles, CLP (Low/Medium)	EPA SOM*	GC/MS
Volatiles, CLP (Trace)	EPA SOM*	GC/MS
Volatiles Trace (CLP + SIM)	EPA SOM*	GC/MS
Volatiles, Drinking Water	EPA 524.2	P&T GC/MS
TCLP Volatiles (10 cmpds)	SW 1311/8260C	TCLP/GC/MS
BTEX	SW 5030/8260C	GC/MS
BTEX & Naphthalene	SW 5030/8260C	GC/MS
BTEX & Naphthalene + MTBE	SW 5030/8260C	GC/MS
Methane, Ethane, Ethene [1]	DCL SOP	Headspace/GC/FID
Semivolatile Organics		
Semivolatiles	SW 8270D	GC/MS
Semivolatiles, CLP	EPA SOM*	GC/MS
Semivolatiles, (CLP + SIM)	EPA SOM*	GC/MS
PAHs Only	SW 8270D	GC/MS
PAHs Only, Low-Level	SW 8270D	GC/MS SIM
TCLP Semivolatiles (12 cmpds)	SW 1311/8270D	TCLP/GC/MS
Pesticides and Aroclors (PCBs)		
Organochlorine Pesticides	SW 8081	GC/ECD
Organochlorine Pesticides/Aroclors, CLP	EPA SOM*	GC/ECD
Aroclors	EPA SOM*	GC/ECD
TCLP Pesticides (7 cmpds)	SW 1311/8081A	TCLP/GC/ECD
Aroclors (PCBs)	SW 8082	GC/ECD
Aroclors (PCBs) in Transformer Oil	SW 8082	GC/ECD
Aroclors (PCBs) in Wipes	SW 8082	GC/ECD
Herbicides		
Chlorinated Herbicides	SW 8151A	GC/ECD
TCLP Herbicides	SW 1311/8151A	TCLP/GC/ECD
Petroleum Hydrocarbons		
Gasoline Range Organics (GRO)	SW 8260C	GC/MS
Diesel Range Organics (DRO)	SW 8015B	GC/FID
Residual Range Organics (RRO)	SW 8015B	GC/FID
BTEX	SW 8260C	GC/MS
BTEX & Napthalene	SW 8260C	GC/MS
BTEX, Napthalene & MTBE	SW 8260C	GC/MS
Oil & Grease (TPH)	EPA 1664A	Gravimetry

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ORGANIC ANALYSIS CON'T.

Parameter	*Method*	*Technique*
Chemical Agent Breakdown Products by LC/MS		
DIMP/DMMP	DCL SOP	LC/MS
Organoacids (EMPA, IMPA, MPA, CAA, FAA)	DCL SOP	Ion Chromatography
Thiodiglycol	DCL SOP	GC/SCD (water)
Explosives		
Explosives	SW 8321	LC/MS
Explosives (Nitroaromatics)	SW 8330	HPLC
Nitroglycerin/PETN	SW 8332	HPLC
Other Organics		
Alcohols	SW 8321	LC/MS
Dioxins, Low Resolution[9]	SW 8280	GC/MS
Dioxins, High Resolution[9]	SW 8290	GC/HRMS
NDMA	DCL SOP	GC/MS
Air Monitoring		
Pesticides & PCBs (High Volume)	EPA TO-4	GC/ECD
Pesticides & PCBs (Low Volume)	EPA TO-10	GC/ECD
Formaldehyde (other aldehydes– contact representative)	EPA TO-11	HPLC
PAHs	EPA TO-13	GC/MS
Volatiles (SUMMA/Silco Canisters)	EPA TO-14/15	GC/MS
Volatiles (Carbotrap Tubes)	EPA TO-17	GC/MS

RADIOCHEMISTRY

Parameter	*Method*
Radon[10]	913.0
Alpha Spectrometry (AS) [10]	
Americium—241	ASTM D3972-90M
Curium—242, 243, 244	ASTM D3972-90M
Neptunium—237	PAI SOP
Plutonium—238, 239/240	ASTM D3972-90M
Polonium—210	ASTM D3972-90M
Thorium—228, 230, 232	ASTM D3972-90M
Thorium—224, 227, 228, 230, 232	ASTM D3972-90M
Uranium—233/234, 235, 238	ASTM D3972-90M
Uranium—Total	ASTM D3972-90M
Gamma Spectrometry (GS) [10]	
Gamma Emitters—Stock Library	EPA 901.1/EPA 901.1M
Gross Gamma	EPA 901.1/EPA 901.1M
Iron—55	RESL Fe-01M
Nickel—59	RESL Ni-01M
Ra-226/228—(Bi/Pb-214 ingrowth)	EPA 901.0M
Ra-226/228—(Screening)	EPA 901.0M
Liquid Scintillation Counting (LSC) [10]	
Carbon—14	EERF C-01M
Tritium	EERF C-01M
Tritium—Water Exchangeable	PAI SOP
Technetium—99	
Lead—210	
Nickel—63	RESL Ni-01M
Plutonium—241	ASTM D3972-90M

Note: Footnotes appear on Page E-11

RADIOCHEMISTRY, CON'T.

Parameter	*Method*
Gas Flow Proportional Counting (GFP) [10]	
Gross Alpha/Beta	900.0/9310
Gross Alpha/Beta (Leach)	900.0M/9310M
Radium Tot. Alpha Emitting Isotopes	903.0/9315
Radium Tot, Alpha Emitting Isotopes	903.0M/9315M
Radium—228 *please inquire*	EPA 9320
Iodine—129	902.0M
Lead—210	ASTM D5811-95M
Sr—90 Total Radiostrontium	ASTM D5811-95M
Sr—89/90 *Sr-90 or Sr-89 reported separately*	ASTM D5811-95M
Tc—99	Eichrom
Pm—147 *please inquire*	
Alpha Scintillation [10]	
Ra—226 (Rn-Emanation)	EPA 903.1
EPA Drinking Water Compliance Methodologies [10]	
Gross Alpha and Beta (GFP)	EPA 900.0/7110
Gross Alpha Coprecipitation (GFP)	EPA 900.1
Radioiodine (GFP)	EPA 902.0
Rn—222	EPA 913
Ra—226 by Alpha-Scintillation (Rn-Emanation)	EPA 903.1
Ra—226 (GFP—Total Radium Alpha)	EPA 903.0
Ra—228 (GFP)	EPA 904.0
Tritium by LSC	EPA 906.0
Total Uranium by Alpha Spectrometry	ASTM D3972-90M
Isotopic Uranium by Alpha Spectrometry	ASTM D3972-90M
Isotopic Thorium by Alpha Spectrometry	ASTM D3972-90M
Gamma Spectroscopy	EPA 901.1
SW 846 Compliance Methodologies [10]	
Gross Alpha and Beta	EPA 9310
Ra—226 by GFP (Total Radium Alpha)	EPA 9315
Ra—228 by GFP	EPA 9320

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SCHEDULE OF SERVICES ARRANGED NUMERICALLY BY METHOD

EPA 100 SERIES

	Analysis	*Instrumentation*
100.1	Asbestos [6]	TEM
110.2	Color	Visual
120.1	Conductivity	Conductivity Meter
130.2	Hardness (as $CaCO_3$)	Titrimetric
140.1	Odor	Olfactory
150.1	pH	Electrode
160.1	Total Dissolved Solids (TDS)	Gravimetric
160.2	Total Suspended Solids (TSS)	Gravimetric
160.3	Total Solids (TS)	Gravimetric
160.4	Total Volatile Residue (TVS)	Oven and Gravimetric
160.5	Settleable Solids	Volumetric
180.1	Turbidity	Nephelometer

EPA 200 SERIES

	Analysis	*Instrumentation*
200.7	Metals Panel (23 metals)	ICP
200.8	Metals Panel (20 metals) [3]	ICP-MS
245.1	Mercury	CVAA
245.5	Mercury in Sediment	CVAA

EPA 300 SERIES

	Analysis	*Instrumentation*
300.0	Anions (Br, Cl, F, NO_3[7], NO_2[7], PO_4[7], SO_4)	Ion Chromatography
300.0	Anions - First Analyte Additional Analytes	Ion Chromatography
305.1	Acidity	Titration
310.1	Alkalinity	Titration
310.2	Alkalinity	AutoAnalyzer
335.4	Total Cyanide	AutoAnalyzer
340.2	Fluoride	Electrode
350.1	Ammonia	AutoAnalyzer
350.1	Ammonia with Distillation	AutoAnalyzer
351.2	TKN	AutoAnalyzer
353.2	Nitrate as N	AutoAnalyzer
353.2	Nitrate + Nitrite as N	AutoAnalyzer
353.2 Mod	Nitrite as N	AutoAnalyzer
365.1	ortho-Phosphorus	AutoAnalyzer
365.4	Total Phosphorus	Auto Analyzer
375.2	Sulfate	Colorimeter
376.1	Sulfide	Titration
377.1	Sulfite	Titration

Note: Footnotes appear on Page E-11

EPA 400 SERIES

	Analysis	*Instrumentation*
410.2 HACH Kits	COD	Colorimetry
415.1	TOC	Oxidation/IR
420.4 [8]	Phenolics	AutoAnalyzer

EPA 500 SERIES

	Analysis	*Instrumentation*
524.2	Volatile Organics	P&T GC/MS

SW-846 EPA 6000 AND 7000 SERIES

	Analysis	*Instrumentation*
6010B	Metals Panel - 26 Metals	ICP
6010B	Single Metal - (Includes Prep Fee) Additional Metals	ICP
6020A/6010B	Metals Panel - 22 Metals	ICP-MS/ICP [2]
6020A	Single Metal - (Includes Prep Fee) Additional Metals	ICP-MS
6010B	Boron*	ICP
6010B	Silicon*	ICP
7196A [4]	Chromium VI*	Colorimetry
7470A	Mercury (in Liquids)*	CVAA
7471B	Mercury (in Solids)*	CVAA
7580	White Phosphorus	GC/FPD

* Prep fee included

SW-846 EPA 8000 SERIES

	Analysis	*Instrumentation*
8015B	Diesel Range Organics (DRO)	GC/FID
8015B	Residual Range Organics (RRO)	GC/FID
8081A	Organochlorine Pesticides	GC/ECD
8082A	PCBs	GC/ECD

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SW-846 EPA 8000 SERIES (CONTINUED)

	Analysis	*Instrumentation*
8151A	Chlorinated Herbicides	GC/ECD
5030/8260C	Volatile Organics - TCL List	GC/MS
5035/8260C	Volatile Organics - TCL List	GC/MS
8260C	Gasoline Range Organics (GRO)	GC/MS
8270D	Semivolatile Organics - TCL List	GC/MS
8270D	PAHs Only	GC/MS
8270D	PAHs Only, Low-Level	GC/MS SIM
8280	Dioxins/Furans[9]	HRGC/LRMS
8290	Dioxins/Furans[9]	HRGC/LRMS
8321	Selected Alcohols	LC/MS
8330	Explosives	HPLC
8332	Nitroglycerine/PETN	HPLC

SW-846 EPA 9000 SERIES AND MISCELLANEOUS

	Analysis	*Instrumentation*
9012A	Total Cyanide	AutoAnalyzer
9030B	Sulfides	Distillation/Titration
9040B	pH in Water	Electrode
9045C	pH in Soil	Electrode
9050A	Specific Conductance	Conductivity Meter
9060	Total Organic Carbon (quad)	Combustion/IR Carbon Analyzer
Lloyd Kahn	Total Organic Carbon	Combustion / IR Carbon Analyzer
9066	Phenolics	AutoAnalyzer
1664A	Oil & Grease	Gravimetric
1680	Fecal Coliform	Visual
1680	Fecal Coliform (Non-drinking water)	Visual
9081	Cation Exchange Capacity	ICP
9095A	Paint Filter Liquids	Paint Filter
SM 2340B	Hardness (Ca & Mg)	ICP (Calculation)
SM 4500-CN I	Weak and Dissociable Cyanide	AutoAnalyzer/UV
EPA 6850	Perchlorate	LC/MS
Air Monitoring		
Pesticides & PCBs (High Volume)	TO-4	GC
Pesticides & PCBs (Low Volume)	TO-10	GC
PAHs	TO-13	GC/MS
Volatiles (SUMMA/Silco Canisters)	TO-14/15	GC/MS
Volatiles (Carbotrap Tubes)	TO-17	GC/MS

1. Based on method RSK 175 and the U. S. EPA Technical Guidance for the Natural Attenuation Indicators, July, 2001.
2. Pricing is dependant on full panel analyses request. Contact your DCL project manager for individual panel pricing.
3. Methods 200.8 and 6020 do not include Mercury as an analyte.
4. Analysis holding time is 48 hours from collection—Laboratory must be contacted prior to shipping samples for Hexavalent Chromium in water by SW7196A
5. Analysis holding time is 48 hours from collection for Nitrate/Nitrite and ortho-phosphate by EPA 300.0. Laboratory must be contacted prior to shipping samples.
6. Subcontracted to DCL - Cincinnati.
7. Unit price is $20 if ICP scan has already been performed.
8. Analysis holding time is 24 hours from collection—Laboratory must be contacted prior to shipping samples for phenolics by EPA 420.2
9. DataChem does not perform these analyses and subcontracts this work with client approval to certified vendors.
10. Subcontracted to DCL - Ft. Collins (Paragon Analytics).

* DCL utilizes the most current Statement of Work

STANDARD REPORT FORMATS

DataChem Laboratories, Inc. has the flexibility to supply your data in a variety of report formats. The enclosed table lists the standard features and options available in each of these formats. There is a marginal surcharge for Level 3 and Level 4 report formats.

Report Level Deliverable	Level 1 Report with Title Page	Level 2 Report with Narrative and QC	Level 3 CLP-Like No Raw Data	Level 4 CLP-Like with Raw Data
Cover Page	Required	Required	Required	Required
Narrative		Required	Required	Required
Client Documentation (COC/ARF/Client Instructions)	Required	Required	Required	Required
Analytical Results	Sample Results	Sample Results	Sample Results RLIMS	Sample Results RLIMS
QC Summaries and Data		Method QC	Method QC Instrument QC CLP Forms	Method QC Instrument QC CLP Forms
Raw Data				All Raw Data
Laboratory Logs			Internal COC	Internal COC Standards Logs Digestion/Extraction Logs Instrument Logs Other Logs
Options	EDD Summary Table	EDD Summary Table	EDD Summary Table	EDD Summary Table

Method QC = Method Blank, Lab Control Standard, Matrix Duplicate, Matrix Spike, Matrix Spike Duplicate, and/or Surrogates where applicable.

Instrument QC = Tuning, Calibration Curve, Calibration Checks, Instrument Blanks, Background Checks, Efficiencies, and/or Interference Checks where applicable.

DCL has extensive experience in supplying a wide range of electronic deliverable formats, from a simple spreadsheet to federal program-based database support (e.g., ERPIMS, ERIS, AFCEE, SEDD). DCL can also customize an electronic deliverable to meet your own format . A surcharge may be assessed for a customized EDD.

All report formats can be delivered via email, on CD or in hard copy. Surcharges may apply for multiple types of deliverables.

SAMPLE PRESERVATION, CONTAINERS AND HOLD TIMES

					Holding Time (Days)	
Analysis	**Matrix**	**Method**	**Sample Size/Container**	**Preservative[1]**	**From Sampling**	**From Extraction**
Acidity	W/WW	305.1	500 mL/P	Cool, 4°C	14	
Alkalinity	W/WW	310.1/310.2	500 mL/P	Cool, 4°C	14	
Ammonia	W/WW	350.1	500 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Anions	W/WW S/SW	300.0 300.0 Mod	500 mL/P 4 oz/G	Cool, 4°C	28 (2 for NO_3, NO_2 & PO_4)	
Aroclors (PCBs)	W/WW S/SW	8082	2 x 1 L/AG 4 oz/AG	Cool, 4°C	7 14	40 40
BTEX	W/WW S/SW	8260C	2 x 40 mL/AG 4 oz/AG	Cool, 4°C, HCl pH<2	14 14	
Chemical Oxygen Demand (COD)	W/WW	COD/HACH	500 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Color	W	110.2	250 mL/P	Cool, 4°C	2	
Conductivity	W/WW S/SW	120.1 9050A	500 mL/P 4 oz/G	Cool, 4°C	28	
Corrosivity	W/WW S/SW	1110	250 mL/P 4 oz/P	NA	7 7	
Cyanide	W/WW S/SW	335.4 9010A/9012A	1L/P 4 oz/P	NaOH, pH>12 Cool, 4°C	14 14	
Diesel Range Organics	W/WW S/SW	8015B	1 L/AG 4 oz/AG	Cool, 4°C	14 14	40 40
DIMP/DMMP	W/WW S/SW	DCL SOP	2 x 1L/AG 4 oz/AG	Cool, 4°C	7 7	— 40
Dioxins/Furans (7)	W/WW S/SW	8280/8290	2 x 1 L/AG 4 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 30	40 45
EMPA, IMPA,MPA, etc.	W/WW S/SW	UT04 DCL SOP	2 x 1L/AG 4 oz/AG	Cool, 4°C	40 40	
Explosives	W/WW S/SW	8330	2 x 1 L/AG 4 oz/AG	Cool, 4°C, Dark 0.008% $Na_2S_2O_3$	7 14	40 40
Fluoride	W/WW	340.2	500 mL/P	NA	28	
Gasoline Range Organics	W/WW S/SW	8260C	2 X 40 mL/AG 4 oz/P	Cool, 4°C HCl, pH<2	14 14	
Herbicides	W/WW S/SW	8151A	2 x 1 L/AG 4 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 14	40 40
Hexavalent Chromium	W/WW S/SW	7196A	500 mL/P 4 oz/P/G	Cool, 4°C	1 28	 1

					Holding Time (Days)	
Analysis	**Matrix**	**Method**	**Sample Size/Container**	**Preservative[1]**	**From Sampling**	**From Extraction**
Ignitability	W/WW S/SW	1010	500 mL/G 4 oz/G	None	7	
Mercury	W/WW S/SW	245.1/245.5 7470A/7471A	250mL/P/G 4 oz/P/G	HNO_3, pH<2	28 28	
Metals ICP/AA	W/WW S/SW	200 Series 6010B/6020	500 mL/P 4 oz/P/G	HNO_3 pH<2	180 180	
NDMA	W/WW S/SW	UM34 and DCL SOP	2 x 1 L/AG 4 oz/AG	Cool, 4°C	7 14	40 40
Nitrate	W/WW	353.2	250 mL/P	Cool, 4°C	2	
Nitrate + Nitrite	W/WW	353.2	250 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Nitrite	W/WW	353.2 Mod	125 mL/P	Cool, 4°C	2	
Nitroglycerin/PETN	W/WW S/SW	8332	2 x 1 L/AG 4 oz/AG	Cool, 4°C	7 14	40 40
Odor	W/WW	140.1	500 mL/G	Cool, 4°C	1	
Oil & Grease	W/WW	1664	1 L/AG	Cool, 4°C H_2SO_4 or HCL pH<2	28	
Organochlorine Pesticides	W/WW S/SW	8081	2 x 1 L/AG 4 oz/AG	Cool, 4°C, pH 5-9 0.008% $Na_2S_2O_3$	7 14	40 40
ortho-Phosphate	W/WW	365.1	125 mL/P	Cool, 4°C Filter Immediately	2	
Perchlorate	W/WW S/SW	EPA 6850	500 mL/P 4 oz/AG	Cool, 4°C	28 28	
pH	W/WW S/SW	150.1 9040B/9045C	500mL/P 4 0z/P/G	Cool, 4°C	ASAP ASAP	
Phenolics	W/WW	420.4 9066	1 L/AG 4 oz/AG	Cool, 4°C H_2SO_4 pH<2	1 28	
Phosphorus—White/Elemental (P4)	WWW S/SW	7580	250 mL/AG 4 oz/AG	Cool, 4°C, No headspace	5 30	
Polynuclear Aromatics (PAHs)	W/WW S/SW	8270D 8310	2 x 1 L/AG 4 oz/AG	Cool, 4°C, Dark 0.008% $Na_2S_2O_3$	7 14	40 40

					Holding Time (Days)	
Analysis	**Matrix**	**Method**	**Sample Size/Container**	**Preservative[1]**	**From Sampling**	**From Extraction**
Reactive Cyanide	W/WW S/SW	7.3.3.2	500 mL/P 4 oz/P/G	Cool, 4°C Dark	7 7	
Reactive Sulfide	W/WW S/SW	7.3.4.2	500 mL/P 4 oz/P/G	Cool, 4°C Dark	7 7	
Semivolatile Organics	W/WW S/SW	8270D	2 x 1 L/AG 4 oz/AG	Cool, 4°C 0.008% $Na_2S_2O_3$	7 14	40 40
Sulfide	W/WW S/SW	376.1 9030B	500 mL/P 4 oz/P/G	Cool, 4°C pH>9 NaOH, ZnOAc	7 7	
TCLP Metals	W/WW S/SW	1311	1 L/P	NA	180	
TCLP Semivolatiles, Pesticides, & Herbicides	W/WW S/SW	1311	3 X 1L/AG 4 oz/AG	Cool, 4°C	14 (leach) 7 (extraction)	40
TCLP Volatiles	W/WW S/SW	1311	3 X 40mL/AG 4 oz/AG	Cool, 4°C	14 (leach) 14 (analyze)	
Thiodiglycol	W/WW S/SW	UL09 LL9	2 x 1 L/AG 4 oz/AG	Cool, 4°C	40 7	— 40
Total Dissolved Solids	W/WW	160.1	500 mL/P	Cool, 4°C	7	
Total Kjeldahl Nitrogen	W/WW	351.2	1 L/P	Cool, 4°C H_2SO_4 pH<2	28	
Total Organic Carbon (TOC)	W/WW S/SW	415.1 9060	250 mL/AG 4 oz/AG	Cool, 4°C H_2SO_4 pH<2	28 28	
Total Phosphorus	W/WW	365.4	125 mL/P	Cool, 4°C H_2SO_4 pH<2	28	
Total Recoverable Petroleum Hydrocarbons (TRPH)	W/WW	418.1	1 L/AG	Cool, 4°C H_2SO_4 pH<2	28	
Total Settleable Solids	W/WW	160.1	500 mL/P	Cool, 4°C	2	
Total Solids Moisture	W/WW S/SW	160.3	500 mL/P 4 oz/G	Cool, 4°C	7 7	
Total Suspended Solids	W/WW	160.2	500 mL/P	Cool, 4°C	7	

					Holding Time (Days)	
Analysis	Matrix	Method	Sample Size/Container	Preservative [1]	From Sampling	From Extraction
Total Volatile Solids	W/WW	160.4	250 mL/P	Cool, 4°C	7	
Turbidity	W/WW	180.1	250 mL/P	Cool, 4°C	2	
Volatile Organics	W/WW	524.2	2 x 40 mL/AG	Cool, 4°C Dechlorination then HCl, pH<2 No Head-space	14	
Volatile Organics	W/WW S/SW	8260C	2 x 40 mL/AG 4 oz/AG	Cool, 4°C HCl, pH<2, No Head-space	14 14	
MISCELLANEOUS						
Asbestos (7)	W	100.1	1 L/P	Cool, 4°C	2	
Asbestos (7)	W/W	100.1	1 L/P	Cool, 4°C	None	

Abbreviations used are as follows:

Matrix		Container		Preservatives	
W	Water	P	Plastic (HDPE)	NaOH	Sodium Hydroxide
WW	Waste Water	AG	Amber Glass	HCl	Hydrochloric Acid
S	Soil/Sediment	G	Glass	HNO_3	Nitric Acid
SW	Solid Waste			H_2SO_4	Sulfuric Acid
				$Na_2S_2O_4$	Sodium Thiosulfate

[1] Chemical Preservative on W/WW matrix only.

NOTES:
1. Sample preservation should be performed during sample collection.
2. Soil samples can be collected in either glass jars or stainless steel liners with both ends sealed with Teflon® paper and plastic caps.
3. Extraction hold times are from the date of sampling, and analysis hold times are from the date of extraction.
4. If analyzing for dissolved metals, the sample shall be field-filtered through a 0.45-µm filter immediately (within 15 minutes) after sample collection and prior to preservation.
5. Provide twice the number of containers listed when matrix spike, matrix duplicate, and matrix spike duplicate analyses are requested for the sample. Minimum frequency is one per 20 field samples.
6. This table includes the requirements of the U. S. Environmental Protection Agency, as published in the *Code of Federal Regulations,* Volume 49, Number 209, 40 CFR 136 dated October 26, 1984, page 43260 and SW846 Chapter 2 Table 2-36 Revision 3, December 1996.
7. DataChem does not perform these analyses and subcontracts this work, with client approval, to certified vendors.

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PREPARATION METHODS
SW-846
EPA 300 SERIES METHODS
METALS PREPARATION METHODS

Regulatory Method	Matrix	Metals Analysis	Instrumentation	Acid
3005	Water/Soil (Modified)	ICP Digestion	Hotplate	HNO_3
3010	Water	ICP Digestion	Hotplate	HNO_3/HCl
3015	Water	ICP	Microwave	HNO_3
3050	Solids	ICP Digestion	Hotplate	HNO_3/H_2O_2/ HCl
3051[1]	Solids	ICP Digestion	Microwave	HNO_3
3060	Solids	Hexavalent Chromium Digestion	Hotplate	NA

[1] Not appropriate for antimony.

ORGANIC PREPARATION METHODS

DCL routinely uses the following preparation methods for aqueous and solid samples

Regulatory Method	Analysis	Preparation Technique
3510	Organics	Separatory Funnel Extraction
3550	Organics	Sonication Extraction

The following preparation techniques are commonly applied for volatiles analysis

Regulatory Method	Analysis	Preparation Description
3810	Volatile Organics	Headspace
5030	Volatile Organics	Purge-and-Trap
5035	Volatile Organics	Closed-System Purge-and-Trap (Encore)

The following preparation methods can be utilized upon client specific request (additional charges may apply)

Regulatory Method	Analysis	Preparation Technique
3520	Organics	Liquid/Continuous Liquid Extraction
3540	Organics	Soxhlet Extraction
3580	Organics	Waste Dilution
3620	Organics	Florisil Cleanup
3640	Organics	Gel Permeation
3660	Organics	Sulfur Cleanup

ANALYTE LISTS

6010B - ICP Metals

Aluminum	***Copper***	***Selenium***
Antimony	***Iron***	Silica
Arsenic	***Lead***	***Silver***
Barium	Lithium	Sodium
Beryllium	***Magnesium***	***Strontium***
Boron	***Manganese***	***Thallium***
Cadmium	Molybdenum	***Titanium***
Calcium	***Nickel***	***Vanadium***
Chromium	Phosphorus	***Zinc***
Cobalt	Potassium	

Note: *Analytes in **bold italics** can be analyzed utilizing **6020A ICP-MS** methodology as well as by method 6010B **I**CP. Please consult your project*

300.0 - Anions

Bromide	Nitrate	Sulfate
Chloride	Nitrite	
Fluoride	Ortho-Phosphate-P	

524.2 – Volatile Organics in Drinking Water

1,1-Dichloroethane	1,2-Dibromo-3-Chloropropane	Hexachlorobutadiene
1,1-Dichloroethene	2,2-Dichloropropane	Isopropylbenzene
1,1-Dichloropropene	4-Chlorotoluene	*m&p*-Xylene
1,1,1-Trichloroethane	Benzene	Methylene Chloride
1,1,1,2-Tetrachloroethane	Bromobenzene	Naphthalene
1,1,2-Trichloroethane	Bromochloromethane	*n*-Butylbenzene
1,1,2,2-Tetrachloroethane	Bromodichloromethane	*n*-Propylbenzene
1,2-Dibromoethane	Bromoform	*o*-Xylene
1,2-Dichlorobenzene	Bromomethane	*p*-Isopropyltoluene
1,2-Dichloroethane	Carbon Tetrachloride	*sec*-Butylbenzene
1,2-Dichloropropane	Chlorobenzene	Styrene
1,2,3-Trichlorobenzene	Chloroethane	*tert*-Butylbenzene
1,2,3-Trichloropropane	Chloroform	Tetrachloroethene
1,2,4-Trichlorobenzene	Chloromethane	Toluene
1,2,4-Trimethylbenzene	*cis*-1,2-Dichloroethene	*trans*-1,2-Dichloroethene
1,3-Dichlorobenzene	*cis*-1,3-Dichloropropene	*trans*-1,3-Dichloropropene
1,3-Dichloropropane	Dibromochloromethane	Trichloroethene
1,3,5-Trimethylbenzene	Dibromomethane	Trichlorofluoromethane
1,4-Dichlorobenzene	Dichlorodifluoromethane	Vinyl Chloride
2-Chlorotoluene	Ethylbenzene	

8081 – Organochlorine Pesticides

4,4'-DDD	delta-BHC	Endrin Ketone
4,4'-DDE	Dieldrin	gamma-Chlordane
4,4'-DDT	Endosulfan I	Heptachlor
Aldrin	Endosulfan II	Heptachlor epoxide
alpha-BHC	Endosulfan Sulfate	Hexachlorobenzene*
alpha-Chlordane	Endrin	Lindane
beta-BHC	Endrin Aldehyde	Methoxychlor
		Toxaphene

* If requested

8082 - Aroclor (PCBs)

Aroclor 1016	Aroclor 1242	Aroclor 1254
Aroclor 1221	Aroclor 1248	Aroclor 1260
Aroclor 1232		

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8270D – Polynuclear Aromatic Hydrocarbons (PAHs)

Acenaphthene
Acenaphthylene
Anthracene
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(ghi)perylene
Benzo(k)fluoranthene
Chrysene
Dibenzo(a,h)anthracene
Fluoranthrene
Fluorene
Indeno(1,2,3-cd)pyrene
Naphthalene
Phenanthrene
Pyrene

8151A – Chlorinated Herbicides

2,4-D
2,4-DB
2,4,5-T
2,4,5-TP
Dalapon
Dicamba
Dichlorprop
Dinoseb
MCPA
MCPP
Pentachlorophenol*

* If requested

8260C – Volatile Organics

1,1,1,2-Tetrachloroethane
1,1,1-Trichloroethane
1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane
1,1-Dichloroethane
1,1-Dichloroethene
1,1-Dichloropropene
1,2,3-Trichlorobenzene
1,2,3-Trichloropropane
1,2,4-Trichlorobenzene
1,2,4-Trimethylbenzene
1,2-Dibromo-3-Chloropropane
1,2-Dibromoethane
1,2-Dichlorobenzene
1,2-Dichloroethane
1,2-Dichloropropane
1,3,5-Trimethylbenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1.3-Dichloropropane
1-Chlorohexane
2,2-Dichloropropane
2-Butanone
2-Chlorotoluene
2-Hexanone
4-Chlorotoluene
4-Methyl-2-pentanone
Acetone
Allyl chloride
Benzene
Bromobenzene
Bromochloromethane
Bromodichloromethane
Bromoform
Bromomethane
Carbon disulfide
Carbon tetrachloride
Chlorobenzene
Chloroethane
Chloroform
Chloromethane
cis-1,2-Dichloroethene
cis-1,3-Dichloropropene
Cyclohexane
Dibromochloromethane
Dibromomethane
Dichlorodifluoromethane
Dichlorofluoromethane
Ethyl acetate
Ethyl ether
Ethyl methacrylate
Ethylbenzene
Hexachlorobutadiene
Iodomethane
Isopropylbenzene
m&p-Xylene
Methyl acetate
Methylcyclohexane
Methylene chloride
Methyl-t-butyl ether
Napthalene
n-butylbenzene
n-propylbenzene
o-Xylene
pentachloroethane
P-Isopropyltoluene
sec-Butylbenzene
Styrene
Tert-Butylbenzene
Tetrachloroethene
Tetrahydrofuran
Toluene
trans-1,2-Dichloroethene
trans-1,3-Dichloropropene
trans-1.4-dichloro-2-butene
Trichloroethene
Trichlorofluoromethane
Trichlorotrifluoroethane
Vinyl chloride

Note: Compounds in ***bold italics*** are part of an expanded list and can be analyzed by 8260C methodology. Those compounds in standard font make up the standard short list for 8260C methodology.

8270D – Semivolatile Organics

1,2-Dichlorobenzene
1,2,4-Trichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
2-Chloronaphthalene
2-Chlorophenol
2-Methylnaphthalene
2-Methylphenol (o-cresol)
2-Nitrophenol
2,4-Dichlorophenol
2,4-Dimethylphenol
2,4-Dinitrophenol
4-Chlorophenyl Phenyl Ether
4-Methylphenol (p-cresol)
4-Nitroaniline
4-Nitrophenol
4,6-Dinitro-2-Methylphenol
Acenaphthene
Acenaphthylene
Anthracene
Benzo[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[ghi]perylene
Dibenzo[a,h]anthracene
Dibenzofuran
Diethylphthalate
Dimethylphthalate
Di-n-butylphthalate
Di-n-octylphthalate
Fluoranthene
Fluorene
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane

8270D – Semivolatile Organics (continued)

3,3-Dichlorobenzidine
Benzo[k]fluoranthene
2,4-Dinitrotoluene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
2,6-Dinitrotoluene
3-Nitroaniline
4-Bromophenyl Phenyl Ether
4-Chloro-3-methylphenol
4-Chloroaniline
Benzoic Acid
Bis(2-chloroethoxy)methane
Bis(2-chloroethyl)ether
Pentachlorophenol
Phenanthrene
Phenol
2-Nitroaniline
Carbazole
Bis(2-ethylhexyl)phthalate
Butylbenzylphthalate
Chrysene
Benzyl alcohol
Bis(2-chloroisopropyl)ether
Indeno(1,2,3-cd)pyrene
Isophorone
Naphthalene
Nitrobenzene
N-nitroso-di-n-propylamine
N-nitrosodiphenylamine
Pyrene
Pyridine

8330 - Explosives

1,3-Dinitrobenzene
1,3,5-Trinitrobenzene
2-Amino-4,6-Dinitrotoluene
2-Nitrotoluene
2,4-Dinitrotoluene
2,4,6-Trinitrotoluene
2,6-Dinitrotoluene
3-Nitrotoluene
4-Amino-2,6-Dinitrotoluene
4-Nitrotoluene
HMX
Nitrobenzene
RDX
Tetryl

TCLP

1311/6010B/7470A - Metals

Arsenic
Barium
Cadmium
Chromium
Lead
Mercury
Selenium
Silver

1311/8081 - Pesticides

Chlordane
Endrin
Heptachlor
Heptachlor epoxide
Lindane
Methoxyclor
Toxaphene

1311/8151A - Herbicides

2,4-D
2,4,5-TP

1311/8260C - Volatiles

1,1-Dichloroethylene
1,2-Dichloroethane
2-Butanone
Benzene
Carbon Tetrachloride
Chlorobenzene
Chloroform
Tetrachloroethylene
Trichloroethylene
Vinyl Chloride

1311/8270D - Semivolatiles

1,4-Dichlorobenzene
2,4-Dinitrotoluene
2,4,5-Trichlorophenol
2,4,6-Trichlorophenol
Hexachloro-1,3-butadiene
Hexachlorobenzene
Hexachloroethane
m&p-Cresol
Nitrobenzene
o-Cresol
Pentachlorophenol
Pyridine

Terms & Conditions

GENERAL INFORMATION

DataChem Laboratories, Inc. provides professional analytical services for all samples submitted. The following statements describe the terms and conditions under which DataChem agrees to operate.

1. GENERAL

1.1 DataChem is not in the position to interpret data as they pertain to regulations, etc. and assumes no responsibility for the quality of samples submitted.

1.2 The Schedule of Fees and Services provides a partial listing of routine analyses performed by DataChem. If you have requirements for analyses not listed, special analytical requirements, or desire information addressing sampling and/or analytical protocols, please contact a member of our project management department.

1.3 Upon request DataChem will supply (at cost plus shipping charges) sampling media, sample bottles and preservatives. Shipping containers will be provided at no cost. No credit will be given for returns.

1.4 Fees are subject to change without notice.

2. ANALYTICAL SERVICE ORDERS

2.1 Requests for analytical services may be made by telephone, FAX, e-mail, or in writing. The client's authorized representative must confirm all requests for services in writing.

2.2 Chain of Custody (C0C) not provided for Industrial Hygiene analysis unless specifically requested by client.

2.3 DataChem reserves the right to refuse to proceed with an analytical request if the customer fails to provide an acceptable written analytical request or to establish acceptable credit arrangements.

2.4 Prior to submission of environmental samples, the client should develop an appropriate project Quality Assurance/Quality Control (QA/QC) plan. This plan should identify, among other items, the intent of the project, sample collection and preservation requirements, types of QC samples that are required (e.g., matrix spikes, matrix spike duplicates, field blanks), laboratory analysis/ methods to be performed, minimum data reporting requirements, and required sample turnaround times. This plan should be submitted to DataChem prior to sample submission. Unless such a plan is submitted, DataChem is not responsible for project-specific QA/QC requirements. DataChem personnel can assist in the preparation of project QA/QC plans.

2.5 DataChem reserves the right to invoke a minimum charge of $50 for each Industrial Hygiene sample project and $200 for each Environmental sample project. Each field QC sample will be billed as a regular field sample. Clients will not be charged for laboratory QC samples.

3. SAMPLE RECEIPT AND PROCESSING

3.1 The client is responsible for the condition and custody of all samples prior to receipt, inspection, and acceptance by DataChem.

3.2 DataChem will use analytical methodologies which have been certified as compliant with requirements published or specified by the U.S. Environmental Protection Agency (EPA), State Environmental or Health Agencies, the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), or other regulatory agencies. DataChem reserves the right to interpret these methodologies when applying them to the analysis of client's samples based on the reasonable, professional judgment of DataChem personnel and recognized standards of the industry.

3.3 All analyses will be monitored under the DataChem Quality Assurance/Quality Control (QA/QC) program. This program includes: instrument calibration, the analysis of spiked samples, quality control samples, laboratory blanks, replicate analyses, comparison of QA/QC data with accepted limits, and monitoring of instrument performance.

3.4 DataChem performs Method Detection Limits Studies on an annual basis. Because MDLs change from study to study, projects in progress are subject to new MDL results.

3.5 DataChem uses QA/QC protocols which are consistent with current industry standards. It is the responsibility of the customer to determine if the proposed QA/QC protocols meet the project or site-specific QA/QC requirements determined by a particular regulatory agent.

3.6 DataChem reserves the right to refuse to proceed with the processing of any sample which is judged by DataChem to be noncompliant with quality assurance requirements of a requested regulatory analytical protocol. In such an event, the client shall reimburse DataChem for any costs incurred prior to the stop-work order.

3.7 DataChem will attempt to comply with applicable Federal and State requirements for storage, processing, and analytical holding times. However, unless samples have been scheduled with a DataChem Project Manager prior to delivery, these time limits cannot be guaranteed.

3.8 Should the QA/QC requirements of a requested regulatory method or protocol specify that a sample must be reanalyzed, any additional sample required for the reanalysis will be provided by the client at the client's expense. Any mandated or requested QA/QC reanalysis, which generates data consistent with original results, will be at the client's expense.

3.9 DataChem will retain any residual sample for a period of 30 days after data is reported, after which the residual sample will be properly disposed of, unless a written agreement directing DataChem otherwise has been established. DataChem reserves the right to return unused portions to the client for disposal.

3.10 DataChem reserves the right to charge $3.00 per sample for handling and disposal. Samples will be disposed of in accordance with current RCRA requirements.

4. ANALYTICAL RESULTS

4.1 DataChem reserves the right to determine the appropriate format in which the analytical results are reported. DataChem will make every effort to honor requests for special hardcopy or electronic report formats where reasonable, advanced notice has been provided by the client. All results are provided for the exclusive use of the client. DataChem accepts no responsibility or liability for the client's use of such results.

4.2 DataChem requires precise and complete instructions pertaining to parties authorized to receive results of analyses. Any subsequent request for client results by unauthorized parties will require written permission from the authorized client.

4.3 When requested, DataChem may release verbal, FAX, e-mail (.pdf) results in advance of the written report of results. Such results are tentative and are subject to subsequent confirmation or modification during standard DataChem QA/QC review procedures.

4.4 DataChem will maintain supporting documentation for analytical results for a period of five (5) years, unless a written agreement directing DataChem has been otherwise established.

5. SERVICES OUTSIDE THE SCOPE OF WORK

5.1 In the event the customer requests DataChem to perform extraordinary services which are not included in the scope of work to which the parties agreed, DataChem reserves the right to invoice for the services performed at a minimum rate of $100/hour. Extraordinary services include, but are not limited to, the following:

1) Correcting client errors.
2) Request for information or data not required by the scope of work.
3) Modifications to deliverables not required by the scope of work.

Prior to performing requested extraordinary services, the estimated number of hours required shall be negotiated with the client. DataChem shall not proceed with extraordinary services until receiving written authorization from the client.

6. PAYMENT AND TERMS

6.1 Any order less than $500 may require payment at the time of sample delivery prior to sample analysis, unless other payment terms have been established. All major credit cards are accepted.

6.2 Any amounts owing DataChem by the client which are not paid within thirty (30) days after invoicing shall accrue interest at the rate of 1 1/2% per month (18% annually).

6.3 In the event it becomes necessary for DataChem to proceed with legal action to collect past due amounts, the client agrees to pay court costs and attorneys' fees.

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **120.1/9050** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Conductivity	50	98.70	100.61	98.22	101.09

Analytical Method: **130.2** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Hardness	24	91.70	111.23	86.82	116.11

Analytical Method: **150.1/9040** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	pH	195	98.80	100.73	98.31	101.22

Analytical Method: **160.1** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Dissolved Solids	160	96.89	103.18	95.32	104.75

Analytical Method: **160.2** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Suspended Solids	154	72.81	108.57	63.87	117.51

Analytical Method: **1664AMod** *Prep Method* **SPE**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Oil and Grease	19	34.45	137.27	8.75	162.98

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **200.7** ***Prep Method*** **200.7**

Matrix	Analyte	*Count*	LWL	UWL	LCL	UCL
WATER	Aluminum	10	94.97	105.00	92.46	107.51
	Antimony	6	88.98	106.58	84.58	110.98
	Arsenic	8	93.06	108.94	89.09	112.92
	Barium	6	93.95	102.40	91.84	104.52
	Beryllium	6	87.50	109.07	82.11	114.46
	Boron	12	92.38	103.27	89.66	105.99
	Cadmium	6	89.27	107.14	84.80	111.61
	Calcium	15	93.77	115.40	88.36	120.80
	Copper	8	32.92	210.12	-11.37	254.42
	Iron	17	92.31	113.73	86.95	119.09
	Lead	8	93.29	104.18	90.57	106.90
	Magnesium	16	91.82	105.60	88.38	109.05
	Manganese	6	92.09	103.80	89.17	106.73
	Molybdenum	12	93.83	110.50	89.66	114.67
	Nickel	8	81.90	135.60	68.48	149.02
	Potassium	7	91.85	104.32	88.74	107.43
	Selenium	8	86.46	115.65	79.17	122.95
	Silver	6	95.93	102.60	94.26	104.27
	Sodium	15	93.75	106.73	90.51	109.98
	Thallium	6	92.22	104.35	89.19	107.38
	Vanadium	7	92.34	104.03	89.42	106.96
	Zinc	17	90.69	106.40	86.76	110.33

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **200.8** ***Prep Method*** **200.8**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Aluminum	64	79.90	128.07	67.85	140.12
	Antimony	65	85.20	112.08	78.48	118.80
	Arsenic	86	84.53	113.40	77.32	120.62
	Barium	65	85.59	114.35	78.41	121.53
	Beryllium	64	83.55	115.26	75.62	123.18
	Cadmium	69	85.91	113.01	79.14	119.79
	Chromium	66	84.12	113.19	76.86	120.46
	Cobalt	41	78.23	117.40	68.44	127.20
	Copper	72	86.36	113.48	79.58	120.26
	Iron	7	92.55	120.16	85.64	127.06
	Lead	92	86.48	111.13	80.32	117.29
	Manganese	64	81.87	113.43	73.98	121.32
	Molybdenum	49	67.79	119.94	54.75	132.97
	Nickel	61	84.23	115.50	76.41	123.32
	Selenium	67	83.32	115.15	75.36	123.11
	Silver	65	77.28	117.77	67.15	127.90
	Strontium	24	9.22	139.25	-23.28	171.75
	Thallium	65	85.61	115.69	78.09	123.21
	Tin	34	27.61	148.25	-2.55	178.41
	Titanium	38	23.86	141.44	-5.53	170.84
	Total Thorium	30	76.54	116.93	66.44	127.03
	Total Uranium	38	29.77	141.71	1.79	169.69
	Vanadium	52	82.20	114.05	74.23	122.01
	Zinc	58	83.02	117.28	74.45	125.85

Analytical Method: **245.1** ***Prep Method*** **245.1**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Mercury	22	96.24	106.19	93.75	108.68

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **300.0** ***Prep Method*** **300.0**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Bromide	9	93.40	107.76	89.82	111.34
	Chloride	22	95.34	105.74	92.75	108.34
	Fluoride	23	96.61	111.01	93.02	114.61
	Nitrate-N	14	91.63	110.78	86.84	115.57
	Nitrite-N	10	95.58	111.39	91.63	115.34
	Phosphate-P	8	91.36	109.92	86.72	114.56
	Sulfate	17	96.70	107.19	94.07	109.82
WATER	Bromide	42	94.83	109.74	91.10	113.47
	Chloride	152	94.99	109.78	91.29	113.48
	Fluoride	80	96.11	111.44	92.27	115.27
	Nitrate	11	95.32	108.46	92.03	111.74
	Nitrate-N	136	94.37	107.29	91.14	110.52
	Nitrite	9	99.73	106.66	98.00	108.39
	Nitrite-N	115	96.52	111.73	92.71	115.54
	Phosphate	8	91.48	113.89	85.88	119.50
	Phosphate-P	64	92.66	111.31	87.99	115.98
	Sulfate	160	94.63	109.72	90.85	113.49

Analytical Method: **305.1** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Acidity	19	93.31	112.96	88.40	117.87

Analytical Method: **310.1** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Alkalinity	107	97.09	107.66	94.44	110.30

Analytical Method: **310.2** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Alkalinity	27	87.33	113.03	80.90	119.46

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **350.1** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Ammonia-Nitrogen	82	90.65	111.60	85.41	116.84

Analytical Method: **351.2** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Kjeldahl Nitrogen	24	87.85	110.69	82.14	116.40

Analytical Method: **353.2** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Nitrate/Nitrite	51	94.51	107.35	91.30	110.57

Analytical Method: **365.1** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Phosphate	15	91.61	108.92	87.28	113.25

Analytical Method: **365.4** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Phosphorus	58	94.14	111.56	89.78	115.92

Analytical Method: **415.1** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Organic Carbon	45	67.98	139.24	50.17	157.06

Analytical Method: **4500/340.2** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Fluoride	41	92.09	113.66	86.69	119.06

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Historical LCS Control Limits

Analytical Method: 524.2 **Prep Method** 524.2

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	1,1,1,2-Tetrachloroethane	65	82.91	122.37	73.04	132.24
	1,1,1-Trichloroethane	65	92.17	127.61	83.31	136.47
	1,1,2,2-Tetrachloroethane	65	78.94	121.71	68.25	132.40
	1,1,2-Trichloroethane	65	82.33	115.81	73.96	124.17
	1,1-Dichloroethane	65	93.01	122.06	85.75	129.32
	1,1-Dichloroethene	65	96.23	125.19	88.98	132.43
	1,1-Dichloropropene	65	90.93	124.42	82.56	132.80
	1,2,3-Trichlorobenzene	65	60.53	155.05	36.90	178.68
	1,2,3-Trichloropropane	65	76.96	124.64	65.04	136.56
	1,2,4-Trichlorobenzene	65	65.76	147.22	45.40	167.58
	1,2,4-Trimethylbenzene	65	87.20	125.85	77.54	135.51
	1,2-Dibromo-3-Chloropropane	65	68.28	137.08	51.08	154.28
	1,2-Dibromoethane	65	84.60	122.88	75.03	132.45
	1,2-Dichlorobenzene	65	83.41	125.60	72.86	136.15
	1,2-Dichloroethane	65	81.01	127.27	69.45	138.83
	1,2-Dichloropropane	65	89.23	118.75	81.85	126.13
	1,3,5-Trimethylbenzene	65	90.01	127.15	80.72	136.44
	1,3-Dichlorobenzene	65	80.61	123.19	69.96	133.83
	1,3-Dichloropropane	65	84.47	118.59	75.94	127.12
	1,4-Dichlorobenzene	65	81.67	124.63	70.93	135.37
	2,2-Dichloropropane	65	90.22	129.69	80.35	139.56
	2-Chlorotoluene	65	85.28	126.09	75.08	136.29
	4-Chlorotoluene	65	88.02	130.52	77.39	141.14
	Benzene	65	97.10	118.93	91.65	124.39
	Bromobenzene	65	89.05	121.68	80.89	129.84
	Bromochloromethane	65	84.34	120.03	75.42	128.95
	Bromodichloromethane	65	81.88	120.24	72.29	129.83
	Bromoform	65	78.76	123.17	67.66	134.27
	Bromomethane	65	85.19	124.16	75.44	133.90

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Historical LCS Control Limits

WATER	Carbon Tetrachloride	65	75.92	137.30	60.58	152.64
	Chlorobenzene	65	92.24	121.37	84.96	128.65
	Chloroethane	65	91.87	125.63	83.43	134.08
	Chloroform	65	89.83	120.68	82.11	128.39
	Chloromethane	65	82.93	135.87	69.70	149.10
	cis-1,2-Dichloroethene	65	91.62	117.64	85.11	124.15
	cis-1,3-Dichloropropene	65	83.56	128.18	72.40	139.34
	Dibromochloromethane	65	80.09	120.33	70.03	130.39
	Dibromomethane	65	85.73	120.25	77.10	128.88
	Dichlorodifluoromethane	65	59.13	149.74	36.47	172.39
	Ethyl Benzene	65	96.44	124.83	89.34	131.93
	Hexachlorobutadiene	65	65.91	147.15	45.60	167.46
	Isopropylbenzene	65	88.38	138.67	75.81	151.24
	m,p-Xylene	65	95.54	125.46	88.07	132.94
	Methylene Chloride	65	90.96	117.94	84.21	124.69
	Naphthalene	64	59.13	141.01	38.66	161.49
	n-Butylbenzene	65	80.10	135.66	66.21	149.55
	n-Propylbenzene	65	87.94	131.04	77.16	141.82
	o-Xylene	65	92.29	124.38	84.26	132.40
	p-Isopropyltoluene	64	82.91	122.80	72.94	132.77
	sec-Butylbenzene	65	87.02	131.53	75.89	142.66
	Styrene	65	93.75	124.71	86.01	132.45
	tert-Butylbenzene	65	82.46	130.67	70.41	142.72
	Tetrachloroethene	65	78.56	141.42	62.84	157.13
	Toluene	65	95.29	124.98	87.87	132.41
	trans-1,2-Dichloroethene	65	96.37	123.17	89.67	129.87
	trans-1,3-Dichloropropene	65	78.83	132.69	65.36	146.16
	Trichloroethene	65	89.74	123.51	81.30	131.96
	Trichlorofluoromethane	65	87.15	125.42	77.58	134.99
	Vinyl Chloride	65	88.60	125.07	79.49	134.18

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Historical LCS Control Limits

Analytical Method: **6010B** *Prep Method* **3015**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER-3015	Aluminum	150	90.25	106.49	86.19	110.55
	Antimony	49	92.69	104.63	89.70	107.61
	Antimony	114	80.14	109.60	72.78	116.97
	Arsenic	111	81.75	119.16	72.39	128.52
	Arsenic	176	85.67	106.26	80.52	111.40
	Barium	201	90.21	106.65	86.10	110.76
	Barium	11	92.33	105.27	89.09	108.51
	Beryllium	165	87.94	102.87	84.21	106.60
	Boron	68	81.02	108.15	74.23	114.94
	Boron	9	87.98	105.11	83.70	109.39
	Cadmium	90	79.56	120.20	69.40	130.36
	Cadmium	183	86.19	103.62	81.84	107.97
	Calcium	196	90.78	109.50	86.10	114.18
	Chromium	24	88.62	107.00	84.03	111.60
	Chromium	250	93.12	108.56	89.26	112.42
	Cobalt	135	90.10	105.00	86.37	108.73
	Copper	24	87.73	107.80	82.71	112.81
	Copper	196	89.69	103.73	86.18	107.24
	Iron	206	90.43	111.01	85.29	116.16
	Lead	209	84.25	111.18	77.52	117.91
	Lead	139	92.38	107.35	88.63	111.10
	Lithium	49	83.49	112.72	76.19	120.03
	Magnesium	193	89.34	102.67	86.01	106.00
	Manganese	181	90.71	103.36	87.55	106.52
	Molybdenum	92	90.36	104.97	86.71	108.62
	Nickel	175	93.17	107.68	89.54	111.31
	Phosphorus	45	80.49	107.97	73.62	114.84
	Potassium	168	86.79	106.88	81.77	111.90
	Selenium	91	79.32	119.61	69.25	129.68

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Historical LCS Control Limits

WATER-3015	Selenium	172	86.86	104.18	82.53	108.51
	Silicon	23	40.31	136.56	16.25	160.62
	Silver	207	67.19	120.66	53.83	134.03
	Silver	17	18.22	142.98	-12.98	174.17
	Sodium	212	89.55	105.46	85.57	109.44
	Strontium	58	89.62	105.94	85.53	110.03
	Thallium	109	89.25	105.61	85.16	109.71
	Thallium	49	94.99	106.88	92.01	109.85
	Tin	35	65.12	123.47	50.53	138.06
	Titanium	21	90.06	103.45	86.71	106.80
	Vanadium	140	90.75	105.16	87.15	108.76
	Zinc	212	88.56	102.28	85.13	105.71

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **6010B** ***Prep Method*** **3050**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL-3050	Aluminum	99	61.48	105.78	50.41	116.85
	Antimony	135	103.86	152.40	91.73	164.54
	Antimony	16	76.82	158.94	56.29	179.47
	Arsenic	101	86.96	118.74	79.01	126.69
	Arsenic	26	102.19	122.11	97.21	127.10
	Barium	153	81.72	116.29	73.08	124.94
	Beryllium	117	91.07	108.52	86.71	112.88
	Cadmium	21	87.77	109.90	82.23	115.43
	Cadmium	106	89.68	111.63	84.19	117.11
	Calcium	92	85.89	106.04	80.85	111.07
	Chromium	154	91.10	108.02	86.87	112.25
	Cobalt	131	84.42	105.05	79.26	110.21
	Copper	139	84.44	106.27	78.99	111.72
	Iron	95	90.06	108.78	85.38	113.45
	Lead	131	80.12	104.83	73.94	111.00
	Lead	23	84.53	120.18	75.62	129.09
	Magnesium	95	87.91	106.72	83.20	111.43
	Manganese	127	86.79	103.84	82.53	108.10
	Molybdenum	57	65.96	120.24	52.39	133.81
	Nickel	140	90.16	111.70	84.77	117.08
	Potassium	48	-29.36	136.35	-70.79	177.78
	Selenium	85	71.94	157.48	50.55	178.87
	Selenium	25	110.64	133.66	104.89	139.41
	Silver	121	74.83	144.66	57.38	162.12
	Sodium	67	22.61	97.40	3.91	116.10
	Strontium	52	85.67	131.13	74.31	142.49
	Thallium	20	92.02	128.64	82.86	137.80
	Thallium	70	54.63	125.60	36.89	143.34
	Vanadium	128	85.99	106.60	80.84	111.76

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Historical LCS Control Limits

SOIL-3050	Zinc		142	88.63	110.61	83.13	116.11

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Historical LCS Control Limits

Analytical Method: **6010B** ***Prep Method*** **3051**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL-3051	Aluminum	22	76.13	113.48	66.79	122.82
	Antimony	10	6.65	150.39	-29.29	186.32
	Arsenic	45	97.95	122.71	91.76	128.91
	Arsenic	122	81.92	110.67	74.73	117.86
	Barium	86	83.22	115.73	75.10	123.85
	Barium	8	81.84	108.39	75.20	115.03
	Beryllium	18	81.79	105.52	75.85	111.46
	Boron	7	69.38	150.07	49.21	170.24
	Cadmium	89	85.51	105.35	80.54	110.32
	Cadmium	13	92.05	106.59	88.41	110.23
	Calcium	19	83.56	104.71	78.28	110.00
	Chromium	12	92.98	101.79	90.77	104.00
	Chromium	94	87.11	107.70	81.96	112.85
	Cobalt	18	81.44	103.68	75.88	109.24
	Copper	26	85.81	100.73	82.08	104.45
	Iron	23	84.08	103.02	79.34	107.76
	Lead	46	85.63	104.83	80.83	109.63
	Lead	152	70.70	104.71	62.20	113.21
	Magnesium	18	86.80	101.86	83.04	105.62
	Manganese	21	86.73	98.93	83.68	101.98
	Molybdenum	11	70.96	103.66	62.78	111.84
	Nickel	31	86.90	105.42	82.27	110.05
	Potassium	7	9.17	88.58	-10.68	108.44
	Selenium	22	104.05	136.23	96.01	144.27
	Selenium	70	76.21	143.00	59.51	159.70
	Silver	10	85.12	123.31	75.58	132.86
	Silver	82	74.77	116.94	64.22	127.48
	Sodium	13	-8.96	85.15	-32.49	108.68
	Strontium	12	103.84	117.39	100.46	120.77

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Historical LCS Control Limits

SOIL-3051	Thallium	7	67.42	104.54	58.14	113.82
	Vanadium	20	86.10	103.08	81.86	107.33
	Zinc	30	87.11	101.60	83.49	105.22

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Historical LCS Control Limits

Analytical Method: **6020A** *Prep Method* **3010M**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Aluminum	68	84.03	125.91	73.56	136.38
	Antimony	124	92.62	109.75	88.33	114.03
	Arsenic	170	91.15	109.24	86.62	113.76
	Barium	115	93.31	111.20	88.84	115.67
	Beryllium	98	89.30	114.01	83.12	120.19
	Boron	32	85.70	112.28	79.05	118.92
	Bromide	8	-23.77	129.39	-62.06	167.68
	Cadmium	156	93.94	109.45	90.06	113.33
	Calcium	21	45.54	151.92	18.95	178.51
	Cerium	30	89.98	109.31	85.14	114.14
	Cesium	30	86.82	110.73	80.84	116.71
	Chromium	133	93.71	108.50	90.01	112.20
	Cobalt	103	92.11	109.77	87.69	114.19
	Copper	152	93.40	110.38	89.15	114.63
	Gallium	26	93.02	110.13	88.75	114.41
	Gold	26	26.74	125.77	1.99	150.53
	Iron	65	68.48	128.91	53.37	144.02
	Lead	182	94.53	107.91	91.18	111.26
	Lithium	45	89.01	112.08	83.25	117.85
	Magnesium	41	42.11	146.36	16.05	172.42
	Manganese	104	91.81	109.85	87.30	114.36
	Molybdenum	75	69.28	131.84	53.64	147.48
	Nickel	104	93.93	110.09	89.90	114.13
	Palladium	27	86.49	112.29	80.04	118.75
	Phosphorus	39	43.67	145.55	18.20	171.03
	Platinum	26	80.09	112.37	72.02	120.44
	Potassium	36	42.22	170.08	10.25	202.05
	Selenium	185	83.86	115.69	75.90	123.65
	Silver	146	55.96	134.80	36.24	154.51

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Historical LCS Control Limits

WATER	Sodium	39	52.06	160.13	25.04	187.15
	Strontium	49	91.76	108.08	87.68	112.16
	Tellurium	28	82.22	122.57	72.14	132.65
	Thallium	124	96.14	111.07	92.41	114.80
	Tin	55	76.25	136.42	61.20	151.47
	Titanium	48	90.34	109.02	85.67	113.70
	Total Thorium	36	89.91	112.73	84.21	118.43
	Total Uranium	51	90.89	110.08	86.10	114.88
	Tungsten	33	24.55	135.60	-3.21	163.37
	Vanadium	96	93.12	109.45	89.04	113.53
	Zinc	133	92.95	110.56	88.55	114.96
	Zirconium	8	92.67	118.93	86.10	125.50

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Historical LCS Control Limits

Analytical Method: **6020A** ***Prep Method*** **3050M**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Aluminum	47	66.45	118.75	53.38	131.82
	Antimony	87	79.66	137.55	65.19	152.02
	Arsenic	149	79.15	125.97	67.45	137.67
	Barium	91	70.67	128.04	56.33	142.38
	Beryllium	87	79.15	139.37	64.09	154.43
	Boron	28	38.40	157.64	8.59	187.45
	Cadmium	136	84.57	128.25	73.65	139.17
	Calcium	27	48.57	146.11	24.19	170.49
	Chromium	99	82.22	129.93	70.29	141.86
	Cobalt	81	77.61	132.76	63.82	146.55
	Copper	90	72.47	124.39	59.49	137.37
	Iron	45	61.94	150.69	39.75	172.88
	Lead	135	71.36	114.81	60.50	125.68
	Magnesium	39	42.82	157.68	14.10	186.40
	Manganese	76	77.29	130.03	64.10	143.21
	Molybdenum	74	79.78	134.12	66.19	147.70
	Nickel	87	73.28	144.52	55.47	162.33
	Phosphorus	8	89.40	135.38	77.91	146.87
	Potassium	36	28.88	63.34	20.27	71.96
	Selenium	143	66.01	138.89	47.79	157.11
	Silver	127	73.61	125.76	60.58	138.79
	Sodium	34	-6.77	84.64	-29.62	107.49
	Strontium	28	61.28	150.17	39.05	172.40
	Thallium	117	69.50	116.93	57.65	128.78
	Tin	32	51.12	149.37	26.55	173.94
	Titanium	34	54.47	155.52	29.20	180.79
	Total Uranium	62	59.21	129.11	41.73	146.58
	Tungsten	13	47.91	229.37	2.54	274.74
	Vanadium	90	78.60	130.34	65.66	143.28

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Historical LCS Control Limits

SOIL	Zinc	85	64.99	119.44	51.38	133.06

Analytical Method: **6850** ***Prep Method*** **6850**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Perchlorate	105	76.83	119.17	66.24	129.76
WATER	Perchlorate	195	82.75	117.54	74.05	126.24

Analytical Method: **7196A** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Chromium VI	68	93.38	109.59	89.33	113.65

Analytical Method: **7196A(M)** ***Prep Method*** **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Chromium VI	29	84.65	112.13	77.78	119.00

Analytical Method: **7470A** ***Prep Method*** **7470A**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Mercury	333	94.67	107.21	91.53	110.34

Analytical Method: **7471A** ***Prep Method*** **7471A**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Mercury	227	89.95	118.88	82.72	126.11

Analytical Method: **7580** ***Prep Method*** **7580**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	White Phosphorus	28	82.05	129.14	70.28	140.91
WATER	White Phosphorus	51	73.11	117.46	62.02	128.55

Analytical Method: **8015B** ***Prep Method*** **3510**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	TPH-Diesel	67	63.92	131.05	47.14	147.84
	TPH-Motor Oil	7	46.94	142.64	23.01	166.56

Analytical Method: **8015B** ***Prep Method*** **3550**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	TPH-Diesel	124	65.92	133.85	48.94	150.84
	TPH-Motor Oil	14	56.11	118.41	40.53	133.99

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Historical LCS Control Limits

Analytical Method: **8081A** *Prep Method* **3510**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	4,4'-DDD	64	71.50	126.71	57.70	140.51
	4,4'-DDE	64	73.55	127.60	60.04	141.11
	4,4'-DDT	61	71.33	131.76	56.23	146.86
	Aldrin	61	76.64	127.80	63.85	140.59
	Alpha Chlordane	56	73.50	126.27	60.30	139.47
	Alpha-BHC	56	76.74	127.40	64.08	140.06
	Beta-BHC	56	68.44	125.65	54.13	139.95
	Delta-BHC	56	74.76	128.81	61.24	142.33
	Dieldrin	64	73.97	127.11	60.68	140.40
	Endosulfan I	57	74.02	124.41	61.43	137.01
	Endosulfan II	56	74.83	126.09	62.02	138.90
	Endosulfan Sulfate	56	75.51	129.88	61.91	143.48
	Endrin	90	79.86	128.01	67.82	140.05
	Endrin Aldehyde	55	71.91	134.39	56.29	150.01
	Endrin Ketone	53	72.69	129.91	58.38	144.22
	Gamma Chlordane	56	74.87	124.73	62.41	137.19
	Heptachlor	97	77.32	126.51	65.03	138.81
	Heptachlor Epoxide	98	77.13	127.91	64.44	140.60
	Lindane	57	73.89	129.27	60.04	143.12
	Methoxychlor	90	69.13	143.48	50.55	162.07

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Historical LCS Control Limits

Analytical Method: 8081A **Prep Method** 3550

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	4,4'-DDD	81	80.30	117.82	70.92	127.20
	4,4'-DDE	81	80.25	117.09	71.04	126.30
	4,4'-DDT	87	81.04	124.24	70.24	135.04
	Aldrin	80	80.80	114.95	72.26	123.48
	Alpha Chlordane	71	76.80	115.42	67.14	125.08
	Alpha-BHC	82	75.92	117.52	65.51	127.93
	Beta-BHC	83	73.90	112.86	64.16	122.61
	Delta-BHC	81	80.34	119.82	70.47	129.69
	Dieldrin	84	81.22	114.67	72.86	123.04
	Endosulfan I	81	80.38	114.34	71.89	122.83
	Endosulfan II	80	81.75	117.36	72.85	126.26
	Endosulfan Sulfate	80	79.37	124.19	68.16	135.40
	Endrin	80	81.93	122.96	71.68	133.22
	Endrin Aldehyde	79	75.53	124.07	63.40	136.20
	Endrin Ketone	75	82.68	122.54	72.71	132.51
	Gamma Chlordane	70	78.06	113.91	69.10	122.88
	Heptachlor	80	79.59	114.50	70.86	123.23
	Heptachlor Epoxide	80	79.97	113.24	71.65	121.56
	Lindane	84	74.25	117.51	63.44	128.32
	Methoxychlor	80	78.79	132.91	65.26	146.44

Analytical Method: 8082 **Prep Method** 3510

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Aroclor 1016	39	72.41	111.06	62.74	120.72
	Aroclor 1260	52	67.17	122.67	53.29	136.55

Analytical Method: 8082 **Prep Method** 3550

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Aroclor 1016	119	75.51	111.41	66.54	120.39
	Aroclor 1260	164	64.25	127.62	48.41	143.46

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Historical LCS Control Limits

Analytical Method: **8151A** *Prep Method* **8151A**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	2,4,5-T	66	70.45	149.58	50.66	169.36
	2,4,5-TP	65	75.61	132.87	61.30	147.19
	2,4-D	66	73.53	147.44	55.06	165.92
	2,4-DB	63	45.56	167.06	15.19	197.44
	Dalapon	62	44.71	134.20	22.33	156.57
	Dicamba	63	73.14	130.93	58.69	145.38
	Dichlorprop	63	79.56	137.63	65.04	152.15
	Dinoseb	63	54.10	132.63	34.46	152.27
	Pentachlorophenol	17	55.51	112.22	41.33	126.40
WATER	2,4,5-T	46	65.08	140.77	46.15	159.69
	2,4,5-TP	75	72.21	123.61	59.36	136.46
	2,4-D	76	75.99	132.43	61.89	146.53
	2,4-DB	38	46.10	153.92	19.14	180.88
	Dalapon	30	20.60	130.52	-6.87	157.99
	Dicamba	40	38.90	128.56	16.49	150.97
	Dichlorprop	37	66.44	140.02	48.05	158.41
	Dinoseb	39	49.38	118.35	32.14	135.59
	Pentachlorophenol	17	38.09	119.01	17.85	139.25

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Historical LCS Control Limits

Analytical Method: **8260C** *Prep Method* **5030**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL-5030	1,1,1,2-Tetrachloroethane	195	75.61	119.14	64.73	130.02
	1,1,1-Trichloroethane	198	79.79	119.50	69.86	129.43
	1,1,2,2-Tetrachloroethane	198	74.94	119.36	63.84	130.46
	1,1,2-Trichloroethane	198	76.66	112.41	67.72	121.35
	1,1-Dichloroethane	198	82.60	115.53	74.36	123.76
	1,1-Dichloroethene	198	83.94	119.13	75.14	127.93
	1,1-Dichloropropene	197	81.59	114.99	73.24	123.34
	1,2,3-Trichlorobenzene	197	66.18	117.55	53.34	130.39
	1,2,3-Trichloropropane	197	71.39	115.82	60.29	126.93
	1,2,4-Trichlorobenzene	198	68.50	119.79	55.68	132.62
	1,2,4-Trimethylbenzene	195	79.66	117.72	70.14	127.24
	1,2-Dibromo-3-Chloropropane	197	58.63	118.82	43.59	133.87
	1,2-Dibromoethane	197	77.30	117.33	67.29	127.34
	1,2-Dichlorobenzene	198	80.00	112.67	71.84	120.83
	1,2-Dichloroethane	200	79.99	118.91	70.25	128.64
	1,2-Dichloropropane	195	81.07	112.60	73.18	120.49
	1,3,5-Trimethylbenzene	195	80.00	118.87	70.29	128.59
	1,3-Dichlorobenzene	198	79.51	113.49	71.02	121.99
	1,3-Dichloropropane	197	77.18	112.82	68.27	121.73
	1,4-Dichlorobenzene	198	81.37	113.97	73.22	122.13
	1-Chlorohexane	121	75.58	119.44	64.61	130.40
	2,2-Dichloropropane	197	70.09	121.82	57.16	134.76
	2-Butanone	198	71.76	140.95	54.47	158.25
	2-Chloroethylvinyl Ether	10	48.94	150.81	23.47	176.28
	2-Chlorotoluene	195	77.93	118.15	67.87	128.21
	2-Hexanone	198	59.03	133.77	40.34	152.46
	4-Chlorotoluene	195	79.81	117.84	70.31	127.35
	4-Isopropyltoluene	172	75.91	117.77	65.44	128.24
	4-Methyl-2-Pentanone	196	68.13	128.77	52.97	143.93

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Historical LCS Control Limits

SOIL-5030	Acetone	196	51.50	160.16	24.33	187.33
	Acrolein	28	54.80	149.52	31.12	173.21
	Acrylonitrile	28	64.52	132.39	47.55	149.36
	Allyl Chloride	197	77.45	115.46	67.95	124.96
	Benzene	232	86.11	115.92	78.66	123.37
	Bromobenzene	197	79.92	115.42	71.05	124.30
	Bromochloromethane	197	81.93	119.79	72.46	129.26
	Bromodichloromethane	195	78.57	114.34	69.63	123.29
	Bromoform	198	70.00	126.05	55.99	140.06
	Bromomethane	198	71.81	126.67	58.09	140.39
	Carbon Disulfide	200	81.46	121.98	71.32	132.11
	Carbon Tetrachloride	198	73.13	125.23	60.10	138.25
	Chlorobenzene	198	82.95	114.20	75.14	122.01
	Chloroethane	198	75.20	122.85	63.29	134.76
	Chloroform	198	83.83	115.85	75.83	123.85
	Chloromethane	198	67.97	121.05	54.70	134.32
	cis-1,2-Dichloroethene	198	81.59	113.23	73.68	121.14
	cis-1,3-Dichloropropene	195	77.11	122.61	65.73	133.98
	Cyclohexane	198	81.52	121.46	71.53	131.44
	Dibromochloromethane	198	74.96	118.18	64.15	128.99
	Dibromomethane	194	80.88	117.10	71.83	126.16
	Dichlorodifluoromethane	198	63.07	131.96	45.85	149.18
	Dichlorofluoromethane	197	73.27	124.68	60.41	137.54
	Ethyl Acetate	174	11.74	152.76	-23.51	188.01
	Ethyl Benzene	232	84.41	116.86	76.30	124.98
	Ethyl Ether	197	72.18	122.29	59.65	134.81
	Ethyl Methacrylate	196	65.69	120.19	52.07	133.81
	Freon 113	198	77.89	121.13	67.08	131.95
	Hexachlorobutadiene	196	63.72	118.99	49.90	132.80
	Iodomethane	197	75.82	128.05	62.76	141.11
	Isopropylbenzene	196	80.80	128.26	68.93	140.13

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Historical LCS Control Limits

SOIL-5030	m,p-Xylene	232	84.44	117.20	76.25	125.39
	Methyl Acetate	198	48.76	152.03	22.95	177.85
	Methyl Cyclohexane	165	82.24	122.19	72.26	132.17
	Methyl Tertiary Butyl Ether	233	73.43	120.46	61.67	132.22
	Methylene Chloride	198	81.35	116.67	72.52	125.50
	Naphthalene	232	60.55	122.02	45.18	137.39
	n-Butylbenzene	195	75.93	122.12	64.38	133.67
	n-Propylbenzene	195	79.77	121.16	69.42	131.51
	o-Xylene	231	82.11	114.99	73.89	123.21
	Pentachloroethane	196	68.60	138.14	51.22	155.52
	sec-Butylbenzene	196	77.70	118.66	67.45	128.90
	Styrene	196	84.74	117.21	76.63	125.33
	tert-Butylbenzene	195	79.33	119.45	69.30	129.49
	Tetrachloroethene	197	75.74	118.21	65.12	128.83
	Tetrahydrofuran	197	69.28	131.26	53.79	146.76
	Toluene	232	83.80	114.75	76.06	122.48
	trans-1,2-Dichloroethene	198	84.16	117.55	75.81	125.90
	trans-1,3-Dichloropropene	197	70.71	123.76	57.45	137.03
	trans-1,4-Dichloro-2-Butene	196	61.20	124.08	45.48	139.80
	Trichloroethene	196	81.84	117.36	72.96	126.24
	Trichlorofluoromethane	198	68.30	128.13	53.34	143.09
	Vinyl Acetate	28	68.63	112.90	57.56	123.97
	Vinyl Chloride	198	76.81	116.54	66.87	126.47
	Xylenes	165	59.31	130.20	41.59	147.92

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Historical LCS Control Limits

Analytical Method: **8260C** ***Prep Method*** **5030/5035**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL_M	1,1,1,2-Tetrachloroethane	48	81.71	117.02	72.88	125.85
	1,1,1-Trichloroethane	48	79.56	122.25	68.89	132.92
	1,1,2,2-Tetrachloroethane	48	76.44	116.44	66.44	126.44
	1,1,2-Trichloroethane	48	77.60	111.10	69.23	119.47
	1,1-Dichloroethane	48	84.43	119.15	75.75	127.83
	1,1-Dichloroethene	48	83.54	128.16	72.39	139.32
	1,1-Dichloropropene	48	83.68	116.16	75.56	124.28
	1,2,3-Trichlorobenzene	48	64.18	123.06	49.46	137.78
	1,2,3-Trichloropropane	48	71.75	110.58	62.04	120.28
	1,2,4-Trichlorobenzene	48	69.16	121.88	55.98	135.06
	1,2,4-Trimethylbenzene	48	79.58	119.41	69.62	129.37
	1,2-Dibromo-3-Chloropropane	48	68.04	114.68	56.37	126.35
	1,2-Dibromoethane	48	81.09	114.48	72.74	122.83
	1,2-Dichlorobenzene	48	83.96	109.54	77.57	115.94
	1,2-Dichloroethane	48	78.46	121.77	67.64	132.60
	1,2-Dichloropropane	48	83.06	114.55	75.18	122.43
	1,3,5-Trimethylbenzene	48	75.45	122.61	63.66	134.40
	1,3-Dichlorobenzene	48	83.96	110.64	77.29	117.31
	1,3-Dichloropropane	48	78.85	111.83	70.60	120.08
	1,4-Dichlorobenzene	48	82.94	109.97	76.18	116.73
	1-Chlorohexane	28	81.93	112.66	74.25	120.35
	2,2-Dichloropropane	47	76.35	118.36	65.84	128.86
	2-Butanone	48	67.19	141.35	48.65	159.89
	2-Chloroethylvinyl Ether	12	34.91	120.66	13.47	142.10
	2-Chlorotoluene	48	81.48	116.58	72.71	125.35
	2-Hexanone	48	59.27	136.34	40.00	155.61
	4-Chlorotoluene	48	79.43	116.27	70.22	125.49
	4-Isopropyltoluene	41	72.99	121.54	60.85	133.68
	4-Methyl-2-Pentanone	48	70.00	124.38	56.40	137.97

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Historical LCS Control Limits

SOIL_M	Acetone	48	62.88	170.34	36.01	197.21
	Acrolein	8	17.34	135.92	-12.30	165.56
	Acrylonitrile	12	69.39	128.54	54.61	143.33
	Allyl Chloride	48	78.57	124.06	67.20	135.43
	Benzene	48	84.75	116.75	76.74	124.76
	Bromobenzene	48	82.18	114.35	74.14	122.40
	Bromochloromethane	48	80.35	121.25	70.13	131.48
	Bromodichloromethane	48	79.85	113.22	71.51	121.56
	Bromoform	48	80.57	110.46	73.09	117.93
	Bromomethane	48	68.91	135.16	52.34	151.72
	Carbon Disulfide	48	77.98	128.66	65.31	141.33
	Carbon Tetrachloride	48	78.94	123.84	67.72	135.06
	Chlorobenzene	48	82.40	115.61	74.10	123.91
	Chloroethane	48	74.81	133.41	60.16	148.06
	Chloroform	48	77.85	119.56	67.42	129.98
	Chloromethane	48	75.34	131.95	61.19	146.10
	cis-1,2-Dichloroethene	48	81.71	118.14	72.60	127.25
	cis-1,3-Dichloropropene	48	80.70	118.93	71.14	128.49
	Cyclohexane	48	71.97	129.00	57.72	143.26
	Dibromochloromethane	48	80.57	109.87	73.25	117.20
	Dibromomethane	48	81.09	116.00	72.36	124.73
	Dichlorodifluoromethane	48	67.34	141.41	48.83	159.92
	Dichlorofluoromethane	48	72.38	130.33	57.89	144.82
	Ethyl Acetate	38	3.17	153.89	-34.51	191.56
	Ethyl Benzene	48	82.58	121.01	72.97	130.62
	Ethyl Ether	48	71.67	115.39	60.74	126.32
	Ethyl Methacrylate	48	63.73	124.44	48.55	139.62
	Freon 113	48	59.16	135.94	39.96	155.14
	Hexachlorobutadiene	48	61.39	128.44	44.63	145.20
	Iodomethane	48	69.70	133.51	53.74	149.46
	Isopropylbenzene	48	76.19	131.18	62.44	144.92

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Historical LCS Control Limits

SOIL_M	m,p-Xylene	48	80.54	119.67	70.75	129.45
	Methyl Acetate	48	42.46	169.91	10.60	201.77
	Methyl Cyclohexane	42	72.69	128.03	58.86	141.87
	Methyl Tertiary Butyl Ether	48	67.49	119.05	54.60	131.95
	Methylene Chloride	48	81.24	121.78	71.11	131.92
	Naphthalene	48	54.19	134.19	34.20	154.19
	n-Butylbenzene	48	76.81	124.18	64.96	136.02
	n-Propylbenzene	48	77.34	125.01	65.42	136.93
	o-Xylene	48	80.16	116.54	71.07	125.63
	Pentachloroethane	48	62.27	133.80	44.39	151.68
	sec-Butylbenzene	48	77.68	123.83	66.14	135.37
	Styrene	48	82.73	118.52	73.78	127.46
	tert-Butylbenzene	48	76.66	122.14	65.29	133.51
	Tetrachloroethene	48	68.18	132.50	52.09	148.59
	Tetrahydrofuran	48	67.51	125.41	53.04	139.88
	Toluene	48	80.31	119.73	70.45	129.59
	trans-1,2-Dichloroethene	48	83.08	122.53	73.22	132.39
	trans-1,3-Dichloropropene	48	75.04	121.06	63.54	132.56
	trans-1,4-Dichloro-2-Butene	48	67.33	113.54	55.78	125.09
	Trichloroethene	48	83.14	117.09	74.65	125.58
	Trichlorofluoromethane	48	70.92	126.42	57.05	140.30
	Vinyl Acetate	12	50.11	142.50	27.02	165.60
	Vinyl Chloride	48	82.20	127.23	70.95	138.48
	Xylenes	35	57.14	131.76	38.49	150.42

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8260C 25mL** *Prep Method* **5030**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
25ML	1,1,1,2-Tetrachloroethane	36	82.48	107.50	76.22	113.75
	1,1,1-Trichloroethane	36	81.94	119.88	72.46	129.37
	1,1,2,2-Tetrachloroethane	36	79.43	106.02	72.79	112.66
	1,1,2-Trichloroethane	36	82.24	106.86	76.09	113.01
	1,1-Dichloroethane	36	91.93	110.24	87.35	114.82
	1,1-Dichloroethene	36	83.84	110.83	77.09	117.58
	1,1-Dichloropropene	36	88.32	110.64	82.74	116.22
	1,2,3-Trichlorobenzene	36	74.77	134.85	59.75	149.87
	1,2,3-Trichloropropane	36	79.02	118.63	69.12	128.54
	1,2,4-Trichlorobenzene	36	73.71	131.86	59.17	146.40
	1,2,4-Trimethylbenzene	36	84.48	116.82	76.39	124.90
	1,2-Dibromo-3-Chloropropane	36	79.56	111.64	71.55	119.66
	1,2-Dibromoethane	36	84.79	108.43	78.88	114.34
	1,2-Dichlorobenzene	36	88.23	106.05	83.78	110.51
	1,2-Dichloroethane	36	84.39	117.92	76.01	126.30
	1,2-Dichloropropane	36	86.40	109.01	80.74	114.66
	1,3,5-Trimethylbenzene	36	85.06	116.15	77.29	123.93
	1,3-Dichlorobenzene	36	86.37	106.55	81.32	111.60
	1,3-Dichloropropane	36	82.00	107.64	75.59	114.05
	1,4-Dichlorobenzene	36	87.38	105.01	82.98	109.42
	1-Chlorohexane	36	88.75	112.78	82.74	118.79
	2,2-Dichloropropane	36	84.94	118.56	76.54	126.97
	2-Butanone	36	68.43	139.25	50.73	156.96
	2-Chloroethylvinyl Ether	36	46.16	123.17	26.91	142.42
	2-Chlorotoluene	36	86.24	116.90	78.57	124.56
	2-Hexanone	35	65.35	137.07	47.42	155.00
	4-Chlorotoluene	36	87.32	118.40	79.55	126.17
	4-Isopropyltoluene	26	83.38	110.73	76.55	117.57
	4-Methyl-2-Pentanone	36	65.78	136.89	48.01	154.67

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Historical LCS Control Limits

25ML	Acetone	35	71.27	127.51	57.21	141.57
	Acrolein	34	10.42	161.09	-27.25	198.76
	Acrylonitrile	36	73.21	129.61	59.11	143.72
	Allyl Chloride	36	88.98	110.28	83.66	115.60
	Benzene	36	89.03	108.83	84.08	113.78
	Bromobenzene	36	84.75	106.84	79.23	112.37
	Bromochloromethane	36	68.92	111.47	58.28	122.11
	Bromodichloromethane	36	80.36	108.55	73.31	115.60
	Bromoform	36	80.18	103.01	74.47	108.72
	Bromomethane	36	71.71	127.20	57.84	141.07
	Carbon Disulfide	36	76.47	110.69	67.91	119.25
	Carbon Tetrachloride	36	83.75	117.81	75.23	126.32
	Chlorobenzene	36	89.90	106.32	85.79	110.42
	Chloroethane	36	83.62	119.95	74.53	129.03
	Chloroform	36	80.63	112.14	72.75	120.02
	Chloromethane	36	86.95	121.76	78.24	130.46
	cis-1,2-Dichloroethene	36	82.15	104.54	76.56	110.14
	cis-1,3-Dichloropropene	36	73.76	111.81	64.25	121.33
	Cyclohexane	34	78.76	118.70	68.77	128.68
	Dibromochloromethane	36	81.11	102.40	75.79	107.72
	Dibromomethane	36	78.77	111.16	70.67	119.25
	Dichlorodifluoromethane	36	57.50	141.31	36.55	162.26
	Dichlorofluoromethane	36	85.19	109.39	79.14	115.44
	Ethyl Acetate	36	45.51	135.56	23.00	158.07
	Ethyl Benzene	36	90.79	113.20	85.19	118.81
	Ethyl Ether	36	64.49	111.02	52.86	122.65
	Ethyl Methacrylate	36	68.40	113.72	57.07	125.05
	Freon 113	34	66.28	104.32	56.77	113.83
	Hexachlorobutadiene	36	80.01	123.18	69.22	133.98
	Iodomethane	36	63.98	96.97	55.73	105.22
	Isopropylbenzene	36	89.28	120.60	81.45	128.43

ALS Laboratory Group

Historical LCS Control Limits

25ML	m,p-Xylene	36	88.30	116.12	81.34	123.08
	Methyl Acetate	36	66.36	148.16	45.92	168.60
	Methyl Cyclohexane	26	84.28	108.65	78.18	114.74
	Methyl Tertiary Butyl Ether	36	60.39	114.07	46.97	127.49
	Methylene Chloride	36	77.63	104.23	70.98	110.88
	Naphthalene	36	68.61	134.49	52.14	150.95
	n-Butylbenzene	36	87.26	122.95	78.34	131.88
	n-Propylbenzene	36	87.82	123.79	78.83	132.78
	o-Xylene	36	85.59	115.08	78.22	122.45
	Pentachloroethane	36	77.25	104.74	70.38	111.61
	sec-Butylbenzene	36	87.83	118.84	80.08	126.59
	Styrene	36	89.58	114.59	83.33	120.84
	tert-Butylbenzene	36	86.31	111.81	79.94	118.19
	Tetrachloroethene	36	80.23	108.66	73.12	115.77
	Tetrahydrofuran	36	67.53	123.65	53.50	137.68
	Toluene	36	87.20	114.68	80.33	121.54
	trans-1,2-Dichloroethene	36	84.66	108.48	78.71	114.44
	trans-1,3-Dichloropropene	36	83.77	105.25	78.39	110.62
	trans-1,4-Dichloro-2-Butene	36	65.85	118.08	52.79	131.13
	Trichloroethene	36	83.81	106.09	78.24	111.67
	Trichlorofluoromethane	36	90.30	119.47	83.01	126.77
	Vinyl Acetate	31	68.93	119.84	56.20	132.57
	Vinyl Chloride	36	82.48	115.93	74.11	124.30
	Xylenes	36	89.20	115.44	82.64	122.00

Analytical Method: **8260C GRO** ***Prep Method*** **5030**

Matrix	Analyte	*Count*	LWL	UWL	LCL	UCL
SOILG	TPH-Gasoline	51	87.31	117.67	79.72	125.25
WATERG	TPH-Gasoline	64	89.49	113.37	83.52	119.34

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Historical LCS Control Limits

Analytical Method: **8260C RL=1** *Prep Method* **5030**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	1,1,1,2-Tetrachloroethane	642	82.21	116.90	73.53	125.57
	1,1,1-Trichloroethane	644	84.48	115.84	76.64	123.68
	1,1,2,2-Tetrachloroethane	644	80.05	119.28	70.24	129.09
	1,1,2-Trichloroethane	644	82.76	110.17	75.90	117.02
	1,1-Dichloroethane	644	87.36	115.33	80.37	122.32
	1,1-Dichloroethene	646	87.30	117.80	79.67	125.43
	1,1-Dichloropropene	643	87.10	111.87	80.90	118.06
	1,2,3-Trichlorobenzene	643	65.77	125.13	50.93	139.97
	1,2,3-Trichloropropane	642	78.16	114.20	69.15	123.21
	1,2,4-Trichlorobenzene	644	71.75	122.85	58.97	135.62
	1,2,4-Trimethylbenzene	642	88.24	114.70	81.62	121.32
	1,2-Dibromo-3-Chloropropane	643	68.11	119.03	55.38	131.75
	1,2-Dibromoethane	643	84.42	115.97	76.53	123.86
	1,2-Dichlorobenzene	643	85.75	110.97	79.44	117.28
	1,2-Dichloroethane	648	83.45	120.76	74.12	130.08
	1,2-Dichloropropane	643	85.53	113.29	78.59	120.23
	1,3,5-Trimethylbenzene	641	87.50	116.21	80.33	123.38
	1,3-Dichlorobenzene	643	87.00	110.31	81.17	116.14
	1,3-Dichloropropane	642	81.13	112.84	73.20	120.76
	1,4-Dichlorobenzene	644	85.96	109.33	80.11	115.17
	1-Chlorohexane	523	81.99	117.49	73.12	126.36
	2,2-Dichloropropane	643	76.88	119.79	66.15	130.52
	2-Butanone	640	66.06	147.96	45.58	168.44
	2-Chloroethylvinyl Ether	241	44.19	138.84	20.53	162.51
	2-Chlorotoluene	642	85.70	113.95	78.64	121.01
	2-Hexanone	643	62.35	148.52	40.81	170.07
	4-Chlorotoluene	642	85.87	114.50	78.71	121.66
	4-Isopropyltoluene	560	86.38	112.26	79.91	118.73
	4-Methyl-2-Pentanone	642	77.18	127.80	64.53	140.45

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Historical LCS Control Limits

WATER	Acetone	612	60.45	168.22	33.51	195.17
	Acrolein	185	37.26	169.92	4.09	203.09
	Acrylonitrile	248	72.21	129.30	57.93	143.57
	Allyl Chloride	643	79.37	119.06	69.44	128.98
	Benzene	678	91.00	111.69	85.83	116.86
	Bromobenzene	643	86.29	112.61	79.71	119.19
	Bromochloromethane	643	83.24	117.94	74.57	126.61
	Bromodichloromethane	642	82.54	113.89	74.70	121.73
	Bromoform	643	76.50	120.24	65.56	131.17
	Bromomethane	644	71.43	123.92	58.30	137.04
	Carbon Disulfide	646	81.61	121.72	71.58	131.75
	Carbon Tetrachloride	645	83.72	122.59	74.00	132.31
	Chlorobenzene	645	88.70	110.44	83.26	115.87
	Chloroethane	644	83.21	122.82	73.30	132.73
	Chloroform	646	85.34	112.57	78.53	119.38
	Chloromethane	644	74.75	123.75	62.49	136.00
	cis-1,2-Dichloroethene	644	84.28	113.24	77.04	120.48
	cis-1,3-Dichloropropene	641	81.91	122.15	71.85	132.21
	Cyclohexane	643	80.83	121.79	70.59	132.03
	Dibromochloromethane	643	80.96	113.63	72.79	121.80
	Dibromomethane	640	84.19	115.83	76.28	123.74
	Dichlorodifluoromethane	643	57.08	136.99	37.11	156.97
	Dichlorofluoromethane	643	79.43	125.73	67.85	137.30
	Ethyl Acetate	548	20.65	167.04	-15.94	203.63
	Ethyl Benzene	675	91.58	115.13	85.69	121.02
	Ethyl Ether	643	78.56	116.77	69.01	126.32
	Ethyl Methacrylate	641	69.01	132.42	53.16	148.27
	Freon 113	643	72.17	117.80	60.77	129.20
	Hexachlorobutadiene	643	66.38	121.52	52.59	135.31
	Iodomethane	643	70.05	123.37	56.72	136.70
	Isopropylbenzene	642	88.04	126.07	78.53	135.57

ALS Laboratory Group

Historical LCS Control Limits

WATER	m,p-Xylene	675	89.95	114.25	83.88	120.32
	Methyl Acetate	643	47.25	149.85	21.60	175.50
	Methyl Cyclohexane	568	84.06	118.26	75.51	126.81
	Methyl Tertiary Butyl Ether	674	76.74	118.80	66.22	129.32
	Methylene Chloride	644	85.48	113.44	78.49	120.43
	Naphthalene	674	59.82	128.66	42.61	145.88
	n-Butylbenzene	643	85.94	117.91	77.95	125.90
	n-Propylbenzene	642	87.89	120.03	79.85	128.07
	o-Xylene	676	88.05	114.30	81.49	120.86
	Pentachloroethane	642	70.87	129.46	56.23	144.10
	sec-Butylbenzene	642	87.58	117.48	80.11	124.95
	Styrene	644	91.12	116.72	84.72	123.13
	tert-Butylbenzene	641	87.00	115.98	79.75	123.23
	Tetrachloroethene	645	80.54	117.29	71.35	126.47
	Tetrahydrofuran	643	74.30	125.31	61.55	138.06
	Toluene	674	89.95	112.85	84.22	118.58
	trans-1,2-Dichloroethene	644	86.84	115.87	79.59	123.13
	trans-1,3-Dichloropropene	642	77.73	125.01	65.92	136.82
	trans-1,4-Dichloro-2-Butene	643	71.19	121.39	58.64	133.94
	Trichloroethene	644	84.85	113.26	77.74	120.36
	Trichlorofluoromethane	643	77.69	124.86	65.90	136.66
	Vinyl Acetate	251	71.05	141.13	53.53	158.65
	Vinyl Chloride	644	81.44	117.61	72.40	126.65
	Xylenes	476	58.01	132.91	39.28	151.64

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8260C RL=5** *Prep Method* **5030**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	1,1,1,2-Tetrachloroethane	642	82.21	116.90	73.53	125.57
	1,1,1-Trichloroethane	644	84.48	115.84	76.64	123.68
	1,1,2,2-Tetrachloroethane	644	80.05	119.28	70.24	129.09
	1,1,2-Trichloroethane	644	82.76	110.17	75.90	117.02
	1,1-Dichloroethane	644	87.36	115.33	80.37	122.32
	1,1-Dichloroethene	646	87.30	117.80	79.67	125.43
	1,1-Dichloropropene	643	87.10	111.87	80.90	118.06
	1,2,3-Trichlorobenzene	643	65.77	125.13	50.93	139.97
	1,2,3-Trichloropropane	642	78.16	114.20	69.15	123.21
	1,2,4-Trichlorobenzene	644	71.75	122.85	58.97	135.62
	1,2,4-Trimethylbenzene	642	88.24	114.70	81.62	121.32
	1,2-Dibromo-3-Chloropropane	643	68.11	119.03	55.38	131.75
	1,2-Dibromoethane	643	84.42	115.97	76.53	123.86
	1,2-Dichlorobenzene	643	85.75	110.97	79.44	117.28
	1,2-Dichloroethane	648	83.45	120.76	74.12	130.08
	1,2-Dichloropropane	643	85.53	113.29	78.59	120.23
	1,3,5-Trimethylbenzene	641	87.50	116.21	80.33	123.38
	1,3-Dichlorobenzene	643	87.00	110.31	81.17	116.14
	1,3-Dichloropropane	642	81.13	112.84	73.20	120.76
	1,4-Dichlorobenzene	644	85.96	109.33	80.11	115.17
	1-Chlorohexane	523	81.99	117.49	73.12	126.36
	2,2-Dichloropropane	643	76.88	119.79	66.15	130.52
	2-Butanone	640	66.06	147.96	45.58	168.44
	2-Chloroethylvinyl Ether	241	44.19	138.84	20.53	162.51
	2-Chlorotoluene	642	85.70	113.95	78.64	121.01
	2-Hexanone	643	62.35	148.52	40.81	170.07
	4-Chlorotoluene	642	85.87	114.50	78.71	121.66
	4-Isopropyltoluene	560	86.38	112.26	79.91	118.73
	4-Methyl-2-Pentanone	642	77.18	127.80	64.53	140.45

ALS Laboratory Group

Historical LCS Control Limits

WATER	Acetone	612	60.45	168.22	33.51	195.17
	Acrolein	185	37.26	169.92	4.09	203.09
	Acrylonitrile	248	72.21	129.30	57.93	143.57
	Allyl Chloride	643	79.37	119.06	69.44	128.98
	Benzene	678	91.00	111.69	85.83	116.86
	Bromobenzene	643	86.29	112.61	79.71	119.19
	Bromochloromethane	643	83.24	117.94	74.57	126.61
	Bromodichloromethane	642	82.54	113.89	74.70	121.73
	Bromoform	643	76.50	120.24	65.56	131.17
	Bromomethane	644	71.43	123.92	58.30	137.04
	Carbon Disulfide	646	81.61	121.72	71.58	131.75
	Carbon Tetrachloride	645	83.72	122.59	74.00	132.31
	Chlorobenzene	645	88.70	110.44	83.26	115.87
	Chloroethane	644	83.21	122.82	73.30	132.73
	Chloroform	646	85.34	112.57	78.53	119.38
	Chloromethane	644	74.75	123.75	62.49	136.00
	cis-1,2-Dichloroethene	644	84.28	113.24	77.04	120.48
	cis-1,3-Dichloropropene	641	81.91	122.15	71.85	132.21
	Cyclohexane	643	80.83	121.79	70.59	132.03
	Dibromochloromethane	643	80.96	113.63	72.79	121.80
	Dibromomethane	640	84.19	115.83	76.28	123.74
	Dichlorodifluoromethane	643	57.08	136.99	37.11	156.97
	Dichlorofluoromethane	643	79.43	125.73	67.85	137.30
	Ethyl Acetate	548	20.65	167.04	-15.94	203.63
	Ethyl Benzene	675	91.58	115.13	85.69	121.02
	Ethyl Ether	643	78.56	116.77	69.01	126.32
	Ethyl Methacrylate	641	69.01	132.42	53.16	148.27
	Freon 113	643	72.17	117.80	60.77	129.20
	Hexachlorobutadiene	643	66.38	121.52	52.59	135.31
	Iodomethane	643	70.05	123.37	56.72	136.70
	Isopropylbenzene	642	88.04	126.07	78.53	135.57

ALS Laboratory Group

Historical LCS Control Limits

WATER	m,p-Xylene	675	89.95	114.25	83.88	120.32
	Methyl Acetate	643	47.25	149.85	21.60	175.50
	Methyl Cyclohexane	568	84.06	118.26	75.51	126.81
	Methyl Tertiary Butyl Ether	674	76.74	118.80	66.22	129.32
	Methylene Chloride	644	85.48	113.44	78.49	120.43
	Naphthalene	674	59.82	128.66	42.61	145.88
	n-Butylbenzene	643	85.94	117.91	77.95	125.90
	n-Propylbenzene	642	87.89	120.03	79.85	128.07
	o-Xylene	676	88.05	114.30	81.49	120.86
	Pentachloroethane	642	70.87	129.46	56.23	144.10
	sec-Butylbenzene	642	87.58	117.48	80.11	124.95
	Styrene	644	91.12	116.72	84.72	123.13
	tert-Butylbenzene	641	87.00	115.98	79.75	123.23
	Tetrachloroethene	645	80.54	117.29	71.35	126.47
	Tetrahydrofuran	643	74.30	125.31	61.55	138.06
	Toluene	674	89.95	112.85	84.22	118.58
	trans-1,2-Dichloroethene	644	86.84	115.87	79.59	123.13
	trans-1,3-Dichloropropene	642	77.73	125.01	65.92	136.82
	trans-1,4-Dichloro-2-Butene	643	71.19	121.39	58.64	133.94
	Trichloroethene	644	84.85	113.26	77.74	120.36
	Trichlorofluoromethane	643	77.69	124.86	65.90	136.66
	Vinyl Acetate	251	71.05	141.13	53.53	158.65
	Vinyl Chloride	644	81.44	117.61	72.40	126.65
	Xylenes	476	58.01	132.91	39.28	151.64

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8270D** *Prep Method* **3510**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATERA	1,2,4-Trichlorobenzene	253	45.84	87.37	35.46	97.75
	1,2-Dichlorobenzene	254	43.59	80.63	34.33	89.89
	1,3-Dichlorobenzene	253	40.73	79.33	31.08	88.98
	1,4-Dichlorobenzene	287	41.11	80.26	31.32	90.04
	2,4,5-Trichlorophenol	284	52.03	102.54	39.41	115.16
	2,4,6-Trichlorophenol	288	47.75	100.36	34.59	113.51
	2,4-Dichlorophenol	254	46.89	92.80	35.41	104.27
	2,4-Dimethylphenol	259	42.77	93.82	30.00	106.59
	2,4-Dinitrophenol	246	26.25	123.23	2.01	147.47
	2,4-Dinitrotoluene	289	59.16	108.78	46.76	121.18
	2,6-Dinitrotoluene	253	59.13	105.35	47.57	116.90
	2-Chloronaphthalene	253	55.34	93.82	45.72	103.44
	2-Chlorophenol	254	44.68	82.68	35.18	92.18
	2-Methylnaphthalene	257	53.76	92.68	44.03	102.41
	2-Methylphenol	289	43.12	85.38	32.56	95.94
	2-Nitroaniline	251	56.39	106.21	43.93	118.66
	2-Nitrophenol	254	43.07	95.43	29.97	108.52
	3,3'-Dichlorobenzidine	242	30.29	164.54	-3.27	198.10
	3-Nitroaniline	246	25.15	159.71	-8.49	193.34
	4,6-Dinitro-2-Methylphenol	252	38.11	120.19	17.60	140.71
	4-Bromophenyl Phenyl Ether	253	59.19	106.14	47.45	117.87
	4-Chloro-3-methylphenol	254	51.68	95.06	40.84	105.90
	4-Chloroaniline	248	28.98	108.00	9.23	127.75
	4-Chlorophenyl Phenyl Ether	253	58.21	105.23	46.46	116.99
	4-Methylphenol	288	38.39	84.78	26.79	96.38
	4-Nitroaniline	251	39.18	122.89	18.25	143.82
	4-Nitrophenol	249	3.98	94.56	-18.67	117.21
	Acenaphthene	260	58.13	96.61	48.52	106.23
	Acenaphthylene	257	51.79	100.90	39.52	113.17

ALS Laboratory Group

Historical LCS Control Limits

WATERA	Anthracene	262	62.37	102.69	52.29	112.77
	Benzo(a)anthracene	260	60.46	105.22	49.27	116.41
	Benzo(a)pyrene	260	60.68	104.76	49.66	115.79
	Benzo(b)fluoranthene	259	58.28	105.92	46.37	117.83
	Benzo(ghi)perylene	256	50.81	113.03	35.26	128.59
	Benzo(k)fluoranthene	260	60.12	105.71	48.72	117.10
	Benzoic acid	227	-8.96	112.20	-39.26	142.49
	Benzyl Alcohol	250	42.14	85.98	31.18	96.94
	Bis(2-chloroethoxy)methane	252	52.80	93.52	42.61	103.70
	Bis(2-chloroethyl)ether	253	46.26	93.84	34.36	105.74
	Bis(2-chloroisopropyl)ether	253	45.24	93.93	33.06	106.11
	Bis(2-ethylhexyl)phthalate	273	55.10	123.73	37.94	140.89
	Butylbenzylphthalate	255	58.87	113.70	45.17	127.41
	Chrysene	260	60.28	104.75	49.16	115.86
	Dibenzo(a,h)anthracene	259	52.41	111.92	37.54	126.80
	Dibenzofuran	258	59.47	99.77	49.40	109.84
	Diethylphthalate	255	58.41	107.68	46.10	119.99
	Dimethylphthalate	253	57.78	105.67	45.81	117.65
	Di-n-butylphthalate	255	62.37	111.57	50.07	123.86
	Di-n-octylphthalate	255	54.36	120.22	37.89	136.69
	Fluoranthene	260	60.61	105.42	49.41	116.62
	Fluorene	260	59.91	101.86	49.43	112.34
	Hexachlorobenzene	288	59.21	104.37	47.91	115.66
	Hexachlorobutadiene	288	39.13	86.95	27.17	98.91
	Hexachlorocyclopentadiene	250	22.92	80.60	8.50	95.02
	Hexachloroethane	288	35.67	80.84	24.37	92.14
	Indeno(1,2,3-cd)pyrene	259	52.30	114.51	36.74	130.06
	Isophorone	253	50.89	92.91	40.38	103.42
	Naphthalene	262	50.00	87.37	40.65	96.71
	Nitrobenzene	288	50.29	91.26	40.04	101.51
	N-nitrosodiphenylamine	256	58.21	125.49	41.39	142.31

ALS Laboratory Group

Historical LCS Control Limits

WATERA	N-nitroso-dipropylamine	253	51.41	96.67	40.09	107.98
	Pentachlorophenol	285	34.44	118.14	13.52	139.06
	Phenanthrene	260	61.56	101.99	51.46	112.09
	Phenol	275	6.96	85.24	-12.61	104.81
	Pyrene	259	59.26	107.62	47.17	119.71

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8270D** ***Prep Method*** **3550**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOILA	1,2,4-Trichlorobenzene	168	56.66	89.47	48.46	97.67
	1,2-Dichlorobenzene	171	53.56	88.21	44.89	96.87
	1,3-Dichlorobenzene	168	53.28	86.49	44.97	94.79
	1,4-Dichlorobenzene	171	53.52	87.17	45.11	95.59
	2,4,5-Trichlorophenol	168	61.70	97.10	52.85	105.95
	2,4,6-Trichlorophenol	168	59.81	95.64	50.85	104.59
	2,4-Dichlorophenol	168	58.06	90.19	50.02	98.23
	2,4-Dimethylphenol	170	57.64	99.32	47.22	109.74
	2,4-Dinitrophenol	167	30.44	116.84	8.84	138.44
	2,4-Dinitrotoluene	170	66.57	104.45	57.09	113.92
	2,6-Dinitrotoluene	168	66.08	99.99	57.60	108.46
	2-Chloronaphthalene	168	62.46	92.76	54.89	100.33
	2-Chlorophenol	168	54.12	86.24	46.09	94.27
	2-Methylnaphthalene	178	60.84	93.81	52.60	102.05
	2-Methylphenol	171	56.54	93.94	47.18	103.30
	2-Nitroaniline	168	63.05	104.36	52.72	114.69
	2-Nitrophenol	168	55.83	91.04	47.03	99.84
	3,3'-Dichlorobenzidine	167	44.06	168.80	12.88	199.99
	3-Nitroaniline	167	40.00	147.40	13.15	174.25
	4,6-Dinitro-2-Methylphenol	168	50.21	115.95	33.77	132.39
	4-Bromophenyl Phenyl Ether	168	64.63	100.62	55.64	109.62
	4-Chloro-3-methylphenol	168	62.20	96.04	53.74	104.50
	4-Chloroaniline	168	40.72	112.28	22.83	130.17
	4-Chlorophenyl Phenyl Ether	167	62.10	101.51	52.25	111.36
	4-Methylphenol	171	58.94	94.51	50.05	103.41
	4-Nitroaniline	168	49.69	127.94	30.12	147.51
	4-Nitrophenol	167	50.87	110.98	35.84	126.01
	Acenaphthene	190	63.36	95.88	55.23	104.01
	Acenaphthylene	188	61.67	96.94	52.86	105.75

ALS Laboratory Group

Historical LCS Control Limits

SOILA	Anthracene	190	67.01	99.79	58.81	107.99
	Benzo(a)anthracene	189	64.16	101.76	54.76	111.15
	Benzo(a)pyrene	190	62.69	102.86	52.65	112.90
	Benzo(b)fluoranthene	190	62.07	103.81	51.64	114.24
	Benzo(ghi)perylene	187	50.91	110.58	36.00	125.50
	Benzo(k)fluoranthene	190	62.58	103.88	52.25	114.21
	Benzoic acid	166	21.40	115.80	-2.20	139.40
	Benzyl Alcohol	168	50.94	97.94	39.19	109.69
	Bis(2-chloroethoxy)methane	168	57.36	93.13	48.41	102.07
	Bis(2-chloroethyl)ether	168	47.01	98.35	34.18	111.18
	Bis(2-chloroisopropyl)ether	168	43.74	104.35	28.59	119.51
	Bis(2-ethylhexyl)phthalate	169	63.75	112.02	51.68	124.09
	Butylbenzylphthalate	169	62.76	110.66	50.78	122.63
	Chrysene	190	63.32	102.35	53.57	112.11
	Dibenzo(a,h)anthracene	190	55.46	107.86	42.36	120.96
	Dibenzofuran	180	64.48	97.95	56.11	106.32
	Diethylphthalate	169	66.56	100.59	58.05	109.10
	Dimethylphthalate	169	66.17	98.04	58.20	106.01
	Di-n-butylphthalate	169	68.00	104.77	58.81	113.96
	Di-n-octylphthalate	169	57.43	118.76	42.10	134.09
	Fluoranthene	190	64.00	102.96	54.26	112.70
	Fluorene	190	63.80	100.22	54.70	109.33
	Hexachlorobenzene	168	64.56	99.88	55.73	108.71
	Hexachlorobutadiene	168	54.76	90.65	45.79	99.62
	Hexachlorocyclopentadiene	168	32.73	86.95	19.17	100.51
	Hexachloroethane	168	51.45	88.26	42.25	97.46
	Indeno(1,2,3-cd)pyrene	190	54.83	110.76	40.85	124.74
	Isophorone	168	56.67	93.46	47.47	102.66
	Naphthalene	190	57.05	90.58	48.67	98.96
	Nitrobenzene	168	54.84	94.04	45.05	103.84
	N-nitrosodiphenylamine	177	63.12	114.41	50.30	127.23

ALS Laboratory Group

Historical LCS Control Limits

SOILA	N-nitroso-dipropylamine	168	54.97	100.77	43.52	112.23
	Pentachlorophenol	168	47.37	112.42	31.11	128.68
	Phenanthrene	190	65.32	99.59	56.75	108.16
	Phenol	170	54.67	91.44	45.48	100.64
	Pyrene	190	59.46	111.91	46.35	125.02

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8270D SIM** *Prep Method* **3510**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATERA	1,2,4-Trichlorobenzene	253	45.84	87.37	35.46	97.75
	1,2-Dichlorobenzene	254	43.59	80.63	34.33	89.89
	1,3-Dichlorobenzene	253	40.73	79.33	31.08	88.98
	1,4-Dichlorobenzene	287	41.11	80.26	31.32	90.04
	2,4,5-Trichlorophenol	284	52.03	102.54	39.41	115.16
	2,4,6-Trichlorophenol	288	47.75	100.36	34.59	113.51
	2,4-Dichlorophenol	254	46.89	92.80	35.41	104.27
	2,4-Dimethylphenol	259	42.77	93.82	30.00	106.59
	2,4-Dinitrophenol	246	26.25	123.23	2.01	147.47
	2,4-Dinitrotoluene	289	59.16	108.78	46.76	121.18
	2,6-Dinitrotoluene	253	59.13	105.35	47.57	116.90
	2-Chloronaphthalene	253	55.34	93.82	45.72	103.44
	2-Chlorophenol	254	44.68	82.68	35.18	92.18
	2-Methylnaphthalene	257	53.76	92.68	44.03	102.41
	2-Methylphenol	289	43.12	85.38	32.56	95.94
	2-Nitroaniline	251	56.39	106.21	43.93	118.66
	2-Nitrophenol	254	43.07	95.43	29.97	108.52
	3,3'-Dichlorobenzidine	242	30.29	164.54	-3.27	198.10
	3-Nitroaniline	246	25.15	159.71	-8.49	193.34
	4,6-Dinitro-2-Methylphenol	252	38.11	120.19	17.60	140.71
	4-Bromophenyl Phenyl Ether	253	59.19	106.14	47.45	117.87
	4-Chloro-3-methylphenol	254	51.68	95.06	40.84	105.90
	4-Chloroaniline	248	28.98	108.00	9.23	127.75
	4-Chlorophenyl Phenyl Ether	253	58.21	105.23	46.46	116.99
	4-Methylphenol	288	38.39	84.78	26.79	96.38
	4-Nitroaniline	251	39.18	122.89	18.25	143.82
	4-Nitrophenol	249	3.98	94.56	-18.67	117.21
	Acenaphthene	260	58.13	96.61	48.52	106.23
	Acenaphthylene	257	51.79	100.90	39.52	113.17

ALS Laboratory Group

Historical LCS Control Limits

WATERA	Anthracene	262	62.37	102.69	52.29	112.77
	Benzo(a)anthracene	260	60.46	105.22	49.27	116.41
	Benzo(a)pyrene	260	60.68	104.76	49.66	115.79
	Benzo(b)fluoranthene	259	58.28	105.92	46.37	117.83
	Benzo(ghi)perylene	256	50.81	113.03	35.26	128.59
	Benzo(k)fluoranthene	260	60.12	105.71	48.72	117.10
	Benzoic acid	227	-8.96	112.20	-39.26	142.49
	Benzyl Alcohol	250	42.14	85.98	31.18	96.94
	Bis(2-chloroethoxy)methane	252	52.80	93.52	42.61	103.70
	Bis(2-chloroethyl)ether	253	46.26	93.84	34.36	105.74
	Bis(2-chloroisopropyl)ether	253	45.24	93.93	33.06	106.11
	Bis(2-ethylhexyl)phthalate	273	55.10	123.73	37.94	140.89
	Butylbenzylphthalate	255	58.87	113.70	45.17	127.41
	Chrysene	260	60.28	104.75	49.16	115.86
	Dibenzo(a,h)anthracene	259	52.41	111.92	37.54	126.80
	Dibenzofuran	258	59.47	99.77	49.40	109.84
	Diethylphthalate	255	58.41	107.68	46.10	119.99
	Dimethylphthalate	253	57.78	105.67	45.81	117.65
	Di-n-butylphthalate	255	62.37	111.57	50.07	123.86
	Di-n-octylphthalate	255	54.36	120.22	37.89	136.69
	Fluoranthene	260	60.61	105.42	49.41	116.62
	Fluorene	260	59.91	101.86	49.43	112.34
	Hexachlorobenzene	288	59.21	104.37	47.91	115.66
	Hexachlorobutadiene	288	39.13	86.95	27.17	98.91
	Hexachlorocyclopentadiene	250	22.92	80.60	8.50	95.02
	Hexachloroethane	288	35.67	80.84	24.37	92.14
	Indeno(1,2,3-cd)pyrene	259	52.30	114.51	36.74	130.06
	Isophorone	253	50.89	92.91	40.38	103.42
	Naphthalene	262	50.00	87.37	40.65	96.71
	Nitrobenzene	288	50.29	91.26	40.04	101.51
	N-nitrosodiphenylamine	256	58.21	125.49	41.39	142.31

ALS Laboratory Group

Historical LCS Control Limits

WATERA	N-nitroso-dipropylamine	253	51.41	96.67	40.09	107.98
	Pentachlorophenol	285	34.44	118.14	13.52	139.06
	Phenanthrene	260	61.56	101.99	51.46	112.09
	Phenol	275	6.96	85.24	-12.61	104.81
	Pyrene	259	59.26	107.62	47.17	119.71

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8270D SIM** ***Prep Method*** **3550**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOILA	1,2,4-Trichlorobenzene	168	56.66	89.47	48.46	97.67
	1,2-Dichlorobenzene	171	53.56	88.21	44.89	96.87
	1,3-Dichlorobenzene	168	53.28	86.49	44.97	94.79
	1,4-Dichlorobenzene	171	53.52	87.17	45.11	95.59
	2,4,5-Trichlorophenol	168	61.70	97.10	52.85	105.95
	2,4,6-Trichlorophenol	168	59.81	95.64	50.85	104.59
	2,4-Dichlorophenol	168	58.06	90.19	50.02	98.23
	2,4-Dimethylphenol	170	57.64	99.32	47.22	109.74
	2,4-Dinitrophenol	167	30.44	116.84	8.84	138.44
	2,4-Dinitrotoluene	170	66.57	104.45	57.09	113.92
	2,6-Dinitrotoluene	168	66.08	99.99	57.60	108.46
	2-Chloronaphthalene	168	62.46	92.76	54.89	100.33
	2-Chlorophenol	168	54.12	86.24	46.09	94.27
	2-Methylnaphthalene	178	60.84	93.81	52.60	102.05
	2-Methylphenol	171	56.54	93.94	47.18	103.30
	2-Nitroaniline	168	63.05	104.36	52.72	114.69
	2-Nitrophenol	168	55.83	91.04	47.03	99.84
	3,3'-Dichlorobenzidine	167	44.06	168.80	12.88	199.99
	3-Nitroaniline	167	40.00	147.40	13.15	174.25
	4,6-Dinitro-2-Methylphenol	168	50.21	115.95	33.77	132.39
	4-Bromophenyl Phenyl Ether	168	64.63	100.62	55.64	109.62
	4-Chloro-3-methylphenol	168	62.20	96.04	53.74	104.50
	4-Chloroaniline	168	40.72	112.28	22.83	130.17
	4-Chlorophenyl Phenyl Ether	167	62.10	101.51	52.25	111.36
	4-Methylphenol	171	58.94	94.51	50.05	103.41
	4-Nitroaniline	168	49.69	127.94	30.12	147.51
	4-Nitrophenol	167	50.87	110.98	35.84	126.01
	Acenaphthene	190	63.36	95.88	55.23	104.01
	Acenaphthylene	188	61.67	96.94	52.86	105.75

ALS Laboratory Group

Historical LCS Control Limits

SOILA	Anthracene	190	67.01	99.79	58.81	107.99
	Benzo(a)anthracene	189	64.16	101.76	54.76	111.15
	Benzo(a)pyrene	190	62.69	102.86	52.65	112.90
	Benzo(b)fluoranthene	190	62.07	103.81	51.64	114.24
	Benzo(ghi)perylene	187	50.91	110.58	36.00	125.50
	Benzo(k)fluoranthene	190	62.58	103.88	52.25	114.21
	Benzoic acid	166	21.40	115.80	-2.20	139.40
	Benzyl Alcohol	168	50.94	97.94	39.19	109.69
	Bis(2-chloroethoxy)methane	168	57.36	93.13	48.41	102.07
	Bis(2-chloroethyl)ether	168	47.01	98.35	34.18	111.18
	Bis(2-chloroisopropyl)ether	168	43.74	104.35	28.59	119.51
	Bis(2-ethylhexyl)phthalate	169	63.75	112.02	51.68	124.09
	Butylbenzylphthalate	169	62.76	110.66	50.78	122.63
	Chrysene	190	63.32	102.35	53.57	112.11
	Dibenzo(a,h)anthracene	190	55.46	107.86	42.36	120.96
	Dibenzofuran	180	64.48	97.95	56.11	106.32
	Diethylphthalate	169	66.56	100.59	58.05	109.10
	Dimethylphthalate	169	66.17	98.04	58.20	106.01
	Di-n-butylphthalate	169	68.00	104.77	58.81	113.96
	Di-n-octylphthalate	169	57.43	118.76	42.10	134.09
	Fluoranthene	190	64.00	102.96	54.26	112.70
	Fluorene	190	63.80	100.22	54.70	109.33
	Hexachlorobenzene	168	64.56	99.88	55.73	108.71
	Hexachlorobutadiene	168	54.76	90.65	45.79	99.62
	Hexachlorocyclopentadiene	168	32.73	86.95	19.17	100.51
	Hexachloroethane	168	51.45	88.26	42.25	97.46
	Indeno(1,2,3-cd)pyrene	190	54.83	110.76	40.85	124.74
	Isophorone	168	56.67	93.46	47.47	102.66
	Naphthalene	190	57.05	90.58	48.67	98.96
	Nitrobenzene	168	54.84	94.04	45.05	103.84
	N-nitrosodiphenylamine	177	63.12	114.41	50.30	127.23

ALS Laboratory Group

Historical LCS Control Limits

SOILA	N-nitroso-dipropylamine	168	54.97	100.77	43.52	112.23
	Pentachlorophenol	168	47.37	112.42	31.11	128.68
	Phenanthrene	190	65.32	99.59	56.75	108.16
	Phenol	170	54.67	91.44	45.48	100.64
	Pyrene	190	59.46	111.91	46.35	125.02

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8310** ***Prep Method*** **3510**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Acenaphthene	33	64.24	166.02	38.80	191.46
	Acenaphthylene	35	47.48	132.41	26.25	153.64
	Anthracene	39	78.31	136.81	63.69	151.44
	Benzo(a)anthracene	39	82.80	133.89	70.03	146.66
	Benzo(a)pyrene	39	80.34	136.68	66.25	150.76
	Benzo(b)fluoranthene	35	80.97	142.27	65.65	157.60
	Benzo(ghi)perylene	36	69.65	148.26	50.00	167.91
	Benzo(k)fluoranthene	39	80.08	137.21	65.80	151.49
	Chrysene	39	85.69	133.48	73.74	145.42
	Dibenzo(a,h)anthracene	36	52.53	160.03	25.65	186.91
	Fluoranthene	35	72.35	147.33	53.61	166.08
	Fluorene	36	56.72	150.00	33.40	173.32
	Indeno(1,2,3-cd)pyrene	39	78.01	136.56	63.37	151.20
	Naphthalene	36	47.41	138.07	24.74	160.74
	Phenanthrene	38	69.90	161.20	47.07	184.03
	Pyrene	39	80.32	143.08	64.64	158.76

ALS Laboratory Group

Historical LCS Control Limits

Analytical Method: **8310** ***Prep Method*** **3550**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Acenaphthene	11	69.66	170.21	44.52	195.35
	Acenaphthylene	13	35.99	154.75	6.30	184.44
	Anthracene	14	80.56	139.19	65.90	153.85
	Benzo(a)anthracene	14	84.78	131.01	73.22	142.56
	Benzo(a)pyrene	14	82.86	144.51	67.45	159.92
	Benzo(b)fluoranthene	13	80.56	142.53	65.07	158.03
	Benzo(ghi)perylene	13	76.12	141.66	59.73	158.05
	Benzo(k)fluoranthene	14	86.25	135.29	73.99	147.54
	Chrysene	14	94.17	122.62	87.06	129.73
	Dibenzo(a,h)anthracene	13	72.42	148.51	53.39	167.53
	Fluoranthene	13	79.73	136.71	65.48	150.96
	Fluorene	13	74.61	139.16	58.47	155.29
	Indeno(1,2,3-cd)pyrene	13	80.11	136.06	66.12	150.04
	Naphthalene	14	62.14	134.88	43.95	153.06
	Phenanthrene	14	63.05	175.17	35.01	203.20
	Pyrene	14	95.63	135.14	85.75	145.01

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Historical LCS Control Limits

Analytical Method: **8330** *Prep Method* **8330**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	1,3,5-Trinitrobenzene	64	72.56	127.68	58.77	141.47
	1,3-Dinitrobenzene	65	86.70	111.94	80.39	118.25
	2,4,6-Trinitrotoluene	91	73.17	110.75	63.77	120.15
	2,4-Dinitrotoluene	65	87.17	112.07	80.94	118.30
	2,6-Dinitrotoluene	65	84.67	124.38	74.74	134.31
	2-Amino-4,6-Dinitrotoluene	65	92.66	114.01	87.32	119.35
	2-Nitrotoluene	65	89.81	113.92	83.79	119.94
	3-Nitrotoluene	65	91.22	113.54	85.64	119.12
	4-Amino-2,6-Dinitrotoluene	65	87.06	127.43	76.96	137.52
	4-Nitrotoluene	65	90.21	112.87	84.54	118.54
	HMX	67	88.18	114.98	81.48	121.67
	Nitrobenzene	65	85.59	109.48	79.62	115.45
	RDX	94	91.97	116.27	85.89	122.34
	TETRYL	68	52.22	121.22	34.97	138.47
WATER	1,3,5-Trinitrobenzene	46	48.04	118.51	30.43	136.12
	1,3-Dinitrobenzene	42	73.81	105.98	65.77	114.02
	2,4,6-Trinitrotoluene	48	71.45	109.56	61.92	119.09
	2,4-Dinitrotoluene	46	77.16	108.30	69.37	116.09
	2,6-Dinitrotoluene	42	75.01	117.79	64.32	128.48
	2-Amino-4,6-Dinitrotoluene	46	81.44	115.13	73.02	123.55
	2-Nitrotoluene	46	78.27	107.65	70.93	115.00
	3-Nitrotoluene	42	79.19	107.91	72.01	115.10
	4-Amino-2,6-Dinitrotoluene	42	68.72	138.46	51.29	155.89
	4-Nitrotoluene	42	78.07	107.57	70.69	114.94
	HMX	43	82.39	110.20	75.44	117.16
	Nitrobenzene	46	69.43	102.88	61.06	111.25
	RDX	53	81.14	115.61	72.52	124.23
	TETRYL	42	32.21	127.33	8.44	151.11

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Historical LCS Control Limits

Analytical Method: 8332 **Prep Method** 8332

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Nitroglycerine	38	80.74	110.60	73.28	118.06
	PETN	26	83.59	115.53	75.60	123.51
WATER	Nitroglycerine	15	74.29	104.63	66.71	112.21
	PETN	9	70.78	113.69	60.05	124.41

Analytical Method: 9012A **Prep Method** 7.3.3.2

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	Reactive Cyanide	13	7.77	51.39	-3.13	62.29

Analytical Method: 9012A/335.4 **Prep Method** MicroDist

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATERM	Cyanide	40	89.66	109.00	84.83	113.84

Analytical Method: 9012A/335.4 **Prep Method** MidiDist

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATERM	Cyanide	40	89.66	109.00	84.83	113.84

Analytical Method: 9030A **Prep Method** NA

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Sulfide	40	26.95	125.56	2.30	150.22

Analytical Method: 9034 **Prep Method** 7.3.4.2

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
REACTI	Reactive Sulfide	34	30.27	145.43	1.48	174.22

Analytical Method: 9034/376.1 **Prep Method** NA

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Sulfide	40	26.95	125.56	2.30	150.22

Analytical Method: 9045 **Prep Method** NA

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
SOIL	pH	81	98.88	100.69	98.43	101.15

Analytical Method: 9060 **Prep Method** NA

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Total Organic Carbon	45	67.98	139.24	50.17	157.06

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Historical LCS Control Limits

Analytical Method: **HACH** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Chemical Oxygen Demand	36	90.77	112.02	85.46	117.33

Analytical Method: **OV-DCL-MEE** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
WATER	Ethane	43	79.46	119.09	69.56	129.00
	Ethene	43	76.17	123.49	64.33	135.33
	Methane	75	75.25	117.25	64.75	127.74

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Historical LCS Control Limits

Analytical Method: **TO-15** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
AIR	1,1,1-Trichloroethane	765	71.63	116.47	60.42	127.68
	1,1,2,2-Tetrachloroethane	945	71.90	122.20	59.32	134.78
	1,1,2-Trichloroethane	752	75.26	116.34	64.99	126.62
	1,1-Dichloroethane	761	77.03	114.30	67.71	123.62
	1,1-Dichloroethene	951	76.83	115.44	67.17	125.10
	1,2,4-Trichlorobenzene	705	51.23	148.74	26.85	173.12
	1,2,4-Trimethylbenzene	712	71.25	129.00	56.82	143.44
	1,2-Dibromoethane	754	75.15	118.24	64.38	129.01
	1,2-Dichlorobenzene	710	70.43	126.11	56.51	140.03
	1,2-Dichloroethane	755	73.78	119.14	62.44	130.48
	1,2-Dichloropropane	753	72.35	118.99	60.69	130.65
	1,3,5-Trimethylbenzene	712	70.24	125.61	56.40	139.46
	1,3-Butadiene	710	71.37	124.87	57.99	138.25
	1,3-Dichlorobenzene	710	70.98	123.72	57.79	136.90
	1,4-Dichlorobenzene	710	70.93	123.92	57.68	137.17
	2-Butanone	712	67.12	128.82	51.69	144.24
	2-Hexanone	707	68.87	132.19	53.04	148.02
	4-Ethyl toluene	712	71.78	128.03	57.72	142.09
	4-Methyl-2-Pentanone	708	68.49	127.32	53.79	142.03
	Acetone	711	59.74	128.71	42.49	145.96
	Benzene	859	74.66	116.75	64.14	127.27
	Benzyl Chloride	705	70.42	140.14	52.99	157.57
	Bromodichloromethane	709	73.79	117.43	62.89	128.34
	Bromoform	710	72.46	123.33	59.75	136.05
	Bromomethane	711	74.42	118.84	63.32	129.94
	Carbon Disulfide	709	74.67	117.94	63.85	128.75
	Carbon Tetrachloride	760	70.23	118.54	58.16	130.61
	Chlorobenzene	710	73.51	116.19	62.84	126.85
	Chlorodibromomethane	708	73.86	119.51	62.44	130.92

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Historical LCS Control Limits

AIR	Chloroethane	715	70.87	123.88	57.62	137.13
	Chloroform	755	76.42	112.73	67.34	121.81
	Chloromethane	715	68.88	123.73	55.17	137.44
	cis-1,2-Dichloroethene	764	78.86	115.17	69.79	124.25
	cis-1,3-Dichloropropene	708	75.67	122.04	64.08	133.63
	Cyclohexane	711	72.19	113.28	61.91	123.55
	Dichlorodifluoromethane	727	71.90	122.48	59.25	135.13
	Ethyl Acetate	710	70.62	139.68	53.36	156.94
	Ethyl Benzene	855	72.97	122.22	60.66	134.53
	Formaldehyde	26	44.66	146.54	19.19	172.01
	Freon 11	709	71.25	120.52	58.93	132.84
	Freon 113	723	77.09	111.45	68.50	120.04
	Freon 114	710	75.15	117.46	64.57	128.04
	Heptane	709	71.81	121.07	59.50	133.39
	Hexachlorobutadiene	706	47.10	134.16	25.33	155.93
	Hexane	710	73.60	118.35	62.41	129.54
	m,p-Xylene	855	72.91	120.60	60.99	132.52
	Methyl Tertiary Butyl Ether	728	73.69	125.16	60.83	138.03
	Methylene Chloride	942	74.40	117.19	63.70	127.89
	o-Xylene	856	72.65	121.68	60.39	133.94
	Styrene	757	73.03	126.21	59.73	139.51
	Tetrachloroethene	773	71.70	115.61	60.73	126.59
	Tetrahydrofuran	710	68.07	137.88	50.62	155.33
	Toluene	1034	74.16	118.94	62.97	130.13
	trans-1,2-Dichloroethene	762	77.53	115.22	68.11	124.64
	trans-1,3-Dichloropropene	753	74.76	125.24	62.14	137.85
	Trichloroethene	959	73.15	116.04	62.42	126.77
	Vinyl Acetate	710	72.96	127.46	59.33	141.08
	Vinyl Chloride	764	73.56	120.53	61.82	132.28

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Historical LCS Control Limits

Analytical Method: **TO15SIM** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
AIR	1,1,1-Trichloroethane	27	73.97	128.67	60.30	142.34
	1,1,2-Trichloroethane	12	68.60	124.37	54.66	138.31
	1,1-Dichloroethane	23	86.82	115.25	79.71	122.36
	1,1-Dichloroethene	26	80.07	117.97	70.59	127.44
	1,2-Dichloroethane	13	69.65	122.47	56.45	135.68
	2-Butanone	11	60.22	117.50	45.90	131.81
	Benzene	22	74.12	130.52	60.03	144.61
	Carbon Tetrachloride	10	76.78	126.07	64.46	138.40
	Chloroethane	13	62.30	138.32	43.30	157.32
	Chloroform	13	80.45	116.81	71.35	125.90
	Chloromethane	10	62.95	146.72	42.01	167.66
	cis-1,2-Dichloroethene	34	76.19	120.19	65.19	131.19
	Dichlorodifluoromethane	10	83.76	109.86	77.23	116.38
	Ethyl Benzene	18	59.24	122.90	43.33	138.81
	m,p-Xylene	18	57.33	123.35	40.83	139.86
	Methyl Tertiary Butyl Ether	24	72.58	114.56	62.09	125.06
	Methylene Chloride	12	90.91	118.33	84.06	125.18
	o-Xylene	18	54.75	127.01	36.69	145.07
	Tetrachloroethene	38	74.34	117.21	63.62	127.93
	Toluene	18	74.98	118.01	64.22	128.76
	trans-1,2-Dichloroethene	26	80.54	114.55	72.04	123.05
	Trichloroethene	40	77.53	114.24	68.35	123.42
	Vinyl Chloride	35	76.40	117.54	66.11	127.83

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Historical LCS Control Limits

Analytical Method: **TO17** *Prep Method* **NA**

Matrix	Analyte	Count	LWL	UWL	LCL	UCL
AIR	1,1,1-Trichloroethane	375	56.05	139.73	35.14	160.65
	1,1,2,2-Tetrachloroethane	376	67.97	143.74	49.03	162.68
	1,1,2-Trichloroethane	257	73.00	127.87	59.28	141.59
	1,1-Dichloroethane	258	61.38	144.25	40.67	164.96
	1,1-Dichloroethene	371	61.00	143.04	40.49	163.56
	1,2,4-Trichlorobenzene	258	63.42	162.99	38.53	187.88
	1,2,4-Trimethylbenzene	261	71.86	142.66	54.16	160.36
	1,2-Dibromoethane	260	69.06	131.52	53.45	147.13
	1,2-Dichlorobenzene	260	65.68	157.07	42.83	179.92
	1,2-Dichloroethane	253	54.03	141.19	32.24	162.98
	1,2-Dichloropropane	258	72.29	125.41	59.01	138.69
	1,3,5-Trimethylbenzene	261	73.46	139.05	57.06	155.45
	1,3-Butadiene	287	66.41	133.46	49.64	150.22
	1,3-Dichlorobenzene	260	66.31	154.37	44.29	176.39
	1,4-Dichlorobenzene	260	63.95	157.90	40.46	181.39
	1-Butanol	30	45.60	160.41	16.90	189.11
	1-Propanol	30	47.08	161.59	18.46	190.21
	2-Butanone	292	57.61	141.07	36.74	161.94
	2-Hexanone	259	75.21	129.56	61.62	143.15
	4-Ethyl toluene	261	73.04	139.00	56.56	155.49
	4-Methyl-2-Pentanone	296	79.07	125.84	67.38	137.53
	Acetone	295	59.35	137.95	39.70	157.60
	Acetonitrile	30	70.15	135.90	53.71	152.34
	Benzene	347	63.41	132.77	46.07	150.11
	Benzyl Chloride	250	60.62	172.50	32.64	200.47
	Bromodichloromethane	258	76.16	125.73	63.76	138.12
	Bromoform	259	68.45	146.93	48.83	166.55
	Bromomethane	247	51.67	157.01	25.33	183.35
	Carbon Disulfide	256	63.11	140.27	43.82	159.56

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Historical LCS Control Limits

AIR	Carbon Tetrachloride	302	72.16	127.19	58.40	140.95
	Chlorobenzene	261	76.42	131.70	62.61	145.52
	Chlorodibromomethane	259	71.61	133.16	56.22	148.55
	Chloroethane	255	59.60	139.46	39.63	159.43
	Chloroform	309	66.55	139.84	48.23	158.17
	Chloromethane	250	63.43	141.05	44.02	160.45
	cis-1,2-Dichloroethene	260	66.79	134.83	49.78	151.84
	cis-1,3-Dichloropropene	258	69.10	127.38	54.52	141.95
	Cyclohexane	261	78.86	122.50	67.95	133.40
	Dichlorodifluoromethane	251	65.38	138.32	47.14	156.56
	Ethanol	270	42.21	164.87	11.55	195.53
	Ethyl Acetate	260	64.11	138.25	45.58	156.78
	Ethyl Benzene	349	76.84	128.25	63.99	141.10
	Freon 113	258	63.82	141.83	44.32	161.33
	Freon 114	253	63.76	146.00	43.20	166.56
	Heptane	258	79.60	122.96	68.76	133.80
	Hexachlorobutadiene	260	69.14	150.90	48.69	171.35
	Hexane	303	72.06	129.46	57.71	143.81
	Hexanenitrile	30	77.10	130.98	63.63	144.45
	Isopropanol	246	59.93	142.74	39.23	163.44
	m,p-Xylene	349	76.02	130.03	62.52	143.53
	Methyl Tertiary Butyl Ether	279	60.78	143.69	40.05	164.42
	Methylene Chloride	298	61.50	138.39	42.27	157.61
	Octane	31	73.39	137.60	57.34	153.65
	o-Xylene	349	74.45	132.32	59.99	146.79
	Pentane	30	65.70	135.78	48.18	153.29
	Pentanenitrile	30	75.20	127.73	62.07	140.86
	Propanenitrile	30	52.60	161.30	25.42	188.48
	Propene	253	60.47	143.24	39.78	163.93
	Styrene	293	73.12	136.42	57.30	152.24
	Tetrachloroethene	385	78.84	125.16	67.26	136.74

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Historical LCS Control Limits

AIR	Tetrahydrofuran	294	56.35	139.74	35.50	160.59
	Toluene	425	77.64	123.71	66.12	135.23
	trans-1,2-Dichloroethene	258	62.76	150.16	40.91	172.01
	trans-1,3-Dichloropropene	257	66.93	128.03	51.66	143.30
	Trichloroethene	299	79.76	122.59	69.06	133.30
	Trichlorofluoromethane	256	62.50	143.88	42.15	164.23
	Vinyl Acetate	237	28.69	189.28	-11.46	229.43
	Vinyl Chloride	255	64.23	140.60	45.13	159.70

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: 524.2	**PrepMethod 524.2**				
WATER					
1,2-Dichlorobenzene-d4	567	78.5	110.59	70.5	118.61
Bromofluorobenzene	567	86.0	109.54	80.1	115.42
AnalyticalMethod: 8015B	**PrepMethod 3550**				
SOIL					
Pentacosane	1056	55.9	136.78	35.7	156.98
AnalyticalMethod: 8015B	**PrepMethod 3510**				
WATER					
Pentacosane	567	55.6	127.53	37.6	145.50
AnalyticalMethod: 8082	**PrepMethod 3550**				
SOIL					
Decachlorobiphenyl	380	43.4	154.64	15.6	182.44
Tetrachloro-meta-Xylene	1248	72.0	137.55	55.7	153.91
AnalyticalMethod: 8082	**PrepMethod 3510**				
WATER					
Decachlorobiphenyl	245	53.8	140.03	32.2	161.58
Tetrachloro-meta-Xylene	275	67.4	125.40	52.9	139.90
AnalyticalMethod: 8310	**PrepMethod 3550**				
SOIL					
Decafluorobiphenyl	63	63.5	142.71	43.7	162.51
AnalyticalMethod: 8310	**PrepMethod 3510**				
WATER					
Decafluorobiphenyl	422	51.6	129.30	32.2	148.72
AnalyticalMethod: 8332	**PrepMethod 8332**				
SOIL					
1-Nitronaphthalene	313	56.1	130.53	37.5	149.13

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: 8332	**PrepMethod 8332**				
WATER					
1-Nitronaphthalene	126	62.5	120.86	47.9	135.45
AnalyticalMethod: 8081A	**PrepMethod 3550**				
SOIL					
Decachlorobiphenyl	852	50.3	135.05	29.1	156.24
Tetrachloro-meta-Xylene	868	57.5	125.47	40.6	142.44
AnalyticalMethod: 8081A	**PrepMethod 3510**				
WATER					
Decachlorobiphenyl	541	47.3	130.45	26.5	151.23
Tetrachloro-meta-Xylene	402	61.3	115.95	47.6	129.61
AnalyticalMethod: 8151A	**PrepMethod 8151A**				
SOIL					
2,4-Dichlorophenylacetic acid	587	17.0	187.40	ND	229.97
AnalyticalMethod: 8151A	**PrepMethod 8151A**				
WATER					
2,4-Dichlorophenylacetic acid	505	57.3	163.90	30.6	190.54
AnalyticalMethod: 8260C 25mL	**PrepMethod 5030**				
25ML					
1,2-Dichloroethane-d4	527	83.1	117.70	74.4	126.35
Bromofluorobenzene	527	90.4	110.76	85.3	115.85
Dibromofluoromethane	527	83.2	107.18	77.2	113.16
Toluene-d8	527	84.3	104.61	79.3	109.67

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: 8260C	**PrepMethod 5030/5035**				
SOIL_M					
1,2-Dichloroethane-d4	323	67.5	121.13	54.0	134.54
Bromofluorobenzene	324	65.9	127.63	50.5	143.04
Dibromofluoromethane	322	66.5	124.99	51.9	139.59
Toluene-d8	324	65.9	122.17	51.9	136.22
AnalyticalMethod: 8260C	**PrepMethod 5030**				
SOIL-5030					
1,2-Dichloroethane-d4	2333	74.6	123.28	62.5	135.44
Bromofluorobenzene	2329	68.6	133.55	52.4	149.77
Dibromofluoromethane	2333	81.1	120.76	71.2	130.66
Toluene-d8	2331	73.7	124.11	61.1	136.70
AnalyticalMethod: 8260C GRO	**PrepMethod 5030**				
SOILG					
1,2-Dichloroethane-d4	479	79.9	125.95	68.4	137.45
Bromofluorobenzene	478	63.0	133.30	45.4	150.87
Dibromofluoromethane	479	83.8	121.62	74.3	131.06
Toluene-d8	479	67.7	135.19	50.8	152.06
AnalyticalMethod: 8260C RL=1	**PrepMethod 5030**				
WATER					
1,2-Dichloroethane-d4	7045	80.7	114.84	72.2	123.36
1,2-Dichloroethane-d4	7045	80.7	114.84	72.2	123.36
Bromofluorobenzene	7041	85.6	114.43	78.4	121.62
Bromofluorobenzene	7041	85.6	114.43	78.4	121.62
Dibromofluoromethane	7014	82.9	115.11	74.8	123.15
Dibromofluoromethane	7014	82.9	115.11	74.8	123.15
Toluene-d8	7034	84.0	109.93	77.5	116.42
Toluene-d8	7034	84.0	109.93	77.5	116.42

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: 8260C GRO	**PrepMethod 5030**				
WATERG					
1,2-Dichloroethane-d4	664	84.0	116.30	75.9	124.37
Bromofluorobenzene	664	80.7	112.57	72.7	120.54
Dibromofluoromethane	664	87.0	111.37	80.9	117.45
Toluene-d8	664	84.0	109.33	77.7	115.64
AnalyticalMethod: 8270D SIM	**PrepMethod 3550**				
SOILA					
2,4,6-Tribromophenol	1996	42.8	126.03	22.0	146.82
2,4,6-Tribromophenol	1996	42.8	126.03	22.0	146.82
2-Fluorobiphenyl	2168	52.6	110.64	38.1	125.14
2-Fluorobiphenyl	2168	52.6	110.64	38.1	125.14
2-Fluorophenol	2051	34.1	109.43	15.3	128.24
2-Fluorophenol	2051	34.1	109.43	15.3	128.24
Nitrobenzene-d5	2137	37.0	115.84	17.3	135.53
Nitrobenzene-d5	2137	37.0	115.84	17.3	135.53
Phenol-d5	2117	34.0	112.36	14.4	131.94
Phenol-d5	2117	34.0	112.36	14.4	131.94
Terphenyl-d14	2166	43.2	145.64	17.6	171.24
Terphenyl-d14	2166	43.2	145.64	17.6	171.24

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: 8270D SIM	**PrepMethod 3510**				
WATERA					
2,4,6-Tribromophenol	2721	33.3	118.62	12.0	139.93
2,4,6-Tribromophenol	2721	33.3	118.62	12.0	139.93
2-Fluorobiphenyl	2907	48.2	100.51	35.1	113.58
2-Fluorobiphenyl	2907	48.2	100.51	35.1	113.58
2-Fluorophenol	2763	9.66	98.72	ND	120.98
2-Fluorophenol	2763	9.66	98.72	ND	120.98
Nitrobenzene-d5	2823	40.0	112.29	22.0	130.34
Nitrobenzene-d5	2823	40.0	112.29	22.0	130.34
Phenol-d5	2693	ND	113.99	ND	145.03
Phenol-d5	2693	ND	113.99	ND	145.03
Terphenyl-d14	2890	37.4	122.30	16.1	143.52
Terphenyl-d14	2890	37.4	122.30	16.1	143.52
AnalyticalMethod: 8330	**PrepMethod 8330**				
SOIL					
3,4-Dinitrotoluene	763	78.3	120.52	67.8	131.06
3-Nitroclorobenzene	15	84.7	109.92	78.4	116.21
AnalyticalMethod: 8330	**PrepMethod 8330**				
WATER					
3,4-Dinitrotoluene	393	72.1	108.88	62.9	118.06
3-Nitrochlorobenzene	8	76.7	97.93	71.4	103.22
AnalyticalMethod: TO-15	**PrepMethod NA**				
AIR					
Bromofluorobenzene	11710	78.0	119.50	67.6	129.86
AnalyticalMethod: TO15SIM	**PrepMethod NA**				
AIR					
Bromofluorobenzene	444	65.9	134.64	48.7	151.81

ALS Historical Surrogate Limits

Method / Analyte	Matrix / Count	Historical Control Limits LWL	UWL	LCL	UCL
AnalyticalMethod: TO17	**PrepMethod NA**				
AIR					
Benzene-d6	403	55.0	166.03	27.3	193.76
Bromofluorobenzene	4673	71.3	129.92	56.7	144.55
Ethylbenzene-d10	416	32.1	145.31	3.92	173.58
Toluene-d8	291	41.2	146.65	14.9	173.00

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
120.1/9050	NA	WATER	PP

Analyte Name	Units	MDL	PQL
Conductivity	umhos/cm	0.135	1

Analytical Method	Preparatory Method	Matrix	Instrument Type
130.2	NA	WATER	TITR

Analyte Name	Units	MDL	PQL
Hardness	mg/L	1.33	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
160.1	NA	WATER	GRAV

Analyte Name	Units	MDL	PQL
Total Dissolved Solids	mg/L	16.2	20

Analytical Method	Preparatory Method	Matrix	Instrument Type
160.1	NA	WATER	PP

Analyte Name	Units	MDL	PQL
Total Dissolved Solids	mg/L	8.26	20

Analytical Method	Preparatory Method	Matrix	Instrument Type
160.2	NA	WATER	GRAV

Analyte Name	Units	MDL	PQL
Total Suspended Solids	mg/L	5.36	20

Analytical Method	Preparatory Method	Matrix	Instrument Type
160.2	NA	WATER	PP

Analyte Name	Units	MDL	PQL
Total Suspended Solids	mg/L	6.02	20

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
1664AMod	**SPE**	***WATER***	***GRAV***

Analyte Name	Units	MDL	PQL
Oil and Grease	mg/L	2.91	5

Analytical Method	Preparatory Method	Matrix	Instrument Type
1664AMod	**SPE**	***WATER***	***PP***

Analyte Name	Units	MDL	PQL
Oil and Grease	mg/L	2.71	5

Analytical Method	Preparatory Method	Matrix	Instrument Type
180.1	**NA**	***WATER***	***PP***

Analyte Name	Units	MDL	PQL
Turbidity	NTU's	0.171	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
200.8	200.8	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	30.7	40
Antimony	ug/L	0.653	2
Arsenic	ug/L	0.877	2
Barium	ug/L	0.437	2
Beryllium	ug/L	0.352	2
Cadmium	ug/L	0.352	2
Cerium	ug/L	0.205	5
Cesium	ug/L	0.272	5
Chromium	ug/L	0.867	2
Cobalt	ug/L	0.345	2
Copper	ug/L	0.608	2
Gallium	ug/L	0.279	5
Iron	ug/L	8.09	50
Lead	ug/L	0.339	2
Lithium	ug/L	0.61	5
Manganese	ug/L	0.328	2
Molybdenum	ug/L	0.367	2
Nickel	ug/L	0.215	2
Selenium	ug/L	1.09	5
Silver	ug/L	0.636	2
Strontium	ug/L	0.349	3
Thallium	ug/L	0.385	2
Tin	ug/L	0.517	3
Titanium	ug/L	1.07	3
Total Thorium	ug/L	0.443	2
Total Uranium	ug/L	0.345	2
Tungsten	ug/L	0.653	3
Vanadium	ug/L	0.514	2
Zinc	ug/L	1.07	3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
245.1	245.1	WATER	CVAA

Analyte Name	Units	MDL	PQL
Mercury	ug/L	0.0218	0.1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
300.0	300.0	SOIL	IC

Analyte Name	Units	MDL	PQL
Bromide	ug/g	0.0578	1
Chloride	ug/g	0.0722	1
Fluoride	ug/g	0.0494	1
Nitrate	ug/g	0.487	1
Nitrate-N	ug/g	0.108	0.23
Nitrite	ug/g	0.067	1
Nitrite-N	ug/g	0.0203	0.31
Phosphate	ug/g	0.143	1
Phosphate-P	ug/g	0.0466	0.33
Sulfate	ug/g	0.0671	1

Analytical Method	Preparatory Method	Matrix	Instrument Type
300.0	300.0	WATER	IC

Analyte Name	Units	MDL	PQL
Bromide	mg/L	0.00578	0.1
Chloride	mg/L	0.00722	0.1
Fluoride	mg/L	0.00494	0.1
Nitrate	mg/L	0.0487	0.1
Nitrate-N	mg/L	0.0108	0.023
Nitrite	mg/L	0.0067	0.1
Nitrite-N	mg/L	0.00203	0.031
Phosphate	mg/L	0.0143	0.1
Phosphate-P	mg/L	0.00466	0.033
Sulfate	mg/L	0.00671	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
305.1	NA	WATER	TITR

Analyte Name	Units	MDL	PQL
Acidity	mg/L	3.75	10

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
310.1	NA	WATER	TITR

Analyte Name	Units	MDL	PQL
Total Alkalinity	mg/L	3.02	10

310.2	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Total Alkalinity	mg/L	2.25	10

350.1	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Ammonia-Nitrogen	ug/L	11.9	50

351.2	NA	WATER	AA

Analyte Name	Units	MDL	PQL
TKN	mg/L	0.0628	0.2

353.2	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Nitrates	ug/L	26.5	50

365.1	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Phosphate	mg/L	0.00848	0.02
Phosphate-P	mg/L	0.00439	0.02

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
365.4	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Total Phosphorus	mg/L	0.0928	0.4

Analytical Method	Preparatory Method	Matrix	Instrument Type
375.4	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Sulfate	mg/L	2.29	5

Analytical Method	Preparatory Method	Matrix	Instrument Type
415.1	NA	WATER	TOC

Analyte Name	Units	MDL	PQL
Total Organic Carbon	mg/L	0.377	1

Analytical Method	Preparatory Method	Matrix	Instrument Type
4500/340.2	NA	WATER	ISE

Analyte Name	Units	MDL	PQL
Fluoride	mg/L	0.0198	0.04

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
524.2	524.2	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/L	0.0436	1
1,1,1-Trichloroethane	ug/L	0.0498	0.5
1,1,2,2-Tetrachloroethane	ug/L	0.0588	1
1,1,2-Trichloroethane	ug/L	0.154	0.5
1,1-Dichloroethane	ug/L	0.0326	1
1,1-Dichloroethene	ug/L	0.0404	0.5
1,1-Dichloropropene	ug/L	0.0617	1
1,2,3-Trichlorobenzene	ug/L	0.0683	1
1,2,3-Trichloropropane	ug/L	0.236	1
1,2,4-Trichlorobenzene	ug/L	0.037	0.5
1,2,4-Trimethylbenzene	ug/L	0.0382	1
1,2-Dibromo-3-Chloropropane	ug/L	0.275	1
1,2-Dibromoethane	ug/L	0.0375	1
1,2-Dichlorobenzene	ug/L	0.0375	0.5
1,2-Dichloroethane	ug/L	0.0374	0.5
1,2-Dichloropropane	ug/L	0.0313	0.5
1,3,5-Trimethylbenzene	ug/L	0.0368	1
1,3-Dichlorobenzene	ug/L	0.0439	1
1,3-Dichloropropane	ug/L	0.0341	0.5
1,4-Dichlorobenzene	ug/L	0.0315	0.5
2,2-Dichloropropane	ug/L	0.0624	1
2-Chlorotoluene	ug/L	0.0448	1
4-Chlorotoluene	ug/L	0.0262	1
Benzene	ug/L	0.0446	0.5
Bromobenzene	ug/L	0.0305	1
Bromochloromethane	ug/L	0.0555	1
Bromodichloromethane	ug/L	0.0474	1
Bromoform	ug/L	0.0421	1
Bromomethane	ug/L	0.0292	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Carbon Tetrachloride	ug/L	0.0486	0.5
Chlorobenzene	ug/L	0.0349	0.5
Chloroethane	ug/L	0.055	1
Chloroform	ug/L	0.0325	1
Chloromethane	ug/L	0.0572	1
cis-1,2-Dichloroethene	ug/L	0.0436	0.5
cis-1,3-Dichloropropene	ug/L	0.0507	1
Dibromochloromethane	ug/L	0.0503	1
Dibromomethane	ug/L	0.0302	1
Dichlorodifluoromethane	ug/L	0.0864	1
Ethyl Benzene	ug/L	0.0424	0.5
Hexachlorobutadiene	ug/L	0.111	1
Isopropylbenzene	ug/L	0.0508	1
m,p-Xylene	ug/L	0.0975	1
Methyl Tertiary Butyl Ether	ug/L	0.0476	0.5
Methylene Chloride	ug/L	0.0333	0.5
Naphthalene	ug/L	0.079	1
n-Butylbenzene	ug/L	0.0539	1
n-Propylbenzene	ug/L	0.0608	1
o-Xylene	ug/L	0.0488	0.5
p-Isopropyltoluene	ug/L	0.0489	1
sec-Butylbenzene	ug/L	0.0564	1
Styrene	ug/L	0.0399	0.5
tert-Butylbenzene	ug/L	0.0595	1
Tetrachloroethene	ug/L	0.0476	0.5
Toluene	ug/L	0.0421	0.5
trans-1,2-Dichloroethene	ug/L	0.0356	0.5
trans-1,3-Dichloropropene	ug/L	0.0493	1
Trichloroethene	ug/L	0.0361	0.5
Trichlorofluoromethane	ug/L	0.0613	1
Vinyl Chloride	ug/L	0.0482	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6010B	3015	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	42	200
Antimony	ug/L	41.7	60
Arsenic	ug/L	91.6	300
Barium	ug/L	1.28	20
Beryllium	ug/L	0.32	5
Boron	ug/L	19.4	100
Cadmium	ug/L	3.13	5
Calcium	ug/L	54.3	100
Chromium	ug/L	3.79	10
Cobalt	ug/L	9.3	50
Copper	ug/L	4.8	20
Iron	ug/L	24.3	50
Lead	ug/L	29.9	100
Lithium	ug/L	5.18	20
Magnesium	ug/L	30.5	100
Manganese	ug/L	0.798	10
Molybdenum	ug/L	25.7	100
Nickel	ug/L	13.2	40
Phosphorus	ug/L	73.1	500
Potassium	ug/L	693	3000
Selenium	ug/L	58.1	300
Silicon	ug/L	31.1	200
Silver	ug/L	5.65	10
Sodium	ug/L	150	200
Strontium	ug/L	0.344	20
Thallium	ug/L	71.5	300
Tin	ug/L	33.6	100
Titanium	ug/L	3.72	20
Vanadium	ug/L	3.79	50

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type	
Zinc	ug/L	8.34	20	

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6010B	3050	SOIL	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/g	2.98	20
Antimony	ug/g	4.48	6
Arsenic	ug/g	6.77	30
Barium	ug/g	0.0922	2
Beryllium	ug/g	0.0118	0.5
Boron	ug/g	4.76	10
Cadmium	ug/g	0.128	0.5
Calcium	ug/g	3.46	10
Chromium	ug/g	0.715	1
Cobalt	ug/g	0.478	5
Copper	ug/g	0.4	2
Iron	ug/g	2.91	5
Lead	ug/g	1.52	10
Lithium	ug/g	0.244	2
Magnesium	ug/g	4.7	10
Manganese	ug/g	0.156	1
Molybdenum	ug/g	1.29	10
Nickel	ug/g	1.63	4
Phosphorus	ug/g	5.88	50
Potassium	ug/g	54.2	300
Selenium	ug/g	4.47	30
Silicon	ug/g	15.4	20
Silver	ug/g	0.524	1
Sodium	ug/g	11.2	20
Strontium	ug/g	0.0578	2
Thallium	ug/g	4.16	30
Tin	ug/g	2.69	10
Titanium	ug/g	0.12	2
Vanadium	ug/g	0.3	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type	
Zinc	ug/g	0.588	2	

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6010B	3051	SOIL	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/g	3.66	20
Antimony	ug/g	5.12	6
Arsenic	ug/g	7.68	30
Barium	ug/g	0.168	2
Beryllium	ug/g	0.0165	0.5
Boron	ug/g	0.925	10
Cadmium	ug/g	0.233	0.5
Calcium	ug/g	9.28	10
Chromium	ug/g	0.337	1
Cobalt	ug/g	0.498	5
Copper	ug/g	0.574	2
Iron	ug/g	3.34	5
Lead	ug/g	2.4	10
Lithium	ug/g	0.233	2
Magnesium	ug/g	2.44	10
Manganese	ug/g	0.0808	1
Molybdenum	ug/g	2.19	10
Nickel	ug/g	0.787	4
Phosphorus	ug/g	5.99	50
Potassium	ug/g	46.1	300
Selenium	ug/g	6.94	30
Silicon	ug/g	6.13	20
Silver	ug/g	0.493	1
Sodium	ug/g	15.8	20
Strontium	ug/g	0.0551	2
Thallium	ug/g	3.58	30
Tin	ug/g	4.36	10
Titanium	ug/g	0.153	2
Vanadium	ug/g	0.78	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Zinc	ug/g	0.782	2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6020	3010M	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	12.9	30
Antimony	ug/L	0.276	2
Arsenic	ug/L	0.299	3
Barium	ug/L	0.134	2
Beryllium	ug/L	0.0688	2
Boron	ug/L	4.58	5
Cadmium	ug/L	0.0592	2
Calcium	ug/L	18.8	50
Cerium	ug/L	0.0584	2
Cesium	ug/L	0.0667	2
Chromium	ug/L	0.171	2
Cobalt	ug/L	0.0615	2
Copper	ug/L	0.154	2
Gallium	ug/L	0.329	3
Gold	ug/L	0.146	2
Iron	ug/L	8.75	50
Lead	ug/L	0.0512	2
Lithium	ug/L	0.564	3
Magnesium	ug/L	0.303	50
Manganese	ug/L	0.116	2
Molybdenum	ug/L	0.0779	2
Nickel	ug/L	0.137	2
Palladium	ug/L	0.831	2
Phosphorus	ug/L	10.7	100
Platinum	ug/L	0.0741	2
Potassium	ug/L	5.29	100
Selenium	ug/L	0.615	5
Silver	ug/L	0.0418	2
Sodium	ug/L	9.22	100

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Strontium	ug/L	0.0451	5
Tellurium	ug/L	0.376	5
Thallium	ug/L	0.12	2
Tin	ug/L	0.184	2
Titanium	ug/L	0.37	5
Total Thorium	ug/L	0.055	2
Total Uranium	ug/L	0.054	2
Tungsten	ug/L	0.221	5
Vanadium	ug/L	0.146	2
Zinc	ug/L	0.568	3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6020	3050M	SOIL	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	ug/g	3.32	15
Antimony	ug/g	0.13	1
Arsenic	ug/g	0.152	1
Barium	ug/g	0.0756	1
Beryllium	ug/g	0.0452	1
Boron	ug/g	2.38	5
Cadmium	ug/g	0.0409	1
Calcium	ug/g	3.29	50
Cerium	ug/g	0.0304	1
Cesium	ug/g	0.0439	1
Chromium	ug/g	0.0666	1
Cobalt	ug/g	0.0384	1
Copper	ug/g	0.0725	1
Gallium	ug/g	0.112	1.5
Gold	ug/g	0.0697	1
Iron	ug/g	3.38	50
Lead	ug/g	0.056	1
Lithium	ug/g	0.202	1
Magnesium	ug/g	0.105	25
Manganese	ug/g	0.0599	1
Molybdenum	ug/g	0.077	1
Nickel	ug/g	0.135	1
Palladium	ug/g	0.134	1
Phosphorus	ug/g	2.49	25
Platinum	ug/g	0.0393	1
Potassium	ug/g	2.99	50
Selenium	ug/g	0.312	2.5
Silver	ug/g	0.0447	1
Sodium	ug/g	7.22	50

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Strontium	ug/g	0.0335	1
Tellurium	ug/g	0.109	1
Thallium	ug/g	0.0299	1
Tin	ug/g	0.0696	1
Titanium	ug/g	0.277	2.5
Total Thorium	ug/g	0.0243	1
Total Uranium	ug/g	0.0132	1
Tungsten	ug/g	0.0313	1
Vanadium	ug/g	0.214	1
Zinc	ug/g	0.943	1.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
6020A	3010M	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	4.42	30
Antimony	ug/L	0.122	2
Arsenic	ug/L	0.367	3
Barium	ug/L	0.204	2
Beryllium	ug/L	0.244	2
Boron	ug/L	1.91	50
Cadmium	ug/L	0.0816	2
Calcium	ug/L	14.9	50
Cerium	ug/L	0.0649	2
Cesium	ug/L	0.0643	2
Chromium	ug/L	0.134	2
Cobalt	ug/L	0.0972	2
Copper	ug/L	0.243	2
Gallium	ug/L	0.172	3
Gold	ug/L	0.311	2
Iron	ug/L	9.19	50
Lead	ug/L	0.0726	2
Lithium	ug/L	0.813	2
Magnesium	ug/L	0.615	50
Manganese	ug/L	0.166	2
Molybdenum	ug/L	0.152	2
Nickel	ug/L	0.494	2
Palladium	ug/L	0.763	2
Phosphorus	ug/L	7.64	50
Platinum	ug/L	0.182	2
Potassium	ug/L	13.3	50
Selenium	ug/L	0.559	5
Silver	ug/L	0.25	2
Sodium	ug/L	21.3	100

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Strontium	ug/L	0.0611	5
Tellurium	ug/L	1.49	5
Thallium	ug/L	0.129	2
Tin	ug/L	0.102	2
Titanium	ug/L	0.46	5
Total Thorium	ug/L	0.0654	2
Total Uranium	ug/L	0.0699	2
Tungsten	ug/L	0.15	5
Vanadium	ug/L	0.12	2
Zinc	ug/L	0.692	3

6850	6850	SOIL	LC/MS
Analyte Name	**Units**	**MDL**	**PQL**
Perchlorate	ug/kg	0.617	2

6850	6850	WATER	LC/MS
Analyte Name	**Units**	**MDL**	**PQL**
Perchlorate	ug/L	0.0617	0.2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
7082	NA	MCE	FLAA

Analyte Name	Units	MDL	PQL
Lead	ug/mL	0.0121	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
7082	NA	SOIL	FLAA

Analyte Name	Units	MDL	PQL
Lead	ug/mL	0.0148	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
7082	NA	WIPE	FLAA

Analyte Name	Units	MDL	PQL
Lead	ug/mL	0.0117	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
7196A	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Chromium VI	ug/L	2.29	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
7196A(M)	NA	SOIL	AA

Analyte Name	Units	MDL	PQL
Chromium VI	ug/g	0.741	2

Analytical Method	Preparatory Method	Matrix	Instrument Type
7470A	7470A	WATER	CVAA

Analyte Name	Units	MDL	PQL
Mercury	ug/L	0.0202	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
7471A	7471A	SOIL	CVAA

Analyte Name	Units	MDL	PQL
Mercury	ug/g	0.00471	0.02

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
7580	**7580**	***SOIL***	***GC/FPD***

Analyte Name	Units	MDL	PQL
White Phosphorus	ug/kg	0.469	1.2

Analytical Method	Preparatory Method	Matrix	Instrument Type
7580	**7580**	***WATER***	***GC/FPD***

Analyte Name	Units	MDL	PQL
White Phosphorus	ug/L	0.0234	0.05

Analytical Method	Preparatory Method	Matrix	Instrument Type
8015B	**3510**	***WATER***	***GC/FID***

Analyte Name	Units	MDL	PQL
TPH-Diesel	ug/L	50	100
TPH-Motor Oil	ug/L	483	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
8015B	**3550**	***SOIL***	***GC/FID***

Analyte Name	Units	MDL	PQL
TPH-Diesel	mg/kg	1.75	4
TPH-Motor Oil	mg/kg	25.1	40

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8081A	3510	WATER	GC/ECD

Analyte Name	Units	MDL	PQL
4,4'-DDD	ug/L	0.00524	0.02
4,4'-DDE	ug/L	0.00518	0.02
4,4'-DDT	ug/L	0.00693	0.02
Aldrin	ug/L	0.0046	0.02
Alpha Chlordane	ug/L	0.00623	0.02
Alpha-BHC	ug/L	0.00443	0.02
Beta-BHC	ug/L	0.00663	0.02
Chlordane	ug/L	0.0231	0.1
Delta-BHC	ug/L	0.00691	0.02
Dieldrin	ug/L	0.00514	0.02
Endosulfan I	ug/L	0.00542	0.02
Endosulfan II	ug/L	0.00705	0.02
Endosulfan Sulfate	ug/L	0.00548	0.02
Endrin	ug/L	0.00599	0.02
Endrin Aldehyde	ug/L	0.00684	0.02
Endrin Ketone	ug/L	0.00566	0.02
Gamma Chlordane	ug/L	0.00568	0.02
Heptachlor	ug/L	0.00567	0.02
Heptachlor Epoxide	ug/L	0.00588	0.02
Lindane	ug/L	0.00531	0.02
Methoxychlor	ug/L	0.00995	0.02
Toxaphene	ug/L	0.217	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8081A	3550	SOIL	GC/ECD

Analyte Name	Units	MDL	PQL
4,4'-DDD	ug/g	0.116	0.67
4,4'-DDD	ug/kg	0.326	0.67
4,4'-DDE	ug/g	0.0604	0.67
4,4'-DDE	ug/kg	0.173	0.67
4,4'-DDT	ug/g	0.0721	0.67
4,4'-DDT	ug/kg	0.202	0.67
Aldrin	ug/g	0.0696	0.67
Aldrin	ug/kg	0.145	0.67
Alpha Chlordane	ug/g	0.0505	0.67
Alpha Chlordane	ug/kg	0.169	0.67
Alpha-BHC	ug/g	0.0484	0.67
Alpha-BHC	ug/kg	0.12	0.67
Beta-BHC	ug/g	0.112	0.67
Beta-BHC	ug/kg	0.309	0.67
Chlordane	ug/kg	0.731	3.3
Chlordane	ug/g	0.731	3.3
Delta-BHC	ug/kg	0.126	0.67
Delta-BHC	ug/g	0.108	0.67
Dieldrin	ug/kg	0.153	0.67
Dieldrin	ug/g	0.0475	0.67
Endosulfan I	ug/kg	0.155	0.67
Endosulfan I	ug/g	0.119	0.67
Endosulfan II	ug/g	0.0857	0.67
Endosulfan II	ug/kg	0.257	0.67
Endosulfan Sulfate	ug/g	0.0488	0.67
Endosulfan Sulfate	ug/kg	0.18	0.67
Endrin	ug/g	0.0749	0.67
Endrin	ug/kg	0.146	0.67
Endrin Aldehyde	ug/kg	0.172	0.67

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Endrin Aldehyde	ug/g	0.0605	0.67
Endrin Ketone	ug/kg	0.157	0.67
Endrin Ketone	ug/g	0.105	0.67
Gamma Chlordane	ug/kg	0.151	0.67
Gamma Chlordane	ug/g	0.0575	0.67
Heptachlor	ug/kg	0.248	0.67
Heptachlor	ug/g	0.067	0.67
Heptachlor Epoxide	ug/g	0.0688	0.67
Heptachlor Epoxide	ug/kg	0.153	0.67
Lindane	ug/g	0.092	0.67
Lindane	ug/kg	0.135	0.67
Methoxychlor	ug/kg	0.182	0.67
Methoxychlor	ug/g	0.234	0.67
Toxaphene	ug/kg	8.14	33
Toxaphene	ug/g	7.68	33

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8082	3510	WATER	GC/ECD

Analyte Name	Units	MDL	PQL
Aroclor 1016	ug/L	0.0639	0.1
Aroclor 1221	ug/L	0.198	0.2
Aroclor 1232	ug/L	0.098	0.1
Aroclor 1242	ug/L	0.0568	0.1
Aroclor 1248	ug/L	0.0819	0.1
Aroclor 1254	ug/L	0.0573	0.1
Aroclor 1260	ug/L	0.0869	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
8082	3550	SOIL	GC/ECD

Analyte Name	Units	MDL	PQL
Aroclor 1016	ug/g	0.033	0.033
Aroclor 1221	ug/g	0.0443	0.067
Aroclor 1232	ug/g	0.0333	0.033
Aroclor 1242	ug/g	0.0328	0.033
Aroclor 1248	ug/g	0.0315	0.033
Aroclor 1254	ug/g	0.0193	0.033
Aroclor 1260	ug/g	0.0106	0.033

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8151A	8151A	SOIL	GC/ECD

Analyte Name	Units	MDL	PQL
2,4,5-T	ug/kg	1.74	10
2,4,5-TP	ug/kg	1.68	10
2,4-D	ug/kg	6.92	20
2,4-DB	ug/kg	7.75	100
Dalapon	ug/kg	15.6	100
Dicamba	ug/kg	1.08	20
Dichlorprop	ug/kg	8.85	20
Dinoseb	ug/kg	2.6	20
MCPA	ug/kg	538	5000
MCPP	ug/kg	549	5000
Pentachlorophenol	ug/kg	1	5

8151A	8151A	SOIL	GC-ECD

Analyte Name	Units	MDL	PQL
2,4,5-T	ug/kg	3.44	6.7
2,4,5-TP	ug/kg	1.25	6.7
2,4-D	ug/kg	17.9	33
2,4-DB	ug/kg	21.5	33
4-Nitrophenol	ug/kg	25.8	67
Dalapon	ug/kg	33	33
Dicamba	ug/kg	2.9	6.7
Dichlorprop	ug/kg	9.05	33
Dinoseb	ug/kg	0.927	6.7
MCPA	ug/kg	1400	6700
MCPP	ug/kg	1470	6700
Pentachlorophenol	ug/kg	0.734	3.3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8151A	8151A	WATER	GC/ECD

Analyte Name	Units	MDL	PQL
2,4,5-T	ug/L	0.0378	0.1
2,4,5-TP	ug/L	0.0194	0.1
2,4-D	ug/L	0.157	0.5
2,4-DB	ug/L	0.372	2
Dalapon	ug/L	0.325	2
Dicamba	ug/L	0.0585	0.5
Dichlorprop	ug/L	0.318	0.5
Dinoseb	ug/L	0.0128	0.5
MCPA	ug/L	35.2	130
MCPP	ug/L	30.1	130
Pentachlorophenol	ug/L	0.0126	0.05

8151A	8151A	WATER	GC-ECD

Analyte Name	Units	MDL	PQL
2,4,5-T	ug/L	0.085	0.2
2,4,5-TP	ug/L	0.0757	0.2
2,4-D	ug/L	0.273	1
2,4-DB	ug/L	0.335	1
4-Nitrophenol	ug/L	0.839	2
Dalapon	ug/L	0.903	1
Dicamba	ug/L	0.0963	0.2
Dichlorprop	ug/L	0.579	1
Dinoseb	ug/L	0.112	0.2
MCPA	ug/L	22.5	200
MCPP	ug/L	41.3	200
Pentachlorophenol	ug/L	0.0307	0.1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B	5030	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	0.123	5
1,1,1-Trichloroethane	ug/Kg	0.225	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.282	5
1,1,2-Trichloroethane	ug/Kg	0.23	5
1,1-Dichloroethane	ug/Kg	0.199	5
1,1-Dichloroethene	ug/Kg	0.236	5
1,1-Dichloropropene	ug/Kg	0.229	5
1,2,3-Trichlorobenzene	ug/Kg	0.244	5
1,2,3-Trichloropropane	ug/Kg	0.421	5
1,2,4-Trichlorobenzene	ug/Kg	0.213	5
1,2,4-Trimethylbenzene	ug/Kg	0.139	5
1,2-Dibromo-3-Chloropropane	ug/Kg	2.64	5
1,2-Dibromoethane	ug/Kg	0.179	5
1,2-Dichlorobenzene	ug/Kg	0.133	5
1,2-Dichloroethane	ug/Kg	0.246	5
1,2-Dichloropropane	ug/Kg	0.212	5
1,3,5-Trimethylbenzene	ug/Kg	0.141	5
1,3-Dichlorobenzene	ug/Kg	0.0796	5
1,3-Dichloropropane	ug/Kg	0.151	5
1,4-Dichlorobenzene	ug/Kg	0.185	5
1-Chlorohexane	ug/Kg	0.177	5
2,2-Dichloropropane	ug/Kg	0.211	5
2-Butanone	ug/Kg	1.81	5
2-Chlorotoluene	ug/Kg	0.181	5
2-Hexanone	ug/Kg	1.25	5
4-Chlorotoluene	ug/Kg	0.15	5
4-Methyl-2-Pentanone	ug/Kg	1.64	5
Acetone	ug/Kg	2.61	5
Allyl Chloride	ug/Kg	0.166	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	0.19	5
Bromobenzene	ug/Kg	0.234	5
Bromochloromethane	ug/Kg	0.177	5
Bromodichloromethane	ug/Kg	0.216	5
Bromoform	ug/Kg	0.344	5
Bromomethane	ug/Kg	0.486	5
Carbon Disulfide	ug/Kg	0.295	5
Carbon Tetrachloride	ug/Kg	0.394	5
Chlorobenzene	ug/Kg	0.234	5
Chloroethane	ug/Kg	0.416	5
Chloroform	ug/Kg	0.283	5
Chloromethane	ug/Kg	0.256	5
cis-1,2-Dichloroethene	ug/Kg	0.179	5
cis-1,3-Dichloropropene	ug/Kg	0.158	5
Cyclohexane	ug/Kg	0.419	5
Dibromochloromethane	ug/Kg	0.234	5
Dibromomethane	ug/Kg	0.152	5
Dichlorodifluoromethane	ug/Kg	0.209	5
Dichlorofluoromethane	ug/Kg	0.484	5
Ethyl Acetate	ug/Kg	2.02	5
Ethyl Benzene	ug/Kg	0.208	5
Ethyl Ether	ug/Kg	0.242	5
Ethyl Methacrylate	ug/Kg	0.192	5
Freon 113	ug/Kg	0.634	5
Hexachlorobutadiene	ug/Kg	0.328	5
Iodomethane	ug/Kg	0.311	5
Isopropylbenzene	ug/Kg	0.174	5
m,p-Xylene	ug/Kg	0.312	10
Methyl Acetate	ug/Kg	0.372	5
Methyl Tertiary Butyl Ether	ug/Kg	0.155	5
Methylcyclohexane	ug/Kg	0.212	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	0.502	5
Naphthalene	ug/Kg	0.102	5
n-Butylbenzene	ug/Kg	0.0941	5
n-Propylbenzene	ug/Kg	0.179	5
o-Xylene	ug/Kg	0.137	5
Pentachloroethane	ug/Kg	0.215	5
p-Isopropyltoluene	ug/Kg	0.15	5
sec-Butylbenzene	ug/Kg	0.204	5
Styrene	ug/Kg	0.118	5
tert-Butylbenzene	ug/Kg	0.199	5
Tetrachloroethene	ug/Kg	0.286	5
Tetrahydrofuran	ug/Kg	3.17	5
Toluene	ug/Kg	0.199	5
TPH-Gasoline	ug/Kg	25.1	50
TPH-Gasoline	ug/Kg	25.1	50
trans-1,2-Dichloroethene	ug/Kg	0.193	5
trans-1,3-Dichloropropene	ug/Kg	0.128	5
trans-1,4-Dichloro-2-Butene	ug/Kg	0.766	5
Trichloroethene	ug/Kg	0.162	5
Trichlorofluoromethane	ug/Kg	0.329	5
Vinyl Chloride	ug/Kg	0.292	5
Xylenes	ug/Kg	0.571	15

8260B	5030	WATER	GC/MS VO
Analyte Name	**Units**	**MDL**	**PQL**
TPH-Gasoline	ug/L	11	50
TPH-Gasoline	ug/L	11	50

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B	5030/5035	SOIL_M	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	36.1	500
1,1,1-Trichloroethane	ug/Kg	38.5	500
1,1,2,2-Tetrachloroethane	ug/Kg	75.2	500
1,1,2-Trichloroethane	ug/Kg	35.2	500
1,1-Dichloroethane	ug/Kg	39.7	500
1,1-Dichloroethene	ug/Kg	44.7	500
1,1-Dichloropropene	ug/Kg	29.9	500
1,2,3-Trichlorobenzene	ug/Kg	70.8	500
1,2,3-Trichloropropane	ug/Kg	64.7	500
1,2,4-Trichlorobenzene	ug/Kg	52.3	500
1,2,4-Trimethylbenzene	ug/Kg	55.2	500
1,2-Dibromo-3-Chloropropane	ug/Kg	260	500
1,2-Dibromoethane	ug/Kg	50.6	500
1,2-Dichlorobenzene	ug/Kg	51	500
1,2-Dichloroethane	ug/Kg	21	500
1,2-Dichloropropane	ug/Kg	29.1	500
1,3,5-Trimethylbenzene	ug/Kg	57.1	500
1,3-Dichlorobenzene	ug/Kg	62.6	500
1,3-Dichloropropane	ug/Kg	40.1	500
1,4-Dichlorobenzene	ug/Kg	61.4	500
1-Chlorohexane	ug/Kg	59.5	500
2,2-Dichloropropane	ug/Kg	49.9	500
2-Butanone	ug/Kg	398	500
2-Chlorotoluene	ug/Kg	64.4	500
2-Hexanone	ug/Kg	94	500
4-Chlorotoluene	ug/Kg	65.7	500
4-Methyl-2-Pentanone	ug/Kg	43	500
Acetone	ug/Kg	235	500
Allyl Chloride	ug/Kg	25.3	500

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	28.5	500
Bromobenzene	ug/Kg	51.7	500
Bromochloromethane	ug/Kg	41.5	500
Bromodichloromethane	ug/Kg	18.1	500
Bromoform	ug/Kg	60.6	500
Bromomethane	ug/Kg	50.7	500
Carbon Disulfide	ug/Kg	46.7	500
Carbon Tetrachloride	ug/Kg	33.4	500
Chlorobenzene	ug/Kg	61	500
Chloroethane	ug/Kg	46.7	500
Chloroform	ug/Kg	24.7	500
Chloromethane	ug/Kg	79.9	500
cis-1,2-Dichloroethene	ug/Kg	19.9	500
cis-1,3-Dichloropropene	ug/Kg	15.1	500
Cyclohexane	ug/Kg	126	500
Dibromochloromethane	ug/Kg	39.2	500
Dibromomethane	ug/Kg	40.9	500
Dichlorodifluoromethane	ug/Kg	41.7	500
Dichlorofluoromethane	ug/Kg	75	500
Ethyl Acetate	ug/Kg	35.9	500
Ethyl Benzene	ug/Kg	70.6	500
Ethyl Ether	ug/Kg	35.3	500
Ethyl Methacrylate	ug/Kg	41.4	500
Freon 113	ug/Kg	152	500
Hexachlorobutadiene	ug/Kg	105	500
Iodomethane	ug/Kg	63.8	500
Isopropylbenzene	ug/Kg	50.5	500
m,p-Xylene	ug/Kg	115	1000
Methyl Acetate	ug/Kg	51.8	500
Methyl Tertiary Butyl Ether	ug/Kg	36.5	500
Methylcyclohexane	ug/Kg	46.3	500

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	45	500
Naphthalene	ug/Kg	50.4	500
n-Butylbenzene	ug/Kg	57.9	500
n-Propylbenzene	ug/Kg	67.7	500
o-Xylene	ug/Kg	38.1	500
Pentachloroethane	ug/Kg	64.5	500
p-Isopropyltoluene	ug/Kg	64.6	500
sec-Butylbenzene	ug/Kg	65.2	500
Styrene	ug/Kg	30.3	500
tert-Butylbenzene	ug/Kg	64.1	500
Tetrachloroethene	ug/Kg	79.5	500
Tetrahydrofuran	ug/Kg	487	500
Toluene	ug/Kg	68.6	500
trans-1,2-Dichloroethene	ug/Kg	41.1	500
trans-1,3-Dichloropropene	ug/Kg	34.3	500
trans-1,4-Dichloro-2-Butene	ug/Kg	116	500
Trichloroethene	ug/Kg	37.7	500
Trichlorofluoromethane	ug/Kg	63.7	500
Vinyl Chloride	ug/Kg	64.5	500
Xylenes	ug/Kg	0.571	15

MDL Studies are updated annually. Only valid MDL Studies are used in testing. MDLs may change at any time. For multiple instrumentation DataChem uses the highest MDL values from all instruments used for the method.

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B	5035	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	0.123	5
1,1,1-Trichloroethane	ug/Kg	0.225	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.282	5
1,1,2-Trichloroethane	ug/Kg	0.23	5
1,1-Dichloroethane	ug/Kg	0.199	5
1,1-Dichloroethene	ug/Kg	0.236	5
1,1-Dichloropropene	ug/Kg	0.229	5
1,2,3-Trichlorobenzene	ug/Kg	0.244	5
1,2,3-Trichloropropane	ug/Kg	0.421	5
1,2,4-Trichlorobenzene	ug/Kg	0.213	5
1,2,4-Trimethylbenzene	ug/Kg	0.139	5
1,2-Dibromo-3-Chloropropane	ug/Kg	2.64	5
1,2-Dibromoethane	ug/Kg	0.179	5
1,2-Dichlorobenzene	ug/Kg	0.133	5
1,2-Dichloroethane	ug/Kg	0.246	5
1,2-Dichloropropane	ug/Kg	0.212	5
1,3,5-Trimethylbenzene	ug/Kg	0.141	5
1,3-Dichlorobenzene	ug/Kg	0.0796	5
1,3-Dichloropropane	ug/Kg	0.151	5
1,4-Dichlorobenzene	ug/Kg	0.185	5
1-Chlorohexane	ug/Kg	0.177	5
2,2-Dichloropropane	ug/Kg	0.211	5
2-Butanone	ug/Kg	1.81	5
2-Chlorotoluene	ug/Kg	0.181	5
2-Hexanone	ug/Kg	1.25	5
4-Chlorotoluene	ug/Kg	0.15	5
4-Methyl-2-Pentanone	ug/Kg	1.64	5
Acetone	ug/Kg	2.61	5
Allyl Chloride	ug/Kg	0.166	5

MDL Studies are updated annually. Only valid MDL Studies are used in testing. MDLs may change at any time. For multiple instrumentation DataChem uses the highest MDL values from all instruments used for the method.

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	0.19	5
Bromobenzene	ug/Kg	0.234	5
Bromochloromethane	ug/Kg	0.177	5
Bromodichloromethane	ug/Kg	0.216	5
Bromoform	ug/Kg	0.344	5
Bromomethane	ug/Kg	0.486	5
Carbon Disulfide	ug/Kg	0.295	5
Carbon Tetrachloride	ug/Kg	0.394	5
Chlorobenzene	ug/Kg	0.234	5
Chloroethane	ug/Kg	0.416	5
Chloroform	ug/Kg	0.283	5
Chloromethane	ug/Kg	0.256	5
cis-1,2-Dichloroethene	ug/Kg	0.179	5
cis-1,3-Dichloropropene	ug/Kg	0.158	5
Cyclohexane	ug/Kg	0.419	5
Dibromochloromethane	ug/Kg	0.234	5
Dibromomethane	ug/Kg	0.152	5
Dichlorodifluoromethane	ug/Kg	0.209	5
Dichlorofluoromethane	ug/Kg	0.484	5
Ethyl Acetate	ug/Kg	2.02	5
Ethyl Benzene	ug/Kg	0.208	5
Ethyl Ether	ug/Kg	0.242	5
Ethyl Methacrylate	ug/Kg	0.192	5
Freon 113	ug/Kg	0.634	5
Hexachlorobutadiene	ug/Kg	0.328	5
Iodomethane	ug/Kg	0.311	5
Isopropylbenzene	ug/Kg	0.174	5
m,p-Xylene	ug/Kg	0.312	10
Methyl Acetate	ug/Kg	0.372	5
Methyl Tertiary Butyl Ether	ug/Kg	0.155	5
Methylcyclohexane	ug/Kg	0.212	5

MDL Studies are updated annually. Only valid MDL Studies are used in testing. MDLs may change at any time. For multiple instrumentation DataChem uses the highest MDL values from all instruments used for the method.

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	0.502	5
Naphthalene	ug/Kg	0.102	5
n-Butylbenzene	ug/Kg	0.0941	5
n-Propylbenzene	ug/Kg	0.179	5
o-Xylene	ug/Kg	0.137	5
Pentachloroethane	ug/Kg	0.215	5
p-Isopropyltoluene	ug/Kg	0.15	5
sec-Butylbenzene	ug/Kg	0.204	5
Styrene	ug/Kg	0.118	5
tert-Butylbenzene	ug/Kg	0.199	5
Tetrachloroethene	ug/Kg	0.286	5
Tetrahydrofuran	ug/Kg	3.17	5
Toluene	ug/Kg	0.199	5
trans-1,2-Dichloroethene	ug/Kg	0.193	5
trans-1,3-Dichloropropene	ug/Kg	0.128	5
trans-1,4-Dichloro-2-Butene	ug/Kg	0.766	5
Trichloroethene	ug/Kg	0.162	5
Trichlorofluoromethane	ug/Kg	0.329	5
Vinyl Chloride	ug/Kg	0.292	5
Xylenes	ug/Kg	0.571	15

8260B	SIM	WATER	GC/MS VO
Analyte Name	**Units**	**MDL**	**PQL**
Vinyl Chloride	ug/L	0.0112	0.05

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B GRO	5030	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
TPH-Gasoline	ug/L	23.2	50
TPH-Gasoline	ug/L	23.2	50

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B GRO	5030	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
TPH-Gasoline	ug/L	17.6	50

MDL Studies are updated annually. Only valid MDL Studies are used in testing. MDLs may change at any time. For multiple instrumentation DataChem uses the highest MDL values from all instruments used for the method.

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B RL=1	5030	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/L	0.0905	1
1,1,1-Trichloroethane	ug/L	0.348	1
1,1,2,2-Tetrachloroethane	ug/L	0.202	1
1,1,2-Trichloroethane	ug/L	0.216	1
1,1-Dichloroethane	ug/L	0.0834	1
1,1-Dichloroethene	ug/L	0.136	1
1,1-Dichloropropene	ug/L	0.143	1
1,2,3-Trichlorobenzene	ug/L	0.158	1
1,2,3-Trichloropropane	ug/L	0.646	1
1,2,4-Trichlorobenzene	ug/L	0.2	1
1,2,4-Trimethylbenzene	ug/L	0.191	1
1,2-Dibromo-3-Chloropropane	ug/L	0.619	1
1,2-Dibromoethane	ug/L	0.133	1
1,2-Dichlorobenzene	ug/L	0.17	1
1,2-Dichloroethane	ug/L	0.134	1
1,2-Dichloropropane	ug/L	0.104	1
1,3,5-Trimethylbenzene	ug/L	0.178	1
1,3-Dichlorobenzene	ug/L	0.167	1
1,3-Dichloropropane	ug/L	0.11	1
1,4-Dichlorobenzene	ug/L	0.153	1
1-Chlorohexane	ug/L	0.165	1
2,2-Dichloropropane	ug/L	0.257	1
2-Butanone	ug/L	1.89	5
2-Chlorotoluene	ug/L	0.203	1
2-Hexanone	ug/L	1.82	5
4-Chlorotoluene	ug/L	0.228	1
4-Methyl-2-Pentanone	ug/L	1.23	5
Acetone	ug/L	2.33	5
Allyl Chloride	ug/L	0.14	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/L	0.0949	1
Bromobenzene	ug/L	0.197	1
Bromochloromethane	ug/L	0.181	1
Bromodichloromethane	ug/L	0.0777	1
Bromoform	ug/L	0.202	1
Bromomethane	ug/L	0.332	1
Carbon Disulfide	ug/L	0.108	1
Carbon Tetrachloride	ug/L	0.229	1
Chlorobenzene	ug/L	0.132	1
Chloroethane	ug/L	0.209	1
Chloroform	ug/L	0.159	1
Chloromethane	ug/L	0.213	1
cis-1,2-Dichloroethene	ug/L	0.0903	1
cis-1,3-Dichloropropene	ug/L	0.186	1
Cyclohexane	ug/L	0.18	1
Dibromochloromethane	ug/L	0.163	1
Dibromomethane	ug/L	0.144	1
Dichlorodifluoromethane	ug/L	0.153	1
Dichlorofluoromethane	ug/L	0.379	1
Ethyl Acetate	ug/L	3.44	5
Ethyl Benzene	ug/L	0.196	1
Ethyl Ether	ug/L	0.222	1
Ethyl Methacrylate	ug/L	0.275	1
Freon 113	ug/L	0.262	1
Hexachlorobutadiene	ug/L	0.542	1
Iodomethane	ug/L	0.131	1
Isopropylbenzene	ug/L	0.11	1
m,p-Xylene	ug/L	0.227	2
Methyl Acetate	ug/L	0.342	1
Methyl Tertiary Butyl Ether	ug/L	0.123	1
Methylcyclohexane	ug/L	0.29	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/L	0.119	1
Naphthalene	ug/L	0.129	1
n-Butylbenzene	ug/L	0.215	1
n-Propylbenzene	ug/L	0.237	1
o-Xylene	ug/L	0.13	1
Pentachloroethane	ug/L	0.208	1
p-Isopropyltoluene	ug/L	0.202	1
sec-Butylbenzene	ug/L	0.239	1
Styrene	ug/L	0.0693	1
tert-Butylbenzene	ug/L	0.313	1
Tetrachloroethene	ug/L	0.232	1
Tetrahydrofuran	ug/L	1.24	5
Toluene	ug/L	0.0854	1
trans-1,2-Dichloroethene	ug/L	0.084	1
trans-1,3-Dichloropropene	ug/L	0.124	1
trans-1,4-Dichloro-2-Butene	ug/L	1.16	5
Trichloroethene	ug/L	0.17	1
Trichlorofluoromethane	ug/L	0.204	1
Vinyl Chloride	ug/L	0.215	1
Xylenes	ug/L	0.387	3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260B RL=5	5030	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/L	0.0905	1
1,1,1-Trichloroethane	ug/L	0.348	5
1,1,2,2-Tetrachloroethane	ug/L	0.202	1
1,1,2-Trichloroethane	ug/L	0.216	5
1,1-Dichloroethane	ug/L	0.0834	5
1,1-Dichloroethene	ug/L	0.136	5
1,1-Dichloropropene	ug/L	0.143	1
1,2,3-Trichlorobenzene	ug/L	0.158	1
1,2,3-Trichloropropane	ug/L	0.646	5
1,2,4-Trichlorobenzene	ug/L	0.2	1
1,2,4-Trimethylbenzene	ug/L	0.191	1
1,2-Dibromo-3-Chloropropane	ug/L	0.619	1
1,2-Dibromoethane	ug/L	0.133	1
1,2-Dichlorobenzene	ug/L	0.17	1
1,2-Dichloroethane	ug/L	0.134	5
1,2-Dichloropropane	ug/L	0.104	5
1,3,5-Trimethylbenzene	ug/L	0.178	1
1,3-Dichlorobenzene	ug/L	0.167	1
1,3-Dichloropropane	ug/L	0.11	1
1,4-Dichlorobenzene	ug/L	0.153	1
1-Chlorohexane	ug/L	0.165	1
2,2-Dichloropropane	ug/L	0.257	1
2-Butanone	ug/L	1.89	5
2-Chlorotoluene	ug/L	0.203	1
2-Hexanone	ug/L	1.82	5
4-Chlorotoluene	ug/L	0.228	1
4-Methyl-2-Pentanone	ug/L	1.23	5
Acetone	ug/L	2.33	5
Allyl Chloride	ug/L	0.14	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/L	0.0949	1
Bromobenzene	ug/L	0.197	1
Bromochloromethane	ug/L	0.181	5
Bromodichloromethane	ug/L	0.0777	1
Bromoform	ug/L	0.202	1
Bromomethane	ug/L	0.332	1
Carbon Disulfide	ug/L	0.108	1
Carbon Tetrachloride	ug/L	0.229	1
Chlorobenzene	ug/L	0.132	1
Chloroethane	ug/L	0.209	1
Chloroform	ug/L	0.159	5
Chloromethane	ug/L	0.213	1
cis-1,2-Dichloroethene	ug/L	0.0903	1
cis-1,3-Dichloropropene	ug/L	0.186	5
Cyclohexane	ug/L	0.18	5
Dibromochloromethane	ug/L	0.163	1
Dibromomethane	ug/L	0.144	5
Dichlorodifluoromethane	ug/L	0.153	1
Dichlorofluoromethane	ug/L	0.379	1
Ethyl Acetate	ug/L	3.44	5
Ethyl Benzene	ug/L	0.196	5
Ethyl Ether	ug/L	0.222	1
Ethyl Methacrylate	ug/L	0.275	5
Freon 113	ug/L	0.262	5
Hexachlorobutadiene	ug/L	0.542	1
Iodomethane	ug/L	0.131	1
Isopropylbenzene	ug/L	0.11	1
m,p-Xylene	ug/L	0.227	2
Methyl Acetate	ug/L	0.342	5
Methyl Tertiary Butyl Ether	ug/L	0.123	5
Methylcyclohexane	ug/L	0.29	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/L	0.119	1
Naphthalene	ug/L	0.129	1
n-Butylbenzene	ug/L	0.215	1
n-Propylbenzene	ug/L	0.237	1
o-Xylene	ug/L	0.13	5
Pentachloroethane	ug/L	0.208	1
p-Isopropyltoluene	ug/L	0.202	1
sec-Butylbenzene	ug/L	0.239	1
Styrene	ug/L	0.0693	5
tert-Butylbenzene	ug/L	0.313	5
Tetrachloroethene	ug/L	0.232	1
Tetrahydrofuran	ug/L	1.24	5
Toluene	ug/L	0.0854	5
trans-1,2-Dichloroethene	ug/L	0.084	5
trans-1,3-Dichloropropene	ug/L	0.124	5
trans-1,4-Dichloro-2-Butene	ug/L	1.16	5
Trichloroethene	ug/L	0.17	1
Trichlorofluoromethane	ug/L	0.204	1
Vinyl Chloride	ug/L	0.215	1
Xylenes	ug/L	0.387	15

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260C	5030	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	0.123	5
1,1,1-Trichloroethane	ug/Kg	0.225	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.283	5
1,1,2-Trichloroethane	ug/Kg	0.23	5
1,1-Dichloroethane	ug/Kg	0.199	5
1,1-Dichloroethene	ug/Kg	0.36	5
1,1-Dichloropropene	ug/Kg	0.229	5
1,2,3-Trichlorobenzene	ug/Kg	0.244	5
1,2,3-Trichloropropane	ug/Kg	0.421	5
1,2,4-Trichlorobenzene	ug/Kg	0.213	5
1,2,4-Trimethylbenzene	ug/Kg	0.178	5
1,2-Dibromo-3-Chloropropane	ug/Kg	2.64	5
1,2-Dibromoethane	ug/Kg	0.179	5
1,2-Dichlorobenzene	ug/Kg	0.168	5
1,2-Dichloroethane	ug/Kg	0.246	5
1,2-Dichloropropane	ug/Kg	0.212	5
1,3,5-Trimethylbenzene	ug/Kg	0.15	5
1,3-Dichlorobenzene	ug/Kg	0.159	5
1,3-Dichloropropane	ug/Kg	0.173	5
1,4-Dichlorobenzene	ug/Kg	0.239	5
1-Chlorohexane	ug/Kg	0.238	5
2,2-Dichloropropane	ug/Kg	0.218	5
2-Butanone	ug/Kg	2.12	5
2-Chlorotoluene	ug/Kg	0.195	5
2-Hexanone	ug/Kg	1.25	5
4-Chlorotoluene	ug/Kg	0.216	5
4-Methyl-2-Pentanone	ug/Kg	1.72	5
Acetone	ug/Kg	2.61	5
Allyl Chloride	ug/Kg	0.447	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	0.19	5
Bromobenzene	ug/Kg	0.265	5
Bromochloromethane	ug/Kg	0.236	5
Bromodichloromethane	ug/Kg	0.216	5
Bromoform	ug/Kg	0.344	5
Bromomethane	ug/Kg	0.486	5
Carbon Disulfide	ug/Kg	0.295	5
Carbon Tetrachloride	ug/Kg	0.394	5
Chlorobenzene	ug/Kg	0.234	5
Chloroethane	ug/Kg	0.416	5
Chloroform	ug/Kg	0.283	5
Chloromethane	ug/Kg	0.403	5
cis-1,2-Dichloroethene	ug/Kg	0.179	5
cis-1,3-Dichloropropene	ug/Kg	0.158	5
Cyclohexane	ug/Kg	0.419	5
Dibromochloromethane	ug/Kg	0.234	5
Dibromomethane	ug/Kg	0.199	5
Dichlorodifluoromethane	ug/Kg	0.209	5
Dichlorofluoromethane	ug/Kg	0.484	5
Ethyl Acetate	ug/Kg	3.02	5
Ethyl Benzene	ug/Kg	0.252	5
Ethyl Ether	ug/Kg	0.242	5
Ethyl Methacrylate	ug/Kg	0.22	5
Freon 113	ug/Kg	0.634	5
Hexachlorobutadiene	ug/Kg	0.328	5
Iodomethane	ug/Kg	0.311	5
Isopropylbenzene	ug/Kg	0.174	5
m,p-Xylene	ug/Kg	0.312	10
Methyl Acetate	ug/Kg	0.578	5
Methyl Tertiary Butyl Ether	ug/Kg	0.155	5
Methylcyclohexane	ug/Kg	0.212	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	0.502	5
Naphthalene	ug/Kg	0.233	5
n-Butylbenzene	ug/Kg	0.148	5
n-Propylbenzene	ug/Kg	0.337	5
o-Xylene	ug/Kg	0.137	5
Pentachloroethane	ug/Kg	1.05	5
p-Isopropyltoluene	ug/Kg	0.15	5
sec-Butylbenzene	ug/Kg	0.204	5
Styrene	ug/Kg	0.175	5
tert-Butylbenzene	ug/Kg	0.308	5
Tetrachloroethene	ug/Kg	0.286	5
Tetrahydrofuran	ug/Kg	3.17	5
Toluene	ug/Kg	0.199	5
TPH-Gasoline	ug/Kg	25.1	50
TPH-Gasoline	ug/Kg	25.1	50
trans-1,2-Dichloroethene	ug/Kg	0.193	5
trans-1,3-Dichloropropene	ug/Kg	0.134	5
trans-1,4-Dichloro-2-Butene	ug/Kg	1.6	5
Trichloroethene	ug/Kg	0.162	5
Trichlorofluoromethane	ug/Kg	0.329	5
Vinyl Chloride	ug/Kg	0.292	5

8260C	5030	WATER	GC/MS VO
Analyte Name	**Units**	**MDL**	**PQL**
TPH-Gasoline	ug/L	11	50
TPH-Gasoline	ug/L	11	50

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260C	5030/5035	SOIL_M	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	44.1	500
1,1,1-Trichloroethane	ug/Kg	38.5	500
1,1,2,2-Tetrachloroethane	ug/Kg	75.2	500
1,1,2-Trichloroethane	ug/Kg	35.2	500
1,1-Dichloroethane	ug/Kg	39.7	500
1,1-Dichloroethene	ug/Kg	45	500
1,1-Dichloropropene	ug/Kg	31.7	500
1,2,3-Trichlorobenzene	ug/Kg	79.6	500
1,2,3-Trichloropropane	ug/Kg	75.6	500
1,2,4-Trichlorobenzene	ug/Kg	80.7	500
1,2,4-Trimethylbenzene	ug/Kg	55.2	500
1,2-Dibromo-3-Chloropropane	ug/Kg	260	500
1,2-Dibromoethane	ug/Kg	50.6	500
1,2-Dichlorobenzene	ug/Kg	54.5	500
1,2-Dichloroethane	ug/Kg	24.1	500
1,2-Dichloropropane	ug/Kg	29.1	500
1,3,5-Trimethylbenzene	ug/Kg	57.1	500
1,3-Dichlorobenzene	ug/Kg	62.6	500
1,3-Dichloropropane	ug/Kg	52.3	500
1,4-Dichlorobenzene	ug/Kg	61.4	500
1-Chlorohexane	ug/Kg	59.5	500
2,2-Dichloropropane	ug/Kg	49.9	500
2-Butanone	ug/Kg	466	500
2-Chlorotoluene	ug/Kg	64.4	500
2-Hexanone	ug/Kg	218	500
4-Chlorotoluene	ug/Kg	65.7	500
4-Methyl-2-Pentanone	ug/Kg	121	500
Acetone	ug/Kg	276	500
Allyl Chloride	ug/Kg	86.2	500

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	28.5	500
Bromobenzene	ug/Kg	68.9	500
Bromochloromethane	ug/Kg	54	500
Bromodichloromethane	ug/Kg	18.1	500
Bromoform	ug/Kg	60.6	500
Bromomethane	ug/Kg	76	500
Carbon Disulfide	ug/Kg	50.9	500
Carbon Tetrachloride	ug/Kg	46.8	500
Chlorobenzene	ug/Kg	61	500
Chloroethane	ug/Kg	46.7	500
Chloroform	ug/Kg	24.7	500
Chloromethane	ug/Kg	79.9	500
cis-1,2-Dichloroethene	ug/Kg	24.6	500
cis-1,3-Dichloropropene	ug/Kg	15.1	500
Cyclohexane	ug/Kg	126	500
Dibromochloromethane	ug/Kg	41.9	500
Dibromomethane	ug/Kg	40.9	500
Dichlorodifluoromethane	ug/Kg	41.7	500
Dichlorofluoromethane	ug/Kg	75	500
Ethyl Acetate	ug/Kg	357	500
Ethyl Benzene	ug/Kg	70.6	500
Ethyl Ether	ug/Kg	39.7	500
Ethyl Methacrylate	ug/Kg	49.2	500
Freon 113	ug/Kg	152	500
Hexachlorobutadiene	ug/Kg	105	500
Iodomethane	ug/Kg	63.8	500
Isopropylbenzene	ug/Kg	50.5	500
m,p-Xylene	ug/Kg	115	1000
Methyl Acetate	ug/Kg	162	500
Methyl Tertiary Butyl Ether	ug/Kg	42.7	500
Methylcyclohexane	ug/Kg	46.3	500

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	45	500
Naphthalene	ug/Kg	50.4	500
n-Butylbenzene	ug/Kg	57.9	500
n-Propylbenzene	ug/Kg	67.7	500
o-Xylene	ug/Kg	38.1	500
Pentachloroethane	ug/Kg	64.5	500
p-Isopropyltoluene	ug/Kg	64.6	500
sec-Butylbenzene	ug/Kg	92.3	500
Styrene	ug/Kg	30.3	500
tert-Butylbenzene	ug/Kg	64.1	500
Tetrachloroethene	ug/Kg	79.5	500
Tetrahydrofuran	ug/Kg	487	500
Toluene	ug/Kg	68.6	500
trans-1,2-Dichloroethene	ug/Kg	41.1	500
trans-1,3-Dichloropropene	ug/Kg	50	500
trans-1,4-Dichloro-2-Butene	ug/Kg	116	500
Trichloroethene	ug/Kg	43.2	500
Trichlorofluoromethane	ug/Kg	63.7	500
Vinyl Chloride	ug/Kg	64.5	500

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260C	5035	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/Kg	0.123	5
1,1,1-Trichloroethane	ug/Kg	0.225	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.283	5
1,1,2-Trichloroethane	ug/Kg	0.23	5
1,1-Dichloroethane	ug/Kg	0.199	5
1,1-Dichloroethene	ug/Kg	0.36	5
1,1-Dichloropropene	ug/Kg	0.229	5
1,2,3-Trichlorobenzene	ug/Kg	0.244	5
1,2,3-Trichloropropane	ug/Kg	0.421	5
1,2,4-Trichlorobenzene	ug/Kg	0.213	5
1,2,4-Trimethylbenzene	ug/Kg	0.178	5
1,2-Dibromo-3-Chloropropane	ug/Kg	2.64	5
1,2-Dibromoethane	ug/Kg	0.179	5
1,2-Dichlorobenzene	ug/Kg	0.168	5
1,2-Dichloroethane	ug/Kg	0.246	5
1,2-Dichloropropane	ug/Kg	0.212	5
1,3,5-Trimethylbenzene	ug/Kg	0.15	5
1,3-Dichlorobenzene	ug/Kg	0.159	5
1,3-Dichloropropane	ug/Kg	0.173	5
1,4-Dichlorobenzene	ug/Kg	0.239	5
1-Chlorohexane	ug/Kg	0.238	5
2,2-Dichloropropane	ug/Kg	0.218	5
2-Butanone	ug/Kg	2.12	5
2-Chlorotoluene	ug/Kg	0.195	5
2-Hexanone	ug/Kg	1.25	5
4-Chlorotoluene	ug/Kg	0.216	5
4-Methyl-2-Pentanone	ug/Kg	1.72	5
Acetone	ug/Kg	2.61	5
Allyl Chloride	ug/Kg	0.447	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/Kg	0.19	5
Bromobenzene	ug/Kg	0.265	5
Bromochloromethane	ug/Kg	0.236	5
Bromodichloromethane	ug/Kg	0.216	5
Bromoform	ug/Kg	0.344	5
Bromomethane	ug/Kg	0.486	5
Carbon Disulfide	ug/Kg	0.295	5
Carbon Tetrachloride	ug/Kg	0.394	5
Chlorobenzene	ug/Kg	0.234	5
Chloroethane	ug/Kg	0.416	5
Chloroform	ug/Kg	0.283	5
Chloromethane	ug/Kg	0.403	5
cis-1,2-Dichloroethene	ug/Kg	0.179	5
cis-1,3-Dichloropropene	ug/Kg	0.158	5
Cyclohexane	ug/Kg	0.419	5
Dibromochloromethane	ug/Kg	0.234	5
Dibromomethane	ug/Kg	0.199	5
Dichlorodifluoromethane	ug/Kg	0.209	5
Dichlorofluoromethane	ug/Kg	0.484	5
Ethyl Acetate	ug/Kg	3.02	5
Ethyl Benzene	ug/Kg	0.252	5
Ethyl Ether	ug/Kg	0.242	5
Ethyl Methacrylate	ug/Kg	0.22	5
Freon 113	ug/Kg	0.634	5
Hexachlorobutadiene	ug/Kg	0.328	5
Iodomethane	ug/Kg	0.311	5
Isopropylbenzene	ug/Kg	0.174	5
m,p-Xylene	ug/Kg	0.312	10
Methyl Acetate	ug/Kg	0.578	5
Methyl Tertiary Butyl Ether	ug/Kg	0.155	5
Methylcyclohexane	ug/Kg	0.212	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/Kg	0.502	5
Naphthalene	ug/Kg	0.233	5
n-Butylbenzene	ug/Kg	0.148	5
n-Propylbenzene	ug/Kg	0.337	5
o-Xylene	ug/Kg	0.137	5
Pentachloroethane	ug/Kg	1.05	5
p-Isopropyltoluene	ug/Kg	0.15	5
sec-Butylbenzene	ug/Kg	0.204	5
Styrene	ug/Kg	0.175	5
tert-Butylbenzene	ug/Kg	0.308	5
Tetrachloroethene	ug/Kg	0.286	5
Tetrahydrofuran	ug/Kg	3.17	5
Toluene	ug/Kg	0.199	5
trans-1,2-Dichloroethene	ug/Kg	0.193	5
trans-1,3-Dichloropropene	ug/Kg	0.134	5
trans-1,4-Dichloro-2-Butene	ug/Kg	1.6	5
Trichloroethene	ug/Kg	0.162	5
Trichlorofluoromethane	ug/Kg	0.329	5
Vinyl Chloride	ug/Kg	0.292	5

8260C	SIM	WATER	GC/MS VO
Analyte Name	**Units**	**MDL**	**PQL**
Vinyl Chloride	ug/L	0.0112	0.05

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260C RL=1	5030	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/L	0.0905	1
1,1,1-Trichloroethane	ug/L	0.348	1
1,1,2,2-Tetrachloroethane	ug/L	0.202	1
1,1,2-Trichloroethane	ug/L	0.216	1
1,1-Dichloroethane	ug/L	0.0834	1
1,1-Dichloroethene	ug/L	0.136	1
1,1-Dichloropropene	ug/L	0.143	1
1,2,3-Trichlorobenzene	ug/L	0.158	1
1,2,3-Trichloropropane	ug/L	0.646	1
1,2,4-Trichlorobenzene	ug/L	0.2	1
1,2,4-Trimethylbenzene	ug/L	0.191	1
1,2-Dibromo-3-Chloropropane	ug/L	0.619	1
1,2-Dibromoethane	ug/L	0.133	1
1,2-Dichlorobenzene	ug/L	0.17	1
1,2-Dichloroethane	ug/L	0.134	1
1,2-Dichloropropane	ug/L	0.104	1
1,3,5-Trimethylbenzene	ug/L	0.178	1
1,3-Dichlorobenzene	ug/L	0.167	1
1,3-Dichloropropane	ug/L	0.11	1
1,4-Dichlorobenzene	ug/L	0.153	1
1-Chlorohexane	ug/L	0.165	1
2,2-Dichloropropane	ug/L	0.257	1
2-Butanone	ug/L	1.89	5
2-Chlorotoluene	ug/L	0.203	1
2-Hexanone	ug/L	1.82	5
4-Chlorotoluene	ug/L	0.228	1
4-Methyl-2-Pentanone	ug/L	1.23	5
Acetone	ug/L	2.33	5
Allyl Chloride	ug/L	0.14	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/L	0.0949	1
Bromobenzene	ug/L	0.197	1
Bromochloromethane	ug/L	0.181	1
Bromodichloromethane	ug/L	0.0777	1
Bromoform	ug/L	0.202	1
Bromomethane	ug/L	0.332	1
Carbon Disulfide	ug/L	0.108	1
Carbon Tetrachloride	ug/L	0.229	1
Chlorobenzene	ug/L	0.132	1
Chloroethane	ug/L	0.209	1
Chloroform	ug/L	0.159	1
Chloromethane	ug/L	0.213	1
cis-1,2-Dichloroethene	ug/L	0.0903	1
cis-1,3-Dichloropropene	ug/L	0.186	1
Cyclohexane	ug/L	0.18	1
Dibromochloromethane	ug/L	0.163	1
Dibromomethane	ug/L	0.144	1
Dichlorodifluoromethane	ug/L	0.153	1
Dichlorofluoromethane	ug/L	0.379	1
Ethyl Acetate	ug/L	3.44	5
Ethyl Benzene	ug/L	0.196	1
Ethyl Ether	ug/L	0.222	1
Ethyl Methacrylate	ug/L	0.275	1
Freon 113	ug/L	0.262	1
Hexachlorobutadiene	ug/L	0.542	1
Iodomethane	ug/L	0.131	1
Isopropylbenzene	ug/L	0.11	1
m,p-Xylene	ug/L	0.227	2
Methyl Acetate	ug/L	0.342	1
Methyl Tertiary Butyl Ether	ug/L	0.123	1
Methylcyclohexane	ug/L	0.29	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/L	0.119	1
Naphthalene	ug/L	0.129	1
n-Butylbenzene	ug/L	0.215	1
n-Propylbenzene	ug/L	0.237	1
o-Xylene	ug/L	0.13	1
Pentachloroethane	ug/L	0.208	1
p-Isopropyltoluene	ug/L	0.202	1
sec-Butylbenzene	ug/L	0.239	1
Styrene	ug/L	0.0693	1
tert-Butylbenzene	ug/L	0.313	1
Tetrachloroethene	ug/L	0.232	1
Tetrahydrofuran	ug/L	1.24	5
Toluene	ug/L	0.0854	1
trans-1,2-Dichloroethene	ug/L	0.084	1
trans-1,3-Dichloropropene	ug/L	0.124	1
trans-1,4-Dichloro-2-Butene	ug/L	1.16	5
Trichloroethene	ug/L	0.17	1
Trichlorofluoromethane	ug/L	0.204	1
Vinyl Chloride	ug/L	0.215	1
Xylenes	ug/L	0.156	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8260C RL=5	5030	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1,2-Tetrachloroethane	ug/L	0.193	5
1,1,1-Trichloroethane	ug/L	0.266	5
1,1,2,2-Tetrachloroethane	ug/L	0.401	5
1,1,2-Trichloroethane	ug/L	0.223	5
1,1-Dichloroethane	ug/L	0.195	5
1,1-Dichloroethene	ug/L	0.234	5
1,1-Dichloropropene	ug/L	0.273	5
1,2,3-Trichlorobenzene	ug/L	0.492	5
1,2,3-Trichloropropane	ug/L	0.454	5
1,2,4-Trichlorobenzene	ug/L	0.2	1
1,2,4-Trimethylbenzene	ug/L	0.276	5
1,2-Dibromo-3-Chloropropane	ug/L	0.619	1
1,2-Dibromoethane	ug/L	0.207	5
1,2-Dichlorobenzene	ug/L	0.353	5
1,2-Dichloroethane	ug/L	0.308	5
1,2-Dichloropropane	ug/L	0.329	5
1,3,5-Trimethylbenzene	ug/L	0.286	5
1,3-Dichlorobenzene	ug/L	0.322	5
1,3-Dichloropropane	ug/L	0.391	5
1,4-Dichlorobenzene	ug/L	0.236	5
1-Chlorohexane	ug/L	0.292	5
2,2-Dichloropropane	ug/L	0.257	1
2-Butanone	ug/L	2.13	5
2-Chlorotoluene	ug/L	0.286	5
2-Hexanone	ug/L	2.48	5
4-Chlorotoluene	ug/L	0.31	5
4-Methyl-2-Pentanone	ug/L	1.88	5
Acetone	ug/L	2.33	5
Allyl Chloride	ug/L	0.482	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzene	ug/L	0.236	5
Bromobenzene	ug/L	0.197	1
Bromochloromethane	ug/L	0.36	5
Bromodichloromethane	ug/L	0.301	5
Bromoform	ug/L	0.202	1
Bromomethane	ug/L	0.332	1
Carbon Disulfide	ug/L	0.336	5
Carbon Tetrachloride	ug/L	0.257	5
Chlorobenzene	ug/L	0.168	5
Chloroethane	ug/L	0.209	1
Chloroform	ug/L	0.328	5
Chloromethane	ug/L	0.358	5
cis-1,2-Dichloroethene	ug/L	0.269	5
cis-1,3-Dichloropropene	ug/L	0.231	5
Cyclohexane	ug/L	0.407	5
Dibromochloromethane	ug/L	0.163	1
Dibromomethane	ug/L	0.252	5
Dichlorodifluoromethane	ug/L	0.31	5
Dichlorofluoromethane	ug/L	0.379	1
Ethyl Acetate	ug/L	1.06	5
Ethyl Benzene	ug/L	0.26	5
Ethyl Ether	ug/L	0.407	5
Ethyl Methacrylate	ug/L	0.443	5
Freon 113	ug/L	0.38	5
Hexachlorobutadiene	ug/L	0.542	1
Iodomethane	ug/L	0.318	5
Isopropylbenzene	ug/L	0.233	5
m,p-Xylene	ug/L	0.227	2
Methyl Acetate	ug/L	0.539	5
Methyl Tertiary Butyl Ether	ug/L	0.276	5
Methylcyclohexane	ug/L	0.331	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Methylene Chloride	ug/L	0.232	5
Naphthalene	ug/L	0.201	5
n-Butylbenzene	ug/L	0.268	5
n-Propylbenzene	ug/L	0.277	5
o-Xylene	ug/L	0.156	5
Pentachloroethane	ug/L	0.286	5
p-Isopropyltoluene	ug/L	0.314	5
sec-Butylbenzene	ug/L	0.328	5
Styrene	ug/L	0.192	5
tert-Butylbenzene	ug/L	0.271	1
Tetrachloroethene	ug/L	0.272	5
Tetrahydrofuran	ug/L	1.63	5
Toluene	ug/L	0.127	5
trans-1,2-Dichloroethene	ug/L	0.229	5
trans-1,3-Dichloropropene	ug/L	0.0924	5
trans-1,4-Dichloro-2-Butene	ug/L	1.06	5
Trichloroethene	ug/L	0.247	5
Trichlorofluoromethane	ug/L	0.226	5
Vinyl Chloride	ug/L	0.299	5
Xylenes	ug/L	0.156	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8270D	3510	WATER	GC/MS SV

Analyte Name	Units	MDL	PQL
1,2,4-Trichlorobenzene	ug/L	0.305	5
1,2-Dichlorobenzene	ug/L	0.265	5
1,3-Dichlorobenzene	ug/L	0.245	5
1,4-Dichlorobenzene	ug/L	0.302	5
1,4-Dithiane	ug/L	0.216	0.5
1,4-Oxathiane	ug/L	0.16	0.5
2,4,5-Trichlorophenol	ug/L	0.266	5
2,4,6-Trichlorophenol	ug/L	0.309	5
2,4-Dichlorophenol	ug/L	0.26	5
2,4-Dimethylphenol	ug/L	0.498	5
2,4-Dinitrophenol	ug/L	4.15	20
2,4-Dinitrotoluene	ug/L	0.463	5
2,6-Dinitrotoluene	ug/L	3.89	5
2-Chloronaphthalene	ug/L	0.237	5
2-Chlorophenol	ug/L	0.276	5
2-Methylnaphthalene	ug/L	0.222	5
2-Methylphenol	ug/L	0.305	5
2-Nitroaniline	ug/L	0.271	5
2-Nitrophenol	ug/L	0.811	5
3,3'-Dichlorobenzidine	ug/L	1.3	5
3-Nitroaniline	ug/L	1.21	5
4,6-Dinitro-2-Methylphenol	ug/L	3.62	20
4-Bromophenyl Phenyl Ether	ug/L	0.337	5
4-Chloro-3-methylphenol	ug/L	0.19	5
4-Chloroaniline	ug/L	1.11	5
4-Chlorophenyl Phenyl Ether	ug/L	1.21	5
4-Methylphenol	ug/L	0.597	5
4-Nitroaniline	ug/L	1.43	5
4-Nitrophenol	ug/L	1.73	20

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Acenaphthene	ug/L	0.204	5
Acenaphthylene	ug/L	0.173	5
Anthracene	ug/L	0.12	5
Benzo(a)anthracene	ug/L	0.208	5
Benzo(a)pyrene	ug/L	0.146	5
Benzo(b)fluoranthene	ug/L	0.214	5
Benzo(ghi)perylene	ug/L	0.266	5
Benzo(k)fluoranthene	ug/L	0.145	5
Benzoic acid	ug/L	2.46	20
Benzothiazole	ug/L	0.128	0.5
Benzyl Alcohol	ug/L	0.996	5
Bis(2-chloroethoxy)methane	ug/L	0.832	5
Bis(2-chloroethyl)ether	ug/L	0.258	5
Bis(2-chloroisopropyl)ether	ug/L	0.296	5
Bis(2-ethylhexyl)phthalate	ug/L	1.83	5
Butylbenzylphthalate	ug/L	0.245	5
Carbazole	ug/L	0.153	5
Chrysene	ug/L	0.157	5
CPMS	ug/L	0.208	0.5
CPMSO	ug/L	0.111	0.5
CPMSO2	ug/L	0.115	0.5
Dibenzo(a,h)anthracene	ug/L	0.542	5
Dibenzofuran	ug/L	0.195	5
Diethylphthalate	ug/L	0.237	5
Dimethyldisulfide	ug/L	0.158	0.5
Dimethylphthalate	ug/L	0.148	5
Di-n-butylphthalate	ug/L	0.315	5
Di-n-octylphthalate	ug/L	0.47	5
Fluoranthene	ug/L	0.273	5
Fluorene	ug/L	0.29	5
Hexachlorobenzene	ug/L	0.229	5

MDL Studies are updated annually. Only valid MDL Studies are used in testing. MDLs may change at any time. For multiple instrumentation DataChem uses the highest MDL values from all instruments used for the method.

ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Hexachlorobutadiene	ug/L	0.368	5
Hexachlorocyclopentadiene	ug/L	1.76	5
Hexachloroethane	ug/L	0.297	5
Indeno(1,2,3-cd)pyrene	ug/L	0.299	5
Isophorone	ug/L	0.178	5
Naphthalene	ug/L	0.24	5
Nitrobenzene	ug/L	0.323	5
N-nitrosodiphenylamine	ug/L	0.203	5
N-nitroso-dipropylamine	ug/L	0.262	5
Pentachlorophenol	ug/L	3.06	20
Phenanthrene	ug/L	0.177	5
Phenol	ug/L	0.267	5
Pyrene	ug/L	0.189	5
Pyridine	ug/L	0.211	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8270D	3550	SOIL	GC/MS SV

Analyte Name	Units	MDL	PQL
1,2,4-Trichlorobenzene	ug/kg	7.11	170
1,2-Dichlorobenzene	ug/kg	6.62	170
1,3-Dichlorobenzene	ug/kg	6.56	170
1,4-Dichlorobenzene	ug/kg	6.67	170
1,4-Dithiane	ug/kg	4.78	17
1,4-Oxathiane	ug/kg	6.3	17
2,4,5-Trichlorophenol	ug/kg	8.36	170
2,4,6-Trichlorophenol	ug/kg	9.95	170
2,4-Dichlorophenol	ug/kg	5.82	170
2,4-Dimethylphenol	ug/kg	22.8	170
2,4-Dinitrophenol	ug/kg	186	670
2,4-Dinitrotoluene	ug/kg	8.87	170
2,6-Dinitrotoluene	ug/kg	8.22	170
2-Chloronaphthalene	ug/kg	6.07	170
2-Chlorophenol	ug/kg	6.57	170
2-Methylnaphthalene	ug/kg	8.65	170
2-Methylphenol	ug/kg	7.75	170
2-Nitroaniline	ug/kg	10.6	170
2-Nitrophenol	ug/kg	7.36	170
3,3'-Dichlorobenzidine	ug/kg	69.5	170
3-Nitroaniline	ug/kg	21.3	170
4,6-Dinitro-2-Methylphenol	ug/kg	108	670
4-Bromophenyl Phenyl Ether	ug/kg	10.4	170
4-Chloro-3-methylphenol	ug/kg	8.02	170
4-Chloroaniline	ug/kg	31.9	170
4-Chlorophenyl Phenyl Ether	ug/kg	8.42	170
4-Methylphenol	ug/kg	7.61	170
4-Nitroaniline	ug/kg	26.7	170
4-Nitrophenol	ug/kg	115	670

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Acenaphthene	ug/kg	4.72	170
Acenaphthylene	ug/kg	7.99	170
Anthracene	ug/kg	5.63	170
Benzo(a)anthracene	ug/kg	7.35	170
Benzo(a)pyrene	ug/kg	5.1	170
Benzo(b)fluoranthene	ug/kg	7.53	170
Benzo(ghi)perylene	ug/kg	14.8	170
Benzo(k)fluoranthene	ug/kg	5.74	170
Benzoic acid	ug/kg	89.4	670
Benzothiazole	ug/kg	5.46	17
Benzyl Alcohol	ug/kg	6.55	170
Bis(2-chloroethoxy)methane	ug/kg	6.95	170
Bis(2-chloroethyl)ether	ug/kg	5.55	170
Bis(2-chloroisopropyl)ether	ug/kg	6.04	170
Bis(2-ethylhexyl)phthalate	ug/kg	8.82	170
Butylbenzylphthalate	ug/kg	8.75	170
Carbazole	ug/kg	8.01	170
Chrysene	ug/kg	10.8	170
CPMS	ug/kg	3.95	17
CPMSO	ug/kg	3.68	17
CPMSO2	ug/kg	4.4	17
Dibenzo(a,h)anthracene	ug/kg	10.6	170
Dibenzofuran	ug/kg	6.34	170
Diethylphthalate	ug/kg	6.66	170
Dimethyldisulfide	ug/kg	3.03	17
Dimethylphthalate	ug/kg	4.57	170
Di-n-butylphthalate	ug/kg	6.08	170
Di-n-octylphthalate	ug/kg	5.56	170
Fluoranthene	ug/kg	9.92	170
Fluorene	ug/kg	7.7	170
Hexachlorobenzene	ug/kg	11.5	170

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Hexachlorobutadiene	ug/kg	12.7	170
Hexachlorocyclopentadiene	ug/kg	49.6	170
Hexachloroethane	ug/kg	7.87	170
Indeno(1,2,3-cd)pyrene	ug/kg	17.3	170
Isophorone	ug/kg	6.88	170
Naphthalene	ug/kg	4.65	170
Nitrobenzene	ug/kg	7.72	170
N-nitrosodiphenylamine	ug/kg	7.12	170
N-nitroso-dipropylamine	ug/kg	12.4	170
Pentachlorophenol	ug/kg	124	670
Phenanthrene	ug/kg	5.83	170
Phenol	ug/kg	8.19	170
Pyrene	ug/kg	6.54	170
Pyridine	ug/kg	54.2	170

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8270D SIM	3510	WATER	GC/MS SV

Analyte Name	Units	MDL	PQL
2-Methylnaphthalene	ug/L	0.011	0.2
Acenaphthene	ug/L	0.0087	0.2
Acenaphthylene	ug/L	0.0101	0.05
Anthracene	ug/L	0.0107	0.05
Benzo(a)anthracene	ug/L	0.00643	0.2
Benzo(a)pyrene	ug/L	0.00795	0.05
Benzo(b)fluoranthene	ug/L	0.0096	0.05
Benzo(ghi)perylene	ug/L	0.0184	0.05
Benzo(k)fluoranthene	ug/L	0.00906	0.2
Chrysene	ug/L	0.00962	0.2
Dibenzo(a,h)anthracene	ug/L	0.0213	0.05
Fluoranthene	ug/L	0.0145	0.05
Fluorene	ug/L	0.00918	0.05
Indeno(1,2,3-cd)pyrene	ug/L	0.0258	0.2
Naphthalene	ug/L	0.0119	0.2
Phenanthrene	ug/L	0.00805	0.05
Pyrene	ug/L	0.00843	0.2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8270D SIM	3550	SOIL	GC/MS SV

Analyte Name	Units	MDL	PQL
2-Methylnaphthalene	ug/kg	0.421	1.7
Acenaphthene	ug/kg	0.361	1.7
Acenaphthylene	ug/kg	0.381	1.7
Anthracene	ug/kg	0.39	1.7
Benzo(a)anthracene	ug/kg	0.341	1.7
Benzo(a)pyrene	ug/kg	0.358	1.7
Benzo(b)fluoranthene	ug/kg	0.373	1.7
Benzo(ghi)perylene	ug/kg	0.523	1.7
Benzo(k)fluoranthene	ug/kg	0.439	1.7
Chrysene	ug/kg	0.48	1.7
Dibenzo(a,h)anthracene	ug/kg	0.334	1.7
Fluoranthene	ug/kg	0.445	1.7
Fluorene	ug/kg	0.37	1.7
Indeno(1,2,3-cd)pyrene	ug/kg	0.527	1.7
Naphthalene	ug/kg	0.472	1.7
Phenanthrene	ug/kg	0.408	1.7
Pyrene	ug/kg	0.361	1.7

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8310	3510	WATER	HPLC

Analyte Name	Units	MDL	PQL
Acenaphthene	ug/L	0.234	0.5
Acenaphthylene	ug/L	0.339	1
Anthracene	ug/L	0.00709	0.05
Benzo(a)anthracene	ug/L	0.0139	0.05
Benzo(a)pyrene	ug/L	0.0249	0.05
Benzo(b)fluoranthene	ug/L	0.0346	0.1
Benzo(ghi)perylene	ug/L	0.0571	0.1
Benzo(k)fluoranthene	ug/L	0.0142	0.05
Chrysene	ug/L	0.0135	0.05
Dibenzo(a,h)anthracene	ug/L	0.0995	0.1
Fluoranthene	ug/L	0.0268	0.1
Fluorene	ug/L	0.0369	0.1
Indeno(1,2,3-cd)pyrene	ug/L	0.0155	0.05
Naphthalene	ug/L	0.185	0.5
Phenanthrene	ug/L	0.009	0.05
Pyrene	ug/L	0.0339	0.05

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8330	8330	SOIL	HPLC

Analyte Name	Units	MDL	PQL
1,3,5-Trinitrobenzene	ug/g	0.0217	0.1
1,3-Dinitrobenzene	ug/g	0.045	0.1
2,4,6-Trinitrotoluene	ug/g	0.0633	0.2
2,4-Dinitrotoluene	ug/g	0.0559	0.2
2,6-Dinitrotoluene	ug/g	0.0479	0.2
2-Amino-4,6-Dinitrotoluene	ug/g	0.0996	0.2
2-Nitrotoluene	ug/g	0.0828	0.4
3-Nitrotoluene	ug/g	0.186	0.4
4-Amino-2,6-Dinitrotoluene	ug/g	0.0846	0.2
4-Nitrotoluene	ug/g	0.174	0.4
HMX	ug/g	0.0541	0.2
Nitrobenzene	ug/g	0.0627	0.2
RDX	ug/g	0.0596	0.2
TETRYL	ug/g	0.0785	0.2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
8330	8330	WATER	HPLC

Analyte Name	Units	MDL	PQL
1,3,5-Trinitrobenzene	ug/L	0.0603	0.65
1,3-Dinitrobenzene	ug/L	0.116	0.65
2,4,6-Trinitrotoluene	ug/L	0.127	0.26
2,4-Dinitrotoluene	ug/L	0.113	0.65
2,6-Dinitrotoluene	ug/L	0.0713	0.26
2-Amino-4,6-Dinitrotoluene	ug/L	0.131	0.26
2-Nitrotoluene	ug/L	0.222	0.52
3-Nitrotoluene	ug/L	0.165	0.52
4-Amino-2,6-Dinitrotoluene	ug/L	0.152	0.26
4-Nitrotoluene	ug/L	0.17	0.52
HMX	ug/L	0.0596	0.26
Nitrobenzene	ug/L	0.0965	0.26
RDX	ug/L	0.125	0.26
TETRYL	ug/L	0.123	0.26

8332	8332	SOIL	HPLC

Analyte Name	Units	MDL	PQL
Nitroglycerine	ug/g	0.175	0.3
Nitroglycerine	ug/g	0.284	0.3
PETN	ug/g	0.223	0.3

8332	8332	WATER	HPLC

Analyte Name	Units	MDL	PQL
Nitroglycerine	ug/L	0.421	0.97
Nitroglycerine	ug/L	0.187	0.97
PETN	ug/L	0.331	0.97

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
9012A/335.4	MicroDist	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	1.36	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
9012A/335.4	MidiDist	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	2.81	20

Analytical Method	Preparatory Method	Matrix	Instrument Type
9012A/335.4	NA	SOIL	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/g	0.0407	0.12

Analytical Method	Preparatory Method	Matrix	Instrument Type
9012A/335.4	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	5.99	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
9034/376.1	NA	WATER	TITR

Analyte Name	Units	MDL	PQL
Sulfide	mg/L	0.144	0.5

Analytical Method	Preparatory Method	Matrix	Instrument Type
9060	NA	WATER	TOC

Analyte Name	Units	MDL	PQL
Total Organic Carbon	ug/L	300	1000
Total Organic Carbon	mg/L	0.3	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
9066	NA	WATER	AA

Analyte Name	Units	MDL	PQL
Phenol	mg/L	0.0168	0.025
Phenol	ug/L	6.78	50

Analytical Method	Preparatory Method	Matrix	Instrument Type
DCL	NA	WATER	LC/MS

Analyte Name	Units	MDL	PQL
CAA	ug/mL	0.00951	0.05
DIMP	ug/mL	0.00679	0.05
DMMP	ug/mL	0.0299	0.05
EMPA	ug/mL	0.0188	0.05
FAA	ug/mL	0.0151	0.05
IMPA	ug/mL	0.0175	0.05
Methyl Phosphonic Acid	ug/mL	0.0407	0.05
Thiodiglycol	ug/mL	0.0204	0.05

Analytical Method	Preparatory Method	Matrix	Instrument Type
HACH	NA	WATER	VIS

Analyte Name	Units	MDL	PQL
Chemical Oxygen Demand	mg/L	8.74	10

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-CN	DS2	SOIL	AA

Analyte Name	Units	MDL	PQL
Cyanide	mg/Kg	0.551	2.5

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-CN	DW2	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	2.81	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-CN	NP1	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	3.39	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-HG	CS1	SOIL	CVAA

Analyte Name	Units	MDL	PQL
Mercury	mg/Kg	0.0167	0.1

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-HG	CW1	WATER	CVAA

Analyte Name	Units	MDL	PQL
Mercury	ug/L	0.018	0.2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-ICP	HS1	SOIL	ICP

Analyte Name	Units	MDL	PQL
Aluminum	mg/Kg	3.32	20
Antimony	mg/Kg	2.68	6
Barium	mg/Kg	0.0685	20
Beryllium	mg/Kg	0.0597	0.5
Cadmium	mg/Kg	0.149	0.5
Calcium	mg/Kg	8.54	500
Chromium	mg/Kg	0.267	1
Cobalt	mg/Kg	0.322	5
Copper	mg/Kg	0.465	2.5
Iron	mg/Kg	1.06	10
Magnesium	mg/Kg	4.34	500
Manganese	mg/Kg	0.166	1.5
Nickel	mg/Kg	0.852	4
Potassium	mg/Kg	50.5	500
Silver	mg/Kg	0.215	1
Sodium	mg/Kg	13.3	500
Vanadium	mg/Kg	0.355	5
Zinc	mg/Kg	0.998	6

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-ICP	HS1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	mg/kg	5.9	20
Antimony	mg/kg	0.235	6
Arsenic	mg/kg	0.301	1
Barium	mg/kg	0.0322	20
Beryllium	mg/kg	0.0279	0.5
Cadmium	mg/kg	0.0121	0.5
Calcium	mg/kg	7.98	500
Chromium	mg/kg	0.463	1
Cobalt	mg/kg	0.0672	5
Copper	mg/kg	0.387	2.5
Iron	mg/kg	1.34	10
Lead	mg/kg	0.221	1
Magnesium	mg/kg	2.28	500
Manganese	mg/kg	0.154	1.5
Nickel	mg/kg	0.871	4
Potassium	mg/kg	8.13	500
Selenium	mg/kg	0.214	3.5
Silver	mg/kg	0.0847	1
Sodium	mg/kg	4.97	500
Thallium	mg/kg	0.213	2.5
Vanadium	mg/kg	0.0745	5
Zinc	mg/kg	0.233	6

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-ICP	MW1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	37.4	200
Antimony	ug/L	26	60
Arsenic	ug/L	1.64	10
Barium	ug/L	1.06	200
Beryllium	ug/L	0.178	5
Cadmium	ug/L	0.122	5
Calcium	ug/L	31.4	5000
Chromium	ug/L	3.16	10
Cobalt	ug/L	6.4	50
Copper	ug/L	5.42	25
Iron	ug/L	6.29	100
Lead	ug/L	1.53	10
Magnesium	ug/L	36.1	5000
Manganese	ug/L	0.74	15
Nickel	ug/L	10.1	40
Potassium	ug/L	567	5000
Selenium	ug/L	3.92	35
Silver	ug/L	3.04	10
Sodium	ug/L	26.4	5000
Thallium	ug/L	1.78	25
Vanadium	ug/L	2.76	50
Zinc	ug/L	9.54	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-ICP	NP1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	51.7	200
Antimony	ug/L	2.17	60
Arsenic	ug/L	1.93	10
Barium	ug/L	0.481	200
Beryllium	ug/L	0.199	5
Cadmium	ug/L	0.0986	5
Calcium	ug/L	5.54	5000
Chromium	ug/L	2.37	10
Cobalt	ug/L	0.4	50
Copper	ug/L	4.11	25
Iron	ug/L	12.5	100
Lead	ug/L	1.42	10
Magnesium	ug/L	18	5000
Manganese	ug/L	0.711	15
Nickel	ug/L	2.24	40
Potassium	ug/L	39.7	5000
Selenium	ug/L	2.2	35
Silver	ug/L	0.592	10
Sodium	ug/L	18	5000
Thallium	ug/L	1.87	25
Vanadium	ug/L	0.673	50
Zinc	ug/L	1.77	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-MS	HW3	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Antimony	ug/L	0.0765	2
Arsenic	ug/L	0.114	1
Barium	ug/L	0.0591	10
Beryllium	ug/L	0.0253	1
Cadmium	ug/L	0.041	1
Chromium	ug/L	0.0438	2
Cobalt	ug/L	0.0132	1
Copper	ug/L	0.0585	2
Lead	ug/L	0.0143	1
Manganese	ug/L	0.0182	1
Nickel	ug/L	0.0511	1
Selenium	ug/L	0.201	5
Silver	ug/L	0.15	1
Thallium	ug/L	0.0174	1
Vanadium	ug/L	0.322	1
Zinc	ug/L	0.239	2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-MS	ILM05.3-SOIL	SOIL	ICP-MS

Analyte Name	Units	MDL	PQL
Antimony	mg/kg	0.063	1
Arsenic	mg/kg	0.0443	0.5
Barium	mg/kg	0.0112	5
Beryllium	mg/kg	0.00854	0.5
Cadmium	mg/kg	0.00511	0.5
Chromium	mg/kg	0.0238	1
Cobalt	mg/kg	0.00573	0.5
Copper	mg/kg	0.0614	1
Lead	mg/kg	0.00986	0.5
Manganese	mg/kg	0.00673	0.5
Nickel	mg/kg	0.0261	0.5
Selenium	mg/kg	0.0941	2.5
Silver	mg/kg	0.057	0.5
Thallium	mg/kg	0.0147	0.5
Vanadium	mg/kg	0.142	0.5
Zinc	mg/kg	0.259	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-MS	NP1	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Antimony	ug/L	0.123	2
Arsenic	ug/L	0.0624	1
Barium	ug/L	0.0556	10
Beryllium	ug/L	0.0405	1
Cadmium	ug/L	0.0332	1
Chromium	ug/L	0.0427	2
Cobalt	ug/L	0.0402	1
Copper	ug/L	0.0434	2
Lead	ug/L	0.0383	1
Manganese	ug/L	0.0359	1
Nickel	ug/L	0.0344	1
Selenium	ug/L	0.156	5
Silver	ug/L	0.0253	1
Thallium	ug/L	0.0483	1
Vanadium	ug/L	0.0443	1
Zinc	ug/L	0.194	2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-T	HS1	SOIL	ICPT

Analyte Name	Units	MDL	PQL
Arsenic	mg/Kg	0.419	1
Cadmium	mg/Kg	0.0388	0.5
Lead	mg/Kg	0.184	1
Selenium	mg/Kg	0.347	3.5
Thallium	mg/Kg	0.547	2.5

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.3-T	MW1	WATER	ICPT

Analyte Name	Units	MDL	PQL
Arsenic	ug/L	3.24	10
Cadmium	ug/L	0.429	5
Lead	ug/L	1.72	10
Selenium	ug/L	3.11	35
Thallium	ug/L	3.02	25

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	CS1	SOIL	CVAA

Analyte Name	Units	MDL	PQL
Mercury	mg/kg	0.0116	0.1
Mercury	ug/g	0.0054	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	CW1	WATER	CVAA

Analyte Name	Units	MDL	PQL
Mercury	ug/L	0.0159	0.2

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	DS2	SOIL	AA

Analyte Name	Units	MDL	PQL
Cyanide	mg/kg	0.907	2.5

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	DW2	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	3.93	10

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	MW1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	15.5	200
Antimony	ug/L	3.79	60
Arsenic	ug/L	2.18	10
Barium	ug/L	0.518	200
Beryllium	ug/L	0.142	5
Cadmium	ug/L	0.0891	5
Calcium	ug/L	16.4	5000
Chromium	ug/L	3.78	10
Cobalt	ug/L	0.802	50
Copper	ug/L	3.73	25
Iron	ug/L	8.18	100
Lead	ug/L	1.57	10
Magnesium	ug/L	22.3	5000
Manganese	ug/L	0.519	15
Nickel	ug/L	1.55	40
Potassium	ug/L	148	5000
Selenium	ug/L	3.16	35
Silver	ug/L	1.4	10
Sodium	ug/L	20.3	5000
Thallium	ug/L	1.68	25
Vanadium	ug/L	0.536	50
Zinc	ug/L	2.17	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4	NP1	WATER	AA

Analyte Name	Units	MDL	PQL
Cyanide	ug/L	1.61	10

ILM05.4	NP1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	12.3	200
Antimony	ug/L	1.54	60
Arsenic	ug/L	1.56	10
Barium	ug/L	0.361	200
Beryllium	ug/L	0.268	5
Cadmium	ug/L	0.0945	5
Calcium	ug/L	12	5000
Chromium	ug/L	1.89	10
Cobalt	ug/L	0.451	50
Copper	ug/L	3.88	25
Iron	ug/L	13.9	100
Lead	ug/L	1.05	10
Magnesium	ug/L	42	5000
Manganese	ug/L	0.891	15
Nickel	ug/L	0.887	40
Potassium	ug/L	68.3	5000
Selenium	ug/L	4.2	35
Silver	ug/L	0.613	10
Sodium	ug/L	31.9	5000
Thallium	ug/L	0.774	25
Vanadium	ug/L	0.464	50
Zinc	ug/L	0.94	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-ICP	HS1	SOIL	ICP

Analyte Name	Units	MDL	PQL
Aluminum	mg/Kg	4.08	20
Antimony	mg/Kg	0.96	6
Arsenic	mg/Kg	0.246	1
Barium	mg/Kg	0.119	20
Beryllium	mg/Kg	0.0139	0.5
Cadmium	mg/Kg	0.0108	0.5
Calcium	mg/Kg	10.7	500
Chromium	mg/Kg	0.459	1
Cobalt	mg/Kg	0.31	5
Copper	mg/Kg	0.572	2.5
Iron	mg/Kg	4.05	10
Lead	mg/Kg	0.22	1
Magnesium	mg/Kg	5.8	500
Manganese	mg/Kg	0.0709	1.5
Nickel	mg/Kg	1.16	4
Potassium	mg/Kg	10.6	500
Selenium	mg/Kg	0.472	3.5
Silver	mg/Kg	0.0493	1
Sodium	mg/Kg	10.2	500
Thallium	mg/Kg	0.201	2.5
Vanadium	mg/Kg	0.0634	5
Zinc	mg/Kg	0.343	6

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-ICP	MW1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	25.7	200
Antimony	ug/L	1.78	60
Arsenic	ug/L	1.53	10
Barium	ug/L	0.336	200
Beryllium	ug/L	0.13	5
Cadmium	ug/L	0.121	5
Calcium	ug/L	23.3	5000
Chromium	ug/L	0.368	10
Cobalt	ug/L	0.438	50
Copper	ug/L	2.93	25
Iron	ug/L	3.31	100
Lead	ug/L	1.19	10
Magnesium	ug/L	23.7	5000
Manganese	ug/L	0.573	15
Nickel	ug/L	0.885	40
Potassium	ug/L	40.8	5000
Selenium	ug/L	2.4	35
Silver	ug/L	0.475	10
Sodium	ug/L	13	5000
Thallium	ug/L	0.805	25
Vanadium	ug/L	0.807	50
Zinc	ug/L	2.31	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-ICP	NP1	WATER	ICP

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	20	200
Antimony	ug/L	1.83	60
Arsenic	ug/L	1.45	10
Barium	ug/L	0.328	200
Beryllium	ug/L	0.0889	5
Cadmium	ug/L	0.0844	5
Calcium	ug/L	5.92	5000
Chromium	ug/L	0.732	10
Cobalt	ug/L	0.324	50
Copper	ug/L	2.55	25
Iron	ug/L	8.96	100
Lead	ug/L	0.942	10
Magnesium	ug/L	26.7	5000
Manganese	ug/L	0.259	15
Nickel	ug/L	1.74	40
Potassium	ug/L	80.4	5000
Selenium	ug/L	2.58	35
Silver	ug/L	0.278	10
Sodium	ug/L	41.6	5000
Thallium	ug/L	0.771	25
Vanadium	ug/L	0.395	50
Zinc	ug/L	2.72	60

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-MS	DCL	SOIL	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	mg/kg	0.788	10

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-MS	HW3	WATER	ICP-MS

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	0.942	30
Antimony	ug/L	0.0848	2
Arsenic	ug/L	0.117	1
Barium	ug/L	0.0339	10
Beryllium	ug/L	0.127	1
Cadmium	ug/L	0.0165	1
Chromium	ug/L	0.0402	2
Cobalt	ug/L	0.015	1
Copper	ug/L	0.0658	2
Lead	ug/L	0.0577	1
Manganese	ug/L	0.034	1
Nickel	ug/L	0.0475	1
Selenium	ug/L	0.233	5
Silver	ug/L	0.0477	1
Thallium	ug/L	0.275	1
Vanadium	ug/L	0.353	1
Zinc	ug/L	0.97	2

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
ILM05.4-MS	**NP1**	*WATER*	*ICP-MS*

Analyte Name	Units	MDL	PQL
Aluminum	ug/L	0.418	30
Antimony	ug/L	0.103	2
Arsenic	ug/L	0.0733	1
Barium	ug/L	0.0275	10
Beryllium	ug/L	0.0163	1
Cadmium	ug/L	0.024	1
Chromium	ug/L	0.0403	2
Cobalt	ug/L	0.017	1
Copper	ug/L	0.0519	2
Lead	ug/L	0.0194	1
Manganese	ug/L	0.0218	1
Nickel	ug/L	0.0523	1
Selenium	ug/L	0.159	5
Silver	ug/L	0.0176	1
Thallium	ug/L	0.0166	1
Vanadium	ug/L	0.0351	5
Zinc	ug/L	0.117	2

KAHN	**NA**	*SOIL*	*TOC*

Analyte Name	Units	MDL	PQL
Total Organic Carbon	mg/Kg	330	1000
Total Organic Carbon	mg/kg	360	1000

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Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300Mod	IH-AN-005	PAINT	ICP

Analyte Name	Units	MDL	PQL
Lead	%	0.000444	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300Mod	IH-AN-021	FILTER	ICP

Analyte Name	Units	MDL	PQL
Lead	ug/sample	0.261	0.87

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300MOD	IH-AN-021	GWIPE	ICP

Analyte Name	Units	MDL	PQL
Beryllium	ug/sample	0.000811	0.0027

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300Mod	IH-AN-021	MCE	ICP

Analyte Name	Units	MDL	PQL
Beryllium	ug/sample	0.00169	0.0056
Lead	ug/sample	0.516	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300Mod	IH-AN-021	SOIL	ICP

Analyte Name	Units	MDL	PQL
Lead	mg/kg	1.19	1000
Lead	ug/g	2.17	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300Mod	IH-AN-021	WIPE	ICP

Analyte Name	Units	MDL	PQL
Lead	ug/sample	0.701	2.3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM 7300MOD	**SMEAR TAB H2S**	*WIPE*	*ICP*

Analyte Name	Units	MDL	PQL
Beryllium	ug/sample	0.00118	0.0039

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM7300Mod	**IH-AN-021**	*MCE*	*ICP*

Analyte Name	Units	MDL	PQL
Lead	ug/sample	0.123	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
NMAM7300Mod	**IH-AN-021**	*WIPE*	*ICP*

Analyte Name	Units	MDL	PQL
Lead	ug/sample	0.16	1000

Analytical Method	Preparatory Method	Matrix	Instrument Type
OV-DCL-MEE	**NA**	*WATER*	*GC/FID*

Analyte Name	Units	MDL	PQL
Ethane	ug/L	2.76	11
Ethene	ug/L	2.48	10
Methane	ug/L	1.17	6

Analytical Method	Preparatory Method	Matrix	Instrument Type
PBPAINT	**NA**	*PAINT*	*FLAA*

Analyte Name	Units	MDL	PQL
Lead	ug/mL	0.0256	0.1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.1	NA	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1-Trichloroethane	ug/Kg	0.137	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.32	5
1,1,2-Trichloroethane	ug/Kg	0.233	5
1,1-Dichloroethane	ug/Kg	0.193	5
1,1-Dichloroethene	ug/Kg	0.51	5
1,2,3-Trichlorobenzene	ug/Kg	0.111	5
1,2,4-Trichlorobenzene	ug/Kg	0.197	5
1,2-Dibromo-3-Chloropropane	ug/Kg	0.413	5
1,2-Dibromoethane	ug/Kg	0.171	5
1,2-Dichlorobenzene	ug/Kg	0.101	5
1,2-Dichloroethane	ug/Kg	0.106	5
1,2-Dichloropropane	ug/Kg	0.255	5
1,3-Dichlorobenzene	ug/Kg	0.164	5
1,4-Dichlorobenzene	ug/Kg	0.102	5
1,4-Dioxane	ug/Kg	33.9	100
2-Butanone	ug/Kg	1.23	10
2-Hexanone	ug/Kg	0.869	10
4-Methyl-2-Pentanone	ug/Kg	0.843	10
Acetone	ug/Kg	2.18	10
Benzene	ug/Kg	0.0985	5
Bromochloromethane	ug/Kg	0.391	5
Bromodichloromethane	ug/Kg	0.157	5
Bromoform	ug/Kg	0.15	5
Bromomethane	ug/Kg	0.216	5
Carbon Disulfide	ug/Kg	0.203	5
Carbon Tetrachloride	ug/Kg	0.31	5
Chlorobenzene	ug/Kg	0.0972	5
Chloroethane	ug/Kg	0.333	5
Chloroform	ug/Kg	0.196	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Chloromethane	ug/Kg	0.361	5
cis-1,2-Dichloroethene	ug/Kg	0.176	5
cis-1,3-Dichloropropene	ug/Kg	0.44	5
Cyclohexane	ug/Kg	0.312	5
Dibromochloromethane	ug/Kg	0.258	5
Dichlorodifluoromethane	ug/Kg	0.361	5
Ethyl Benzene	ug/Kg	0.0639	5
Freon 113	ug/Kg	0.458	5
Isopropylbenzene	ug/Kg	0.147	5
m,p-Xylene	ug/Kg	0.133	5
Methyl Acetate	ug/Kg	0.636	5
Methyl Tertiary Butyl Ether	ug/Kg	0.323	5
Methylcyclohexane	ug/Kg	0.332	5
Methylene Chloride	ug/Kg	0.176	5
o-Xylene	ug/Kg	0.168	5
Styrene	ug/Kg	0.17	5
Tetrachloroethene	ug/Kg	0.254	5
Toluene	ug/Kg	0.184	5
trans-1,2-Dichloroethene	ug/Kg	0.213	5
trans-1,3-Dichloropropene	ug/Kg	0.396	5
Trichloroethene	ug/Kg	0.679	5
Trichlorofluoromethane	ug/Kg	0.231	5
Vinyl Chloride	ug/Kg	0.243	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.1P	SOM01.1	SOIL	GC/ECD

Analyte Name	Units	MDL	PQL
4,4'-DDD	ug/kg	0.404	3.3
4,4'-DDE	ug/kg	0.217	3.3
4,4'-DDT	ug/kg	0.264	3.3
Aldrin	ug/kg	0.106	1.7
Alpha Chlordane	ug/kg	0.114	1.7
Alpha-BHC	ug/kg	0.0857	1.7
Beta-BHC	ug/kg	0.145	1.7
Delta-BHC	ug/kg	0.118	1.7
Dieldrin	ug/kg	0.218	3.3
Endosulfan I	ug/kg	0.133	1.7
Endosulfan II	ug/kg	0.258	3.3
Endosulfan Sulfate	ug/kg	0.283	3.3
Endrin	ug/kg	0.248	3.3
Endrin Aldehyde	ug/kg	0.312	3.3
Endrin Ketone	ug/kg	0.296	3.3
Gamma Chlordane	ug/kg	0.181	1.7
Heptachlor	ug/kg	0.14	1.7
Heptachlor Epoxide	ug/kg	0.163	1.7
Lindane	ug/kg	0.0954	1.7
Methoxychlor	ug/kg	1.7	17
Toxaphene	ug/kg	6.68	170

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.1P	SOM01.1	WATER	GC/ECD

Analyte Name	Units	MDL	PQL
4,4'-DDD	ug/L	0.00709	0.1
4,4'-DDE	ug/L	0.00647	0.1
4,4'-DDT	ug/L	0.00755	0.1
Aldrin	ug/L	0.00359	0.05
Alpha Chlordane	ug/L	0.00514	0.05
Alpha-BHC	ug/L	0.00266	0.05
Beta-BHC	ug/L	0.00955	0.05
Delta-BHC	ug/L	0.00437	0.05
Dieldrin	ug/L	0.00686	0.1
Endosulfan I	ug/L	0.00396	0.05
Endosulfan II	ug/L	0.0073	0.1
Endosulfan Sulfate	ug/L	0.0096	0.1
Endrin	ug/L	0.00755	0.1
Endrin Aldehyde	ug/L	0.0106	0.1
Endrin Ketone	ug/L	0.00958	0.1
Gamma Chlordane	ug/L	0.00574	0.05
Heptachlor	ug/L	0.00833	0.05
Heptachlor Epoxide	ug/L	0.00443	0.05
Lindane	ug/L	0.00295	0.05
Methoxychlor	ug/L	0.0567	0.5
Toxaphene	ug/L	0.569	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.2	LOW SOIL	SOIL	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1-Trichloroethane	ug/Kg	0.164	5
1,1,2,2-Tetrachloroethane	ug/Kg	0.324	5
1,1,2-Trichloroethane	ug/Kg	0.137	5
1,1-Dichloroethane	ug/Kg	0.272	5
1,1-Dichloroethene	ug/Kg	0.322	5
1,2,3-Trichlorobenzene	ug/Kg	0.142	5
1,2,4-Trichlorobenzene	ug/Kg	0.122	5
1,2-Dibromo-3-Chloropropane	ug/Kg	0.202	5
1,2-Dibromoethane	ug/Kg	0.0957	5
1,2-Dichlorobenzene	ug/Kg	0.129	5
1,2-Dichloroethane	ug/Kg	0.677	5
1,2-Dichloropropane	ug/Kg	0.505	5
1,3-Dichlorobenzene	ug/Kg	0.185	5
1,4-Dichlorobenzene	ug/Kg	0.225	5
1,4-Dioxane	ug/Kg	25.8	100
2-Butanone	ug/Kg	2.06	10
2-Hexanone	ug/Kg	1.53	10
4-Methyl-2-Pentanone	ug/Kg	0.628	10
Acetone	ug/Kg	2.6	10
Benzene	ug/Kg	0.299	5
Bromochloromethane	ug/Kg	0.161	5
Bromodichloromethane	ug/Kg	0.142	5
Bromoform	ug/Kg	0.374	5
Bromomethane	ug/Kg	0.181	5
Carbon Disulfide	ug/Kg	0.192	5
Carbon Tetrachloride	ug/Kg	0.125	5
Chlorobenzene	ug/Kg	0.113	5
Chloroethane	ug/Kg	0.46	5
Chloroform	ug/Kg	0.132	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Chloromethane	ug/Kg	0.167	5
cis-1,2-Dichloroethene	ug/Kg	0.173	5
cis-1,3-Dichloropropene	ug/Kg	0.396	5
Cyclohexane	ug/Kg	0.247	5
Dibromochloromethane	ug/Kg	0.118	5
Dichlorodifluoromethane	ug/Kg	0.218	5
Ethyl Benzene	ug/Kg	0.159	5
Freon 113	ug/Kg	0.167	5
Isopropylbenzene	ug/Kg	0.181	5
m,p-Xylene	ug/Kg	0.19	5
Methyl Acetate	ug/Kg	1	5
Methyl Tertiary Butyl Ether	ug/Kg	0.161	5
Methylcyclohexane	ug/Kg	0.581	5
Methylene Chloride	ug/Kg	0.264	5
o-Xylene	ug/Kg	0.17	5
Styrene	ug/Kg	0.372	5
Tetrachloroethene	ug/Kg	0.178	5
Toluene	ug/Kg	0.156	5
trans-1,2-Dichloroethene	ug/Kg	0.235	5
trans-1,3-Dichloropropene	ug/Kg	0.61	5
Trichloroethene	ug/Kg	0.197	5
Trichlorofluoromethane	ug/Kg	0.17	5
Vinyl Chloride	ug/Kg	0.202	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.2	LOW WATER	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1-Trichloroethane	ug/L	0.274	5
1,1,2,2-Tetrachloroethane	ug/L	0.143	5
1,1,2-Trichloroethane	ug/L	0.898	5
1,1-Dichloroethane	ug/L	0.104	5
1,1-Dichloroethene	ug/L	0.559	5
1,2,3-Trichlorobenzene	ug/L	0.277	5
1,2,4-Trichlorobenzene	ug/L	0.284	5
1,2-Dibromo-3-Chloropropane	ug/L	0.269	5
1,2-Dibromoethane	ug/L	0.18	5
1,2-Dichlorobenzene	ug/L	0.22	5
1,2-Dichloroethane	ug/L	0.156	5
1,2-Dichloropropane	ug/L	0.374	5
1,3-Dichlorobenzene	ug/L	0.248	5
1,4-Dichlorobenzene	ug/L	0.33	5
1,4-Dioxane	ug/L	11.4	100
2-Butanone	ug/L	3.83	10
2-Hexanone	ug/L	4.05	10
4-Methyl-2-Pentanone	ug/L	0.481	10
Acetone	ug/L	1.68	10
Benzene	ug/L	0.454	5
Bromochloromethane	ug/L	0.154	5
Bromodichloromethane	ug/L	0.337	5
Bromoform	ug/L	0.112	5
Bromomethane	ug/L	0.367	5
Carbon Disulfide	ug/L	0.218	5
Carbon Tetrachloride	ug/L	0.326	5
Chlorobenzene	ug/L	0.199	5
Chloroethane	ug/L	0.353	5
Chloroform	ug/L	0.395	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Chloromethane	ug/L	0.181	5
cis-1,2-Dichloroethene	ug/L	0.17	5
cis-1,3-Dichloropropene	ug/L	1.03	5
Cyclohexane	ug/L	0.324	5
Dibromochloromethane	ug/L	0.112	5
Dichlorodifluoromethane	ug/L	0.32	5
Ethyl Benzene	ug/L	0.218	5
Freon 113	ug/L	0.243	5
Isopropylbenzene	ug/L	0.206	5
m,p-Xylene	ug/L	0.232	5
Methyl Acetate	ug/L	0.636	5
Methyl Tertiary Butyl Ether	ug/L	0.256	5
Methylcyclohexane	ug/L	0.293	5
Methylene Chloride	ug/L	0.178	5
o-Xylene	ug/L	0.223	5
Styrene	ug/L	0.188	5
Tetrachloroethene	ug/L	0.273	5
Toluene	ug/L	0.215	5
trans-1,2-Dichloroethene	ug/L	0.246	5
trans-1,3-Dichloropropene	ug/L	0.43	5
Trichloroethene	ug/L	0.418	5
Trichlorofluoromethane	ug/L	0.264	5
Vinyl Chloride	ug/L	0.224	5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01.2	TRACE	WATER	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1-Trichloroethane	ug/L	0.0379	0.5
1,1,2,2-Tetrachloroethane	ug/L	0.027	0.5
1,1,2-Trichloroethane	ug/L	0.035	0.5
1,1-Dichloroethane	ug/L	0.0329	0.5
1,1-Dichloroethene	ug/L	0.0924	0.5
1,2,3-Trichlorobenzene	ug/L	0.0515	0.5
1,2,4-Trichlorobenzene	ug/L	0.0306	0.5
1,2-Dibromo-3-Chloropropane	ug/L	0.0575	0.5
1,2-Dibromoethane	ug/L	0.022	0.5
1,2-Dichlorobenzene	ug/L	0.0304	0.5
1,2-Dichloroethane	ug/L	0.0317	0.5
1,2-Dichloropropane	ug/L	0.0354	0.5
1,3-Dichlorobenzene	ug/L	0.0322	0.5
1,4-Dichlorobenzene	ug/L	0.0307	0.5
2-Butanone	ug/L	0.362	5
2-Hexanone	ug/L	0.739	5
4-Methyl-2-Pentanone	ug/L	0.112	5
Acetone	ug/L	1.32	5
Benzene	ug/L	0.027	0.5
Bromochloromethane	ug/L	0.0203	0.5
Bromodichloromethane	ug/L	0.0159	0.5
Bromoform	ug/L	0.0315	0.5
Bromomethane	ug/L	0.0538	0.5
Carbon Disulfide	ug/L	0.0546	0.5
Carbon Tetrachloride	ug/L	0.0448	0.5
Chlorobenzene	ug/L	0.0292	0.5
Chloroethane	ug/L	0.0391	0.5
Chloroform	ug/L	0.0389	0.5
Chloromethane	ug/L	0.044	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
cis-1,2-Dichloroethene	ug/L	0.0362	0.5
cis-1,3-Dichloropropene	ug/L	0.0249	0.5
Cyclohexane	ug/L	0.0371	0.5
Dibromochloromethane	ug/L	0.028	0.5
Dichlorodifluoromethane	ug/L	0.0621	0.5
Ethyl Benzene	ug/L	0.0285	0.5
Freon 113	ug/L	0.0635	0.5
Isopropylbenzene	ug/L	0.0285	0.5
m,p-Xylene	ug/L	0.0267	0.5
Methyl Acetate	ug/L	0.119	0.5
Methyl Tertiary Butyl Ether	ug/L	0.0334	0.5
Methylcyclohexane	ug/L	0.034	0.5
Methylene Chloride	ug/L	0.0571	0.5
o-Xylene	ug/L	0.0309	0.5
Styrene	ug/L	0.0242	0.5
Tetrachloroethene	ug/L	0.0311	0.5
Toluene	ug/L	0.0287	0.5
trans-1,2-Dichloroethene	ug/L	0.0521	0.5
trans-1,3-Dichloropropene	ug/L	0.0255	0.5
Trichloroethene	ug/L	0.0365	0.5
Trichlorofluoromethane	ug/L	0.0625	0.5
Vinyl Chloride	ug/L	0.0549	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01-SIM	SOM01.1	SOIL	GC/MS

Analyte Name	Units	MDL	PQL
2-Methylnaphthalene	ug/kg	1.74	13
Acenaphthene	ug/kg	0.525	13
Acenaphthylene	ug/kg	0.375	13
Anthracene	ug/kg	0.288	13
Benzo(a)anthracene	ug/kg	0.44	13
Benzo(a)pyrene	ug/kg	0.439	13
Benzo(b)fluoranthene	ug/kg	0.797	13
Benzo(ghi)perylene	ug/kg	1.02	13
Benzo(k)fluoranthene	ug/kg	0.498	13
Chrysene	ug/kg	0.225	13
Dibenzo(a,h)anthracene	ug/kg	0.815	13
Fluoranthene	ug/kg	0.512	13
Fluorene	ug/kg	0.289	13
Indeno(1,2,3-cd)pyrene	ug/kg	1	13
Naphthalene	ug/kg	1.97	13
Pentachlorophenol	ug/kg	0.997	13
Phenanthrene	ug/kg	0.41	13
Pyrene	ug/kg	0.436	13

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01-SIM	SOM01.1	SOIL	GC/MS SV

Analyte Name	Units	MDL	PQL
2-Methylnaphthalene	ug/kg	1.81	3.3
Acenaphthene	ug/kg	0.478	3.3
Acenaphthylene	ug/kg	0.449	3.3
Anthracene	ug/kg	0.315	3.3
Benzo(a)anthracene	ug/kg	0.28	3.3
Benzo(a)pyrene	ug/kg	0.3	3.3
Benzo(b)fluoranthene	ug/kg	0.521	3.3
Benzo(ghi)perylene	ug/kg	0.864	3.3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Benzo(k)fluoranthene	ug/kg	0.409	3.3
Chrysene	ug/kg	0.297	3.3
Dibenzo(a,h)anthracene	ug/kg	0.605	3.3
Fluoranthene	ug/kg	0.388	3.3
Fluorene	ug/kg	0.288	3.3
Indeno(1,2,3-cd)pyrene	ug/kg	0.617	3.3
Naphthalene	ug/kg	2.6	3.3
Pentachlorophenol	ug/kg	0.749	6.7
Phenanthrene	ug/kg	0.388	3.3
Pyrene	ug/kg	1.47	3.3

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOM01-SIM	SOM01.1	WATER	GC/MS SV

Analyte Name	Units	MDL	PQL
2-Methylnaphthalene	ug/L	0.0154	0.1
Acenaphthene	ug/L	0.00868	0.1
Acenaphthylene	ug/L	0.00765	0.1
Anthracene	ug/L	0.011	0.1
Benzo(a)anthracene	ug/L	0.00657	0.1
Benzo(a)pyrene	ug/L	0.0148	0.1
Benzo(b)fluoranthene	ug/L	0.02	0.1
Benzo(ghi)perylene	ug/L	0.0175	0.1
Benzo(k)fluoranthene	ug/L	0.02	0.1
Chrysene	ug/L	0.00602	0.1
Dibenzo(a,h)anthracene	ug/L	0.0135	0.1
Fluoranthene	ug/L	0.0126	0.1
Fluorene	ug/L	0.011	0.1
Indeno(1,2,3-cd)pyrene	ug/L	0.0145	0.1
Naphthalene	ug/L	0.0286	0.1
Pentachlorophenol	ug/L	0.0113	0.1
Phenanthrene	ug/L	0.012	0.1
Pyrene	ug/L	0.0123	0.1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOW	**NA**	***WATER***	***GC/MS VO***

Analyte Name	Units	MDL	PQL
1,2-Dichloroethane	ug/L	0.467	5
1,4-Thioxane	ug/L	4.12	5
2-chloroethanol	ug/L	5720	5000
Allyl Alcohol	ug/L	70.3	100
Carbon Disulfide	ug/L	0.445	5
Cyanogen Chloride	ug/L	1.88	5
Ethylene Oxide	ug/L	5.72	5
Propylene Oxide	ug/L	1.28	5

Analytical Method	Preparatory Method	Matrix	Instrument Type
SOW-VOA-SIM	**5030**	***WATER***	***GC/MS VO***

Analyte Name	Units	MDL	PQL
1,2-Dichloroethane	ug/L	0.0397	0.1
1,4-Thioxane	ug/L	0.475	2
2-chloroethanol	ug/L	1910	2000
Allyl Alcohol	ug/L	9.93	20
Carbon Disulfide	ug/L	0.0942	0.1
Cyanogen Chloride	ug/L	1.24	2
Ethylene Oxide	ug/L	10.8	20
Propylene Oxide	ug/L	0.443	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
TO-15	NA	AIR	GC/MS VO

Analyte Name	Units	MDL	PQL
1,1,1-Trichloroethane	ppb v/v	0.321	0.5
1,1,1-Trichloroethane	PPB V/V	0.0744	0.5
1,1,2,2-Tetrachloroethane	PPB V/V	0.0628	0.5
1,1,2,2-Tetrachloroethane	ppb v/v	0.252	0.5
1,1,2-Trichloroethane	PPB V/V	0.0862	0.5
1,1,2-Trichloroethane	ppb v/v	0.224	0.5
1,1-Dichloroethane	ppb v/v	0.355	0.5
1,1-Dichloroethane	PPB V/V	0.108	0.5
1,1-Dichloroethene	ppb v/v	0.39	0.5
1,1-Dichloroethene	PPB V/V	0.315	0.5
1,2,4-Trichlorobenzene	ppb v/v	0.361	0.5
1,2,4-Trichlorobenzene	PPB V/V	0.147	0.5
1,2,4-Trimethylbenzene	ppb v/v	0.224	0.5
1,2,4-Trimethylbenzene	PPB V/V	0.0789	0.5
1,2-Dibromoethane	ppb v/v	0.315	0.5
1,2-Dibromoethane	PPB V/V	0.0654	0.5
1,2-Dichlorobenzene	ppb v/v	0.224	0.5
1,2-Dichlorobenzene	PPB V/V	0.109	0.5
1,2-Dichloroethane	ppb v/v	0.297	0.5
1,2-Dichloroethane	PPB V/V	0.134	0.5
1,2-Dichloropropane	ppb v/v	0.318	0.5
1,2-Dichloropropane	PPB V/V	0.0923	0.5
1,3,5-Trimethylbenzene	ppb v/v	0.248	0.5
1,3,5-Trimethylbenzene	PPB V/V	0.0533	0.5
1,3-Butadiene	ppb v/v	0.338	0.5
1,3-Butadiene	PPB V/V	0.193	0.5
1,3-Dichlorobenzene	ppb v/v	0.236	0.5
1,3-Dichlorobenzene	PPB V/V	0.0599	0.5
1,4-Dichlorobenzene	ppb v/v	0.303	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
1,4-Dichlorobenzene	PPB V/V	0.0916	0.5
1,4-Dioxane	PPB V/V	0.117	0.5
2-Butanone	PPB V/V	0.137	0.5
2-Butanone	ppb v/v	0.248	0.5
2-Hexanone	PPB V/V	0.0677	0.5
2-Hexanone	ppb v/v	0.346	0.5
4-Ethyl toluene	ppb v/v	0.183	0.5
4-Ethyl toluene	PPB V/V	0.0584	0.5
4-Methyl-2-Pentanone	ppb v/v	0.212	0.5
4-Methyl-2-Pentanone	PPB V/V	0.0418	0.5
Acetone	ppb v/v	0.195	0.5
Acetone	PPB V/V	0.308	0.5
Benzene	ppb v/v	0.314	0.5
Benzene	PPB V/V	0.101	0.5
Benzyl Chloride	ppb v/v	0.252	0.5
Benzyl Chloride	PPB V/V	0.0422	0.5
Bromodichloromethane	ppb v/v	0.226	0.5
Bromodichloromethane	PPB V/V	0.0518	0.5
Bromoform	PPB V/V	0.0637	0.5
Bromoform	ppb v/v	0.226	0.5
Bromomethane	ppb v/v	0.326	0.5
Bromomethane	PPB V/V	0.121	0.5
Carbon Disulfide	PPB V/V	0.164	0.5
Carbon Disulfide	ppb v/v	0.388	0.5
Carbon Tetrachloride	PPB V/V	0.0734	0.5
Carbon Tetrachloride	ppb v/v	0.281	0.5
Chlorobenzene	ppb v/v	0.27	0.5
Chlorobenzene	PPB V/V	0.0387	0.5
Chloroethane	ppb v/v	0.267	0.5
Chloroethane	PPB V/V	0.135	0.5
Chloroform	PPB V/V	0.102	0.5

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
Chloroform	ppb v/v	0.35	0.5
Chloromethane	ppb v/v	0.405	0.5
Chloromethane	PPB V/V	0.142	0.5
cis-1,2-Dichloroethene	PPB V/V	0.185	0.5
cis-1,2-Dichloroethene	ppb v/v	0.387	0.5
cis-1,3-Dichloropropene	PPB V/V	0.0797	0.5
cis-1,3-Dichloropropene	ppb v/v	0.289	0.5
Cyclohexane	ppb v/v	0.359	0.5
Cyclohexane	PPB V/V	0.169	0.5
Dibromochloromethane	ppb v/v	0.288	0.5
Dibromochloromethane	PPB V/V	0.0609	0.5
Dichlorodifluoromethane	ppb v/v	0.432	0.5
Dichlorodifluoromethane	PPB V/V	0.0987	0.5
Ethanol	PPB V/V	0.398	0.5
Ethyl Acetate	ppb v/v	0.261	0.5
Ethyl Acetate	PPB V/V	0.317	0.5
Ethyl Benzene	ppb v/v	0.307	0.5
Ethyl Benzene	PPB V/V	0.0874	0.5
Freon 11	ppb v/v	0.384	0.5
Freon 11	PPB V/V	0.101	0.5
Freon 113	ppb v/v	0.369	0.5
Freon 113	PPB V/V	0.0719	0.5
Freon 114	ppb v/v	0.409	0.5
Freon 114	PPB V/V	0.102	0.5
Heptane	ppb v/v	0.302	0.5
Heptane	PPB V/V	0.106	0.5
Hexachlorobutadiene	ppb v/v	0.241	0.5
Hexachlorobutadiene	PPB V/V	0.0784	0.5
Hexane	ppb v/v	0.287	0.5
Hexane	PPB V/V	0.127	0.5
m,p-Xylene	ppb v/v	0.52	1

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ALS Laboratory Group MDLs Report

Analytical Method	Preparatory Method	Matrix	Instrument Type
m,p-Xylene	PPB V/V	0.171	0.5
Methyl Tertiary Butyl Ether	ppb v/v	0.255	0.5
Methyl Tertiary Butyl Ether	PPB V/V	0.162	0.5
Methylene Chloride	ppb v/v	0.339	0.5
Methylene Chloride	PPB V/V	0.141	0.5
o-Xylene	ppb v/v	0.262	0.5
o-Xylene	PPB V/V	0.0694	0.5
Styrene	ppb v/v	0.227	0.5
Styrene	PPB V/V	0.104	0.5
Tetrachloroethene	PPB V/V	0.0906	0.5
Tetrachloroethene	ppb v/v	0.35	0.5
Tetrahydrofuran	ppb v/v	0.35	0.5
Tetrahydrofuran	PPB V/V	0.113	0.5
Toluene	ppb v/v	0.279	0.5
Toluene	PPB V/V	0.102	0.5
trans-1,2-Dichloroethene	PPB V/V	0.2	0.5
trans-1,2-Dichloroethene	ppb v/v	0.437	0.5
trans-1,3-Dichloropropene	ppb v/v	0.224	0.5
trans-1,3-Dichloropropene	PPB V/V	0.0938	0.5
Trichloroethene	ppb v/v	0.291	0.5
Trichloroethene	PPB V/V	0.0602	0.5
Vinyl Acetate	PPB V/V	0.146	0.5
Vinyl Acetate	ppb v/v	0.222	0.5
Vinyl Chloride	ppb v/v	0.443	0.5
Vinyl Chloride	PPB V/V	0.0926	0.5

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QAPP Appendix 14.16

Marginal Exceedances

The number of sporadic marginal exceedances is based on the total number of analytes spiked. As the number of analytes in the LCS increases, more marginal exceedances are allowed. The number of allowable marginal exceedances is based on a policy decision that no more than 5% of the total number of analytes spiked in the LCS may exceed the limits used. Table 1 presents the allowable number of marginal exceedances for a given number of analytes.

TABLE 1. NUMBER OF MARGINAL EXCEEDANCES

Number of Analytes	Allowable Number of Marginal Exceedances
<5	0
5 - 15	1
15 – 30	2
31 – 45	3
46 – 60	4
61 – 75	5
76 - 90	6
91 – 105	7

A marginal exceedance is defined as beyond the control limit but still within the marginal exceedance limits (set at 4 standard deviations around the mean for LCSs and no more than 40% RSD for CCVs). This outside boundary prevents a grossly out-of-control analyte from passing.

Marginal exceedances must be sporadic (i.e., random) or listed in the method as a poor performer. If the same analyte exceeds the control limit repeatedly (e.g., 2 out of 3 consecutive times), that is an indication that the problem is systemic and something is wrong with the measurement system. The source of error should be located and the appropriate corrective action taken.

DataChem Analytical/Prepartion Methods

Analytical Method:	Preparation Method:	Matrix:
120.1/9050	NA	WATER
130.2	NA	WATER
150.1/9040	NA	WATER
160.1	NA	WATER
160.2	NA	WATER
1664AMod	SPE	WATER
200.7	200.7	WATER
200.8	200.8	WATER
245.1	245.1	WATER
300.0	300.0	SOIL
300.0	300.0	WATER
305.1	NA	WATER
310.1	NA	WATER
310.2	NA	WATER
350.1	NA	WATER
351.2	NA	WATER
353.2	NA	WATER
365.1	NA	WATER
365.4	NA	WATER
415.1	NA	WATER
4500/340.2	NA	WATER
524.2	524.2	WATER

DataChem Analytical/Prepartion Methods

Analytical Method:	Preparation Method:	Matrix:
6010B	3050	SOIL-3050
6010B	3051	SOIL-3051
6010B	3015	WATER-3015
6020A	3050M	SOIL
6020A	3010M	WATER
6850	6850	SOIL
6850	6850	WATER
7196A	NA	WATER
7196A(M)	NA	SOIL
7470A	7470A	WATER
7471A	7471A	SOIL
7580	7580	SOIL
7580	7580	WATER
8015B	3550	SOIL
8015B	3510	WATER
8081A	3550	SOIL
8081A	3510	WATER
8082	3550	SOIL
8082	3510	WATER
8151A	8151A	SOIL
8151A	8151A	WATER
8260C	5030/5035	SOIL_M
8260C	5030	SOIL-5030
8260C 25mL	5030	25ML

DataChem Analytical/Prepartion Methods

Analytical Method:	Preparation Method:	Matrix:
8260C GRO	5030	SOILG
8260C GRO	5030	WATERG
8260C RL=1	5030	WATER
8260C RL=5	5030	WATER
8270D	3550	SOILA
8270D	3510	WATERA
8270D SIM	3550	SOILA
8270D SIM	3510	WATERA
8310	3550	SOIL
8310	3510	WATER
8330	8330	SOIL
8330	8330	WATER
8332	8332	SOIL
8332	8332	WATER
9012A	7.3.3.2	SOIL
9012A/335.4	MicroDist	WATERM
9030A	NA	WATER
9034	7.3.4.2	REACTI
9034/376.1	NA	WATER
9045	NA	SOIL
9060	NA	WATER
HACH	NA	WATER
OV-DCL-MEE	NA	WATER
TO-15	NA	AIR

DataChem Analytical/Prepartion Methods

Analytical Method:	Preparation Method:	Matrix:
TO15SIM	NA	AIR
TO17	NA	AIR

DoD QSM Version 4.1 Requirements not included in the ALS Quality System

Instructions on the following requirements must be included in the project requirements or Horizon Profiles for all DoD projects. Each requirement must be reviewed and documented by project mangers in the project records. These requirements are enforced when Data Quality Objectives (DQOs) or QAPPs are not submitted or included with the project documentation from the client.

I. The source of method blank contamination shall be investigated and measures taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the reporting limit. If one-half the reporting limit [RL] is exceeded, the laboratory shall evaluate whether reprocessing of the samples is necessary. (DoD QSM, V4.1, D.1.1.1 d), Box D-1 and Appendix F Tables)

II. Laboratory Report Contents – Time of Analysis: For DoD work, both date and time of analysis are considered to be essential information, regardless of the length of the holding time, and shall be included as part of the laboratory report. DoD QSM, V4.1, Section 4.12.2.5.3, and Box 14.

III. All target analytes must be spiked in the LCS and MS/MSD (with the exception of PCB analysis which is spiked per the method). Target Analytes are identified by the client on a project specific basis. This may require the preparation of multiple LCS's to avoid interference. DoD QSM V4.1, D1.1.1.2, Box D-2, D.1.1.3, and Box D-8.

IV. a) LCS/LCSD control limits used for DoD projects are ALS Historical Limits. When ALS in-house limits are outside the DoD control limits (upper and /or lower), the laboratory must evaluate ALS performance and adjust method parameters to comply with the DoD Limits. The laboratory always uses the historical LCS limits in the laboratory report. Data is flagged outside historical limits even if they fall within the DoD limits. DoD QSM, V4.1, Appendix G.

Appendix G LCS Limits

V. These flags must be used with DoD QSM projects unless otherwise designated in project requirements. DoD QSM V4.1, section 5.10.3.1, and Box 47


DoD QSM Qualifier Flags Box-47

VI. Method Acceptance Criteria for DoD QSM Projects for all technologies

The DoD QSM in Appendix F has specified in tables for SW-846 methods criteria for method performance. These must be followed unless specific exceptions are noted in project requirement documentation.


F-1 Summary for All Analyses


F-2 Organic Methods


F-3 8330B


F-4 8260/8270


F-7 ICP/CVAA


F-8 ICP/MS


F-9 7196


F-10 9012


F-11 9056/300.0


F-12 6850


F Tables Acronyms

VII. Reporting Requirements.
SW-846 Method Reporting Requirements, DoD QSM V4.1, Appendix E.
The following document designates elements required in data packages for the DoD. This list is not a format or structure but all elements must be present with the data.


Appendix E

VIII Laboratories must ensure that subcontracted laboratories meet the requirements of the DoD QSM. Subcontracted laboratories must be accredited by DoD or its designated representatives. Subcontracted laboratories must receive project-specific approval from the DoD client before any samples are analyzed.

These requirements also apply to the use of any laboratory under the same corporate umbrella, but at a different facility or location.
DoD QSM, V4.1, section 4.5.1, Box 10

IX Sub-sampling procedures listed in section 7.0 of the DCL SOP XX-DC-025 "Sub-sampling for Soils and Sediments" must be specified on all project requiring compliance with DoD QSM.

X. For volatile analyses (8260 Only), storage blanks will be placed in applicable refrigerators used for samples storage and analyzed any time there is unknown contamination in method blanks and associated samples. Unknown contamination is considered when contamination is not normal laboratory contaminants such as Acetone, Methylene Chloride, or Carbon Disulfide. These samples are analyzed as part of corrective actions and as per method requirements in DoD QSM, V4.1, section 5.3.3, and Box 19. No other testing requires storage blanks because contamination levels for semi-volatile organic compounds, water quality parameters and metals are in insufficient concentrations to cause sample cross contamination in refrigerators and these contaminants are indicative of container, glassware and reagent contamination.

XI. Detection Limit, LOD and LOQ reporting

The detection limit (DL) is calculated using applicable procedures in the ALS SOP Lab-024.
This detection limit is verified by analyzing an extracted LCS at approximately 2 to 4 times the calculated detection limit on a quarterly basis. The criteria for LOD are three times the noise level or 3 times the standard deviation of the mean method blanks. This spike value becomes the LOD.
The LOQ shall be set at or above the lowest standard and greater than the LOD. All results below the LOQ are reported with one significant figure.

XII. Quality Assurance Review

The quality assurance manager or designee will review 10% of data for any DoD QSM project. The technical manager review is designated as a quality assurance review.

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ALS Laboratory Group

ANLYTICAL CHEMISTRY & TESTING SERVICES

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Quality Assurance Manual

Approved By:

_____ _____

David Berwanger *Date*
Laboratory Director, CT Laboratories

Reviewed By:

_____ _____

Dan Elwood *Date*
Quality Assurance Coordinator, CT Laboratories

Abstract

The purpose of this document is to provide details of the Quality Assurance program for CT Laboratories. The scope includes all practices within the laboratory sections aimed at providing results that are of known and acceptable quality, and ensuring that CT Laboratories and the client's objectives for precision, accuracy, and detectability of analytical results, and reporting are met.

This Quality Assurance Manual (QAM) outlines the general Quality Assurance/Quality Control (QA/QC) measures employed in the following areas:

- Organizational structure and position responsibilities
- Staff training and proficiency demonstration
- Facility and equipment capabilities
- Sample collection and handling
- Sample, process, and document control
- Assessments, method performance, and corrective actions
- Data validation and reporting

Additional details of sample collection, preparation, and analysis procedures, along with method-specific QA/QC requirements, can be found in the separately bound CT Laboratories Standard Operating Procedures (SOPs). In-depth health and safety guidelines are covered in CT Laboratories Health and Safety Plan.

Supplements to the QAM are available to provide more detailed QA/QC guidance specific to a given technique or method. All supplements are included in their entirety with every controlled copy of the QAM document. For purposes of client review, uncontrolled copies of the QAM may include only supplements of interest. Supplements may also be provided to clients as stand-alone references. Topics covered in each supplement are presented in the following format ("x" denotes the letter identifier for a given supplement):

Sx 1.0 Data Quality Objectives
Sx 2.0 Methods Requirements
Sx 3.0 Instrument Testing, Inspection, and Maintenance Requirements
Sx 4.0 Instrument Calibration and Frequency
Sx 5.0 Quality Control
Sx 6.0 Data Management

Laboratory Acronyms, Abbreviations, and Symbols

Acronym	*Description*	*Acronym*	*Description*
%R	percent recovery	**QA**	quality assurance
%RSD	percent relative standard deviation	**QAC**	quality assurance coordinator
CA	corrective action	**QAM**	quality assurance manual
CCV	continuing calibration verification	**QAPjP**	quality assurance project plan
COC	chain of custody	**QC**	quality control
CRDL	contractor required detection limit	**RPD**	relative percent difference
DQO	data quality objective	**RSD**	relative standard deviation
ICAL	initial calibration	**RT**	retention time
ICV	initial calibration verification	**SOP**	standard operating procedure
IDC	initial demonstration of capability	**VTSR**	validated time of sample receipt
IDL	instrument detection limit	**X**	mean value
IPR	initial precision and recovery standard	**°C**	degrees Celsius
LCS	laboratory control sample	**>**	greater than
LOD	limit of detection	**<**	less than
LOQ	limit of quantitation	**%**	Percent
MB	method blank	**+/-**	plus or minus
MDL	method detection limit	**g**	Gram
MS	matrix spike	**kg**	Kilogram
MSA	method of standard additions	**h**	Hour
MSD	matrix spike duplicate	**g/L**	gram per liter
MSDS	material safety data sheet	**L**	Liter
NCR/CAR	nonconformance report/corrective action report	**mg**	Milligram
ng	nanograms	**mg/kg**	milligram per kilogram
NIST	National Institute of Standards and Technology	**mg/L**	milligram per liter
PE	performance evaluation	**mg/mL**	milligram per milliliter
ppb	parts per billion (e.g., µg/L or µg/kg)	**mL**	Milliliter
ppm	parts per million (e.g., mg/L or mg/kg)	**rpm**	revolutions per minute
ppt	parts per trillion	**µg/kg**	microgram per kilogram
PQL	practical quantitation limits	**mg/m^3**	milligram per cubic meter
PRQL	Program-required quantitation limit		

Table of Contents

Table of Contents *(continued)*

1.0 Quality Assurance Program

1.1 Quality Assurance Policy

CT Laboratories has established, implemented and maintains a quality system based on, and appropriate to, the type range and volume of environmental testsing undertaken. The reliability of the data resulting from day-to-day analysis depends on a strong, effective, and consistently practiced quality assurance (QA) program. The following Quality Assurance Manual (QAM) outlines that program for all aspects of laboratory operations. CT Laboratories objectives for precision, accuracy, and sensitivity of analytical results, and the quality control measures taken in each of these areas are described. These areas include:

- Organizational structure and position responsibilities
- Staff training and proficiency demonstration
- Facility and equipment capabilities
- Sample handling
- Sample, process, and document control
- Assessments, method performance, and corrective actions
- Data validation and reporting

The CT Laboratories QA program is dynamic in nature. It is designed to facilitate the fulfillment of CT Laboratories and the client's goals for its analytical products. It must also satisfy applicable company, local, state, and federal regulatory and program requirements. As such, the QAM is updated as required, based on the results of quality assurance monitoring of analytical processes, internal and external assessments, and changing regulatory policies.

In separately bound supplements to the QAM, more detailed QA/QC guidance is provided, specific to a given technique or method. All supplements are included in their entirety with every controlled copy of the QAM document. For purposes of client review, uncontrolled copies of the QAM may include only supplements of interest. Supplements may also be provided to clients as stand-alone references. Topics covered in each supplement are presented in the following format ("x" denotes the letter identifier for a given supplement):

Sx1.0 Data Quality Objectives
Sx2.0 Methods Requirements
Sx3.0 Instrument Testing, Inspection, and Maintenance Requirements
Sx4.0 Instrument Calibration and Frequency
Sx5.0 Quality Control
Sx6.0 Data Management

CT Laboratories Standard Operating Procedures (SOPs) are also available, which contain specific details of company and method QC practices. SOPs are also updated as required.

The managers and supervisors of CT Laboratories assume responsibility to ensure that all analytical and office staff understand these practices, and their revisions, and implement them immediately. As part of their initial orientation, each laboratory staff member is required to read the QAM and all supplements applicable to their work area. The employee is required to document, through their signature, that they have read, and fully understand the scope of this

document. Signed statements to this effect are placed in the employee's QA training file. Employees are expected to practice policies outlined in these documents as a matter of habit.

CT Laboratories is committed to conducting business ethically and pursuant to the highest standard of honesty and integrity. This requires providing a work environment free from financial, commercial, and other pressures which would adversely affect the quality of work performed by its personnel. Quality control systems described in this manual are in place to help identify analytical quality issues. However, it is the responsibility of each staff member to implement the guidelines of the QAM, and begin the process of corrective action where quality issues are observed. Within the laboratory, both the Laboratory Director and Quality Assurance Coordinator maintain the authority to stop work for issues of quality originating from any of these sources. CT Laboratories is committed to Chapter 5 (Quality Systems) for each test accredited by National Environmental Laboratory Accreditation Program (NELAC), its' accreditation authorities and to the various state and federal agencies that govern environmental testing.

1.2 Data Quality Objectives

The structure of the laboratory's organization and QA program is designed to most effectively and efficiently accomplish established data quality objectives (DQOs) for its analytical services. The quality of measurements made by the laboratory are determined by the following DQOs, or characteristics: representativeness, accuracy, precision, detectability, completeness, and comparability. Specific objectives for each characteristic are generally established to assist in the selection of appropriate sampling and analytical protocols and to identify applicable documentation, sample handling procedures, and measurement system procedures. These quality objectives are established based on site conditions, requirements of the project, and knowledge of available measurement systems, and are addressed whenever appropriate for the data generated.

1.2.1 Representativeness

Representativeness is a qualitative measure of the extent to which a sample acquired from a matrix describes the chemical or physical characteristics of that matrix. Sample collection, handling (e.g., splitting, preservation, storage), and measurements are all conducted according to protocols allowing for the highest degree of representativeness possible for the sample media (air, soil, water, etc.). Recording procedures are utilized which document adherence to proper protocols and maintain sample identification and integrity.

1.2.2 Accuracy

Accuracy describes the degree of agreement between an observed value and an accepted reference (true) value. It includes a combination of random error (precision) and systematic error (bias) components which are introduced in sampling and analytical operations. DQOs for accuracy are established through quality control limits for each parameter measured and for each analytical technique, per matrix where applicable. These objectives are assessed through the analysis of matrix spike/matrix spike duplicates, laboratory control sample, surrogate spike compounds and internal standards, as specified by the analytical method, required by the project, or generated and updated from data acquired through required quality control measurements. Nominal quality control limits for each parameter and analytical technique are specified in the analytical methods and data validation checklists.

1.2.3 Precision

Precision is a measure of the reproducibility of an analysis under a given set of conditions, regardless of the true value of the target analyte in a sample. The overall precision of a sampling event has both a sampling and an analytical component. DQOs for precision are established through quality control limits for each parameter measured and for each analytical technique, per

matrix where applicable. These objectives are assessed through the analysis of MSDs, LCS duplicates (if available), field duplicates, laboratory replicates, and split laboratory samples, as specified by the analytical method, required by the project, or generated and updated from data acquired through required quality control measurements. Nominal quality control limits are specified for each parameter and analytical technique in the analytical methods and data validation checklists.

1.2.4 Detectability

Method detectability objectives (commonly referred to as method reporting limits (RLs)) define the lowest concentration or quantities required of the measurement system, for each analyte or parameter. A RL is threshold value below which the laboratory reports a result as "<", with an associated threshold number. The laboratory has established method detection limits (MDLs), limits of detection, (LODs), and limits of quantitation (LOQ) for routine laboratory analytes, any of which may be used as method reporting limits (RLs). Data quality objectives for detectability (i.e., RLs) are established for each parameter measured and for each analytical technique. These objectives are either specified by the analytical method, required by the project, or determined and updated from data acquired through required quality control measurements (e.g., the replicate analyses of samples or standards containing low concentrations of the analyte of concern).

The method RL for an analyte is a function of the specific analytical procedures and can vary substantially as a result of dilutions and similar procedure modifications. In all cases, the method RL necessary to fulfill data quality objectives is confirmed by laboratory measurements. Nominal method RLs for each parameter and analytical technique are listed on the report of analysis.

1.2.5 Completeness

The characteristic of completeness is a measure of the amount of valid data obtained compared to the amount that was expected to be obtained under normal conditions. The amount of valid data expected is based on the measurements required to accomplish project objectives.

1.2.6 Comparability

The characteristic of comparability reflects both internal consistency of measurements and expression of results in units consistent with other organizations reporting similar data. The generation of comparable data requires operating within the calibrated range of an instrument and utilizing analytical methodologies which produce comparable results (e.g., data obtained for phenol by spectrophotometry are not comparable to data obtained for phenol by gas chromatography/mass spectrometry). Appropriate standard units for measurement values are utilized for each measurement system, which yields internally and externally comparable results assuming other comparability criteria are met.

2.0 Organization, Responsibilities, and Training

2.1 Organization

The Baraboo Laboratory facility is comprised of two analytical lab sections: Inorganic and Organic sections. These analytical areas function with support from the Project Management and Sample Entey. Each group is responsible for different processes required to produce the analytical data and report.

2.2 Staff Responsibilities

All laboratory personnel are involved in the QA program. Their level of involvement and responsibilities under the program vary depending on assignment within the unit. In general, laboratory scientists and technicians are responsible for performing and documenting required quality control procedures while they are conducting analyses, whereas laboratory management personnel are primarily involved in monitoring and evaluating results of quality control procedures. Exhibit 2-1 illustrates the organization underlying the following discussion of staff QA responsibilities.

2.2.1 President

The company, including its corporate staff, is headed by the CT Laboratories President. The president functions in a legally binding capacity for all laboratory decisions and operational issues. The President may call upon any of the company management staff or technical staff to perform or assist in special project activities within or outside their normal functional areas, at her discretion.

2.2.2 Laboratory Quality Assurance Coordinator

The Laboratory Quality Assurance Coordinator (QAC) is responsible for the direction of all laboratory QA activities, and reports to the President and Laboratory Director. To promote objectivity in the management and operation of the QA program, the QAC is organizationally independent of the laboratory production functions (Exhibit 2-1). QAC responsibilities include development, documentation, and evaluation of quality assurance/quality control (QA/QC) procedures and policy. The QAC conducts internal audits, reviews data reports, compiles and evaluates method performance, trains staff in QA/QC requirements, tracks nonconformances and corrective actions, prepares quality documents and reports, reviews standard operating procedures, and reports findings and quality issues to the CT Laboratories President and Laboratory Director. A primary responsibility of the QAC is to ensure that all personnel have a clear understanding of the QA program, know their roles relative to one another, and appreciate the importance of their roles to the overall success of the program.

Deputies to act in the Quality Assurance Coordinator's absence include the Laboratory Director and Analytical Group Leader (relative to their particular work areas). The Quality Assurance Coordinator and any deputies performing in a QAC capacity, have the authority to stop any work where quality is deemed questionable.

2.2.3 Laboratory Director

The Laboratory Director reports directly to the President. The Director is responsible for the supervision of the following laboratory areas, from which there are direct managerial reports: Business Services, Client Services & Sales, Analytical Group Leaders, Data Management (Information Systems). Exhibit 2-1 shows the functional areas and interfaces within the laboratory.

The Laboratory Director oversees all functional aspects of these systems. Duties may include, but are not limited to, overseeing personnel training, equipment and systems maintenance, laboratory safety, working with customers to identify project-specific requirements, monitoring scheduling and status of work, approval of CT Laboratories Standard Operating Procedures, implementing preventive and corrective actions, and cost control. The Laboratory Director is ultimately responsible for the timely reporting of data and for ensuring that the data meet the client's specifications. Deputies to act in the Laboratory Director's absence include the Analytical Group Leaders and Quality Assurance Coordinator, relative to their particular work areas.

2.2.4 Client Service and Sales Manager

The Client Service and Sales Manager reports directly to the Laboratory Director. Manager of Client Services and Sales directs Project Management, Sample Receiving and Sales. The main objective of this position is developing new client relationships, providing prices to clients, getting costs from subcontracting laboratories and assigning specific clients to Project Managers.

2.2.5 Project Manager

Project Managers report directly to the Client Services and Sales Manager and are assigned specific clients and projects to manage. They are the client's primary point of contact for field and laboratory analytical services. Project managers review analytical results to ensure project data and QC requirements have been satisfied, prepare narrative reports where applicable, and monitor project work so deadlines are met. They are responsible for seeing that clients are informed of any quality problems as soon as possible. Project Managers work directly with the Analytical Group Leaders and laboratory staff involved in their assigned projects to keep staff informed of QA/QC requirements and to monitor work progress. They also work closely with clients to develop work plans and DQOs for current and future work.

2.2.6 Analytical Group Leader

Each Laboratory Section is headed by an Analytical Group Leader (GL), who reports directly to the Laboratory Director. The GL's objective is to ensure the generation of technically valid data through their staff. The GL directly supervises, and is personally involved with, employee training, work load assignments, provides guidance in corrective action situations, oversees internal quality control measures, validates raw data, and manages scheduling within their section.

The Analytical Group Leader is responsible for directing laboratory personnel under their authority to comply with required laboratory quality control practices. This includes monitoring section activities and informing the QA department of any concerns pertaining to data quality. The GL also provides guidance and assistance in the development of new laboratory procedures and associated SOPs. As such, the GL serves as the analysts' first-line resource for technical assistance. The GL is required to evaluate any quality issues observed or reported from the staff in their section, and initiate and document any necessary corrective action, enlisting the assistance of a QAC when needed.

2.2.7 Laboratory Analyst

The Laboratory Analyst reports directly to an Analytical Group Leader for the section in which he or she works. The Laboratory Analyst is responsible for generating technically valid analytical results to be reported on environmental samples, and for documenting all data in support of those results. It is the responsibility of the analyst to follow quality control procedures specified in laboratory standard operating procedures (SOPs), as well as the fulfillment of any special quality control (QC) procedures that are designated for an analysis, and to document any deviations from QC specifications, when conducting sample preparations, analyses, data entry, data reductions and validation.

The Laboratory Analyst also must perform, when applicable, instrument calibration, maintenance and troubleshooting. The Laboratory Analyst may be required to write analytical SOPs at the direction of their group leader, QA Coordinator, or Laboratory Director. They are responsible for critically observing and evaluating all procedures they perform, and for bringing any practices or occurrences that might affect the reliability of analytical data to the attention of the appropriate Analytical GL or QAC. The Laboratory Analyst is required to perform and document any necessary corrective action, enlisting the assistance of their GL or a QAC when needed.

2.2.8 Laboratory Technician

The Laboratory Technician reports directly to an Analytical Group Leader for the section in which they work. The Laboratory Technician performs support work required to produce analytical results. This work may include sample preparation, maintenance activities on equipment (such as ovens, balances, and glassware), data archiving, and other duties, as needed. The Laboratory Technician is required to follow quality control procedures specified in laboratory standard operating procedures (SOPs), as well as the fulfillment of any special quality control (QC) procedures that are designated for an activity, and to document any deviations from QC specifications. He/she is also responsible for critically observing and evaluating all procedures they perform, and for bringing any practices or occurrences that might affect the reliability of analytical data to the attention of the appropriate GL or QAC.

2.2.9 Sample Entry Technician

Sample Entry Technicians reports directly to the Client Service Manager. Their main responsibilities are shipping, receiving and Login.

Sample Entry Technicians primary responsibility is receiving and processing all incoming samples. Received samples and corresponding documentation are carefully reviewed and noted by the Sample Entry Technician. Sample information is entered into the laboratory information management system (LIMS). Logged in samples are labeled with a unique LIMs number and delivered to the lab groups in a timely fashion. On occasion, some samples submitted may require special handling and documentation, where they can be traced through all steps of the laboratory process. In these instances a detailed protocol is followed, where all steps in the laboratory processes are controlled and documented.

The Sample Entry Technician records all discrepancies in sample documentation received with the samples and reconciles the discrepancies with the applicable Project Manager. In addition, specific Login activities include processing samples for subcontracting, processing subcontracting documentation, logging received chemical information into the LIMS, aiding in sample disposal. He/she also maintains bottle inventory, bottle orders, preparation and distribution of collection kits, cooler tracking, and receipt of incoming supplies.

All Sample Entry Technicians are required to follow quality control procedures specified in sample management and laboratory standard operating procedures (SOPs), as well as the fulfillment of any special quality control (QC) procedures that are designated for an activity, and to document any deviations from QC specifications. He/she is also responsible for critically observing and evaluating all procedures they perform, and for bringing any practices or occurrences that might affect the reliability of analytical data to the attention of the Laboratory Director or QAC.

2.3 Indoctrination and Training

The generation of reliable data by a laboratory requires that all operations are conducted by knowledgeable and trained personnel. The laboratory requires the accomplishment of a prescribed sequence of training objectives by a staff member before that individual is designated qualified and permitted to independently conduct any assignment or analyses (SOP FO-11) . The indoctrination and qualification process includes as a minimum:

- Reading and understanding laboratory Quality Assurance Program Plan,
- Reading and understanding applicable laboratory SOPs,
- Reading and understanding applicable reference documents,
- Initially, and annually thereafter, reading and understanding CT Laboratories' Ethics, Integrity and Responsibility Statement.
- Initially, and annually thereafter, participate in Data Integrity training
- Hands-on training by an experienced and qualified individual,
- For analytical methods performing measurements, to successfully demonstrate analytical capability (i.e., four replicate measurements which satisfy precision and accuracy criteria for the method, Section 6.1.3), and
- Continued demonstration of analytical capability by annually performing and obtaining acceptable result on at least one blind sample, for every analytical test that person is certified to perform.

Training records are maintained by the applicable Group Leader, and training files are kept for each staff member in the QA office. A summary of training accomplishments is recorded on a training summary form (Exhibit 2-2).

Exhibit 2-1. CT Laboratories Laboratory Organizational Structure

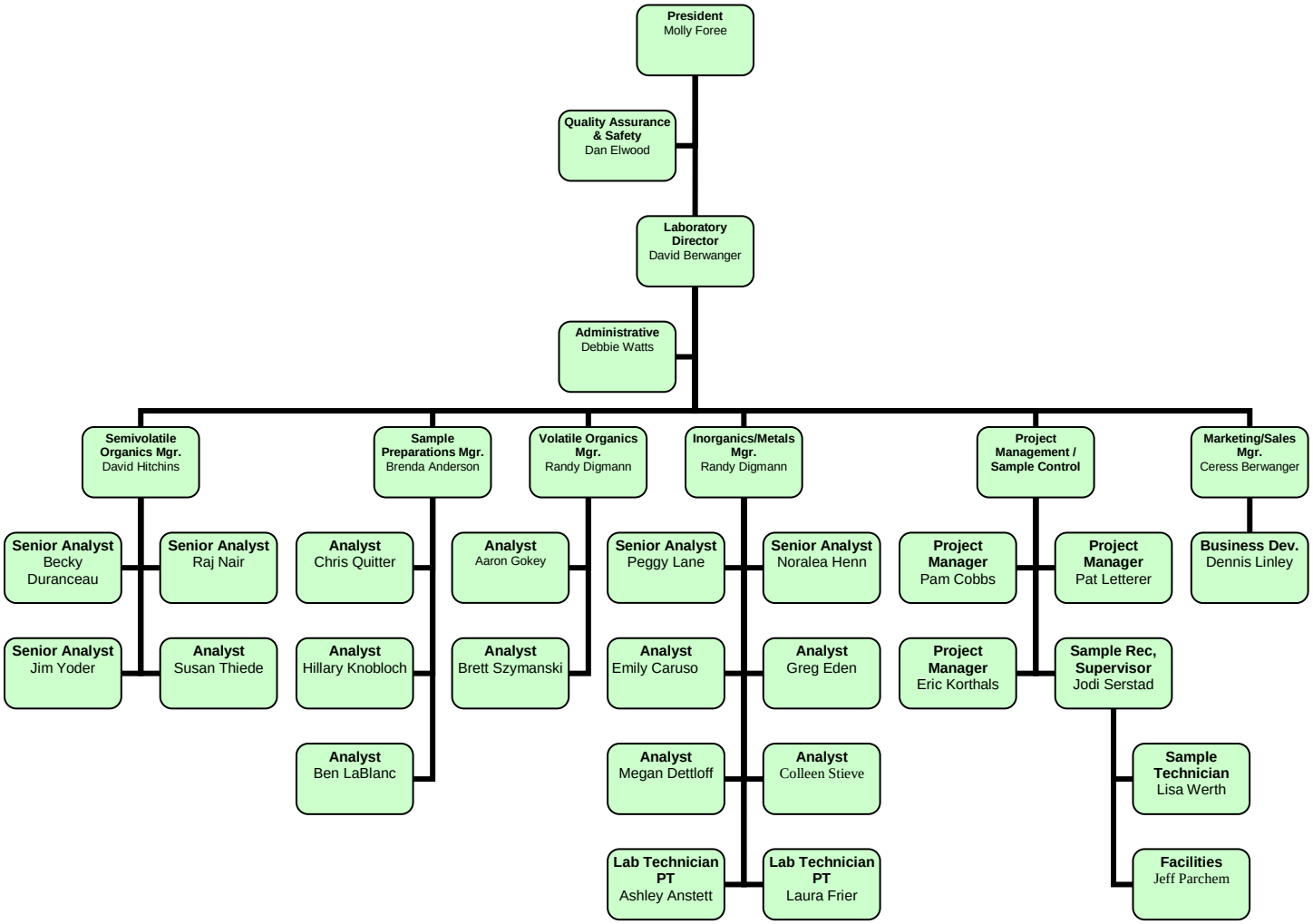


Exhibit 2-2. Technical Training Record

Employee:
Department:
Supervisor:

LABORATORY METHODS

Parameter	Method Reference	Analysis or Prep.	IDCs	Blinds

SUPPLEMENTAL TRAINING

Topic or Area	Date	Documentation

3.0 Facilities, Equipment, and Capabilities

3.1 Laboratory Facilities

CT Laboratories is housed in a 10,800 square foot complex, of which 3,728 square feet is dedicated laboratory space. The laboratory, sample receiving, and administrative office areas are separated, and all are maintained by a full-time physical plant manager and staff.

Six independent heating, ventilation, and air conditioning (HVAC) zones are in place in the laboratories. Zone division is designed to optimize on temperature needs, while minimizing potential cross-contamination. The following table outlines the systems used in each area listed (Table 3.1).

Table 3.1 HVAC System Zoning

Laboratory Area	Number of HVAC Systems
Inorganic Laboratories	1
Organics Laboratories	3
Support Areas	2

Combined laboratory areas (Exhibit 3-1) include 280 linear feet of bench space, 6 fume hoods, 2 walk-in sample storage coolers (secured), 4 incubators, and 8 additional refrigerators. An additional 2,000 square feet of warehouse space is used to support sample storage, sample equipment and secured archives.

The Baraboo facility is operated 365 days a year, employing multiple shifts to enhance turnaround times. Staffing levels are sufficient to support 24-hour shifts for select project workloads.

3.2 Analytical Capabilities and Equipment

3.2.1 Analytical Procedures

The scope of the laboratory's analytical capabilities extends to sampling programs for drinking water, municipal and industrial wastewater, solid/hazardous waste, air, biosolids, and biological tissues. The laboratory performs work on a routine basis for a number of local, state, and federal regulatory programs, including Safe Drinking Water, WPDES/NPDES, RCRA, CWA, UST, etc. The lab also maintains certifications with agencies appropriate to the category of testing. Appendix VI lists the methods and analytes accredited by NELAP. Other federal and state agencies accreditations and certifications are available on request. Table 3.2 provides a detailed listing of testing capabilities and techniques utilized.

Table 3.2 Laboratory Testing Capabilities

Traditional Water Quality Parameters by Various EPA Methods		
❖ Spectrophotometry (Colorimetry) ❖ Selective Ion Electrodes ❖ Titrations	❖ Gravimetry ❖ Continuous Flow Analyzer (Autoanalyzer) ❖ Ion Chromatography	
Metals Analysis on Liquids and Solids by EPA Methods 200, 6000, and 7000 Series		
❖ Inductively Coupled Plasma Spectrometry (ICP) ❖ Graphite Furnace Atomic Absorption (AA) Spectrometry ❖ Cold Vapor Generation Atomic Absorption Spectrometry (for Mercury)		
Organics by Gas Chromatography (GC)		
❖ Organics by EPA Methods	8015 Solid Waste 8020 Solid Waste 8081 Solid Waste 8082 Solid Waste	
❖ Hydrocarbon Analysis in Ground Water and Solid Waste State Methods	8015GRO Gasoline 8015DRO Extractables WGRO WI Gasoline Range WDRO WI Diesel Range	
Organics by Gas Chromatography/Mass Spectrometry (GC/MS)		
❖ Organics by EPA Methods	524.2 Drinking Water 8260 Solid Waste 8270 Solid Waste NIST Library Searches	
Organics by High Performance Liquid Chromatography (HPLC)		
❖ Polynuclear Aromatic Hydrocarbons by EPA Methods	610 Wastewater 8310 Solid Waste	
❖ Explosives by EPA / ACOE Methods	8330 Solid Waste 8332 Solid Waste	
Hazardous Waste Characterizations		
❖ Toxicity Characteristics Leaching Procedure (TCLP) ❖ Synthetic Precipitation Leaching Procedure (SPLP)	❖ Paint Filter ❖ Free Liquids ❖ Corrosivity (pH) ❖ Ignitability	

Table 3.2 Laboratory Testing Capabilities *(continued)*

Biosolids Chemical and Biological Testing	
❖ Heavy Metals	❖ Fecal Coliform
❖ Solid, Total and Volatile	❖ Specific Oxygen Uptake Rate (SOUR)
❖ Nitrogen content	❖ Anaerobic Bench Scale Digestions
❖ Aerobic Bench Scale Digestions	❖ UST Bioenumeration
Air Monitoring	
❖ Volatile Organics (VOCs) on Charcoal Tubes	
❖ Heavy Metals on Wipes	
❖ Various Organic Industrial Chemicals	

3.2.2 Equipment Listing

The term "equipment", as used in this manual, includes equipment or instrumentation used in the areas of preparation or analysis. This may include laboratory glassware, as appropriate. The laboratory utilizes key equipment (Table 3.3) as appropriate to standard practice, for a given technique, as specified in a referenced method, or as required by regulatory programs. The equipment investment and subsequent capabilities are sufficient for the analysis of the testing listed in Table 3.2. Instrument redundancy exists for most equipment on-site.

Table 3.3 Equipment List

Instrument	Total No. of Units
GC/MS – Gas Chromatograph/Mass Spectrometers	5
GC – Gas Chromatographs	15
HPLC – High Pressure Liquid Chromatographs	3
ICP	2
GFAA – Graphite Furnace Atomic Absorption	2
Mercury Cold-Vapor Atomic Absorption Spectrophotometers	1
Colorimetric Autoanalyzers	2
Ion Chromatograph	2

3.2.3 Preventative Maintenance

Manufacturer recommended preventative maintenance schedules must be performed internally for all equipment, in all lab areas. Additionally, some equipment, such as analytical balances, require service checks by the manufacturer. Service calls of this nature are scheduled by the Quality Assurance Coordinator according to the maintenance schedule.

Maintenance logs must be used to document any procedures performed either internally, or by vendor service technicians. These logs must also document maintenance, which may be necessary as a part of corrective action resulting from QC failures. Documentation in the logs is the responsibility of the analyst or technician operating the instrument or equipment.

3.2.4 Equipment Operation

All equipment must be operated according to manufacturer instructions, as detailed in the appropriate CT Laboratories SOPs. The SOPs incorporate the operating instructions, analytical

methodology, and QC requirements for the method performed with the equipment. On occasion, necessary information from the manufacturer's instruction manuals (e.g. tables, lists, etc.) are too massive to reiterate in the CT Laboratories SOP, so direct reference to the manual is allowed.

Internal quality control checks must be performed prior to and during equipment use to monitor and evaluate performance. The frequency of these checks ranges from "per use" to annually, depending on the type of check being performed. Corrective action, which may include maintenance, must be performed if QC checks do not meet SOP or instrument manual specified criteria. QC criteria employed for individual techniques is detailed beginning with Section 8 of this document, and in the applicable SOP.

3.2.5 Equipment Calibration

Equipment requiring calibration must be calibrated according to manufacturer's instructions or the analytical method. General guidelines for analytical instrument calibrations are covered beginning in Section 8 of this manual, and more specifically in the corresponding analytical SOPs.

For equipment where documentation of the calibration can be obtained in the form of hardcopy printouts, the calibration data must be filed with the analytical run data. Where printouts are not possible, the following minimum information must be recorded in a calibration log or on the raw data sheet: equipment identification, calibration date, analyst initials, standard(s) used, certified concentration(s), equipment reading(s) per standard, calibration verification standard(s) results, due date for next calibration (if not "per use").

It is the responsibility of the analyst performing calibration to record this information in the calibration log. Further, when persons who are not CT Laboratories staff perform calibration on any equipment, it is also the responsibility of the analyst to record the details of this work performed, and obtain any applicable certificates from the vendor.

3.3 Analytical Reagents and Standards

3.3.1 Analytical Reagents

Reagents and chemicals used for preservation and analysis must be of ACS-equivalent, or higher, grade. For ultra-trace analysis, higher purity chemicals may be required to reduce interferences, and may be purchased in those instances. Reagents and chemicals must be labeled with the receipt date upon their arrival at the lab. They must be stored according to chemical type and compatibility. Laboratory Group Leaders and analysts using these chemicals are responsible for labeling, proper storage, monitoring of expiration dates, and maintaining a sufficient stock of suitable chemicals (SOP FO-7).

3.3.2 Laboratory-Pure Water

Deionized water must be used to rinse glassware, prepare blanks for analyses, and for routine dilutions of samples, standards, and reagents. The water is produced from a five tank deionizing system, which is composed of a carbon filter tank, a cation bed, an anion bed, and two mixed resin beds. Typically, the resistivity of the product exceeds 2 umho/cm, and it is monitored continuously in the flow path from the resins.

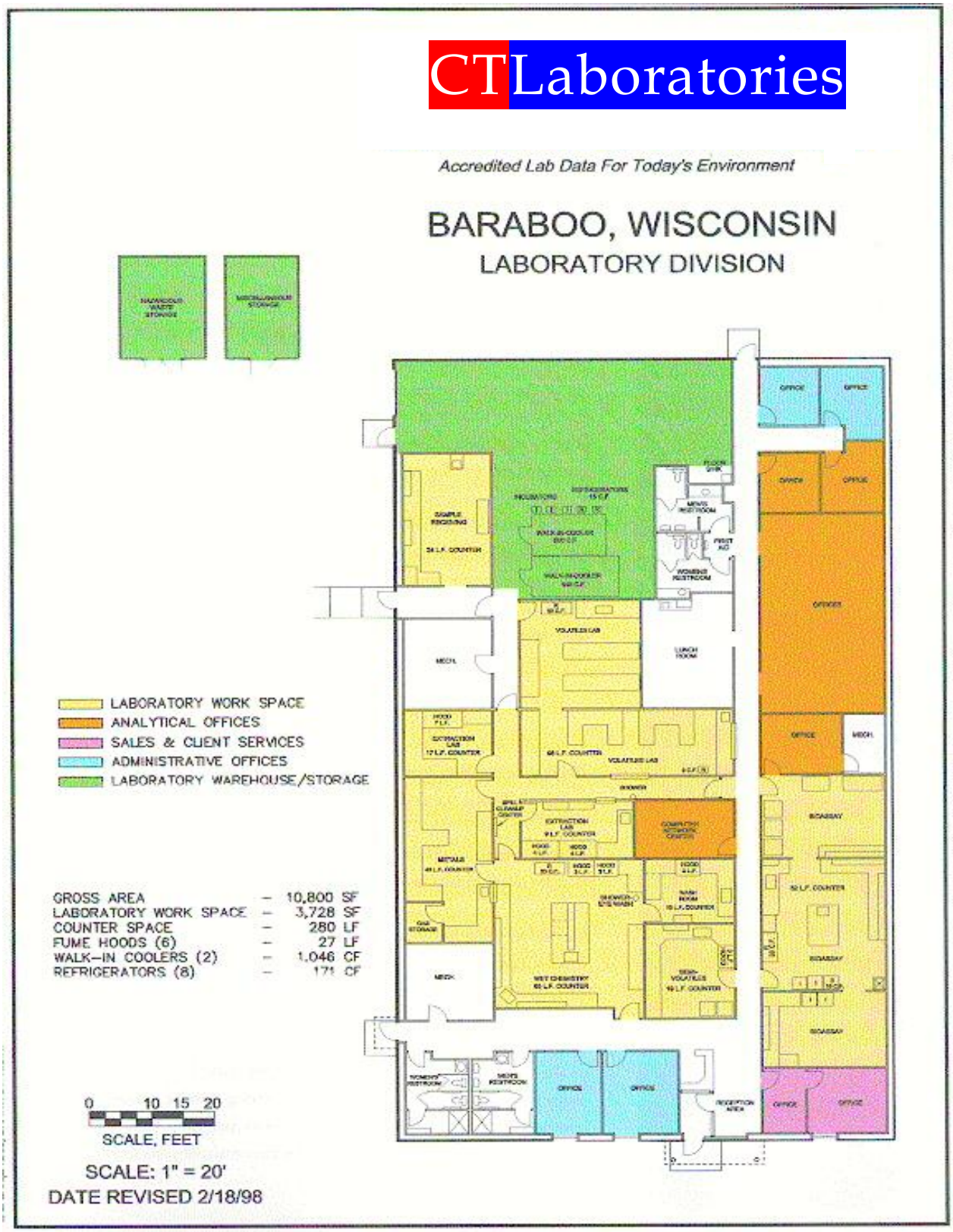
In addition, a secondary scrubbing system for water purification is used at four outlets, and produces water with resisitivity at 18 Mohm. This water is used for all laboratory operations.

3.3.3 Calibration/Reference Standards

While it is possible to prepare many calibration standards in-house, many standards for calibration or calibration verification require NIST traceability, and must be obtained from external sources. All certificates of traceability must be retained on file in the appropriate laboratory section. As an additional measure, analytical checks, spikes, and calibration verification standards must from sources secondary to the calibration standards. Every analytical SOP contains a section on standards, specifying requirements for each analysis.

Standards must be labeled with the receipt date upon their arrival at the lab. The expiration date should be noted, or one assigned and documented on the container, if absent. Standards must be stored separately from other reagents or samples, and the expiration date recorded in a standards logbook with each preparation. Standards exceeding their expiration date must not be used, and must be discarded in accordance with CT Laboratories wastes disposal SOP (FO-8).

Exhibit 3-1. CT Laboratories Laboratory Facility Floor Plan



4.0 Control of Samples

Sample collection, handling, receiving, storage, and associated record keeping procedures are integral parts of the QA program. The policies are designed to ensure that each sample is accounted for at all times. The primary objectives of CT Laboratories sample control procedures are as follows:

- Each sample received for analysis is uniquely identified,
- The correct samples are analyzed and are traceable to the applicable data records,
- Important and necessary sample characteristics are preserved,
- Samples are protected from loss, damage, or tampering,
- Any alteration of samples during collection or shipping (e.g., filtration, preservation, breakage) is documented, and
- A record of sample custody and integrity is established which will satisfy legal scrutiny.

4.1 Sample Collection

Staff at CT Laboratories no longer performs field sampling. Although we do not perform this function it is imperative that we, as a laboratory, understand the process. Field sampling cover the collection and shipping of environmental samples. Samples collected are placed in appropriate containers, having the required preservatives or additives (Appendix I), and labeled with site-specific information to uniquely identify each container at the time of collection. A generic sample label is shown in Exhibits 4-1. Conditions of sampling sites, sample IDs, number of samples, dates/times of collection, equipment calibrations, etc., are recorded on site in field logbooks and / or on chains of custody as appropriate. Samples are stored on ice in chest coolers until their receipt at the laboratory.

Exhibit 4-1. General Sample Container Label

PROJECT NAME		
SAMPLE ID	**SAMPLE DATE**	**SAMPLE TIME**
SAMPLED BY	**PRESERVATIVE**	
ANALYSIS REQUESTED		**___GRAB ___COMPOSITE**

4.2 Sample Custody

All samples remanded to CT Laboratories' custody are documented on a chain of custody (COC), example shown in Appendices II-A. Any information provided by the client (client COCs, special instructions, packing slips, etc.) is recorded on or kept with the COC. The transfer of samples to the laboratory's Sample Management group by CT Laboratories personnel or directly from the client requires a release signature from the representative or client, and an acceptance signature from the laboratory representative receiving the samples, on the COC. The courier service used for shipped samples is noted on the COC at time of receipt. Courier tracking mechanisms serve to document handling of samples prior to receipt at the lab.

4.3 Sample Entry and Storage

The lab Sample Entry Technician verifies that all samples submitted are listed on the COC, and that the COC documentation is complete, prior to signing for the sample delivery group (SDG). Received samples and corresponding documentation are carefully reviewed by the Sample Entry Technician for compliance with regard to condition of containers, sample preservation and temperature, holding times (collection date/time), and accurate identification on the COC (SOPs SS-4 & SS-5).

Once the COC has been verified against the contents of the SDG, sample information is entered into the laboratory information management system (LIMS) by the Login Technician. The LIMS assigns each SDG a unique laboratory number. In addition to the SDG, each sample is given a sample number independent of the SDG. The sample numbers are consecutive, starting at 1, and increase accordingly for all samples. These numbers are used to track all in-house information available on the sample. Login is completed by the end of the day for all samples received on a given day.

After samples are processed they are distributed to various sections of the laboratory for proper storage and analysis. On occasion some samples submitted may require special handling and documentation, where they can be traced through all steps of the laboratory process. In these instances a detailed protocol is followed, where all steps in the laboratory processes are controlled and documented (SOP SS-4).

4.4 Sample Distribution and Handling

The information entered into the LIMS is used to generate status reports showing the analytical work required for a given sample. All samples in-house, logged in through the end of the previous working day are reflected on the status reports. Status reports are printed each morning, and are used by laboratory staff to prioritize sample prep and analysis, and to plan their work schedule for the day.

Restrictive samples (SOP SS-4), retrieved from the sample custodian, must be documented in an internal COC logbook. Personnel removing samples from the storage areas are required to log out the sample numbers removed, date, time, and their initials. Staff must also document in the log the date and time samples are returned to storage. Routine samples not requiring this formal process are removed / returned from designated appropriate storage by the analysts.

Notification of samples arriving with critically short hold times parameters (i.e., less than 48 hours) or special requirements are provided and approved by Project and/or Group Leaders before the receipt or analysis of such samples. It is the responsibility of the analyst to perform the requested analysis within the appropriate hold time or requirements, once notified. Records documenting the notification are retained by the Project Management group.

4.5 Sample Disposal

In general, samples are disposed of 30 days from receipt at the laboratory (21 days for BOD and TSS samples). Arrangements for shorter or longer storage times are made with client approval based on specific project requirements.

Hazardous, or RCRA "D" listed, wastes are returned to the client for disposal. The lab maintains status as a small quantity generator of hazardous waste. Non-hazardous aqueous samples are disposed of by pouring the neutralized sample into a conventional drain to the municipal sewage treatment system. Non-hazardous and special solid wastes are disposed in landfills licensed to accept these wastes, and hauled by licensed special waste haulers. Empty sample containers are recycled by local municipal contracted firms.

5.0 Control of Processes

To ensure the analytical services of the CT Laboratories laboratory satisfy specified quality objectives, the laboratory's processes are carried out under controlled conditions. The controls include the following:

- Laboratory capabilities are defined,
- Work contracts are reviewed prior to accepting work,
- Processes and equipment are approved prior to use,
- Work instructions are documented,
- Criteria for acceptable work and products are defined,
- Work is monitored during a process and verified after completion, and
- Records are kept to document activities.

5.1 Contract Review

The CT Laboratories laboratory process for soliciting and accepting work is designed to prevent the laboratory from accepting work that it does not have either the capability or capacity to perform.

In soliciting analytical service work, the laboratory's capabilities, as described in this document and in the laboratory's Statement of Qualifications, are clearly stated to potential clients. Potential clients are also invited to tour the laboratory and discuss their needs in detail with appropriate laboratory staff. Interested clients are assigned a Project Manager (PM) who works with the client to develop a contract/work plan.

Prior to accepting work, or amending work, a contract is reviewed by the Laboratory Director and applicable Group Leaders to ensure the laboratory has the capability and capacity to perform the work. Determining the schedule for accepting and completing the work is based on the laboratory's current and planned workloads. The Laboratory Director and Laboratory Group Leaders meet weekly to review work status and prioritize, and PMs meet weekly to review status of projects. These meetings keep appropriate personnel informed of laboratory workload and facilitate planning for future work.

5.2 Documents

The CT Laboratories laboratory quality requirements for its analytical services are implemented through this QAM and laboratory standard operating procedures (SOPs).

5.2.1 Key Documents

The CT Laboratories laboratory QAM describes the operational requirements and procedures used by the laboratory to satisfy quality requirements for organization, communication, data, and documentation. Review, approval, and control requirements for the laboratory's QAM are described in Sections 5.2.2 and 5.2.3.

Standard Operating Procedures (SOPs) are used to provide written instruction and implementation detail for operational and analytical functions defined in the laboratory's QAM. These SOPs follow a specific format (outlined in SOP FO-1 *Procedures – Formats and Updates*) that includes, as a minimum, a statement of purpose and scope of the SOP and a step-by-step description of the applicable administrative or analytical process. Review, approval, and control requirements for laboratory SOPs are provided in Sections 5.2.2 and 5.2.3.

5.2.2 Document Review and Approval

All of the laboratory's key quality documents and SOPs receive, minimally, one annual review by the applicable Group Leader, QA Coordinator and / or the Laboratory Director. If it is found that no changes are needed, the reviewer will initial and date the cover page near the document header. Documents and SOPs requiring change follow the procedures outlined in SOP FO-1 (*Procedures – Formats and Updates*) and SOP 1040 (*Document Control*) Note: see next section.

5.2.3 Document Control

All of the laboratory's key quality documents, namely the QAM and SOPs are controlled documents. A controlled document has been through the preparation, review, and approved cycle and may not be changed after release and issue without going through a formal review and change authorization process. Each controlled document contains a document assignment page that assigns the document to a named individual, office, or lab area, indicates the controlled document copy number, and instructs the document assignee on how to maintain the document and enter changes.

Revisions of controlled documents are identified by a consecutive revision number, and the date of the revision on the document title page and page headers within the document. Within one month of final change approval, changes are distributed to those assigned a controlled copy of the applicable document. Each change transmittal is assigned a sequential issue number, which indicates the number of revisions the document has undergone. A record of revisions will accompany each change transmittal to indicate the number and type of changes to the document. Any document designated as an “Uncontrolled Copy” is not subject to updated revisions.

5.3 Records Management

5.3.1 Control of Records

The CT Laboratories laboratory has an established administrative system for the preparation, distribution, filing and archiving of correspondence, records, and data (SOP FO-4). Laboratory records are separated into files based on subject matter. Within the analytical section, subject matter files are essentially the categories of analytical tests performed. Within those categories, the files are further segregated by analysis batch and organized chronologically. The Operations and Project Management sections' files are organized by project/client, then by data reports within a project, and chronologically thereafter.

CT Laboratories laboratory records are maintained in accordance with EPA National Enforcement Investigations Center (NEIC) guidelines. Electronic and magnetic media are physically protected from inadvertent damage or deterioration.

All laboratory paper records are stored in file cabinets within the secure laboratory facility for a period of six months to one year. After than period, the records are placed in labeled boxes and transferred to a locked separate company building. Electronic data are stored in the laboratory's information management system (LIMS) computer (SOP SS-11). Full server backups are performed nightly. Other electronic data include instrument magnetic tapes and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Records are maintained by the laboratory in the event of any change in laboratory ownership. For any unforeseeable event (e.g., no longer in business) all records will be maintained by the laboratory owner.

5.3.2 Disposition of Records

Records are stored for a nominal period of at least five years. Records are stored for longer periods if requested or required by the customer or regulatory authority. Paper records are disposed of through recycling and electronic records are deleted.

5.3.3 Requests for Records

Access to recent (i.e., within the previous year) laboratory records is restricted to laboratory personnel. Access to archived laboratory records is restricted to the Laboratory Director, Analytical Group Leaders, Project Managers, and QACs. All requests for laboratory records should be directed to one of those individuals. Original documents shall not be taken from the file storage area without written permission from one of the listed individuals, and copying and distribution of such documents must also have their authorization.

5.4 Procurement

To maintain efficient, safe, and high quality operations in an analytical chemistry laboratory, it is essential that standardized and clearly understood procedures are used for ordering and receipt of materials and services. Consequently, the CT Laboratories requires its staff to follow specific procurement procedures, which are described in detail in SOP 1100 *Procurement of Materials and Services*. This SOP implements laboratory procurement procedures and describes the practices for source verification, ordering, receiving, inspection and testing, record-keeping, and, if necessary, return to source.

The objectives of the laboratory's procurement procedures are as follows:

- Procurement procedures, including associated documentation, satisfy company and customer requirements
- Timely receipt of requested materials and services
- Received materials and services fulfill intended purposes
- Minimization of costs

5.5 Analytical Work Processes

5.5.1 Control of Analytical Processes

All aspects of laboratory operations are controlled by the key documents, the QAM and SOPs. The SOPs detail and document the procedures which implement the activities and requirements specified in the QAM.

The laboratory uses several means of communication to ensure staff is informed of all quality requirements. Routine operational requirements are communicated to applicable staff through distribution of this QAM and laboratory SOPs. All these documents are controlled internally (see Section 5.2.3) and are issued to selected laboratory staff on an individual basis, depending on staff assignment, task responsibilities, and work location. The QAM and all SOPs are available to all laboratory staff in read only format on the laboratory's computer network. Changes in requirements are communicated to laboratory staff by distribution of revisions to this QAM and applicable SOPs.

Any laboratory staff member observing any occurrence (e.g., equipment failure) that impacts the schedule of deliverables or laboratory capabilities must immediately bring that observation to the attention of their Group Leader and the applicable Project Manager. The PM shall immediately communicate the situation to the affected customer. These communications shall be recorded by the PM in the client's record in laboratory's contact management database, and a copy shall be placed in the project files. Laboratory management staff determines necessary corrective actions for such occurrences at the weekly status meetings, attended by the Laboratory Director, Group Leaders and PMs.

5.5.2 Identification and Traceability of Items

Identification and control of items and materials begins with the procurement process. The laboratory procedures (see Section 5.4) describe the processes for source verification, ordering, receiving, inspection and testing, record-keeping, and if necessary, return to source. Nonconforming items are identified and controlled as described in CT Laboratories SOP 1020, *Nonconformance Identification and Corrective Action*. Items and materials once installed or in use are controlled in accordance with detailed analysis method procedures (SOPs) for the applicable analysis systems (see Section 5.5.1 and all applicable QAM supplements). Samples, standards, and wastes are identified and controlled as described in applicable CT Laboratories SOPs (see Section 4.0).

5.5.3 Computer Hardware and Software

Computer hardware is tested before use and is not used for laboratory work if it does not satisfy manufacturer specifications and laboratory requirements. Likewise, computer software acquired or developed is tested and the test results documented. Computer software installation must be approved and performed by a member of the Information Systems (IS) staff. It is the responsibility of the IS staff member performing the process to document the activity.

6.0 Assessment and Oversight

6.1 Audits and Assessments

Audits and assessments are tools used to examine laboratory systems as they normally operate, and determine if quality assurance needs are being met by current policies.

Audits are used to evaluate and report successes and failures of a system, and offer recommendations for effective improvements or corrections. The laboratory is evaluated through both external and internal auditing procedures. All audits require objective evidence, usually in the form of documentation, to support that stated practices are being followed. Lack of this documentation may be noted as a "deficiency". The audit process involves a review of the system in question, documentation of any deficiencies observed, a debriefing to review the deficiencies, followed by corrective actions and closing report identifying the same.

Assessments are used to evaluate and document specific areas of laboratory and analyst performance. Examples of assessments include an analyst's Initial Demonstration of Capability study, analysis of external and/or internal performance evaluation (PE) samples, calibration curve verifications, etc. Assessment results may be evaluated as part of an audit.

6.1.1 External Audits

External audits are initiated primarily by states, agencies, or affiliations through whom CT Laboratories holds some form of certification (third-party assessments). Audits of this nature cover the entire scope of the accreditation, including sample handling, preparation, analysis, and reporting for all certified parameters. Clients may also perform external audits, or employ a qualified second-party assessor on their behalf. These audits cover the same types of material, but the scope is often limited to parameters of concern to a particular project. The level of detail of an external audit is at the discretion of the auditor.

6.1.2 Internal Audits

Internal audits are conducted by a CT Laboratories Quality Assurance Coordinator (QAC, first-party assessments) (SOP FO-12). An audit may be performed by another designated staff member who is knowledgeable of the process, under the supervision of a QAC, as long as the auditing staff member is not directly performing the process being evaluated. Activities of an internal audit include, but are not limited to:

- Review of the SOP against the referenced method(s)
- Review of the procedure with a staff member who routinely performs the process
- Review of data files for complete and proper documentation, calculations, and quality control frequency (examination may include all testing records showing standardization, spikes, duplicates, and QC samples from one or more analytical runs)
- Review of logbooks for accuracy and completeness
- Review of the process for compliance with company QA policies including error corrections, corrective action, solvent/standard/reagent labeling policies, etc.

CT Laboratories internal audits occur at minimum of one per year. Areas are defined by method or technique for analytical audits, and by section for operational activities audits. Auditing in this manner allows for a comprehensive, on-going review of several areas throughout the year. The scheduling of the audits is at the discretion of the QACs and Laboratory Director.

6.1.3 Demonstration of Capability

An analyst training on a given method must perform an Initial Demonstration of Capability (IDC) study prior to analyzing or reporting client data independently (i.e., without the supervision of a senior analyst)(SOP CL-1). The analyst must prepare four aliquots of a known level of the analyte of interest, analyzed them according to the appropriate method, and demonstrate the ability to recover the analyte within established acceptance criteria. Calculation of IDC results is done through a standard spreadsheet, and may be performed by either the analyst, or a QAC. Results are filed in the employee's technical training file, as well as the IDC file in the QA records.

6.1.4 Performance Evaluations

Performance evaluation (PE) studies involve the analysis of a blind sample (i.e., a sample whose true analyte concentrations and/or analyte identities are not known by the laboratory) for the analyte(s) of interest, followed by evaluation of the results for accuracy by a third party (SOP SS-1). The majority of PEs are performed by the lab in order to maintain state or agency certifications. PE sample analysis may also be required by specific client contract requirements. PE samples may either be provided by the state, agency, or client independently, or ordered by the lab from approved vendors having established PE programs. In-house blind samples may be prepared or purchased and submitted to the lab by a QAC at any time. For routine demonstrations of performance, however, the lab relies on its extensive external PE participation to provide adequate blind performance evaluations.

Upon receipt at the lab, PE sample login is conducted in the same manner as for routine samples. Most PEs are received in the form of concentrates, which must be prepared according to the vendor's instructions in order to obtain an aliquot that is ready for routine sample prep and analysis. The reconstituted aliquot must be prepared and analyzed according to the applicable method along with routine samples. The PE sample results must be subjected to the same QC requirements as used for validating a routine sample result.

All PE raw data and results must be reviewed and approved (initialed and dated) by the appropriate Analytical Group Leader. Copies of raw data and final worksheets, showing the Group Leader's approval with results to be reported, are compiled and filed per method of analysis. Scoring is performed by the provider, and the issued report is retained the QAC files. These reports are available to all staff, auditing agents, and clients upon request.

6.2 Corrective Actions

Any condition that adversely affects compliance with established QC requirements must be identified and corrected as soon as practical. Action taken to correct or preclude the recurrence of that condition is called "corrective action". Some examples of corrective actions include repairs to equipment, revision of an SOP to eliminate a repetitive problem, or obtaining an approved variance to a procedure.

6.2.1 Nonconformances

Nonconformances are items or conditions of a process which do not meet established QAM, SOP, method, or project requirements. As described in CT Laboratories SOP 1020, "Nonconformance Identification and Corrective Action", all nonconformances, and the corrective actions taken as a result, must be documented on a Non-Conformance/Corrective Action Report (CAR). Completion of a CAR should include not only a description of the problem and corrective actions, but also copies of any documentation to support the same. CARs must be routed through the levels of immediate supervisor, Lab Director, and QAC for respective approvals.

Should a nonconformance affect the reportability of a client's data, or the ability to analyze a sample, it is the responsibility of the staff member documenting the nonconformance to notify the Project Manager for that client immediately. The Project Manager must in turn contact the client within two days, describe the details of the problem, act on any further instructions received, and follow up with written notice to the client of the problem and its resolution. A copy of the CAR may be used for this purpose. The CAR must also be signed by the Project Manager in this case.

Client inquiries concerning quality assurance are handled in a similar manner. When a client has a concern regarding laboratory results or procedures, it is the responsibility of the Project Manager to initiate a CAR. The appropriate Group Leader will review testing records for the sample (if applicable) and any circumstances surrounding the complaint. This review may include examination of bench sheets, compiled results (worksheet), the LIMS archives, or applicable log books to check for errors. A copy of the CAR, detailing all findings, will be kept with the file copy of the formal report for the sample in question. Review and approval of the CAR by the Project Manager, Group Leader, the Laboratory Director, and a QAC is required. Again, a written follow-up to the client is required. All CARs are logged and originals retained in QAC files.

6.2.2 Variances

A variance is a type of corrective action involving an approved change to a process or procedure. A variance describes a deviation from a method which affects the operation of the method, but not the method's ability to achieve the performance standards or quality assurance objectives required. Variances must be requested in writing with approvals from the appropriate Group Leader, Laboratory Director, and a QAC (SOP SS-7).

6.2.3 Emergency Alternatives Policy

Under extreme or unavoidable circumstances (such as equipment failure, or irreconcilable matrix difficulties) samples may not be able to be analyzed by methods specified by the client or program (SOP SS-7). Alternative procedures may be acceptable. However, use of these procedures must be approved by the client. Laboratory staff identifying the problem must notify the appropriate Project Manager. The Project Manager is responsible for communicating the situation to the client. This communication must take place prior to reporting the results of the test by the alternate method, and must be documented. The Project Manager may also inform the client if an option exists to sub-contract the samples to an appropriately certified laboratory. Sub-contracting options are also subject to client approval. All information regarding any changes to an existing test for a given sample in the LIMS must be documented.

6.3 Quality Improvement

The CT Laboratories Laboratory Director, QA Coordinator, Client Services and Group Leaders meet weekly to continually assess project work processes, identify needed improvements, assign responsibilities for making improvements, and monitor progress on improvement actions.

The CT Laboratories quality improvement processes are summarized as follows:

- Nonconformance reporting - see Section 6.2
- Corrective Actions - see Section 6.2
- Internal Audits - see Section 6.2.1
- Management assessments - see Section 6.2.1
- Trend Analysis - see Section 6.3.1
- Control Charting - see Section 6.3.2

6.3.1 Trend Analysis

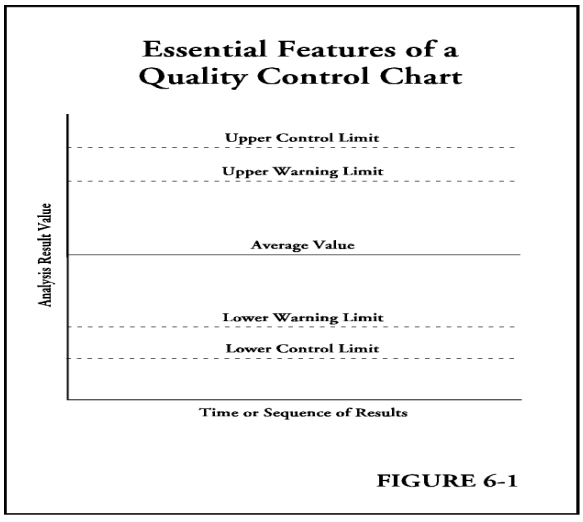
As described in CT Laboratories SOP 1020, "Nonconformance Identification and Corrective Action", the laboratory uses trend analysis to monitor its analytical systems and associated activities. The goals of the trend analysis are as follows:

- To detect quality problems before they become significantly adverse to the quality of the products,
- To allow timely initiation of corrective actions to prevent development of significant quality problems, and
- To ensure continuous quality improvement.

6.3.2 Control Charts

Control charts may be used to monitor trends in analytical performance (SOP SS-3). As illustrated in Exhibit 6-1 a control chart consists of a graph with the vertical axis labeled in units of the analysis or parameter of interest and the horizontal axis labeled in units of time or sequence of results. The upper and lower warning and control limits, which are statistically determined, may be used as criteria for instituting corrective actions. When the parameter being plotted is the relative percent difference (RPD) the lower limits do not apply (i.e., the minimum value of the RPD plotted is always zero and the limits plotted are upper limits).

Exhibit 6-1. Quality Control Charting



A basic principle in a QA program is the establishment of control limits. Such limits are utilized as decision criteria during analytical processes to reduce errors to acceptable levels and statistically characterize the results. Control limits are finite values which are comparable to the measurement values and can be used to statistically assess the acceptability of analytical measurements. There are two goals in establishing control limits. They should yield a narrow enough acceptance range so measurements that lie outside the upper or lower control limit indicate problems within the analytical system (i.e., the system is out of control). The limits, however, should not provide a range so narrow as to cause unnecessary adjustments of the analytical system and rejection of acceptably accurate and reliable results.

CT Laboratories general policy is to utilize control limits where specified by the analytical method or where a sufficient data base exists to establish control limits of ±3s from the mean value of replicate measurements, where "s" is the estimated standard deviation for replicate measurements for the system of concern. Measurements exceeding the control limits (either blank or control sample recovery measurements or precision measurements) usually require halting the analytical process, institution of corrective action measures necessary to obtain acceptable measurements, and documenting the corrective measures taken. This occurrence also normally requires rejection of any results generated between the last acceptable measurement and the unacceptable measurement or reporting those results with the notation that the analytical system was out of control. Warning limits of ±2s may also be utilized. Measurements inside the control limits but exceeding the warning limits require close examination of the measurement system by the analyst. Measurements in this category do not normally require halting the analytical process and rejection of data unless a significant problem is discovered.

6.4 QA Reports to Management

On a weekly basis, a meeting, lead by the Laboratory Director, and attended by the Quality Assurance Coordinator, Analytical Group Leaders, Client Service/Sales Manager and PMs is conducted. One of the purposes of the meeting is to address any unresolved quality issues pertinent to each area of lab operation. Any deficiencies noted through internal or external audits, concerning equipment, systems, training, and/or staffing levels required to maintain or improve product quality, are included. A report detailing the meeting is filed on-line and available to all attendees (SOP FO-12).

In addition, the Laboratory Director, Quality Assurance Coordinator, Analytical Group Leaders and Operations Manager meet monthly to discuss progress and / or closure of all Corrective Action Reports.

7.0 Data Validation, Usability, and Reporting

All processes at CT Laboratories (sample receiving and handling, sample analysis, data reduction, data reporting, data review, etc.) are subject to examination to evaluate adherence to project specifications. This examination consists of several layers of technical and QA review. These reviews ensure that all data released by CT Laboratories were scrutinized by qualified independent reviewers and are scientifically sound, appropriate to the method, and completely documented. Tests performed at CT Laboratories are all performed by EPA or Standard Methods. These methods have been reviewed and found to be EPA Type II methods regarding uncertainty. CT Laboratories statistical quality control data, serves to provide the data necessary data for the uncertainty for these test methods.

All data shall receive analyst review and independent analyst (i.e., qualified peer) review. Analytical Group Leaders, Project Managers, and QA Coordinator also review the data to varying degrees at different points in the review process. These review processes are appropriately documented before data are released from the laboratory.

7.1 Data Review, Verification, and Validation

Data review ensures that raw data are properly collected, reduced, and reported. *Data verification* confirms by examination of the measurement process and provision of evidence, that specified requirements have been met. For example, QC measurements must indicate that deviations between measured values and known values are smaller than the maximum allowable error. *Data validation* is the process of substantiating that specified performance criteria were achieved. At CT Laboratories, a data validation checklist (DVC) for each analytical process outlines the performance criteria for the process. An example DVC is presented in Appendix 3. The checklist is completed and signed for each analysis batch by both the analyst and a qualified peer to document the process.

The CT Laboratories review process must examine as a minimum the following data recording requirements for analyses:

- All original data must be recorded, signed, and dated in blue or black waterproof ink.
- All data must be recorded clearly and accurately in laboratory records, bench sheets, or logbooks, and include applicable sample identification numbers.
- All changes and additions to original data must be made with a single-line strike-out, initialed, and dated by the individual making the change (an explanation of the change or addition must be included if the change or addition deals with rejecting data).
- All data used from logbooks and laboratory records must be transferred and reduced completely and accurately.
- All laboratory records shall be maintained in permanent files.
- Data shall be organized into standard formats.
- All electronic data shall be stored appropriately to ensure that sample and QC data are protected and readily retrievable. Corrections made to hardcopy data must also be made in electronic data files whenever possible.

7.1.1 Data Generator Review and Verification

Data generators (i.e., the analyst or personnel conducting analyses) are responsible for conducting real-time review and verification of 100% of the

data resulting from their activities. This review must be documented by the data generator's signature and review date on the raw data and on a data validation checklist. Data generators are accountable for ensuring that all data they generate are complete, accurate, and compliant with applicable requirements (QAM, SOP, method, or client-specified criteria). Data generators are responsible for performing all data reduction required prior to independent technical review and reporting, and for notifying the appropriate Group Leader, Project Manager, and/or QA Coordinator of any problems encountered during analysis and data review that may potentially impact data quality.

7.1.2 Independent Technical Review and Validation

A minimum of ten percent (10%) of laboratory data must also receive *independent* technical review. The independent technical reviewer(s) must be a qualified individual other than the data generator (e.g., peer analyst or Group Leader). He/she must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The independent reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used.
- Data are reported in the proper units and with the correct number of significant figures.
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations.
- All variances from an accepted method and the rationale for the variations were documented and approved.
- Data were reviewed for transcription errors.
- Analytical data documentation file or data package is complete, including sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary, and completed data validation checklist.
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified.
- Analytical sample holding times were met, or exceptions are documented.

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented on every run sheet, utilizing a data validation checklist. The run sheet is archived in the associated data package.

7.1.3 Project Management Review

One hundred percent (100%) of the data reports must receive a relational technical review by the Project Manager. This review must ensure that:

- Data are technically reasonable based on the technique used.
- Reported analytical data documentation or data package meets the clients' data quality objectives (DQOs) and includes raw data, data forms, calculation records, QC measurement results, narrative comments, COC forms, and sample tags, as appropriate to the report level requested.
- Quality control (QC) criteria (e.g., holding times, spike criteria, etc.) were met, or exceptions are documented.
- Relationships between related parameters are scientifically reasonable.

The PM relational review occurs after the data have been entered into LIMS, and analytical peer review has taken place. This PM review is documented by the Project Manager's signature and date on the final reports, and is done before the reports are released to the client.

7.1.4 Quality Assurance Coordinator Review

Periodically selected data packages are reviewed by the QA Coordinator. This review does not technically validate the data, but rather serves as an overall quality evaluation. This review must ensure that:

- Independent and project management technical reviews were performed as evidenced by the appropriate signature releases.
- Analytical QC documentation is complete.
- Required laboratory QC measurements were properly performed and QC criteria that were not met are documented in a CAR (Section 6.2).
- If the data package is noncompliant with one or more of the project specifications, the QA Coordinator evaluates the nature of the nonconformance. If the nonconformance can be rectified by correcting an error or omission in the data package, the data package is returned to the responsible section for correction. If the nonconformance cannot be rectified by correcting the data package, a CAR must be initiated (Section 6.2).

7.2 Verification Methods and Calculations

During the data review process there are standardized methods and calculations used to examine the measurement process against the specified requirements. These general methods and calculations organized by DQO characteristics outlined in Section 1.2 are described in the remainder of this section and in SOP CL-2.

7.2.1 Representativeness

The appearance and records for samples should, at a minimum, be checked against project requirements for the following:

- Sampling protocols
- Sample types
- Sample containers
- Sample sizes
- Sample numbers
- Sample preservation
- Sample storage
- Sample analysis hold time
- Maintenance of sample chain-of-custody

7.2.2 Accuracy

Accuracy (bias) is a measurement of the extent to which a measured value of a quantity (parameter or analyte) agrees with the accepted value of that quantity. It is assessed by the analysis of samples of known concentration for the analytes of concern.

For LCSs, calibration standards, field reference standards, or additional QC samples of known concentration, accuracy is quantified by calculating the *percent recovery* (%R) of analyte from a known quantity of analyte as follows:

$$\%\,R = \frac{V_m}{V_t} \times 100$$

where:

V_m = measured value (concentration determined by analysis)

V_t = true value (concentration or quantity as calculated or certified by the manufacturer)

A matrix spike (MS) sample or a matrix spike duplicate (MSD) sample is designed to provide information about the effect of the sample matrix on the digestion and measurement methodology. A known amount of the analyte of interest is added to a sample prior to sample preparation and instrumental analysis. To assess the effect of sample matrix on accuracy, the %R for the analyte of interest in the spiked sample is calculated as follows:

$$\%\,R = \frac{(SSR - SR)}{SA} \times 100$$

where:

SSR = spiked sample result

SR = sample result

SA = spike added

7.2.3 Precision

Precision is a measurement of the random error in an analytical measurement process. It reflects the degree of agreement between independent measurements determined by the analysis of replicate samples. When calculated for duplicate sample analyses, precision is expressed as the *relative percent difference* (RPD), which is calculated as:

$$RPD\,(\%) = \frac{|S - D|}{(S + D)/2} \times 100$$

where:

S = first sample value (original result)

D = second sample value (duplicate result)

When precision is calculated for three or more replicate determinations, the *relative standard deviation* (RSD), also known as the coefficient of variation, expressed in units of percentage, is used. This is an expression of the spread of the data relative to the mean value of the determinations. The specific formulas used for calculating the RSD are:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

$$s = \left[\frac{\sum_{i=1}^{n} (x_i - \bar{x})^2}{n-1} \right]^{1/2}$$

$$\text{RSD (\%)} = \frac{s}{\bar{x}} \times 100$$

where:

$\bar{x}$ = mean of n measurements

x_i = result value for the i_{th} measurement

n = total number of measurements

s = standard deviation

7.2.4 Method Detection Limits

Method Detection Limits (MDL) or Limits of Detection (LOD) are determined for each analyte for each method used in liquid and solid mediums. These MDLs are determined by (a) conducting replicate analyses of standards at quantities approximately one to five times the estimated MDL, (b) determining the standard deviation, s, of the replicate measurements, and then (c) calculating the MDL from:

$$\text{MDL} = t_{(n-1,\ 1 - \alpha = 0.99)} \times s$$

where:

n = number of replicate analyses (For LOD determination the number of replicates is 8)

$t_{(n-1,1 - \alpha = 0.99)}$ = t distribution value appropriate to a 99% confidence level (one-tailed) and standard deviation estimate with n - 1 degrees of freedom

s = standard deviation of the data set

The ratio between the mean spike concentration and the measured MDL should be within one to five for reagent water matrix and one to ten for other matrices. The MDL calculated in this manner, based on 1 % false positive, represents the minimum amount of a substance that can be measured and reported, with 99% confidence that the analyte quantity is greater than zero.

The MDL does *not* represent the analyte quantity for which there is a 99% probability that the analyte will be detected; there is a 50% probability of detection and reporting of the analyte whose actual amount is at the MDL. The analyte quantity at which there is a 99% probability that the analyte will be detected and reported is twice the MDL (1 % false negative).

Because MDLs are usually determined using standards in a clean matrix, they represent optimum obtainable performance. MDLs for actual sample matrices are likely to be higher than those determined using clean matrices.

7.2.5 Quantitation/Reporting Limits

Because of significant uncertainty (±100 %) associated with MDLs determined in a "clean" matrix, plus possible additional variability due to actual sample matrix, CT Laboratories may use higher levels, referred to as "limits of quantitation" or "reporting limits", down to which it routinely reports measured values.

The *limit of quantitation* (LOQ) is defined as 10 times the standard deviation (s) from the MDL determination (see Section 7.2.4). Therefore, the LOQ is roughly 3.33 times the MDL, since the MDL is usually about three times the standard deviation of the data set from the MDL study.

The *reporting limit* (RL), a generic term, is not as rigidly defined as the LOQ. RLs can be either Laboratory RLs, Method RLs, Program RLs, Action RLs or Client Specified RLs. Reporting Limits are usually chosen at a level three to 10 times higher that the MDL. As much as possible, it is also chosen at a level which is below applicable regulatory action levels and which simplifies data review and reporting (e.g., RL of 5.0 µg/L for numerous volatile organic compounds of similar chemical behavior and regulatory action levels).

7.2.6 Completeness

The characteristic of completeness is a measure of the amount of valid analytical data obtained compared to the total number of analyses performed. Valid analytical data are those for which all QC specifications are met. Completeness of the reported data (expressed as a percentage) is calculated as:

$$C\,(\%) = \frac{M_v}{M_t} \times 100$$

where:

M_v = number of measurements judged to be valid (meets all QC specifications)

M_t = total number of measurements performed (based upon number of samples submitted)

7.2.7 Comparability

Comparability of analysis results is evaluated by at a minimum checking the following against project requirements:

- Analysis method utilized
- Analysis QC measurement results
- Units utilized for reporting measurement values

7.2.8 Rejection of Data

Rejection of an analytical result for a sample may be required if established quality control acceptance criteria are not satisfied at any point during the course of analysis. Nominal quality control decision criteria are provided in analytical method SOPs and the corresponding data validation checklists.

Additionally, the CT Laboratories uses a statistical outlier test (*Standard Methods*, 1010 B. Statistics, 17th, 18th, or 19th Editions) for rejection of a questionable value from a group of replicate readings, measurements, results, etc., for an individual sample or standard. Briefly, the test involves dividing the difference between the questionable value and the replicates' mean value by the standard deviation for all replicate values, to calculate a quotient, T. The questionable value is rejected if the calculated T is greater than an established rejection T. The outlier test (Table 7.1) is conducted at the 99% confidence level, which means if the calculated T exceeds the rejection $T_{0.99}$, then the questionable value may be rejected with 99% probability that it is significantly different from the other values.

Table 7.1 Outlier Test for evaluation of a questionable value from a group of replicate values.

Questionable Value[a]	Formula for Calculating T[b]	Number of Values	Rejection Quotient $T_{0.99}$
Smallest value (X_1)	$T = \frac{X_{ave} - X_1}{s}$	3	1.15
		4	1.49
		5	1.75
Largest value (X_n)	$T = \frac{X_n - X_{ave}}{s}$	6	1.94
		7	2.10
		8	2.22
		9	2.32
		10	2.41
		12	2.55
		14	2.66
		16	2.75

a. Arrange values in order of increasing magnitude.
b. If $T > T_{0.99}$ reject questionable value.
X_{ave}= Average value for all replicates.
s = Standard deviation for all replicates, where $s = [\sum(X_n - X_{ave})^2/(n - 1)]^{1/2}$

7.3 Data Usability

Reconciliation of data with DQOs to determine data usability is performed primarily by the applicable Project Managers working in direct communication with the analysts and, if needed, the Group Leader and QA Coordinator. Data which do not satisfy project DQOs may necessitate reanalysis of involved samples or other corrective actions to satisfy the DQOs. If DQOs cannot be satisfied (e.g., no sample available for reanalysis) and data must be reported, an explanation appropriately qualifying the data must accompany the report of analysis. Reference and definitions lists for qualifying flags are provided in Appendix II-A and B.

7.4 Data Reporting

After completion of analyses, sample results are entered into the laboratory's computer-based laboratory information management system (LIMS). After peer review of the data is completed (Section 7.1.2) and the results are acceptable, the results in LIMS are approved and a preliminary report is generated. The applicable Project Manager (PM) reviews the preliminary report (Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections. A final report is then produced. The final report is also reviewed and signed by an appropriate data reviewer before it is submitted to the customer. Each final report has a unique identification number, which is the CT Laboratories Work Order No. listed in the upper right hand corner of the report.

CT Laboratories offers four levels of data reports as illustrated in Table 7.2. For Level II, III, and IV deliverables formats the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management, where the complete package is assembled. The PM reviews the complete package and writes the cumulative analysis, or case, narrative. After final review, approval, and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of 5 years. The retention period may be longer or shorter if requested by the client. These records are stored in the laboratory for approximately twelve months, then transferred to another company building for secure, long term storage.

CT Laboratories provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CT Laboratories LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. The LIMS is maintained on-site by information system personnel. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Table 7.2 Analysis Report Deliverable Formats

Level I:
Analytical Results Surrogate Recoveries – when requested
Level II:
Analytical Results Surrogate Recoveries – where appropriate Method Blank Laboratory Control Sample (LCS) Summary Laboratory Control Sample Duplicate (LCSD) Summary – where appropriate Matrix Spike (MS) Summary Matrix Spike Duplicate (MSD) Summary – where appropriate Replicate/Duplicate – where appropriate Chain-of-Custody documentation
Level III:
Analytical Results Surrogate Recoveries – where appropriate Method Blank Laboratory Control Sample (LCS) Summary Laboratory Control Sample Duplicate (LCSD) Summary – where appropriate Matrix Spike (MS) Summary Matrix Spike Duplicate (MSD) Summary – where appropriate Replicate/Duplicate – where appropriate GC/MS Tune - where appropriate Initial Calibration Continuing Calibration Verification (CCV) Chain-of-Custody documentation
Level IV:
Analytical Results Surrogate Recoveries – where appropriate Method Blank Laboratory Control Sample (LCS) Summary Laboratory Control Sample Duplicate (LCSD) Summary – where appropriate Matrix Spike (MS) Summary Matrix Spike Duplicate (MSD) Summary – where appropriate Replicate/Duplicate – where appropriate GC/MS Tune - where appropriate Initial Calibration Continuing Calibration Verification (CCV) Case Narrative Raw data – including, but not limited to, instrument logs, data sheets, chromatograms, spectra, extraction logs, digestion logs and instrument sequences Chain-of-Custody documentation

Parameter	Matrix	Container	Preservation	Hold Time
Classical Chemistry				
Alkalinity	Aqueous	125 mL plastic	4° C	14 days
Ammonia	Aqueous	250 mL plastic	H_2SO_4 pH< 2	28 days
Ammonia	Solid	4oz cup or 125 mL plastic	4° C	28 days
BOD	Aqueous	1 Liter plastic	4° C	48 hours
CBOD	Aqueous	1 Liter plastic	4° C	48 hours
Chloride	Aqueous	125 mL plastic	4° C	28 days
Chloride	Solid	4oz cup or 125 mL plastic	4° C	28 days
Chlorine, Residual	Aqueous	125 mL plastic	4° C	analyze immediately
Chlorophyll A	Aqueous	1 Liter amber glass	4° C	21 days
COD	Aqueous	125 mL plastic	H_2SO_4 pH< 2	28 days
Conductivity	Aqueous	125 mL plastic	4° C	28 days
Cyanide	Aqueous	500 mL plastic	H_2SO_4 pH< 2	14 days
Cyanide	Solid	4oz cup or 125 mL plastic	4° C	14 days
Fluoride	Aqueous	125 mL plastic	4° C	28 days
Hardness	Aqueous	250 mL plastic	H_2SO_4 pH< 2	6 months
Hexavalent Chromium	Aqueous	125 mL plastic	4° C	24 hours
Hexavalent Chromium	Solid	4oz cup or 125 mL plastic	4° C	28 days
Total Kjeldahl Nitrogen	Aqueous	125 mL plastic	H_2SO_4 pH< 2	28 days
Total Kjeldahl Nitrogen	Solid	4oz cup or 125 mL plastic	4° C	28 days
Nitrate	Aqueous	125 mL plastic	4° C	48 hours
Nitrate	Solid	4oz cup or 125 mL plastic	4° C	48 hours
Nitrate + Nitrite	Aqueous	125 mL plastic	H_2SO_4 pH< 2	14 days
Nitrite	Aqueous	125 mL plastic	4° C	48 hours
Nitrite	Solid	4oz cup or 125 mL plastic	4° C	48 hours
Oil and Grease	Aqueous	1 Liter glass	HCL pH< 2	28 days
Oil and Grease	Solid	4 oz Glass jar	4° C	28 days
Ortho- Phosphate	Aqueous	125 mL plastic	4° C	48 hours
pH	Aqueous	125 mL plastic	4° C	analyze immediately
pH	Solid	4oz cup or 125 mL plastic	4° C	analyze immediately
Phenolics	Aqueous	1 Liter glass	H_2SO_4 pH< 4	28 days
Phenolics	Solid	4 oz Glass jar	4° C	28 days
Available Phosphorus	Solid	4 oz cup	4° C	28 days
Total Phosphorous	Aqueous	125 mL plastic	H_2SO_4 pH< 2	28 days
Total Phosphorous	Solid	4oz cup or 125 mL plastic	4° C	28 days
Total Residue	Aqueous	1 Liter plastic	4° C	7 days
Total Dissolved Solids	Aqueous	1 Liter plastic	4° C	7 days
Total Suspended Solids	Aqueous	1 Liter plastic	4° C	7 days
Total Solids	Aqueous	1 Liter plastic	4° C	7 days
Percent Solids	Solid	4 oz cup	4° C	7 days
Sulfate	Aqueous	125 mL plastic	4° C	28 days
Sulfate	Solid	4oz cup or 125 mL plastic	4° C	28 days
Sulfide	Aqueous	500 mL plastic	NaOH pH > 12/Zinc Acetate	7 days
Sulfide	Solid	4oz cup or 125 mL plastic	4° C	7 days
Turbidity	Aqueous	125 mL plastic	4° C	24 hours
TOC as % Organic Matter	Aqueous	125 mL plastic	4° C	n/a

TOC as % Organic Matter	Solid	4oz cup or 125 mL plastic	4° C	n/a
Metals				
Graphite Furnace Metals	Aqueous	250 mL plastic or 1 L Plastic	HNO_3 pH<2	6 months
Graphite Furnace Metals	Solid	4 oz cup	4° C	6 months
ICP Metals	Aqueous	250 mL plastic or 1 L Plastic	HNO_3 pH<2	6 months
ICP Metals	Solid	4 oz cup	4° C	6 months
Mercury	Aqueous	250 mL plastic	HNO_3 pH<2	28 days
Mercury	Solid	4 oz cup	4° C	28 days
Microbiology				
Total Coliform	Aqueous	100 mL sterile plastic	Sodium Thiosulfate	30 hours
Fecal Coliform	Aqueous	100 mL sterile plastic	Sodium Thiosulfate	30 hours
Fecal Coliform	Solid	100 mL sterile plastic	4° C	30 hours
Fecal MPN	Solid	100 mL sterile plastic	4° C	30 hours
Heterotrophic Bacteria	Aqueous	125 mL plastic	4° C	n/a
Heterotrophic Bacteria	Solid	4oz cup or 250 mL plastic	4° C	n/a
Petroleum Degraders	Aqueous	125 mL plastic	4° C	n/a
Petroleum Degraders	Solid	4oz cup or 250 mL plastic	4° C	n/a
Organics- Volatiles				
BTEX	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4 degree C	14 days
BTEX	Solid	4 oz Glass jar	4° C	14 days
GRO	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4 degree C	14 days
GRO	Solid	4 oz Glass jar	4° C	21 days
Dissolved Gases	Aqueous	40 oz VOA vial	HCl pH<2, 4 degree C	14 days
Methanol Blank	Aqueous	40 oz VOA vial	Methanol	21 days
PVOC	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4 degree C	14 days
PVOC	Solid	4 oz Glass jar	4° C	14 days
Volatiles	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4 degree C	14 days
Volatiles	Solid	Encore	4° C	48 hours to preservation
Organics- Semi-Volatiles				
Semi-Volatiles	Aqueous	1 Liter glass	4° C	7 days to prep
Semi-Volatiles	Solid	4 oz Glass jar	4° C	14 days to prep
DRO	Aqueous	1 Liter glass	4° C	7 days to prep
DRO	Solid	4 oz Glass jar	4° C	14 days to prep
Explosives	Aqueous	1 Liter glass	4° C	7 days to prep
Explosives	Solid	4 oz Glass jar	4° C	14 days to prep
Fingerprint Identification	Aqueous	1 Liter glass	4° C	7 days to prep
Fingerprint Identification	Solid	4 oz Glass jar	4° C	14 days to prep
PAH	Aqueous	1 Liter glass	4° C	7 days to prep
PAH	Solid	4 oz Glass jar	4° C	14 days to prep
PCB	Aqueous	1 Liter glass	4° C	7 days to prep
PCB	Solid	4 oz Glass jar	4° C	14 days to prep
Pesticides	Aqueous	1 Liter glass	4° C	7 days to prep
Pesticides	Solid	4 oz Glass jar	4° C	14 days to prep
TPH	Aqueous	1 Liter glass	4° C	7 days to prep
TPH	Solid	4 oz Glass jar	4° C	14 days to prep

Physical Properties				
Air Filled Porosity	Solid	Shelby Tube		n/a
Corrosivity Index	Aqueous	250 mL plastic	4° C	14 days
Grain Size Analysis	Solid	4 oz cup		6 months
Sieve Analysis P200	Solid	4 oz cup		6 months
Soil Moisture Holding Capacity	Solid	Shelby Tube		n/a
Soil Permeability	Solid	Shelby Tube		n/a
Specific Gravity	Aqueous	125 mL plastic		n/a
Specific Gravity	Solid	4oz cup or 125 mL plastic		n/a
Waste Charaterization				
ASTM Leachate	Solid	4 oz cup	4° C	see test
Cyanide-Reactive	Aqueous	500 mL plastic	NaOH pH > 12	14 days
Cyanide-Reactive	Solid	8 oz glass	4° C	14 days
Flashpoint	Aqueous	8 oz glass	4° C	10 days
Flashpoint	Solid	8 oz glass	4° C	10 days
pH	Aqueous	125 mL plastic	4° C	analyze immediately
pH	Solid	4 oz cup	4° C	analyze immediately
SPLP- Metals	Aqueous	250 mL plastic	HNO3 pH<2	see test
SPLP- Metals	Solid	minimum of 150 grams in glass	4° C	see test
SPLP- Volatiles	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4 degree C	see test
SPLP- Volatiles	Solid	60 mL glass Amber	4° C	see test
SPLP- Semi-Volatiles	Aqueous	(3) 1 Liter Glass	4° C	see test
SPLP- Semi-Volatiles	Solid	minimum of 150 grams in glass	4° C	see test
Sulfide-Reactive	Aqueous	500 mL plastic	NaOH pH > 12/Zinc Acetate	7 days
Sulfide-Reactive	Solid	8 oz glass	4° C	7 days
TCLP- Metals	Aqueous	250 mL plastic	HNO_3 pH<2	see test
TCLP- Metals	Solid	minimum of 150 grams in glass	4° C	see test
TCLP- Volatiles	Aqueous	(3) 40 oz VOA vials	HCl pH<2, 4° C	see test
TCLP- Volatiles	Solid	60 mL glass Amber	4° C	see test
TCLP- Semi-Volatiles	Aqueous	(3) 1 Liter Glass	4° C	see test
TCLP- Semi-Volatiles	Solid	minimum of 150 grams in glass	4° C	see test

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Chain of Custody

Page _____ of _____

Company:
Project Contact:
Telephone:
Project Name:
Project Number:
Project Location:
Sampled By:

Regulatory Program:
UST RCRA SDWA NPDES
Solid Waste Other _____

CTLaboratories

1230 Lange Court, Baraboo, WI 53913
608-356-2760 Fax 608-356-2766
www.ctlaboratories.com

Turnaround Time
Normal RUSH*
Date Needed _____

*Notify Lab prior to sending in RUSH samples. Surcharges:
24 hr 200% 2-3 days 100% 4-9 days 50%, subject to change without notice.

Lab Use Only
Place Header Sticker Here:

Mail Report To:
Company:
Address:
City/State/Zip:

Invoice To:
Company:
Address:
City/State/Zip:

PO No.

Client Special Instructions:

Landfill License Number:

Collection Date	Collection Time	Grab/ Comp	Sample ID Description	Filt? Y/N	WDNR Well ID #	**Matrix:								Total # of Containers	Preservation*	Lab ID #

Fill in Spaces with Bottles per Test

*** Preservation Code**
A=None B=HCL
C=H2SO4 D=HNO3
E=Encore F=Methanol
G=NaOH
O=Other _____

Relinquished By:	Date/Time	Relinquished By:	Date/Time
Received by:	Date/Time	Received for Laboratory by:	Date/Time

Ice Present Yes No
Temperature _____
Cooler # _____

****Matrix**
S–Soil **A**–Air **Sl**–Sludge **M**–Misc Waste
GW–Groundwater **SW**–Surface Water
WW–Wastewater **DW**–Drinking Water

III. Data Validation Checklist

Appendix *Data Validation Checklist*

Run #:	Method: CYANIDE EPA335.4		Page 1 of 1	
Analysis Date	Analyst / Data Interpretor	Independent Reviewer	Date of Review	Approved
				Yes No

Instructions: Complete one checklist per *analytical run*. Enter the appropriate response for each question. Each "No" response requires an explanation in the Comments section, and may require the initiation of a Nonconformance Report.

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
1. Were samples preserved correctly?	pH >=12 NaOH					
2. Were the samples distilled appropiately?	---					
3. Were the distilled samples accompanied by a prep sheet?	---					
4. Were method blanks prepared at the required frequency?	1per 20 field samples					
5. Was the LCS prepared from a separate source than the calibration standards?	---					
6. Were LCSs prepared at the required frequency?	1per 20 field samples					
7. Were the MS and MSD prepared at the required frequency?	1per 20 field samples					
8. Was the calibration performed using the required number of standards?	Minimum of 3					
9. Was the correlation coefficient acceptable?	>= 0.995					
10. Were the ICV and ICB run immediately after the calibration curve?	---					
11. Were the CV recoveries acceptable?	90 – 110 %					
12. Were the CB results acceptable?	< 0.01 mg/L					
13. Were the CCVs and the CCBs analyzed at the required frequency?	1per 10 analyses					
14. Was the method blank result acceptable?	< 0.1 mg/L					
15. Was the LCS recovery acceptable?	90 – 110 %					
16. Were the MS and MSD recoveries acceptable?	80 – 120 %					
17. Was the RPD between the MS and MSD acceptable?	< 20 %					
18. Were the samples analyzed within holding time?	14 days					

Lab Qualifier	DoD Qualifier	Definitions
A		Analyte averaged calibration criteria within acceptable limits.
B	B	Analyte detected in associated Method Blank.
C		Toxicity present in BOD sample.
D		Diluted out.
E		Safe, No Total Coliform detected.
F		Unsafe, Total Coliform detected, no E. Coli detected.
G		Unsafe, Total Coliform detected and E. Coli detected.
H		Holding time exceeded.
J	J	Estimated value.
L		Significant peaks were detected outside the chromatographic window.
M	Q	Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.
N		Insufficient BOD oxygen depletion.
O		Complete BOD oxygen depletion.
P	J	Concentration of analyte differs more than 40% between primary and confirmation analysis.
Q	Q	Laboratory Control Sample outside acceptance limits.
R	Q	See narrative at end of report.
S	Q	Surrogate standard recovery outside acceptance limits due to apparent matrix effects.
T		Sample received with improper preservation or temperature.
U	U	The analyte was analyzed for but not detected.
V		Raised Quantitation or Reporting Limit due to limited sample amount or dilution for matrix/background interference.
W		Sample amount received was below program minimum.
X	Q	Analyte exceeded calibration range.
Y	Q	Replicate/Duplicate precision outside acceptance limits.
Z	Q	Calibration criteria exceeded.
	N	Nontarget analyte

A Analyte averaged calibration criteria within acceptable limits.

Given the large number of analytes that may be analyzed in some methods, it is likely that some analytes may exceed individual acceptance limit for the Relative Standard Deviation (RSD) for a given calibration. In those instances where the RSD for one or more analytes exceed the individual limit, the calibration is still valid if the average of all analytes is within acceptable limits.

B Analyte detected in associated Method Blank.

For many tests, it is not permissible to have analytes detected in the method blank. However, in some instances it is appropriate to do so. This data flag tells the client that all, or a portion of, the amount found in a sample may be due to laboratory sources. For example, methylene chloride may be found in method blanks for EPA SW846 method 8260 analyses. If methylene chloride is found above the detection limit, in a sample associated with such a blank, the methylene chloride value would then be flagged with a "B" qualifier.

C Toxicity present in the BOD sample.

The presence of toxic compounds, such as some organic compounds, metals, and salts, inhibit the micro-organisms in the sample. In a series of dilutions prepared for the sample, the dilution showing the least toxic effect is chosen to calculate the concentration.

D Diluted out

At times a sample requires dilution in order to overcome a matrix effects or because of a high level of analytes present. This dilution may cause other analytes of interest to be diluted out of range. This qualifier is added to let the data user know normal quantitation is not available.

E Safe, No Total Coliform detected.

Coliform bacteria, a group of indicator organisms, were not found in the sample.

F Unsafe, Total Coliform detected, no E. coli detected.

Coliform bacteria, a group of indicator organisms, were found in the sample. Although E. coli, a type of bacteria harmful to humans, was not found in the sample, conditions exist that indicate the water is potentially dangerous. Boiling water may be advised.

G Unsafe, Total Coliform detected, E. coli detected.

Coliform bacteria, a group of indicator organisms, were found in the sample. In addition, E. coli, a type of bacteria found in excreta of human and other animals that is harmful to humans, was also found. Conditions exist that indicate the water is potentially dangerous and should not be consumed unless boiled.

H Holding time exceeded.

Most EPA and ASTM methodologies have prescribed holding times, within which the sample must be extracted, digested or analyzed. In some cases, samples are received or analyzed by the laboratory past the prescribed holding time. However, such data may still be deemed usable by the data user. In such instances, the client is notified of the occurrence and the sample is analyzed past the holding time, if requested by the client. An "H" qualifier is applied to the flag field to indicate to the data user that the sample was analyzed past the prescribed holding time and the data should be evaluated in that context.

J Estimated value.

Various clients and programs require data reported below a set reporting limit, but above the Method Detection Limit (MDL) to be qualified estimated. Normal statistical confidence may not be applicable within this range. When required, the "J" qualifier is used for this purpose.

L Significant peaks were detected outside the chromatographic window.

Clients may request specific hydrocarbon analyses such as Diesel (DRO) and Gasoline (GRO) analyses. While a sample may or may not contain the hydrocarbon of interest, it may contain significant levels of hydrocarbons that are lighter or heavier than the hydrocarbon of interest. In those cases the result is flagged with an "L" qualifier.

M Matrix Spike and/or Matrix Spike Duplicate recovery outside acceptance limits.

Many EPA methods require that laboratories spike client/field samples to determine potential matrix effects for the analytes of interest. The percent recovery of these spiked analytes can be outside the acceptance limits for various reasons. The most common reasons are that: 1.) the matrix may adversely affect the extraction/digestion and/or analysis of the analyte of interest or 2.) the analytical system is out of control. The laboratory also spikes laboratory water with the same analytes of interest. This is referred to as an LCS sample. A passing LCS indicates the analytical system or process is in control and the anomalous Matrix Spike/Matrix Spike Duplicate (MS/MSD) results are most likely due to matrix effects. In this instance, the MS and/or MSD should be flagged with an "M" data qualifier and the data reported.

If the Matrix Spike recovery is below acceptable limits, it may be likely that the reported results for the associated samples may be underestimated. Conversely, if the Matrix Spike results are high, it may be likely that the reported results for the associated samples may be overestimated. A failing LCS indicates the analytical system is not in control and the sample should be prepared again and reanalyzed. The original data would not be reported in this case

N Insufficient BOD oxygen depletion.

The method calls for a depletion of at least 2 mg/L oxygen for valid readings. In a series of dilutions prepared for the sample, if none of the dilutions deplete by this amount, the results are estimated from the dilution with the greatest oxygen depletion.

O Complete BOD oxygen depletion.

The method calls for a residual concentration of at least 1 mg/L oxygen at the end of five days for valid readings. In a series of dilutions prepared for the sample, if all of the dilutions have less than 1 mg/L residual, then the result is estimated from the dilution with the greatest residual oxygen.

P Concentration of analyte differs more than 40% between primary and confirmation analysis.

When sample results are confirmed the agreement between the quantitative results are evaluated. If one result is significantly higher (>40%) the higher result is reported and the data user alerted by use of the "P" qualifier.

Q Laboratory Control Sample outside acceptance limits.

A Laboratory Control Sample (LCS) is a control matrix (e.g., clean water, clean soil) that has been spiked with the targets of interest, or a subset of those target analytes. The laboratory measures the percent recovery of these spiked compounds to ensure that the analytical system is operating appropriately. By definition, if the LCS recoveries are within acceptance criteria, the laboratory system is in control. If the LCS is out of acceptance criteria, the samples associated with that analytical batch should be prepared again and reanalyzed.

In those instances where it may not be possible to prepare the samples again and reanalyze, the LCS data and associated sample results will be flagged with the "Q" qualifier. If the LCS spike recovery is below acceptable limits, it may be likely that the reported results for the associated samples may be underestimated. Conversely, if the LCS Spike results are high, it may be likely that the reported results for the associated samples may be overestimated.

R See narrative at the end of report

Narratives are added to reports on an as needed bases. This qualifier directs data users to this additional information

S Surrogate standards outside acceptance limits due to apparent matrix effects.

Surrogates measure the preparation and analytical efficiency of an analysis for each sample. This is done by spiking the sample prior to preparation with a compound similar in nature to the target analytes and then measuring the recovery of the surrogate. Surrogates may be outside the acceptance criteria because of matrix affects or system errors. When this occurs and the LCS data are within acceptable limits, the surrogate recovery is flagged with an "S" qualifier.

T Sample received exceeding proper temperature or preservation criteria.

Preservatives are added to samples to protect the integrity of the sample once it has been collected. Adherence to preservation requirements is checked when samples are received at the laboratory. The lack of the proper preservative or the lack of the proper amount of preservative can alter the analytical results for a sample and the data should be evaluated accordingly. Consequently, these results are flagged with a "T" qualifier.

U The analyte was analyzed for but not detected.

Some programs do not allow the usage of the 'less than' sign (<). In these programs this letter is added to the Qualifier column in place of the less than sign.

V Raised Quantitation or Reporting Limit due to limited sample amount or dilution for matrix/background interference.

Laboratory Quantitation or Reporting Limits (RLs) are established in laboratory grade water or in a clean, representative matrix of the sample of interest (e.g., clean soil). However, when samples contain elevated levels of interferences, it becomes impossible to detect target compounds at the normal reporting levels. Consequently, the RL must be raised, whether or not the analytes of interest are detected in the sample. In these cases, sample results, whether below detection or not, are flagged with a "V" qualifier to indicate the RLs have been adjusted due to matrix interferences. Laboratory Quantitation or Reporting Limits (RLs) are established using minimum sample amounts. In the event that the minimum amount is not available, the analyte RL must be elevated accordingly

W Sample amount was below program minimum.

The sample amount provided was less than the amount specified in the analytical method or sampling protocol. The laboratory must rely on the client's sampling staff to provide the laboratory with the appropriate amount of sample. The client is contacted when the sample amount received is less than the amount required.

X Analyte exceeded calibration range.

Given the large number of analytes that may be analyzed in some methods, it is likely that some analytes may exceed the established instrument calibration. In those instances where the calibration curve is exceed, and the analyte can not be reanalyzed, an estimated concentration is provided with an "X" qualifier.

Y Replicate/Duplicate precision outside acceptance limits.

There are many Quality Control (QC) replicates or duplicates that monitor analytical precision. Based on the type of replicate chosen, there are many factors that may affect analytical precision, such as sample homogeneity. In the event that the precision between two analyses is outside the normal acceptance criteria, the data are flagged with a "Y" qualifier to alert the data user to this fact.

Z Calibration criteria exceeded.

The initial standard calibration or calibration verification for the analyte was not within the acceptance criteria of the method.

Absorbance	A measure of the decrease in incident light passing through a sample into the detector.
Accuracy	Accuracy describes the degree of agreement between an observed value (or average of a set of values) and an accepted reference (true) value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations. Accuracy is assessed through the analyses of MS/MSDs, LCS, surrogate spike compounds and internal standards. Results are expressed as percent recovery (%R) and are calculated according to the following formula: $\%R = Result_{meas}/True\ Value \times 100\%$. For MS/MSD sample analyses, the original or "native" sample concentration is taken into account. The following equation is used for the determination of percent recoveries of MS/MSD samples: %R = (Spiked sample result - Sample result)/Amt of Spike Added x 100.
Aliquot	A measured portion or subsample of a field sample taken for analysis.
Analysis	The separation of a compound into its constituent parts, or the breaking down of a complex substance into simpler substances, for the purpose of identification and quantitation of one or more of those components.
Analysis Date and Time	The date and military time (24-hour clock) of the introduction of the sample, standard, or blank into the analysis system.
Analyte	The element, ion, or compound an analysis seeks to determine, which may also be referred to as the target, or target analyte.
Analytical Balance	A mechanical or electronic balance having a sensitivity of 0.1 milligram or less.
Analytical Batch	An Analytical Batch is composed of prepared environmental samples, extracts, digestates or concentrates, which are ***analyzed*** *together as a group.* The length of an Analytical Batch is not limited by number of samples or analyses conducted, but may be limited to a specified time frame, depending on the method. An Analytical Batch can include prepared samples originating from various environmental matrices. An Analytical Batch must contain all associated quality assurance measurements, as required by the CTL QAPP, method, or client contract specifications.
Analytical Method	The sample preparation and instrumentation procedures or steps that must be performed to estimate the quantity of an analyte in a sample.
Analytical Reagent (AR) Grade	Designation for the high purity of certain chemical reagents and solvents given by the American Chemical Society.
Analytical Run	A continuous analytical sequence consisting of prepared samples and all associated quality assurance measurements as required by the CTL QAPP, method, or client contract specifications.
Analytical Sample	Any solution or media introduced into an instrument on which an analysis is performed, excluding instrument calibrations, initial calibration verification, initial calibration blank, continuing calibration verification, and continuing calibration blank. Note that the following are all defined as analytical samples: undiluted and diluted samples, predigestion spikes, duplicates , serial dilutions, analytical spikes, post-digestion spikes, interference check samples (ICS), CRDL standard for AA, CRDL standard for ICP, laboratory control samples (LCS), preparation blanks (PB), method blanks (MB), and linear range analysis sample (LRS).
Arithmetic Mean (Average)	The sum of a set of values divided by the number of values comprising the set.
Audit	An audit is a qualitative evaluation of all components of measurement systems, including the physical facilities for sampling, calibration, and measurement, to determine the adequacy, effectiveness, and compliance with established procedures, instructions, drawings, or other applicable documents. Audits typically involve a comparison of the activities of the laboratory's QA Program Plan with those actually scheduled and performed.

Autozero	Zeroing the instrument at the proper wavelength. It is equivalent to running a standard blank with the absorbance set at zero.
Background Correction	A technique to compensate for variable background contribution to the instrument signal in the determination of trace elements.
Bias	Consistent deviation of measured values from the true value, caused by systematic errors in a procedure.
Blank	A ***Blank*** is an analyte-free matrix carried through a process and designed to monitor the potential introduction of contaminants into that process. For aqueous samples, laboratory-pure reagent water (deionized or distilled) is used as a Blank matrix. Method-specified solvents may also serve as Blanks. Although a universal Blank matrix does not exist for solid samples, it is permissible to use a sample-equivalent aliquot of kiln-fired sand as a suitable Blank. A Blank may be required for any or all appropriate steps of a process. For environmental sampling, this may include: bottle prep, equipment cleaning, sample collection, transport, storage, sample preparation, and/or analysis. The Blank is subjected to the usual analytical measurement process to establish a zero baseline or background value, and is sometimes used to adjust or correct routine analytical results. Specifications of different Blank types are included in this glossary.
Blank, Bottle	A Bottle Blank consists of a blank solution prepared in the lab, placed in a standard sample container containing the same preservative matrix as routinely used when collecting the sample for the specified analyte, and carried through the entire analytical scheme. Bottle blanks evaluate any contamination from containers or preservatives used.
Blank, Calibration	A Calibration Blank consist of a blank solution prepared in the lab, and may be used in the "zeroing", calibration, or calibration monitoring of an instrument. Calibration blanks are used to determine the degree of contamination in the instrumental analysis system, if any. These may also be referred to as instrument blanks.
Blank, Equipment	An Equipment Blank consists of blank solution prepared in the lab, transported to the field, opened, and the contents poured appropriately over or through the sample collection device. The solution is recollected in a sample container, and returned to the laboratory for analysis as a sample. Equipment Blanks permit evaluation of equipment decontamination procedures and potential cross-contamination of environmental samples between sampling locations.
Blank, Field	A Field Blank consists of blank solution prepared in the lab, placed in a sample container in the laboratory or in the field, and treated as a sample in all respects, including preservation, exposure to sampling site conditions, storage, and all analytical procedures. Field Blanks may include equipment blanks, trip blanks, etc. The purpose of the Field Blank is to determine if the field or sample transporting procedures and environments have contaminated the sample.
Blank, Holding	A Holding Blank is blank solution prepared in the lab which is stored and analyzed with samples at the laboratory. Holding Blanks (also known as Storage Blanks) test for contamination in sample storage as well as sample preparation and analysis.
Blank, Laboratory Fortified	A term, equivalent to LCS, used in conjunction with EPA 600/4-88/039m, Method 524.2, which describes an aliquot of reagent water to which known quantities of the method analytes are added in the laboratory. The Laboratory Fortified Blank (LFB) is analyzed exactly like a sample, and its purpose is to determine whether the sample matrix contributes bias to the analytical results. The background concentrations of the analytes in the sample matrix must be determined in a separate aliquot and measured values in the LFM corrected for background concentrations.
Blank, Trip	Trip Blanks are prepared in the same manner as Field Blanks, and transported with empty sample containers to the site of work, ***except*** that Trip Blanks ***remain sealed*** until analyzed with collected environmental samples. Trip blanks permit evaluation of contamination generated from sample containers, preservatives, or occurring under site conditions or during the shipping and laboratory storage process.

Blind Sample, Single	A performance evaluation sample with a composition known to the submitter, but unknown to the analyst. The analyst/laboratory may know the identity of the sample but not its composition. It is used to test the analyst's or laboratory's proficiency in the execution of the measurement process.
Calibration	Analysis of a series of analytical standards at different specified concentrations, used to define the quantitative response, linearity, and dynamic range of the instrument for target analytes. An analytical curve is established based on the absorbance, emission intensity, or other measured characteristic of known standards. Calibration standards must be prepared using the same type of acid or concentration of acids as used in the sample preparation. The range of the applied calibration should bracket the range of planned or expected sample measurements.
Calibration Curve	The graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.
Calibration Standards	A series of known standard solutions prepared from a primary standard solution, including internal standards and surrogate analytes, used to calibrate the instrument response with respect to analyte concentration (preparation of the analytical curve).
Calibration Verification	The periodic analysis of one or more standards (independent of the calibration standards) following calibration, to verify the accuracy of the calibration standards, and that the relationship established in the initial calibration continues to be valid.
Certified Reference Material	A Certified Reference Material (CRM) is a standard in a specified matrix whose analyte values or properties are certified by a technically valid procedure, and which is accompanied by or traceable to a certificate or other documentation is issued by the certifying body.
Chain of Custody	A document designed to trace the custody of a sample(s) from the point of origin to final disposition with the intent of legally proving that custody remained intact and that tampering or substitutions were precluded.
Check Sample	A Check Sample is matrix blank which has been spiked with the target analyte(s) from an independent source to the calibration standards, in order to monitor the execution of the analytical method. The level of the spike shall be at the regulatory action level when applicable. Otherwise, the spike shall be at 5 times the estimate of the quantification limit. The matrix used shall be phase matched with the samples and well characterized: for an example reagent grade water is appropriate for an aqueous sample.
Comparability	Data Comparability is an expression of the confidence with which one data set can be compared with another. Comparability is a significant concern when existing data are being integrated into the data base of an ongoing project, or wherever historical data are being used in support of a project. Comparability is primarily concerned with whether the field sampling techniques, analytical procedures, and concentration units of one data set can be validly compared with another. To ensure comparability, field procedures must be standardized by adhering to SOPs, laboratory procedures must follow the same standard analytical methods, and standard units of measurement must be utilized.
Completeness	Completeness is a measure of whether all information necessary to meet the data quality objectives of a project has been collected. It is defined as the percentage of valid or acceptable results relative to the total number of relevant sample results expected to be obtained under ideal, normal conditions. Valid or acceptable results are those data that meet all acceptance criteria.
Composite Sample	Portions of material collected from more than one spatial location or at different times that are blended and submitted for chemical analysis. Composite samples can provide data representative of a large area with relatively few samples. However, the resulting data are less accurate with regard to the concentrations of contaminants detected in a specific location, because they represent average values.
Concentration	The relative fraction of one substance in another, normally expressed in a weight per volume ratio, weight percent, or volume percent .

Confidence Coefficient	The probability, %, that a measurement result will lie within the confidence interval or between the confidence limits.
Confidence Interval	A Confidence Interval is the set of possible values within which the true value will lie with a specified level of probability. The range includes the upper and lower limits of the interval. It is determined from the standard deviation of a set of analytical values obtained through multiple evaluations for a given analyte. Individual confidence intervals must be calculated for each method or technique, for each matrix. Usually a 95% or 99% confidence coefficient is used for data validation.
Confidence Limit	One of the boundary values defining the confidence interval.
Confirmation	Verification of the presence of a component through a second, separate reanalysis (including prep procedures) of another aliquot of a sample, or by reanalysis using an alternate analytical technique. Alternate techniques may include second column confirmation, alternate wavelength, derivatization, mass spectral interpretation, alternative detectors, additional cleanup procedures, etc.
Continuing Calibration Verification Standard	A Continuing Calibration Verification (CCV) standard is an analytical standard run every 10 analytical samples or every 2 hours, whichever is more frequent, to verify the calibration of the analytical system. The frequency is established based on a reasonable time interval to monitor for drift in the calibration. The concentration level is typically set at mid-range of the calibration curve, but may have other specifications based on method or client contract requirements.
Contract Required Detection Limit (CRDL)	Minimum level of detection for an Analyte that is acceptable under the client contract specifications.
Control Limits	Control Limits define the range within which specified measurement results must fall to be compliant. Corrective action is required if control limits are exceeded, and noncompliant data must be flagged. Courses of corrective actions are dependent on the nature of the exceedence.
Corrective Action	Corrective actions are measures taken to correct conditions adverse to quality and, where necessary, to eliminate the cause in order to prevent recurrence of the problem. Corrective actions involve a systematic problem-solving approach using data to draw conclusions about likely reasons for a problem, and must be documented.
Data Quality Objectives (DQO)	Statements that explain the purpose of collecting the data. DQO's may contain qualitative and quantitative statements that describe the overall level of uncertainty that a decision maker is willing to accept in results derived from environmental data. Dos are determined based on the end uses of the data to be collected.
Data Reduction	The process of transforming raw data by arithmetic or statistical calculations, standard curves, concentration factors, etc., and collation into a more useful form.
Data Review	An evaluation of laboratory data quality based on a review of method-specific quality control documentation, the CTL QAPP, or as specified in the project-specific laboratory subcontract.
Data Review	The process used to ensure that the proper reduction of raw data has been accomplished.
Data Validation	The act of confirming, through documented evidence, that a process or data set is, in fact, that which is claimed. Data Validation is the process used to confirm that all review and method-specific performance criteria procedures have been completed and met. Validation is documented by signature release.
Defensibility	The degree to which data and its supporting documentation can withstand technical, regulatory, and legal scrutiny.

Deficiency	An unauthorized deviation from acceptable procedures or practices, or a defect in an item. May also be referred to as a non-conformance, finding, or violation.
Document Control	The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly and controlled to ensure use of the correct version at the location where the prescribed activity is performed.
Dry Weight	The weight of a sample based on it's percent solids, as determined through drying in an oven.
Duplicate	Two representative aliquots (subsamples or splits from the same container) of the same sample matrix subjected to identical analytical procedure independently, in order to assess the precision. The results from duplicate analyses are used to evaluate analytical or measurement precision, but *not* the precision of sampling, preservation or storage internal to the laboratory. Precision is expressed through the calculation of relative percent difference (% RPD).
Duplicate, Field	Field Duplicates are two samples, collected independently, at the same time from the same source and submitted to one laboratory as separate samples. Field duplicate samples are usually composited in the field prior to submittal to the lab, and containerized, handled, and analyzed in an identical manner. The purpose of Field Duplicate samples is to assess the consistency of the *overall* sampling effort and the precision of the entire measurement system, including sampling and analytical procedures. Precision is evaluated based on the relative percent difference (RPD) between the two samples.
Effluent	Effluents may be defined as solid, liquid, or gas wastes which enter the environment as a by-product of man-oriented processes, or the discharge or outflow of water from ground or subsurface storage.
External Standards	External standards are those standards of known concentration which are used to aid in quantitation of data. They may generally include calibration standards, calibration verifications, certified reference materials, etc.
Field Sample	A portion of material received by the lab to be analyzed. A single field sample may be contained in single or multiple containers, depending on container and preservative requirements. All containers of the same sample must be identified by a unique reference.
Frequency	A specification during a prep procedure or analytical sequence allowing for no more than the indicated number of field samples in a prep batch, or no more than the indicated number of analyses between required calibration verification measurements. The indicated number may originate from the CTL QAPP, method, or client contract specifications.
Good Laboratory Practices (GLP)	Either general guidelines or formal regulations for performing basic laboratory operations or activities that are known or believed to influence the quality and integrity of the results.
Grab Sample	An field sample collected from a single location at a specific time. Grab samples must be collected and placed in the appropriate sample containers with no prior mixing.
Headspace	Any area in a container not completely filled by liquid or solid sample, allowing gases to collect in that space.
Holding Time	The storage time allowed between sample collection, extraction, and sample analysis when the designated preservation and storage techniques are employed.
Holding Times	The maximum times that samples may be held prior to analysis and still be considered valid.
Homogeneous	The quality of uniform or representative composition. A homogenous (representative) sample is one which is collected and mixed to ensure representativeness prior to containerizing. Homogenous aliquots are also required to be used by the lab in extraction and analysis. Homogenization is not suitable for volatile organic samples, as mixing will deplete the levels of volatiles present.
Independent Standard	A standard that is composed of analytes from a different source (I.e., different manufacturer) than that used for initial calibration standards.

In-house	Within the laboratory's facility.
Initial Calibration Verification Standard	An Initial Calibration Verification (ICV) standard is an analytical standard prepared from a source independent of that used for calibration, run at the beginning of every analytical run, to verify the calibration of the analytical system. The concentration level is typically set at mid-range of the calibration curve, but may have other specifications based on method or client contract requirements.
Initial Demonstration of Analytical Capability	Initial Demonstration of Analytical Capability (IDC) is a procedure to establish the ability of an analyst, method, or technique to generate acceptable accuracy and precision. The procedure includes the addition of a specified concentration of the target analyte to each of four separate aliquots of laboratory pure water (IPRs). These are carried through the entire analytical procedure, and the percentage recovery and the standard deviation of the results are determined and compared to specified limits.
Initial Precision and Recovery Standards	Initial Precision and Recovery (IPR) standards are four aliquots of a standard at a prescribed concentration, are analyzed to initially establish the ability of an analyst, method, or technique to generate acceptable precision and accuracy. An IPR demonstration is performed the first time a method is used, any time the method or instrumentation is modified, and to certify a new or cross-training analyst on the procedure.
Instrumental Detection Level (IDL)	The analyte concentration that produces a signal greater than five times the signal/noise ratio of the instrument. This is determined by analysis of a standard solution of the analyte in reagent water (not processed through any prep methods) at a concentration of 3x-5x the estimated. IDL, measured on three nonconsecutive days, with seven consecutive measurements per day. The standard deviation obtained for these measurements is then multiplied by three to obtain the IDL concentration.
Interferents	Substances that affect the analysis for the compound or element of interest with either a positive or negative bias.
Internal Standards (IS)	Use of Internal Standards (IS) provides a method for quantifying chromatographic data, and permits correction for inefficiencies. A known amount (concentration) of one or more IS standard compounds is added to a sample prior to preparation and analysis. They are added to every standard blank, sample, matrix duplicate, matrix spike duplicate, etc. Quantitation of the target compounds is made by comparing the peak areas (or heights) of the targets to the areas of appropriate closely-eluting "added" internal standards. Response factors for each sample target relative to an appropriate internal standard are required, and are obtained by analysis of standard solutions containing the organic components and the internal standards.
Laboratory Control Sample	A Laboratory Control Sample is an uncontaminated, interference-free aliquot of sample matrix spiked with known amounts of analyte(s) from a source independent of the calibration standards. The LCS is analyzed using the same sample preparation, reagents, and analytical method as for samples. An LCS must accompany each batch of 20 or fewer prepared samples, per matrix. Aqueous LCSs are prepared using laboratory pure water, while soil/solid LCSs may be prepared using either standardized kiln fired sand, ACS reagent grade sodium sulfate, or a certified reference material (CRM). It's primary function is to verify that analysis is being performed in control. An LCS may also be used to establish intra-laboratory or analyst specific precision and bias.
Laboratory Pure Water	Distilled or deionized water or Type II reagent water which is free of contaminants that may interfere with the analytical test in question.

Level of Detection (LOD)	The analyte concentration in reagent water that produces a signal 2(1.645)s above the mean of blank analyses. This sets both Type I and Type II errors at 5%. May also be referred to as "lower level of detection" (LLD).
Level of Quantitation (LOQ)	The analyte concentration that produces a signal sufficiently greater than the blank that it can be detected within specified levels by laboratories during routine operating conditions. Typically it is the concentration that produces a signal 10s above the reagent water blank signal.
Linear (Dynamic) Range	The concentration range over which the analytical curve (instrument response) remains linear.
Log-in	The receipt and initial management of a sample or group of samples. Log-in generally involves acknowledging receipt at the lab by signing the chain of custody, documenting preservation characteristics, analyses requested (including methodology and/or special instructions), and entering the appropriate sample, reporting and invoice information into the laboratory information management system (LIMS), where it is assigned a discreet in-lab identification number or bar code.
Matrix	The predominant material of which the sample to be analyzed is composed. A sample matrix maybe either waste water, drinking water, soil/sediment, sludge, paint, oil, solid, etc. NOTE: "matrix" is not synonymous with "phase" (liquid or solid).
Matrix Interference	The influence of the sample matrix or sample components upon the ability to qualitatively identify and/or quantitatively measure analytes in environmental samples.
Matrix Spike	A Matrix Spike (MS) is prepared by adding a known amount of target analyte to a specified amount of sample matrix for which an independent estimate of target analyte concentration is available. Matrix spikes are used to determine the effect of the sample's matrix on a method's recovery efficiency for that analyte. Spikes may also be referred to as Laboratory Fortified Matrix (LFM) samples.
Matrix Spike Duplicate	A Matrix Spike Duplicate (MSD) is a second aliquot of the same sample as the matrix spike (MS), prepared and analyzed in the same manner as the MS, in order to determine the precision of the method. An MSD is a replicate of the MS. The relative percent difference (%RPD) between the MS and MSD results is calculated to estimate this precision.
Matrix, Air	Media used to retain the analyte of interest from an air sample such as sorbent tubes or summa canisters. Each medium shall be considered as a distinct matrix.
Matrix, Aqueous	Any water sample excluded from the definition of Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater and effluents.
Matrix, Biological Tissue	Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.
Matrix, Chemical Waste	A product or by-product of a industrial process that results in a matrix not previously defined.
Matrix, Drinking water	Any aqueous sample that has been designated a potable or potential potable water source.
Matrix, Non-Aqueous Liquid	Any organic liquid with <15% settleable solids.
Matrix, Solids	Includes soils, sediments, sludges and other matrices with >15% settleable solids (>10% Total Solids for landfarming applications).
Method Detection Level (MDL)	The method detection limit is defined as the minimum concentration of a substance that can be measured and reported with a 99% confidence that the analyte concentration is greater than zero and is determined from the analysis of a sample in a givin matrix containing the analyte. (Ref.-40CFR136 App. B).

Method of Standard Additions (MSA)	The Method of Standard Additions (MSA) may be required to compensate for matrix effects, but will not counteract spectral effects.. This technique should not be used for interferences which cause baseline shift. The MSA involves the addition of 3 increments of a standard solution (spikes) to sample aliquots of the same size from the same sample. The technique involves the analysis of the "unknown" sample and "unknown-plus-known-amounts of standard" with extrapolation of this internal calibration curve to the baseline. Measurements are made on the original sample and after each spike addition. The slope, x-intercept and y-intercept are determined by least-squares analysis. The analyte concentration is determined by the absolute value of the x-intercept. Ideally, the spike volume is low relative to the sample volume (approximately 10% of the volume). Also referred to as Standard Additions.
Objective Evidence	Any documented statement of fact, other information, or record, either quantitative or qualitative, pertaining to the quality of an item or activity, based on observations, measures, or tests that can be verified.
Percent Solids	The determination of the total dry solids in a sample aliquot (typically for soil samples) by drying a pre-weighed original aliquot in an oven at 105^0, measuring the weight after cooling, and expressing the dried weight as a percent of the wet weight. The percent total solids (%TS) is used to calculate expressions of individual analytes in the sample on a dry weight basis.
Performance Evaluation (PE) Sample	Generally, a single-blind sample submitted to the laboratory through a certifying agency or per client contract specifications. Inter-laboratory comparisons may be used in evaluating the performance, rather than recoveries against analyte true values in the PE sample.
Post-Digestion Spike	The Post-Digestion Spike (PDS) resembles a single-point Method of Standard Additions technique, with the addition of a known amount of standard to a single additional sample aliquot after digestion.
Practical Quantitation Limit (PQL)	The practical quantitation limit is the lowest level that can be *reliably* achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The PQL is highly dependent upon the sample matrix, and is by definition higher than the MDL.
Precision	Precision is a measure of the reproducibility of an analysis under a given set of conditions, regardless of the true value of the target analyte in a sample. The overall precision of a sampling event has both a sampling and an analytical component. Precision data will be assessed from the analysis of MSDs, LCS duplicates (if available), field duplicates, laboratory replicates, and split laboratory samples. Precision is expressed as either standard deviation or relative percent difference (RPD). RPD is calculated according to the following equation, where A and B represent duplicate sample results: RPD (%) = [A - B]/ ([A+B]/2) x 100
Prep Log	An official record of the sample preparation (digestion).
Preparation Batch	The Preparation (Prep) Batch is defined as a group of </= 20 field samples of similar matrix that are prepared together by the same person(s) using the same equipment, with the same method sequence, and same reagent lots, within the same period. The Prep Batch will contain all of the appropriate number and type of QC samples, as specified by the CTL QAPP, method, or client contract specifications.
Preservation	Methods used to retard degradation of chemical analytes within samples by inhibiting decomposition from biological action, chemical reactions, and reducing sorption effects. Methods include limiting headspace, chemical, acid, or base addition, protection from light, cooling, etc.
Procedure	A document that specifies or describes how an activity is to be performed. The document contains detailed, step-by-step descriptions of the sequence of actions to be followed in order to perform a given task. If followed in sequence, a procedure provides enough information that a trained person could complete the covered task without additional information. May also be referred to as a "protocol".
Qualitative Analysis	An analysis to determine the presence, absence or identity of a target analyte.
Quality Assessment	Procedure for determining the quality of laboratory measurements by use of data from internal and external quality control measures, including audits and PE results.

Quality Assurance (QA)	A system of documented procedures, measurements, audits, and corrective actions to ensure that all technical and reporting activities produce legally defensible data with a known and stated level of confidence.
Quality Assurance Manual (QAM)	A CTL document stating the quality policy, quality system and quality practices of the company. This may be also called a Quality Assurance Plan, Quality Plan, or Quality Manual. NOTE: The QAM may include by reference other documentation relating to the laboratory's quality arrangements.
Quality Control (QC)	Those quality assurance activities that specifically measure the performance of a process against defined standards in order to verify that it meets stated requirements. The set of measurements within a sample analysis methodology including calibration, CV/CB, MB, LCS, spikes, duplicates, etc. are examples of quality control activities (QCs). They are used to assure that the prep and analytical process is in control. QC standards are defined by the CTL QAPP, and method or client contract specifications.
Quality System	A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization, ensuring quality in its work processes, products, items, and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities.
Quantitative Analysis	An analysis to measure or determine the amount of a target analyte with measurable precision and accuracy.
Random Error	The deviation in any step in an analytical procedure that can be treated by standard statistical techniques.
Raw Data	Any original factual information from a measurement activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof that are necessary for the reconstruction and evaluation of the report of the activity or study recorded in a laboratory notebook, worksheets, records, memoranda, notes, or exact copies thereof, that are necessary for the reconstruction and evaluation of the report, activity, or study. Raw data may include photography microfilm or microfiche copies, computer printouts, magnetic media, including dictated observations, and recorded data from automated instruments. If exact copies of raw data have been prepared (e.g., tapes which have been transcribed verbatim, data and verified accurate by signature), the exact copy or exact transcript may be submitted.
Recovery	The numerical ratio of an amount of analyte measured by the laboratory method to that of the known amount (true value) of analyte present in a sample. Usually expressed as a percent recovery (%R).
Relative Percent Difference	A measure of precision that is calculated as the difference between two results, relative to their arithmetic mean, expressed as a percent.
Relative Standard Deviation (RSD)	Relative Standard Deviation (RSD) is a measure of precision that is calculated as the standard deviation(s) of a *set* of values, relative to their arithmetic mean (x), expressed as a percent. May also be referred to as "coefficient of variation".
Repeatability	The precision of repeated measurements made on subsamples of the same sample at the same laboratory at different times. This measurement may also be referred to as "reproducibility".

Replicate	Any number of representative aliquots (subsamples or splits from the same container) of the same sample matrix subjected to identical analytical procedure independently, in order to assess the precision. Duplicate analyses represent the smallest number of replicates (two) that can be performed. Precision is expressed through the calculation of average relative percent difference (% RPD).
Representativeness	Representativeness is the degree to which a field sample reflects a characteristic of the population of samples taken at a specific location and under a given set of environmental conditions. It may also be seen as a qualitative measure of the extent to which a sample(s) acquired from a medium describe the chemical characteristics of that medium.
Rounding Rules	The following are CTL-employed rules for the rounding of data: *A*. If the figure following those to be retained is less than 5, the figure is dropped, and the retained figures are kept unchanged. As an example, 11.443 is rounded off to 11.44. *B*. If the figure following those to be retained is greater than 5, the figure is dropped, and the last retained figure is raised by 1. As an example, 11.446 is rounded off to 11.45. *C*. If the figure following those to be retained is 5, and if there are no figures other than zeros beyond the five, the figure 5 is dropped, and the last-place figure retained is increased by one if it is an odd number or it is kept unchanged if an even number. As an example, 11.435 is rounded off to 11.44, while 11.425 is rounded off to 11.42. *D*. If a series of multiple operations is to be performed (add, subtract, divide, multiply), all figures are carried through the calculations, only then the final answer is rounded to the proper number of significant figures.
Sample Delivery Group (SDG)	A set of field samples received on the same day and at the same time that are grouped together on a chain of custody (COC) for purposes of analysis, tracking, and reporting. SDGs may have more specific definitions (number of samples, by matrix, etc.) depending upon the client contract specifications.
Sample Number	A unique identification number that is designated at the lab for each sample. The sample number appears in all references to the sample, on pertinent sample containers, raw data, reports, and invoices. The chain of custody must reference any field-assigned identifiers relative to the sample.
Sediment	Solid material settled from suspension in a liquid.
Sensitivity	The capability of a method or instrument to discriminate between small differences in analyte concentration. Sensitivity is usually expressed as the slope of the analytical curve, where the slope defines the functional relationship between instrument response and concentration.
Serial Dilution	When a new or unusual matrix is encountered, a series of tests is recommended prior to release of results to verify that no matrix effects are occurring. A 1:4 dilution (1:5 for CLP) is recommended to be run on the sample where the background concentration of the analyte is 10X IDL, with results from the diluted analysis agreeing within + 10% of the original determination.
Sludge	Solid, semisolid, or liquid waste generated from a municipal, commercial, or industrial waste treatment facility or wastewater treatment plant, waste supply treatment plant, or air pollution control facility exclusive of treated effluent from a wastewater treatment plant.
Soil	A natural aggregate of mineral grains, with or without organic materials, that can be separated by mechanical means.
Solution	A liquid mixture of two or more substances where one is dissolved in the other.
Solvent	Liquid that is capable of dissolving another substance. Solvents are used in analytical procedures to extract target analytes from sample matrices. Solvents may also be present in field samples due to their use in a number of manufacturing/industrial processes including the manufacture of paints and coatings for industrial and household purposes, equipment clean-up, and surface degreasing in metal fabricating industries.
Standard Deviation	The square root of the variance of a set of values.

Standard Operating Procedure (SOP)	A written document which details the method of an operation, analysis or action whose techniques and procedures are thoroughly prescribed, and which is accepted as the method for performing certain routine or repetitive tasks.
Statistically Significant	When the difference between a predicted and an observed value is so large that it is improbable that it could be attributed to chance.
Stock Standard	A standard solution which can be diluted to derive other standards of lower concentration, for the purposes of calibration, calibration verification, or method performance evaluation.
Surrogate	A Surrogate is a pure organic compound similar in chemical composition to analytes of interest, but which are not normally found in environmental samples (brominated, fluorinated, or isotopically labeled compounds). Surrogate standards are typically only run with organic (GC, HPLC, and GC/MS) analyses. They are added to EVERY blank, sample, MS, MSD, DUP, standard, etc. in order to evaluate the extraction and analytical process efficiency by measuring recovery. They may also provide additional reference chromatographic information for each sample matrix encountered.
Tentatively Identified Compounds (TICs)	Non-target compounds identified by GC/MS mass spectral library searches. These reported concentrations have a higher associated uncertainty than the reported target analyte concentrations.
Traceability	The ability to trace the history, development, application, or location of an entity by means of an unbroken chain of recorded identifications. In a calibration sense, Traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for quality of the project.
Trend Analysis	A process whereby performance data are collected, organized, displayed, and evaluated for changes over a period of time. Trend analysis is often an integral part of evaluating control chart information.
Validated Time of Sample Receipt (VTSR)	The date and time at which a sample or group of samples is received at the laboratory, as recorded on the COC, the shipper's delivery receipt, or the sample traffic report documentation. The VTS is used to determine sample holding times and data report due dates.
Variance	A measure of the dispersion of a series of results around their average. It is the sum of the squares of the individual deviations from the average of the results, divided by the number of results minus one.
Wet Weight	The weight of a sample aliquot including any original moisture (undried).

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED
ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

CT LABORATORIES
1230 LANGE CT.
BARABOO, WI 53913

NELAP ACCREDITED
ACCREDITATION NUMBER #100457

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Ron Turpin
Manager
Environmental Laboratory Accreditation Program

Scott D. Siders
Accreditation Officer
Environmental Laboratory Accreditation Program

Certificate No.: 001867
Expiration Date: 09/30/2008
Issued On: 10/04/2007

Page 1 of 5

State of Illinois
Environmental Protection Agency

Certificate No.: 001867

Awards the Certificate of Approval

CT Laboratories
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Baraboo, WI 53913

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Hazardous and Solid Waste, Inorganic

1010
Ignitability

1311
TCLP (Organic and Inorganic)

1312
Synthetic Precipitation Leaching Procedure

6010B

Aluminum	Antimony	Arsenic
Barium	Beryllium	Cadmium
Calcium	Chromium	Cobalt
Copper	Iron	Lead
Magnesium	Manganese	Molybdenum
Nickel	Potassium	Selenium
Silver	Sodium	Thallium
Vanadium	Zinc	

7041
Antimony

7060A
Arsenic

7196A
Chromium VI

7421
Lead

7470A
Mercury

7471A
Mercury

7740
Selenium

7761
Silver

7841
Thallium

9010B
Cyanide

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Hazardous and Solid Waste, Inorganic	*9012A*	
Cyanide		
9040B		
Hydrogen Ion (pH)		
9045C		
Hydrogen Ion (pH)		
9056		
Bromide	Chloride	Fluoride
Nitrate	Nitrite	Phosphate
Sulfate		
9065		
Phenolics		
9095A		
Paint Filter		
Chapter 7/9012A		
Reactive Cyanide		
Chapter 7/9034		
Reactive Sulfide		
Hazardous and Solid Waste, Organic		
8015B		
Diesel range organics (DRO)	Gasoline range organics (GRO)	
8081A		
4,4'-DDD	4,4'-DDE	4,4'-DDT
Aldrin	alpha-BHC	alpha-Chlordane
beta-BHC	Chlordane - not otherwise specified	delta-BHC
Dieldrin	Endosulfan I	Endosulfan II
Endosulfan sulfate	Endrin	Endrin aldehyde
Endrin ketone	gamma-BHC (Lindane)	gamma-Chlordane
Heptachlor	Heptachlor epoxide	Methoxychlor
Toxaphene		
8082		
PCB-1016	PCB-1221	PCB-1232
PCB-1242	PCB-1248	PCB-1254
PCB-1260		
8260B		
1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene
1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane
1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (EDB)	1,2-Dichlorobenzene	1,2-Dichloroethane
1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
1,3-Dichloropropane	1,4-Dichlorobenzene	2,2-Dichloropropane
2-Butanone (Methyl ethyl ketone, MEK)	2-Chloroethyl vinyl ether	2-Chlorotoluene
2-Hexanone	4-Chlorotoluene	4-Methyl-2-pentanone (Methyl isobutyl ketone

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Hazardous and Solid Waste, Organic	*8260B*	Acetone
Benzene	Bromobenzene	Bromochloromethane
Bromodichloromethane	Bromoform	Bromomethane
Carbon disulfide	Carbon tetrachloride	Chlorobenzene
Chlorodibromomethane (Dibromochloromethan	Chloroethane	Chloroform
Chloromethane	cis-1,2-Dichloroethene	cis-1,3-Dichloropropene
Dibromomethane	Dichlorodifluoromethane	Dichloromethane (Methylene chloride)
Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene
Methyl-t-butyl ether	m-Xylene	Naphthalene
n-Butylbenzene	n-Propylbenzene	o-Xylene
p-Isopropyltoluene	p-Xylene	sec-Butylbenzene
Styrene	tert-Butylbenzene	Tetrachloroethene
Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene
trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane
Vinyl acetate	Vinyl chloride	Xylenes (total)
8270C		
1,2,4,5-Tetrachlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene
1,2-Diphenylhydrazine	1,3-Dichlorobenzene	1,4-Dichlorobenzene
2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol
2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene (2,4-DNT)
2,6-Dichlorophenol	2,6-Dinitrotoluene (2,6-DNT)	2-Chloronaphthalene
2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol (o-Cresol)
2-Naphthylamine	2-Nitroaniline	2-Nitrophenol
3,3'-Dichlorobenzidine	3-Methylphenol (m-Cresol)	3-Nitroaniline
4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol
4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Methylphenol (p-Cresol)
4-Nitroaniline	4-Nitrophenol	Acenaphthene
Acenaphthylene	Acetophenone	Aniline
Anthracene	Benzidine	Benzo(a)anthracene
Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perlyene
Benzo(k)fluoranthene	Benzoic acid	Benzyl alcohol
Bis(2-chloroethoxy) methane	Bis(2-chloroethyl) ether	Bis(2-chloroisopropyl) ether
Bis(2-ethylhexyl)phthalate	Butyl benzyl phthalate	Carbazole
Chrysene	Dibenz(a,h)anthracene	Dibenzofuran
Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate
Di-n-octyl phthalate	Diphenylamine	Fluoranthene
Fluorene	Hexachlorobenzene	Hexachlorobutadiene
Hexachlorocyclopentadiene	Hexachloroethane	Hexachloropropene
Indeno(1,2,3-cd) pyrene	Isophorone	Naphthalene
Nitrobenzene	N-Nitrosodimethylamine	N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine	N-Nitrosopyrrolidine	Pentachlorophenol
Phenanthrene	Phenol	Pyrene
Pyridine		
8310		
Acenaphthene	Acenaphthylene	Anthracene
Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene

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Hazardous and Solid Waste, Organic	*8310*	Dibenz(a,h)anthracene
Fluoranthene	Fluorene	Indeno(1,2,3-cd) pyrene
Naphthalene	Phenanthrene	Pyrene
8330		
1,3,5-Trinitrobenzene (1,3,5-TBN)	1,3-Dinitrobenzene (1,3-DNB)	2,4,6-Trinitrotoluene (2,4,6-TNT)
2,4-Dinitrotoluene (2,4-DNT)	2,6-Dinitrotoluene (2,6-DNT)	2-Amino-4,6-dinitrotoluene (2-Am-DNT)
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
m-Nitrotoluene (3-Nitrotoluene, 3-NT)	Nitrobenzene	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocin
o-Nitrotoluene (2-Nitrotoluene, 2-NT)	p-Nitrotoluene (4-Nitrotoluene, 4-NT)	

Supplement A: Inorganic Analysis by Wet Chemistry

This supplement describes the quality control (QC) requirements, procedures, and measurements utilized in performing inorganic analyses by a variety of wet chemistry techniques. These techniques are those other than colorimetric autoanalyzer (Supplement B). The QC activities presented here are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SA 1.0 Data Quality Objectives

The general laboratory DQOs are listed in CTL QAM Section 1.2. How each of the general DQO categories are assessed for inorganic analyses and what are the nominal QC acceptance criteria for associated QC specifications, are described in the remainder of this section. Tables SA1 and SA2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical method and/or in the project plan.

SA 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see CTL QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see CTL QAM Section 4.4).

SA 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing MS samples, LCSs, and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SA1 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SA 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of matrix spike (MS) samples, and replicate analyses of laboratory control samples (LCS). Results from these measurements are compared to the criteria listed in Tables SA1 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SA 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in CTL QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SA1 or the project-specific RLs.

Table SA1. DQOs for Inorganic Analyses of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (mg/L)	Completeness[c] (%)
Alkalinity	90-110	80-120	≤ 20	20	100
Ammonia	90-110	80-120	≤ 20	1	100
BOD, 5-Day	Not applicable	Not applicable	≤ 20	2	100
Chlorophyll-a	Not applicable	Not applicable	≤ 20	6000	100
Color	Not applicable	Not applicable	≤ 20	5	100
Conductivity	Not applicable	Not applicable	≤ 20	1 uhmos/cm	100
Fluoride	90-110	80-120	≤ 20	0.8	100
Oil and Grease	90-110	80-120	≤ 20	1	100
pH	Not applicable	Not applicable	≤ 20	0.1	100
Residue – TDS	Not applicable	Not applicable	≤ 20	1	100
Residue – TS	Not applicable	Not applicable	≤ 20	1	100
Residue – TSS	Not applicable	Not applicable	≤ 20	1	100
Residue – TVS	Not applicable	Not applicable	≤ 20	1	100
Residue – TVSS	Not applicable	Not applicable	≤ 20	1	100
Sulfide	90-110	80-120	≤ 20	1	100
Turbidity	Not applicable	Not applicable	≤ 20	1	100

LCS = laboratory control sample MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ 10X MDL.
b. Typical values listed. Exact values depend on specific method.
c. Typical values listed. Exact values depend on specific method, compound and project.

SA 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SA 1.6 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SA 2.0 Method Requirements

SA 2.1 Criteria for Standards and Materials

Primary standards are purchased from the quality sources (e.g., Solutions Plus, VWR). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards, for calibration and QC measurements, are prepared from primary standards. Detailed instructions for preparation of secondary standards are

provided in the applicable CTL analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in CTL QAM Section 3.2. Additional material must meet the minimum requirements outlined in approved methods.

SA 2.2 Criteria for Instruments

All analytical instrumentation must meet all the requirements for the analytical method to be conducted (see CTL QAM Section 3.2.1) and must be equipped with the appropriate manifolds and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Instruments operation must always be in accordance with manufacturers' and methods' instructions, and performance criteria specified in the methods must be met before analysis of any samples.

SA 2.3 Criteria for Analysis

Wet chemistry analyses performed by the CTL laboratory may include both sample preparation/extraction methods and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the more frequently utilized techniques and methods are listed in the remainder of this section.

SA 2.3.1 Calibrated Methods

All calibrated methods involve the measurement of an initial analytical response of a standard or series of standards, and relating the response(s) mathematically to the concentration of analyte present in the sample. Most methods require multiple-point calibrations to be used. Calibration curves are characterized by upper and lower limits, and data is not reported outside these boundaries unless suitable dilution or concentration of the sample has been performed. All such manipulations are recorded and appropriately utilized in calculations of final results. In general, curve regressions for inorganic chemistry calibrated methods are linear, although multi-order curves may have applicability to some methods. All calibrations require initial and periodic verification using known standards from sources independent of the calibration standards. Details of calibration for specific methods may be found in the SOPs.

SA 2.3.1.1 Ammonia

The potentiometric method of ammonia analysis utilizes an ammonia combination electrode. The ammonia electrode is a combination pH electrode immersed in a solution which is seperated from the sample by a glass permeable membrane. Ammonia deffuses across the membrane until equilibrium between the sample and the internal filled solution is obtained. The response of the pH electrode to changes in hydrogen ion activity is related to the ammonia concentration in a NERSTIAN manner.

SA 2.3.1.2 Biochemical Oxygen Demand (BOD, 5-Day)

The method consists of filling with sample, to overflowing, and storing in airtight 300-mL glass and incubating it at 20^0C +/- 1^0C for 5 days. Dissolved oxygen is measured initially and after incubation, and the BOD is computed from the difference between initial and final DO measurements. A purchased commercial seed preparation is used to provide a population of microorganisms to oxidize the

biodegradable organic matter in the sample. A solution of glucose-glutamic acid is used as a control standard.

SA 2.3.1.3 Chlorophyll-a

A known volume of a water sample is filtered through a glass fiber filter. Chlorophyll-a present in the sample will be retained, in addition to other suspended material. The filter is extracted using a 90% acetone solution to dissolve the chlorophyll-a. Measure and record absorbances of sample at 750, 664, 647, and 630 nm. Calculate the chlorophyll-a concentration in the extract with the trichromatic formula. The chlorophyll-a concentration in the extract is then used to calculate the concentration in the original sample in mg/m^3.

SA 2.3.1.4 Color

Cobalt-platinum (Co-Pt) color, end-on visual comparison of the sample in matched color-comparison tubes, is made against a prepared series of standards.

SA 2.3.1.7 Conductivity (Specific Conductance)

The ability of a sample aliquot to carry an electric current (conductivity) is measured using a commercially available conductivity meter equipped with an electrode and temperature compensation mechanism. The meter is calibrated against standard KCl solutions spanning the measurement range of the meter. A calibration verification standard is required for each range used which contains reportable data.

SA 2.3.1.8 Fluoride

Fluoride is determined potentiometrically using a fluoride electrode in conjunction with a standard electrode and a pH meter, having an expanded millivolt scale. The fluoride electrode consists of a lanthanum fluoride crystal across which a potential is developed by fluoride ions. The concentration is thus arrived at based on the relative potentials of the calibration curve.

SA 2.3.1.9 pH

The activity of the hydrogen ion (H^+) is determined by potentiometric measurement using a standard glass hydrogen electrode and reference electrode. The electromotive force produced in the glass electrode system varies linearly with pH, and measurement in a sample is compared against a standard curve of buffers with different pH values.

SA 2.3.1.10 Sulfide

Sulfide is determined by adding excess iodine to a sample which has been treated with zinc acetate to produce zinc sulfide. The iodine oxidizes the sulfate to sulfur under acidic conditions. The excess iodine is back titrated with phenylarseine oxide to determine the relative concentration of sulfide in the sample.

SA 2.3.1.11 Turbidity

The method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity. Formazin polymer is used as the primary standard. A HACH nephelometer equipped with several ranges for measurement is used. Each range is calibrated with a single standard. Standards may be prepared fresh, in-house, with each use, although some "permanent" standards are also available. Permanent standard concentrations are verified annually.

SA 2.3.2 Titrated Methods

Titration generally involves two chemical species which combine in a known ratio when both are present in solution. If the concentration of one species is known (titrant), the concentration of the other (analyte) can be determined by use of an endpoint indicator and addition of the titrant until the endpoint is detected. The volume of titrant used, together with the combination ratio of the species, allows the calculation of the analyte concentration.

SA 2.3.2.1 Alkalinity

Hydroxyl ions present in a sample as a result of dissociation or hydrolysis of solutes react with additions of standard acid. Titration of the sample aliquot with sulfuric acid of standardized concentration to a pre-selected pH using a standard pH electrode is performed.

SA 2.3.3 Gravimetric Methods

Gravimetric techniques employ a sample preparation which results in a solid residue that is or contains the analyte of interest. The residue is dried, desiccated, and weighed. The concentration of the analyte in the original sample is then calculated using the dried residue weight and the initial sample volume (to obtain mg/L) or initial sample wet weight (to obtain % of total solids).

SA 2.3.3.1 Solids (Residues)

The total solids fraction of a sample is determined by driving off the aqueous fraction of a pre-characterized sub-sample and weighing the residue that remains. Pre-characterization may involve either taking a initial "wet" weight for expression as TS%, or an initial volume measurement for expression as mg/L TS. Solid matter in waters, either suspended or dissolved, is measured through filtration followed by appropriate analysis of either the weight retained on the filter (total suspended solids or TSS), or the weight obtained after drying the filtrate (total dissolved solids or TDS). Total volatile solids (TVS) or total volatile suspended solids (TVSS) fractions may also be determined from either total solids (TS) or total suspended solids (TSS) by heating the appropriate residues at 500^0C, and quantifying the weight loss in the desired units.

SA 2.3.3.2 Oil and Grease

A separately collected sample is preserved to pH< 2 with sulfuric acid, and the entire sample is serially extracted three times with trichlorotrifluroethane in a separatory funnel. The extract is dried, solvent evaporated and the resulting residue is weighed. Results are expressed in mg/L, based on the intial sample volume.

SA 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in standard operating procedures and appropriate instrument maintenance manuals. The applicable Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as required. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SA 4.0 Instrument Calibration and Frequency

Specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the analytical SOP for each method.

General calibration requirements of inorganic analyses are summarized in Table SA3. As previously stated, calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Table SA3 and corrective actions if requirements are not satisfied are applicable to all calibrated analytical methods. An instrumental analysis batch includes all samples and QC from prep batches contained in an instrumental analytical run, as well as calibration and instruement performance monitoring QC as addressed in Table SA3.

Table SA3. General Calibration Requirements for Inorganic Calibrated Methods

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Three-point to five-point initial calibration plus blank (ICAL)	Initially and as needed	$r \geq 0.995$ for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	Second source, %R: 90-110% for all analytes	Remake and reanalyze ICV standard once, if still unacceptable repeat ICAL
Initial calibration blank (ICB)	After each ICV, prior to sample analysis	< MDL	Remake and reanalyze CB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or repeat ICAL.
Continuing calibration verification (CCV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R: 90-110% for all analytes	Remake and reanalyze CCV once, if still unacceptable investigate and correct problem, cannot proceed until valid CCV obtained or ICAL repeated.
Continuing calibration blank (CCB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	< MDL	Remake and reanalyze CCB once, if still unacceptable investigate and correct problem, cannot proceed until valid CCB obtained or ICAL repeated.

%R = percent recovery
RSD = relative standard deviation
MDL = method detection limit

SA 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all inorganic analyses, as applicable. The QA Coordinators and Analytical Section Managers are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Analytical Section Managers are responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SA4. Analytical QC samples are associated with field samples through the use of both instrumental analysis and preparation batches. A preparation or "prep" batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A prep batch must not exceed 20 field samples and must also contain all applicable preparation associated QC samples described below. More specific criteria are provided in the analytical method SOPs.

SA 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be acceptably demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses of a known standard and achieve precision and accuracy equal to or better than those listed in the method. In the absence of method criteria, the general criteria listed in Table SA4 are used.

SA 5.2 Blanks

A method blank (MB) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The MB is analyzed at the beginning of every analytical run and prior to the analysis of any samples. MB results are acceptable if the concentrations of the target analyte are not higher than the highest of ether the method detection limit, or five percent of the regulatory limit, or five percent of the measured concentration in the associated sample(s). If any target analyte concentration in the MB exceeds the criteria, the source of contamination must be identified and eliminated. Analysis of samples cannot proceed until a compliant MB is obtained.

SA 5.3 Duplicates

A duplicate sample (DUP) or duplicate matrix spike sample (MSD) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD), must be within the in-house determined acceptance ranges listed or project specified limits.

If the QC criteria for duplicate sample or spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SA 5.4 Matrix Spikes

Spikes (MS) are prepared every 20 field samples for each matrix, depending on the specific method or project requirements. Spike recoveries must fall within the in-house determined acceptance ranges listed or project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SA 5.5 Laboratory Control Samples

A laboratory control sample (LCS) is prepared at a frequency of one per every 20 field samples depending on the specific method or project requirements. The LCS results are acceptable if the percent recovery of each analyte is within the in-house determined acceptance range listed or project specified limits. If the LCS results do not meet specification, sample analyses must be stopped until the problem is corrected, and all associated samples in the analysis batch must be reanalyzed.

SA 5.6 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results is received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem. All findings must be documented and available for review.

Table SA4. Summary of QC Requirements for Inorganic Analyses

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration sample (IDC)	Four (4) prepared samples analyzed one time prior to any sample analyses	Method criteria for accuracy and precision, default ±20%	Retrain and repeat until acceptable
Method Blank (MB)	One (1) per analytical batch	< MDL, or 5% of the concentration in the associated samples, or 5% of the regulatory limit (highest of)	Halt analysis, take corrective action as needed to obtain acceptable criteria and reanalyze MB.
Laboratory control sample (LCS)	One (1) per analytical batch	In-house derived limits or 90% $\leq$ %R $\leq$ 110%, which ever is tighter or applicable	Halt analysis, take corrective action as needed to obtain acceptable criteria, reanalyze LCS.
Sample duplicate (DUP) or matrix spike duplicate (MSD)	One (1) per analytical batch	In-house derived limits or RPD $\leq$ 20% if analytes > MDL, which ever is tighter or applicable	Investigate problem, if LCS is in control the problem is judged to be matrix or solution related
Matrix spike sample (MS)	One (1) per analytical batch	In-house derived limits or 80% $\leq$ %R $\leq$ 120%, which ever is tighter or applicable	Investigate problem, if LCS is in control the problem is judged to be matrix or solution related.
Blind performance evaluation sample (PE)	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

%R = percent recovery
MDL = method detection limit
RPD = relative percent difference

SA 6.0 Data Management

SA 6.1 Data Generation

Sample analyses at the laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see SB5.0).

SA 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis.

Deviations from the specified data reduction procedures are permitted only with approval of the applicable Analytical Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SA 6.3 Data Validation

As stated in QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary.
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is and archived in the associated data package/file.

SA 6.4 Data Reporting

After peer review of the data is completed, and the results approved, a report is generated. The applicable Project Manager (PM) reviews the report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections. The final report is signed by the PM before it is submitted to the customer. Each final report has a unique identification number, the CTL Folder No., listed in the upper right hand corner of the report.

The laboratory offers four levels of data reports (illustrated in QAM Table 7-1). For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide a copy of the analysis data and any related narrative comments to Project Management, where the completed package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of 5 years, or longer if requested by the client. These records are stored in the laboratory facility for about one year then transferred to another building for secure, long term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. The LIMS is maintained on-site by CTL's Information System personnel. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement B: Inorganic Analysis by Colorimetric Autoanalyzer

This supplement describes the quality control (QC) requirements, procedures, and measurements utilized in performing colorimetric analyses by autoanalyzers, specifically the Lachat QuikChem 4 and AE. These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SB 1.0 Data Quality Objectives

The general laboratory DQOs are listed in CTL QAM Section 1.2. How each of the general DQO categories are assessed for inorganic analyses by autoanalyzer, and what are the nominal QC acceptance criteria for associated QC specifications, are described in the remainder of this section. Tables SB1 and SB2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical method and/or in the project plan.

SB 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see CTL QAM Section 3.2.1), and completing the analysis within the applicable analysis holding time (see CTL QAM Section 4.4).

SB 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing MS samples, LCSs, and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SB1 and SB2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SB 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of matrix spike (MS) samples, and replicate analyses of laboratory control samples (LCS). Results from these measurements are compared to the criteria listed in Tables SB1 and SB2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SB 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in CTL QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SB1 and SB2 or the project-specific MDLs.

Table SB 1. DQOs for Inorganic Analyses by Autoanalyzer of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (mg/L)	Completeness[c] (%)
Alkalinity, as $CaCO_3$	90-110	80-120	$\leq$ 20	20	100
Ammonia, as N	90-110	80-120	$\leq$ 20	0.1	100
Chloride	90-110	80-120	$\leq$ 20	0.5	100
Chromium (Hexavalent)	90-110	80-120	$\leq$ 20	12	100
Cyanide	90-110	80-120	$\leq$ 20	0.005	100
Hardness, as $CaCO_3$	90-110	80-120	$\leq$ 20	20	100
Nitrate	90-110	80-120	$\leq$ 20	2	100
Nitrite	90-110	80-120	$\leq$ 20	0.2	100
Phenolics	60-140	60-140	$\leq$ 40	0.005	100
Phosphorus	90-110	80-120	$\leq$ 20	0.1	100
Sulfate	90-110	80-120	$\leq$ 20	1	100
Total Kjeldahl Nitrogen	90-110	80-120	$\leq$ 20	0.2	100

LCS = laboratory control sample MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations $\geq$ 10X MDL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound and project.

Table SB 2. DQOs for Inorganic Analyses by Autoanalyzer of Solid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (mg/kg)	Completeness[c] (%)
Ammonia, as N	90-110	80-120	≤ 20	1	100
Cyanide	90-110	80-120	≤ 20	0.7	100
Chromium (Hexavalent)	90-110	80-120	≤ 20	12	100
Nitrate	90-110	80-120	≤ 20	20	100
Nitrite	90-110	80-120	≤ 20	2	100
Phenolics	60-140	60-140	≤ 40	0.25	100
Sulfate	90-110	80-120	≤ 20	10	100
Total Phosphorus (non-Ortho)	90-110	80-120	≤ 20	0.7	100
Total Kjeldal Nitrogen	90-110	80-120	≤ 20	20	100

LCS = laboratory control sample MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation % R = percent recovery
a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ 10X MDL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound and project.

SB 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SB 1.6 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SB 2.0 Method Requirements

SB 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g., ERA). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in CTL QAM Section 3.2. Additional material must meet the minimum requirements outlined in approved methods.

SB 2.2 Criteria for Instruments

The colorimetric autoanalyzer instrument must meet all the requirements for the analytical method to be conducted (see CTL QAM Section 3.2.1) and must be equipped with the appropriate manifolds and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Instruments operation must always be in accordance with manufacturers' and methods' instructions, and performance criteria specified in the methods must be met before analysis of any samples.

SB 2.3 Criteria for Analysis

Colorimetric autoanalyzer (Lachat) analyses performed by the CTL laboratory include sample preparation/extraction and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section.

SB 2.3.1 Alkalinity

Methyl orange is used as a color indicator for determining alkalinity colorimetrically. Use of this indicator allows comparability to the equivalence point for alkalinity determined by titration. The methyl orange indicator is prepared in a dilute pH 3.1 buffer, which is just below its color change pH. When an alkaline sample is injected, the poorly buffered methyl orange changes color in proportion to the change in pH of the weak buffer, and thus proportional to the alkalinity of the sample, when measured at 550 nm.

SB 2.3.2 Ammonia

Based on the Berthelot reaction, ammonia reacts with alkaline phenol, then with sodium hypochlorite to form indophenol blue. Sodium nitroprusside (nitroferricyanide) is added to enhance sensitivity.The absorbance of the reaction product is directly proportional to the original ammonia concentration in the sample, when measured at 630 nm.

SB 2.3.3 Chloride

Thiocyanate ion is liberated from mercuric thiocyanate by the formation of soluble mercuric chloride. In the presence of ferric ion, free thiocyanate ion forms the highly colored ferric thiocyanate, of which the absorbance, 480 nm, is proportional to the chloride concentration.

SB 2.3.4 Chromium (Hexavalient)

Hexavalent chromium is determined colormetrically by reaction with diphenylcarbizide in acidic solution, producing a red-violet color. The absorbance of the reaction product is directly proportional to the in the sample, when measured at 540 nm.

SB 2.3.5 Cyanide

Cyanide in the form of hydrocyanic acid (HCN) is released from cyanide complexes in samples by way of a manual reflux-distillation. The gaseous HCN produced is absorbed in a scrubber containing sodium hydroxide solution. The CN^- ion in the trapping solution

is converted to cyanogen chloride through reaction with Chloramine-T. This subsequently reacts with pyridine and barbituric acid to give a red-blue color complex, which absorbs at 570 nm.

SB 2.3.6 Hardness

Disodium magnesium EDTA is used to exchange magnesium on an equivalent basis for calcium and/or any other cation which forms a more stable EDTA chelate than magnesium. Non-chelated magnesium is then reacted with calmagite at a pH of 10.0 to form a red-violet complex with a maximum absorbance at 520 nm.

SB 2.3.7 Nitrate and/or Nitrite

Nitrate is reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide, followed by coupling with N-(1-naphyl)ethylenediamine dichloride. The resulting water soluble dye has a magenta color which is read at 520 nm. Nitrate alone can be determined by the same analysis, without the cadmium reduction column. Both analysis run in combination will the produce information for nitrite calculated concentration.

SB 2.3.8 Phenolics

Volatile phenolic compounds are separated from the sample matrix by distillation. The distillate is collected and analyzed colorimetrically, at 500 nm. Phenol, ortho- and meta-substituted phenols, and para-substituted phenols, where the para-group is a carboxyl, halogen, methoxyl, or sulfuric acid group, are all determined by a reaction with 4-aminoantipyrine. Para-cresol, and para-substituted phenols where the group is an alkyl, aryl nitro, benzoyl, nitroso, or aldehyde group are *not* determined.

SB 2.3.9 Phosphorus

Conversion of polyphosphates and organic phosphorus to orthophosphate is done through sulfuric acid and persulfate digestion. Existing orthophosphate can be measured without digestion. Orthophosphate ion (PO_4^{3-}) reacts with ammonium molybdate and antimony potassium tartrate under acidic conditions to form a complex. This complex is reduced with ascorbic acid to form a blue complex which absorbs light at 880 nm. The absorbance is directly proportional to the concentration of orthophosphate, and thus total converted phosphorus, in the sample.

SB 2.3.10 Sulfate

Interfering multivalent metal ions are removed with the use of a sodium form cation exchange column. The remaining sulfate is then reacted with an alcohol solution of barium chloride and methylthymol blue, at a pH of 2.5 – 3, to form barium sulfate. The combined solution is then raised to pH 12.5 – 13 so that excessive barium reacts with methylthymol blue, and measured at 460 nm. Initially, the barium and methylthymol blue are equimolor, equivalent to 300 mg sulfate / L, thus the amount of uncomplexed methylthymol blue is equal to the sulfate present.

SB 2.3.11 Total Kjeldahl Nitrogen

The preparatory digestion converts nitrogen components of biological origin (amino acids, proteins, peptides) to ammonia. It may *no*t convert the nitrogenous compounds of som industrial wastes (amines, nitor compounds, hydrazones, oximes, semicarbazones and some refractory tertiary amines). Ammonia is then measured colorimetrically through formation of indophenol blue (SB 2.3.2)

SB 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in standard operating procedures and appropriate instrument maintenance manuals. The applicable Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SB 4.0 Instrument Calibration and Frequency

Specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP for each method.

General calibration requirements of inorganic analyses by Lachat are summarized in Table SB3. As previously stated, calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Table SB3 and corrective actions if requirements are not satisfied are applicable to all autoanalyzer analytical methods.

SB 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all autoanalyzer analyses. The QA Coordinators and Analytical Section Managers are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Analytical Section Managers are responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SB4. Analytical QC samples are associated with field samples through the use of analysis batches. An analysis batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. An analysis batch must not exceed 20 field samples. More specific criteria are provided in the analytical method SOPs ..

Table SB 3. Autoanalyzer (Lachat) Calibration Requirements

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Three-point or five-point initial calibration plus blank (ICAL)	Initially and as needed	≤ 20% RSD for individual response factors or r ≥0.99 for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	Second Source, %R 90-110% for all analytes	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	< MDL	Remake and reanalyze ICB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or repeat ICAL
Calibration verification (CV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 90-110% for all analytes	Remake and reanalyze CV once, if still unacceptable investigate and correct problem, cannot proceed until valid CV obtained or ICAL repeated
Continuing calibration blank (CCB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	< MDL	Remake and reanalyze ICB once, if still unacceptable investigate and correct problem, cannot proceed until valid CCB obtained or repeat ICAL

%R = percent recovery
RSD = relative standard deviation
MDL = method detection limit

SB 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be acceptably demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses and achieve precision and accuracy equal to or better than those listed in the method. In the absence of in-house determined criteria, the general criteria listed in Table SB4 are used.

SB 5.2 Blanks

A method blank (MB) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The MB is analyzed at the beginning of every analytical run and prior to the analysis of any samples. MB results are acceptable if the concentrations of the target analyte are not higher than the highest of either the method detection level, or five percent of the regulatory level, or five percent of the measured concentration in the associated sample(s). If any target analyte concentration in the MB exceeds the criteria, the source of contamination must be identified and eliminated. Analysis of samples cannot proceed until a compliant MB is obtained.

SB 5.3 Duplicates

A duplicate sample (DUP) or duplicate matrix spike sample (MSD) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD), must be within the in-house determined acceptance ranges or project specified limits.

If the QC criteria for duplicate sample or spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SB 5.5 Matrix Spikes

Spikes (MS) are prepared every 20 field samples depending on the specific method or project requirements. Spike recoveries must fall within the in-house determined acceptance ranges or project specified limits.If the QC criteria for the matrix spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SB 5.6 Laboratory Control Samples

A laboratory control sample (LCS) is prepared at a frequency of one per every 20 field samples depending on the specific method or project requirements. The LCS results are acceptable if the percent recovery of each analyte is within the in-house determined acceptance range or project specified limits. If the LCS results do not meet specification, sample analyses must be stopped until the problem is corrected, and all associated samples in the analysis batch must then be reanalyzed.

SB 5.7 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results is received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem. All findings must be documented and available for review.

Table SB 4. Summary of QC Requirements for Autoanalyzer Analysis

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration sample (IDC)	Four (4) prepared samples analyzed one time prior to any sample analyses	Method criteria for accuracy and precision, default ±20%	Retrain and repeat until acceptable.
Method blank (MB)	Daily, prior to sample analysis	< MDL, or 5% of the concentration in the associated samples, or 5% of the regulatory limit (highest of)	Halt analysis, take corrective action as needed to obtain acceptable criteria and reanalyze MB.
Laboratory control sample (LCS)	One (1) per analytical batch	In-house derived limits or 90% ≤ %R ≤ 110%, which ever is tighter or applicable	Halt analysis, take corrective action as needed to obtain acceptable criteria, reanalyze LCS.
Sample duplicate (DUP) or matrix spike duplicate (MSD)	One (1) per analytical batch	In-house derived limits or RPD ≤ 20% if analytes > MDL, which ever is tighter or applicable	Investigate problem, if LCS is in control the problem is judged to be matrix or solution related.
Matrix spike sample (MS)	One (1) per analytical batch	In-house derived limits or 80% ≤ %R ≤ 120%, which ever is tighter or applicable	Investigate problem, if LCS is in control the problem is judged to be matrix or solution related.
Blind performance evaluation sample	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

%R = percent recovery
RPD = relative percent difference
MDL = method detection level

SB 6.0 Data Management

SB 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see SB5.0).

SB 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis

Deviations from the specified data reduction procedures are permitted only with approval of the applicable Analytical Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SB 6.3 Data Validation

As stated in CTL QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary.
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented and archived in the associated data package/file.

SB 6.4 Data Reporting

After peer review of the data is completed, and the results approved, a report is generated. The applicable Project Manager (PM) reviews the report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections. The final report is signed by the PM before it is submitted to the customer. Each final report has a unique identification number, the CTL Folder No., listed in the upper right hand corner of the report.

The laboratory offers four levels of data reports (illustrated in QAM Table 7-1). For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide a copy of the analysis data and any related narrative comments to Project Management, where the completed package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of 5 years, or longer if requested by the client. These records are stored in the laboratory facility for about one year then transferred to another building for secure, long term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. The LIMS is maintained on-site by CTL's Information System personnel. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement C: Inorganic Analysis by Ion Chromatography

This supplement describes the quality control (QC) requirements, procedures, and measurements utilized in performing analysis for inorganic anions by ion chromatography. These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SC 1.0 Data Quality Objectives

The general laboratory DQOs are listed in CTL QAM Section 1.2. How each of the general DQO categories are assessed for inorganic analyses by ion chromatography, and what are the nominal QC acceptance criteria for associated QC specifications, are described in the remainder of this section. Tables SC1 and SC2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical and/or in the project plan.

SC 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see CTL QAM Section 3.2.1), and completing the analysis within the applicable analysis holding time (see CTL QAM Section 4.4).

SC 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing MS samples, LCSs, and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SC1 and SC2 or, if more specific criteria apply, to that listed in the applicable method's DVC. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SC 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of matrix spike (MS) samples, and replicate analyses of laboratory control samples (LCS). Results from these measurements are compared to the criteria listed in Tables SC1 and SC2 or, if more specific criteria apply, to the criteria in the applicable method's data validation checklist (DVC). These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SC 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in CTL QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SC1 and SC2 or the project-specific MDLs.

Table SC1. DQOs for Inorganic Analyses by Ion Chromatography of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (mg/L)	RL[c] (mg/L)	Completeness (%)
Bromide	90-110	80-120	≤ 20	0.1	30	100
Chloride	90-110	80-120	≤ 20	0.2	10	100
Fluoride	90-110	80-120	≤ 20	0.2	0.8	100
Nitrate as N	90-110	80-120	≤ 20	0.01	2	100
Nitrite as N	90-110	80-120	≤ 20	0.01	0.2	100
Ortho-Phosphate as P	90-110	80-120	≤ 20	0.5	1	100
Sulfate	90-110	80-120	≤ 20	0.5	1	100

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound, and project.

LCS = laboratory control sample
% R = percent recovery
MS = matrix spike
% RSD = percent relative standard deviation
RPD = relative percent difference
MDL = method detection limit
RL = reporting limit

Table SC2. DQOs for Inorganic Analyses by Ion Chromatography of Solid Sample Extracts

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (mg/kg)	RL[c] (mg/kg)	Completeness (%)
Chloride	90-110	80-120	≤ 20	2	200	100
Fluoride	90-110	80-120	≤ 20	2	5	100
Nitrate as N	90-110	80-120	≤ 20	0.1	1	100
Nitrite as N	90-110	80-120	≤ 20	0.1	1	100
Ortho-Phosphate as P	90-110	80-120	≤ 20	5	10	100
Sulfate	90-110	80-120	≤ 20	5	50	100

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound, and project.

LCS = laboratory control sample
% R = percent recovery
MS = matrix spike
% RSD = percent relative standard deviation
RPD = relative percent difference
MDL = method detection limit
RL = reporting limit

SC 1.5 Quantitation/Reporting Limits

The capability to quantitate analytes at or below the limit of quantitation (LOQ) and/or reporting limit (RL) concentrations listed in Tables SC1 and SC2, or project-specified limits, is demonstrated by annual determination or verification of MDLs and by setting the concentration of at least one calibration standard at or below the LOQ/RL for each analyte.

SC 1.6 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SC 1.7 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SC 2.0 Method Requirements

SC 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g. Fisher Scientific). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in CTL QAM Section 3.2. Other materials used must meet the minimum requirements outlined in the approved methodology.

SC 2.2 Criteria for Instruments

Ion chromatographic instruments must meet all the requirements for the analytical method to be conducted (see CTL QAM Section 3.2.1) and must be equipped with the appropriate columns, supressors, and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Instruments operation must always be in accordance with manufacturers' and methods' instructions, and performance criteria specified in the methods must be met before analysis of any samples.

SC 2.3 Criteria for Analysis

Ion chromatography analyses performed by the CTL laboratory include sample preparation/extraction and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized follow in the remainder of this section.

A small volume of sample, typically 5 mL, is introduced into the ion chromatograph (Dionex DX-120) using an autosampler. The anions of interest (bromide, chloride, fluoride, nitrate, nitrite, *ortho*-phosphate and sulfate) are separated and measured using a system comprised of a guard column, analytical separation column, suppression device, and a conductivity detector. The mobile phase used is an eluent solution with a concentration of 1 mM sodium bicarbonate and 3.2 mM sodium carbonate in reagent water. The pump flow rate for the system is 2.00 mL/min.

Anion measurements in soils and solids involves a water extraction using five grams of the solid sample mixed with 50 mL of reagent water. The sample/water slurry is mixed for thirty minutes, then filtered through a 0.45 um membrane filter, and analyzed.

SC 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The applicable Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SC 4.0 Instrument Calibration and Frequency

Specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP and data validation checklist for each method.

General calibration requirements of inorganic analyses by ion chromatography are summarized in Table SC3. As previously stated, calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Table SC3 and corrective actions if requirements are not satisfied are applicable to all ion chromatography analytical methods.

SC 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all ion chromatography analyses. The QA Coordinators and Analytical Section Managers are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Analytical Section Managers are responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SC4. Analytical QC samples are associated with field samples through the use of preparation or "prep" batches. A prep batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A prep batch must not exceed 20 field samples. More specific criteria are provided in the analytical method SOPs and data validation checklists.

Table SC3. Ion Chromatograph Calibration Requirements

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Three-point or five-point initial calibration plus blank (ICAL)	Initially and as needed	$\leq$ 20% RSD for individual response factors or r$\geq$0.99 for regression line	Repeat until acceptable
Calibration Check Standard	After each ICAL, prior to sample analysis	%R 90-110% for all analytes	Remake and reaanalyze calibration check standard once, if still unacceptable repeat ICAL
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	Second source material, %R 90-110% for all analytes	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	< RL	Remake and reaanalyze ICB standard once, if still unacceptable repeat ICAL
Calibration verification (CV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 90-110% for all analytes	Remake and reanalyze CV once, if still unacceptable investigate and correct problem, cannot proceed until valid CV obtained or ICAL repeated
Calibration Blank (CB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	< RL	Remake and reanalyze CB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or ICAL repeated

%R = percent recovery
RSD = relative standard deviation

SC 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be acceptably demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses of a known standard and achieve precision and accuracy equal to or better than the most recent in-house determined acceptance ranges for laboratory duplicates and laboratory control samples, respectively. In the absence of in-house determined criteria, the general criteria listed in Table SC4 are used.

SC 5.2 Blanks

A method blank (MB) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The MB is analyzed at the beginning of every analytical run and prior to the analysis of any samples. MB results are acceptable if the concentrations of the target analyte does not exceed the reporting limit (RL). If any target analyte concentration in the MB exceeds the RL, the source of contamination must be identified and eliminated. Analysis of samples cannot proceed until a compliant MB is obtained.

SC 5.3 Duplicates

A duplicate sample (DUP) or duplicate matrix spike sample (MSD) is prepared at a frequency of one per 20 field samples depending on the specific method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD), must be within the in-house determined acceptance ranges listed in the data validation checklist or project specified limits.

If the QC criteria for duplicate sample or spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

Table SC4. Summary of QC Requirements for Ion Chromatography Analysis

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration sample (IDC)	Four (4) prepared samples analyzed one time prior to any sample analyses	In-house determined criteria for LCS recovery and duplicate precision	Repeat until acceptable
Method blank (MB)	Daily prior to sample analysis	Analytes < RL	Clean analytical system, repeat until MBs are in control
Sample duplicate (DUP) or matrix spike duplicate (MSD)	One (1) per analytical batch	In-house derived limits Default: RPD $\leq$ 20% if analytes > RL	Investigate problem, if system precision in control qualify results, if system precision out of control reanalyze entire batch
Matrix spike sample (MS)	One (1) per analytical batch	In-house derived limits Default: 80% $\leq$ %R $\leq$120%	Investigate problem, if system accuracy in control qualify results, if system accuracy out of control reanalyze entire batch
Laboratory control sample (LCS)	One (1) per analytical batch	Second source material, 90% $\leq$ %R $\leq$ 110%	Halt analysis, fix problem, repeat associated sample analyses
Blind performance evaluation sample (PE)	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results

%R = percent recovery RPD = relative percent difference
RL = reporting limit

SC 5.5 Matrix Spikes

Spikes (MS) are prepared every 20 field samples depending on the specific method or project requirements. Spike recoveries must fall within the in-house determined acceptance ranges listed in the data validation checklist or project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause of the problem must be determined and corrected. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SC 5.6 Laboratory Control Samples

A laboratory control sample (LCS) is second-source to the calibration standards and must be analyzed at a frequency of one per every 20 field samples depending on the specific method or project requirements. The LCS results are acceptable if the percent recovery of each analyte is within the in-house determined acceptance range listed in the data validation checklist or project specified limits. If the LCS results do not meet specification, sample analyses must be stopped until the problem is corrected, and all associated samples in the analysis batch must then be reanalyzed.

SC 5.7 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results is received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem. All findings must be documented and available for review.

SC 6.0 Data Management

SC 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see SB5.0).

SC 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis. The analyst then enters the results for both samples and QC measurements into the laboratory information management system (LIMS).

Deviations from the specified data reduction procedures are permitted only with approval of the applicable Analytical Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SC 6.3 Data Validation

As stated in CTL QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary, and completed data validation checklist
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented with a signed data validation checklist. The checklist is archived in the associated data package/file.

SC 6.4 Data Reporting

After peer review of the data is completed as described in Section SC6.3 and the results are approved, the analyst approves the result in LIMS and a report is generated. The applicable Project Manager (PM) reviews the report (CTL QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections. The final report (CTL QAM Exhibit 7-2) is signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Lab No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports (illustrated in QAM Table 7-1). For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 10 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. The LIMS is maintained on-site by CTL's Information System personnel. Full server backups are performed nightly. Other electronic data including instrument magnetic tape media are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement D: Metals Analysis

This supplement to the CTL's Quality Assurance Program Plan (QAM) describes the quality control (QC) requirements, procedures, and measurements utilized in performing metals analyses by cold vapor atomic absorption (CVAA), graphite furnace atomic absorption (GFAA), and inductivety coupled plasma (ICP). These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SD 1.0 Data Quality Objectives

The general laboratory DQOs are listed in Section 1.2 of the CTL QAM. How each of the general DQO categories are assessed for metals analyses by CVAA, GFAA, and ICP and what are the nominal QC acceptance criteria for associated QC specifications are described in the remainder of this section. Tables SD-1 and SD-2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical method and/or in the project plan.

SD 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see QAM Section 4.4).

SD 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing matrix spike (MS) samples, laboratory control samples (LCSs), and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SD-1 and SD-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SD 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of MS samples, and replicate analyses of LCSs. Results from these measurements are compared to the criteria listed in Tables SD-1 and SD-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

Table SD-1. DQOs for Metals Analyses of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/L)	Completeness (%)
Mercury by CVAA	80-120	75-125	≤20	0.2	100
Metals by FLAA					
Potassium	80-120	75-125	≤20	10	100
Sodium	80-120	75-125	≤20	30	100
Metals by GFAA					
Antimony	80-120	75-125	≤20	3	100
Arsenic	80-120	75-125	≤20	1	100
Beryllium	80-120	75-125	≤20	0.2	100
Cadmium	80-120	75-125	≤20	0.1	100
Chromium	80-120	75-125	≤20	1	100
Copper	80-120	75-125	≤20	1	100
Lead	80-120	75-125	≤20	1	100
Selenium	80-120	75-125	≤20	0.6	100
Silver	80-120	75-125	≤20	0.2	100
Thallium	80-120	75-125	≤20	1	100
Metals by ICP					
Aluminum	80-120	75-125	≤20	20	100
Antimony	80-120	75-125	≤20	8	100
Arsenic	80-120	75-125	≤20	8	100
Barium	80-120	75-125	≤20	1	100
Beryllium	80-120	75-125	≤20	0.3	100
Boron	80-120	75-125	≤20	3	100
Cadmium	80-120	75-125	≤20	1	100
Calcium	80-120	75-125	≤20	10	100
Chromium	80-120	75-125	≤20	4	100
Cobalt	80-120	75-125	≤20	2	100
Copper	80-120	75-125	≤20	3	100
Iron	80-120	75-125	≤20	30	100
Lead	80-120	75-125	≤20	10	100
Magnesium	80-120	75-125	≤20	20	100
Manganese	80-120	75-125	≤20	1	100
Molybdenum	80-120	75-125	≤20	4	100
Nickel	80-120	75-125	≤20	5	100
Potassium	80-120	75-125	≤20	80	100
Selenium	80-120	75-125	≤20	20	100
Silver	80-120	75-125	≤20	2	100
Sodium	80-120	75-125	≤20	100	100
Thallium	80-120	75-125	≤20	20	100
Vanadium	80-120	75-125	≤20	3	100
Zinc	80-120	75-125	≤20	2	100

LCS = laboratory control sample MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

Table SD-2. DQOs for Metals Analyses of Solid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/kg)	Completeness (%)
Mercury by CVAA	80-120	75-125	≤20	2	100
Metals by FLAA					
Potassium	80-120	75-125	≤20	1000	100
Sodium	80-120	75-125	≤20	3000	100
Metals by GFAA					
Antimony	80-120	75-125	≤20	80	100
Arsenic	80-120	75-125	≤20	500	100
Beryllium	80-120	75-125	≤20	2	100
Cadmium	80-120	75-125	≤20	5	100
Chromium	80-120	75-125	≤20	100	100
Copper	80-120	75-125	≤20	700	100
Lead	80-120	75-125	≤20	700	100
Selenium	80-120	75-125	≤20	600	100
Silver	80-120	75-125	≤20	500	100
Thallium	80-120	75-125	≤20	700	100
Tin	80-120	75-125	≤20	700	100
Metals by ICP					
Aluminum	80-120	75-125	≤20	2000	100
Antimony	80-120	75-125	≤20	800	100
Arsenic	80-120	75-125	≤20	800	100
Barium	80-120	75-125	≤20	100	100
Beryllium	80-120	75-125	≤20	30	100
Boron	80-120	75-125	≤20	300	100
Cadmium	80-120	75-125	≤20	100	100
Calcium	80-120	75-125	≤20	1000	100
Chromium	80-120	75-125	≤20	400	100
Cobalt	80-120	75-125	≤20	200	100
Copper	80-120	75-125	≤20	300	100
Iron	80-120	75-125	≤20	3000	100
Lead	80-120	75-125	≤20	1000	100
Magnesium	80-120	75-125	≤20	2000	100
Manganese	80-120	75-125	≤20	100	100
Molybdenum	80-120	75-125	≤20	400	100
Nickel	80-120	75-125	≤20	500	100
Selenium	80-120	75-125	≤20	2000	100
Silver	80-120	75-125	≤20	200	100
Thallium	80-120	75-125	≤20	2000	100
Vanadium	80-120	75-125	≤20	300	100
Zinc	80-120	75-125	≤20	200	100

LCS = laboratory control sample MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery
a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations $\geq$ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

SD 1.4 Detectability

Method detection limits (MDLs) are determined or verified at least annually using the procedure and calculation described in QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SD-1 and SD-2 or the project-specific MDLs.

SD 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SD 1.6 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SD 2.0 Method Requirements

SD 2.1 Criteria for Standards and material

Primary standards are purchased from the best available source (e.g., CPI, Solutions Plus). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in QAM Section 3.2. Other material used in tests must meet the minimum requirements found in the approved methodology.

SD 2.2 Criteria for Instruments

Each instrument used for metals analyses must meet all the requirements for the analytical method (see QAM Section 3.2.1) and must be equipped with the appropriate samplers and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Instruments operation must always be in accordance with manufacturers' and methods' instructions, and instrument performance criteria specified in a method must be met before analysis of any samples.

SD 2.3 Criteria for Analysis

Metals analyses performed by the CTL laboratory include sample preparation/extraction methods and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section. All metals analysis are batched in groups of 20 or less samples of similar matricies

SD 2.3.1 Acid Digestion of Aqueous Samples and Extracts for ICP

A mixed acid digestion procedure is used to prepare water samples for metals analysis by inductively coupled plasma (ICP). Non-preserved water samples may be filtered through a 0.45 µm membrane filter, prior to preservation / digestion, if dissolved metal concentrations are to be determined. The samples are acid-digested with nitric acid and hydrochloric acid on a hot plate or in a block heater to digest the organic matter and dissolve the metals. Samples are monitored periodically during digestion to ensure an adequate, non-boiling reflux, and are not allowed to go to dryness. The digestates from this method can be analyzed for metals by ICP.

SD 2.3.2 Acid Digestion of Aqueous Samples and Extracts for GFAA

An acid digestion procedure is used to prepare water samples for graphite furnace atomic absorption (GFAA) metals analysis. Non-preserved water samples may be filtered through a 0.45 µm membrane filter, prior to preservation / digestion, if dissolved metal concentrations are to be determined. The samples are acid-digested with nitric acid (and hydrogen peroxide for As and Se) in a block heater to digest the organic matter and dissolve the metals. Samples are monitored periodically during digestion to ensure an adequate, non-boiling reflux, and are not allowed to go to dryness.

SD 2.3.3 Acid Digestion of Soils and Sediments for Metals by ICP, and GFAA

A mixed acid digestion procedure is used to prepare soil, sediment, and sludge samples for metals analysis. The samples are digested with nitric acid, hydrogen peroxide, and hydrochloric acid (for ICP) or nitric acid and hydrogen peroxide (for GFAA) in a block heater to remove the organic matter and dissolve the metals. Samples are monitored periodically during digestion to ensure an adequate, non-boiling reflux, and are not allowed to go to dryness. The digestate is then analyzed.

SD 2.3.4 TCLP Preparation for Metals

Toxicity characteristic leaching procedure (TCLP) is EPA SW-846 Method 1311 for determining the mobility of both organic and inorganic contaminants including metals present in all types of environmental matrices. TCLP leachates are prepared from soil and solid waste samples containing minimal or no filterable fluids. Sample leachates are generated using pH-adjusted acetic acid-based extraction fluids at amounts equal to 20 times the mass of the solid being leached. The specific extraction fluid employed is a function of the alkalinity of the solid phase of the sample. Following an 18 hour extraction, the TCLP extract is filtered, acid digested, and submitted for appropriate metals analyses.

SD 2.3.5 Acid Digestion and Analysis of Solid and Liquid Samples for Mercury by CVAA

Water samples are heat digested at 95°C in a water bath with a mixture of sulfuric acid, nitric acid and permanganate to oxidize organic materials and convert organo-mercurials to the mercuric ion. Persulfate oxidation is included to ensure that organo-mercury compounds, if present, will be oxidized to the mercuric ion before measurement. Soil samples are heat digested at 95ºC in a water bath with a mixture of nitric acid, sulfuric acid, and permanganate (and persulfate for soils) to oxidize organic materials and convert organo-mercurials to the mercuric ion. Following digestion, excess permanganate is reduced with hydroxlamine hydrochloride. Mercury is measured by cold vapor atomic absorption (CVAA) analysis.

Mercury is reduced to the elemental state with stannous chloride solution and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of the CVAA. Mercury concentrations are measured as a function of absorbance.

SD 2.3.6 Metals Analysis by ICP

This technique determines metallic elements in digestates using inductively coupled plasma (ICP) atomic emission spectroscopy. The method is applicable to a large number of metals and samples types, all sample matrices require digestion prior to analysis. For dissolved analytes, all samples are preserved with nitric acid to a pH < 2 immediately following field filtration. The ICP emission spectrometer used allows simultaneous multiple metal determination of elements by measuring element specific light at precise wavelengths by optical spectrometry. Samples are nebulized, the resulting aerosol is transported to the plasma torch, and element-specific atomic-line emission spectra are measured electronically.

SD 2.3.7 Metals Analysis by GFAA

Graphite furnace atomic absorption (GFAA) spectrophotometry is used for the determination of metals at trace levels in all samples matrices. It involves injecting a fixed volume of digested sample into an electrically heated graphite furnace atomizer. A light beam from a hollow cathode lamp, specific to the element to be determined, is directed through the atomizer into a monochromator and absorption is measured, typically by dual beam optical systems. Absorption follows Beer's Law and is directly proportional to the concentration of the specific metal atoms in the light atomizer light path. For dissolved analytes, all samples are preserved with nitric acid to a pH < 2 immediately following field filtration.

SD 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The Metals Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SD 4.0 Instrument Calibration and Frequency

General calibration requirements for metals analyses by CVAA and GFAA are summarized in Table SD-3, and requirements for metals analyses by ICP are summarized in Table SD-4. Calibration requirements for specific reference methods or project may differ slightly from the listed general requirements, but the components of the calibration process described in Tables SD-3 and SD-4 and corrective actions if requirements are not satisfied are applicable to all metals analytical methods.

As previously stated, specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP and for each method.

SD 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all metals analyses. The QA Coordinators and Metals Section Manager are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Metals Section Manager is responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies by instrumental technique type are summarized in Tables SD-5 (CVAA and GFAA) and SD-6 (ICP). Analytical QC samples are associated with field samples through the use of preparation batches. A preparation batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A preparation batch must not exceed 20 samples. The acceptance criteria listed in Tables SD-5 and SD-6 are general guidance values only because the specific criteria depend on the individual metal, specific reference method, and any special project requirements. More specific criteria are provided in the analytical method SOPs.

Table SD-3. Calibration Requirements for Mercury by CVAA and GFAA

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Five-point initial calibration plus blank	Initially and as needed	r≥0.995 for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	%R 90-110% for all analytes	Reanalyze ICV standard once. If it is still unacceptable, repeat ICAL.
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	< MDL or RL	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Continuing Calibration Verification (CCV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 80-120% for all analytes	Reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until a valid CV is obtained or ICAL is repeated. Must reanalyze samples analyzed since last acceptable CV.
Continuing Calibration Blank (CCB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	< MDL or RL	Remake and reanalyze CB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or ICAL repeated.

%R = percent recovery
RSD = relative standard deviation
MDL or RL= method detection limit or reporting limit

Table SD-4. General Metals Instrument Calibration Requirements: ICP

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Linear dynamic range study	Annually	$r \geq 0.995$ for regression line	Repeat until acceptable
Two-point initial calibration plus blank	Initially and as needed	$r \geq 0.995$ for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	%R 90-110% for all analytes	Reanalyze ICV standard once. If it is still unacceptable, repeat ICAL.
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	±2x MDL or RL	Remake and reaanalyze ICB standard once, if still unacceptable repeat ICAL
Calibration verification (CV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 90-110% for all analytes	Reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until a valid CV is obtained or ICAL is repeated. Must reanalyze samples analyzed since last acceptable CV.
Calibration Blank (CB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	±2x MDL or RL	Remake and reanalyze CB twice, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or ICAL repeated.

%R = percent recovery
RSD = relative standard deviation
MDL or RL= method detection limit or reporting limit

Table SD-5. Summary of QC Requirements for Mercury Analysis by CVAA and GFAA

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration	Four (4) prepared samples analyzed prior to any customer sample analyses	Method criteria for LCS recovery and duplicate precision	Repeat until acceptable
Method blank	Daily prior to sample analysis	Analytes $\leq$ MDL or RL	Clean analytical system and repeat MB analysis. Identify and eliminate source of contamination. Reanalyze any samples > RL and <20x MB level.
Laboratory control sample	One (1) per preparation batch	Lab generated limits or defaults for Liquid: 80% $\leq$%R$\leq$120% Solid: within vendor limits	Investigate and identify the problem. If system accuracy is in control (e.g., MS acceptable), no corrective action needed. If system is out of control, reanalyze entire batch.
Matrix spike sample	One (1) per preparation batch	Lab generated limits or default 75% $\leq$%R$\leq$125% (Not applicable if sample is > 4X spike level)	Investigate problem. If system accuracy is in control, qualify results. If system accuracy is out of control, reanalyze entire batch.
Sample duplicate or matrix spike duplicate	One (1) per preparation batch	RPD $\leq$20% if analyte > 5X RL	Investigate problem. If system precision is in control, qualify results. If system precision is out of control, reanalyze entire batch.
Post digestion spike	As needed to confirm matrix effects	85%$\leq$%R<115%	Repeat analysis. If it is still out, investigate for possible matrix effect or system problem.
Method of standard additions	As needed for samples with suspected or confirmed matrix effects	r$\geq$0.995	Repeat analysis. If it is still out, investigate for possible matrix effect or system problem.
Blind performance evaluation sample	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

PE = performance evaluation
QC = quality control
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
%R = percent recovery
RL = reporting limit
RPD = relative percent difference

Table SD-6. Summary of QC Requirements for Metals Analysis by ICP

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration	Four (4) prepared samples analyzed prior to any customer sample analyses	Method criteria for LCS recovery and duplicate precision	Repeat until acceptable
Interference Check Samples (ICSA and ICSAB)	At the beginning of each analytical run, or twice per 8 hours,but not before the CCV	80% ≤%R≤120% for target analytes, <2X MDL or RL for non-target analytes	Recalibrate and reanalyze back to last acceptable ICSA / ICSAB
Method blank	Daily prior to sample analysis	Analyte ≤ MDL or RL	Clean analytical system and repeat MB analysis. Identify and eliminate source of contamination. Reanalyze any samples >RL and <20x MB level.
Laboratory control sample	One (1) per preparation batch	Liquid: 80% ≤%R≤120% Solid: within vendor limits	Investigate and identify the problem. If system accuracy is in control (e.g., MS acceptable), no corrective action needed. If system is out of control, reanalyze entire batch.
Matrix spike sample	One (1) per preparation batch	75% ≤%R≤125%	Investigate problem. If system accuracy is in control perform a PDS. If system accuracy is out of control, reanalyze entire batch.
Sample duplicate or matrix spike duplicate	One (1) per preparation batch	RPD ≤20% if analyte >5x RL	Investigate problem. If system precision is in control, perform a PDS. If system precision is out of control, reanalyze entire batch.
Post digestion spike (PDS)	As needed to confirm matrix effects	85%≤%R<115%	If PDS passes do not flag, if PDS fails flag data
Serial dilution	As needed to assess new and unusual matrices	RPD≤10%	Repeat analysis. If it is still out, investigate for possible matrix effect or system problem.
Method of standard additions	As needed for samples with suspected or confirmed matrix effects	r≥0.995	Repeat analysis. If it is still out, investigate for possible matrix effect or system problem.
Blind performance evaluation sample	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

PE = performance evaluation
QC = quality control
LCS = laboratory control sample
MB = method blank
MDL = method detection limit
%R = percent recovery
RL = reporting limit
RPD = relative percent difference

SD 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses and achieve precision and accuracy within the acceptance ranges for laboratory duplicates and laboratory control samples, respectively. General acceptance criteria are listed in Tables SD-5 and SD-6.

SD 5.2 Blanks

A method blank (MB) is analyzed at the beginning of every analytical run and prior to instrumental analysis of any samples. MB results are acceptable if the concentrations of all target metals do not exceed reporting limits (RLs).

If any target metal concentration in the MB exceeds its RL, the source of contamination must be identified and eliminated. If contamination found in a MB is found in associated samples (where the sample level is >RL and <20x MB level), the samples should be re-digested. If it is not possible to re-digest the samples, the data must be appropriately qualified and the project manager notified. If contamination found in a method blank is not found in associated samples (where the sample level is <RL or $\geq$20x MB level) , the samples' results may be reported, but the source of the contamination should still be investigated and eliminated.

SD 5.3 Laboratory Control Samples

A laboratory control samples (LCS) is second-source to the calibration standards and must be analyzed at a frequency of one per every 10 to 20 samples depending on the specific reference method or project requirements. The LCS results are acceptable is the percent recovery of each analyte is $\geq$ 80% and $\leq$ 120% for liquids and within vendor provided acceptance range for solids or within project specified limits.

If the LCS results do not meet specifications, the cause and impact of the problem must be determined. If the LCS results appear anomalous (e.g., isolated digestion problem, bad injection into instrument) and the matrix spike results and other batch QC are acceptable, the samples' results for the batch are acceptable. If both the LCS and MS results are unacceptable, then instrumental analysis of the batch must be repeated. If after instrumental reanalysis both the LCS and MS are still unacceptable, then the batch must be re-digested. If it is not possible to re-digest, the project manager must be notified. The project manager will contact the client and possibly arrange for recollection of samples.

SD 5.4 Matrix Spikes

Spikes are run every 10 to 20 samples depending on the specific reference method or project requirements. Spike recoveries must be $\geq$75% and $\leq$125% or within project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause and impact of the problem must be determined. If the associated LCS results are acceptable, then the MS results are reportable with the qualifier that a matrix effect was observed. If the problem adversely affected the entire analysis batch, such as LCS results also unacceptable (see LCS discussion in SD 5.3), all samples in the batch must be re-digested and instrumentally reanalyzed.

SD 5.5 Duplicates

A duplicate sample or duplicate matrix spike sample is analyzed at a frequency of one per 10 to 20 samples depending on the specific method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than 10 times their respective MDL, or between a matrix spike (MS) and matrix spike duplicate (MSD) must be $\leq$20% or within project specified limits.
If the QC criteria for duplicate sample or spike analyses are not satisfied, the cause and impact of the problem must be determined. If the problem adversely affected the entire analysis batch, all samples in the batch must be re-digested and instrumentally reanalyzed.

SD 5.6 Post Digestion Spikes

Post digestion spike (PDS) is analyzed as needed to evaluate matrix effects. Generally, when a matrix spike recovery is outside the 75-125% acceptance range, a PDS is used to determine if the sample digestate matrix is interfering with the analysis of the analyte. The sample is spiked at a level consistent with the matrix spike. Acceptable recovery is within 15% of the spike true value, indicating that the sample digestate matrix is not interfering with analysis. If the recovery is outside of that range, than the digestate matrix is causing interference with analysis and the PDS may be used as the single addition method of standard additions (MSA) to correct the sample result and to recalculate the MDL, as appropriate.

SD 5.7 Serial Dilution

Serial dilution of sample digestate is performed as need to evaluate matrix effects. Generally, sample digestate is diluted 1:5 with method blank solution and analyzed. For diluted results $\geq$10x the MDL, the diluted digestate result should be within 10% of the undiluted digestate result, or a matrix effect is suspected. This is performed on the MS/MSD sample for each batch of solid samples or as required by a project.

SD 5.8 Method of Standard Additions

Method of standard additions (MSA) is used as needed to analyze samples with suspected or confirmed matrix effects (e.g., TCLP extracts). Equal volumes of sample are added to a water blank and three separate aliquots of standard containing approximately 50%, 100%, and 150% of the expected amount of metal. The absorbance of each solution is determined and then plotted on the vertical axis of a graph, with the concentrations of the known standards plotted on the horizontal axis. When the resulting line is extrapolated back to zero absorbance, the point of interception of the abscissa is the concentration of the unknown. The abscissa on the left of the ordinate is scaled the same as a linear regression of the absorbance plot should be linear (i.e., $r \geq 0.995$) or repeat MSA analysis once.

SD 5.9 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results are received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem.

SD 6.0 Data Management

SD 6.1 Data Generation

Qualified analysts perform sample analyses at the CTL laboratory, and appropriate analytical methods are used to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see Section SD 5.0).

SD 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis.

Deviations from the specified data reduction procedures are permitted only with approval of the Metals Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SD 6.3 Data Validation

As stated in QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results .
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented and archived in the associated data package/file.

SD 6.4 Data Reporting

After peer review of the data is completed as described in Section SD 6.3 and the results are approved, the analyst approves the results in LIMS and a preliminary report is generated. The applicable Project Manager (PM) reviews the preliminary report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections, then a final report is produced. The final report (QAM Exhibit 7-2) is also reviewed and signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Work Order No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports as illustrated in QAM Table 7-1. For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 3 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long-term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. CTL's Information System personnel maintain the LIMS on-site. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement E: Organic Analysis by Gas Chromatography

This supplement to the CTL's Quality Assurance Manual (QAM) describes the quality control (QC) requirements, procedures, and measurements utilized in performing organic analyses by gas chromatography (GC). These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SE 1.0 Data Quality Objectives

The general laboratory DQOs are listed in Section 1.2 of the CTL QAM. How each of the general DQO categories are assessed for organic analyses by GC and what are the nominal QC acceptance criteria for associated QC specifications are described in the remainder of this section. Tables SE-1 and SE-2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical method and/or in the project plan.

SE 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see QAM Section 4.4).

SE 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing matrix spike (MS) samples, laboratory control samples (LCSs), and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SE-1 and SE-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SE 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of MS samples, and replicate analyses of LCSs. Results from these measurements are compared to the criteria listed in Tables SE-1 and SE-2 or, if more specific criteria apply, to the criteria in the applicable method's DVC. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

Table SE-1. DQOs for Organic Analyses by Gas Chromatography of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/L)	Completeness (%)
Pesticides / PCBs	70-130	70-130	≤ 20	0.5	100
Petroleum hydrocarbons	60-140	60-140	≤ 20	100	100
Volatile organic compounds	70-130	70-130	≤ 20	0.3	100

LCS = laboratory control sample
MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound, and project.

Table SE-2. DQOs for Organic Analyses by Gas Chromatography of Solid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/kg)	Completeness (%)
Pesticides / PCBs	70-130	70-130	≤ 20	0.5	100
Petroleum hydrocarbons	60-140	60-140	≤ 20	2000	100
Volatile organic compounds	70-130	70-130	≤ 20	25	100

LCS = laboratory control sample
MDL = method detection limit RPD = relative percent difference
MS = matrix spike % RSD = percent relative standard deviation
% R = percent recovery

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Typical values listed. Exact values depend on specific method, compound, and project.

SE 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SE-1 and SE-2 or the project-specific MDLs.

SE 1.6 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SE 1.7 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SE 2.0 Method Requirements

SE 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g., Accu Standards, Absolute, Ultra Scientific, Chem Services). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in QAM Section 3.2. Other material used in testing must meet the minimum requirements identified in the approved methodology.

SE 2.2 Criteria for Instruments

Each gas chromatograph used for organic analyses must meet all the requirements for the analytical method (see QAM Section 3.2.1) and must be equipped with the appropriate separation columns and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Operation of instruments must always be in accordance with manufacturers' and methods' instructions, and instrument performance criteria specified in a method must be met before analysis of any samples.

SE 2.3 Criteria for Analysis

GC-based organic analyses performed by the CTL laboratory include sample preparation/extraction methods, clean-up methods, and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section.

SE 2.3.1 Liquid/Liquid Extraction-Separatory Funnel

Liquid/liquid extraction with separatory funnel is used to extract semivolatile organic compounds from liquid samples. The sample is pH-adjusted, if necessary, then extracted with methylene chloride in a separatory funnel. Residual water is removed from the extract with sodium sulfate, then the extract is concentrated by evaporation. For analysis of pesticides and PCBs, the extract is solvent exchanged into hexane.

SE 2.3.2 Pressurized Fluid Extraction

Pressurized Fluid Extraction (PFE) is a procedure for extracting water insoluble or water slightly soluble semi-volatile organic compounds from clays, sediments, sludges and waste solids. The method uses an elevated temperature and pressure to achieve analyte recoveries equivalent to those from soxhlet extraction, using less solvent and taking significantly less time than the soxhlet procedure.

SE 2.3.3 Solid-Phase Extraction

Solid-phase extraction (SPE) is used to extract semivolatile and other extractable organic compounds from aqueous samples. A measured volume of sample is adjusted to a specified pH and then extracted using a SPE device. Target analytes are eluted from the solid-phase media using methylene chloride or other appropriate solvent. Residual water is removed from the resulting solvent extract using sodium sulfate, then the extract is concentrated by evaporation. The concentrated extract may be exchanged into a solvent compatible with subsequent cleanup procedures or determinative procedures employed for the measurement of the target analytes.

SE 2.3.4 Ultrasonic Extraction

Ultrasonic extraction is a procedure for extracting nonvolatile and semi-volatile organic compounds from solids, such as soils, sludges and solid wastes. A measured volume of sample is mixed with a drying agent to form a free flowing powder. This is solvent extracted three times using ultrasonic extraction. The resulting extract is ready for clean-up and/or analysis following concentration.

SE 2.3.5 Purge and Trap Extraction

Purge and trap extraction is used for extracting volatile organic compounds (VOCs) from water and soil samples, linked to analyses of VOCs by GC and GC/MS. The extraction is identical regardless of the measurement procedure. Helium is "purged" through the sample, stripping the volatiles and carrying them to a sorbent trap downstream. The analytes are thermally desorbed and backflushed into a GC where the components are separated and analyzed using a variety of detectors. Highly contaminated soil samples may be extracted with methanol prior to analysis. Highly contaminated water samples are often diluted prior to analysis.

SE 2.3.6 TCLP Preparation for Organics

Toxicity characteristic leaching procedure (TCLP) is EPA SW-846 Method 1311 for determining the mobility of both organic and inorganic contaminants present in all types of environmental matrices. TCLP leachates are prepared from soil and solid waste samples containing minimal or no filterable fluids. Sample leachates are generated using pH-adjusted acetic acid-based extraction fluids at amounts equal to 20 times the mass of the solid being leached. The specific extraction fluid employed is a function of the alkalinity of the solid phase of the sample. Following an 18 hour extraction, the TCLP extract is filtered and submitted for appropriate organics or metals analyses.

SE 2.3.7 TCLP ZHE Preparation for Organics

Toxicity characteristic leading procedure (TCLP) using a zero-headspace extraction vessel (ZHE) is part of EPA SW-846 Method 1311 for determining the mobility of volatile organic contaminants present in all types of environmental matrices. The ZHE device allows for liquid/solid separation, extraction, and final extract filtration without opening the vessel, so loss of volatiles is precluded. TCLP leachates are prepared from soil and solid waste samples containing minimal or no filterable fluids. Sample leachates are generated in a ZHE device using pH-adjusted acetic acid-based extraction fluid at amounts equal to 20 times the mass of

the solid being leached. Following the 18 hour extraction, the TCLP extract is filtered, stored with minimal headspace, and submitted for volatile organics analysis.

SE 2.3.8 Petroleum Hydrocarbons

Petroleum hydrocarbons including volatile and semivolatile are determined by a capillary GC technique with flame ionization detection (FID). Volatile products (e.g., gasoline) are determined using purge and trap (P/T) extraction, semivolatile products (e.g., diesel and lube oils) are determined on solvent extracts. Calibrations are conducted using products, typically, gasoline, diesel, jet fuels, or some type of residual fuel oil. All petroleum products should be referenced to a hydrogen specific range using synthetic n-alkyl hydrocarbons. Extractable hydrocarbons as diesel correspond to an approximate alkane range of C10-C28. Volatile hydrocarbons as gasoline typically correspond to alkane ranges between C4 and C8, and include the BTEX components (i.e., benzene, toluene, ethylbenzene, xylene).

P/T or solvent extracts are applied onto a capillary column in a GC equipped with FID. Quantification is performed by comparing the total chromatographic area of the petroleum product standard (e.g., diesel or gasoline, including resolved and unresolved components) to the response of the sample. Both volatile and extractable hydrocarbon determinations are typically required for full site characterization and closure.

SE 2.3.9 Volatile Organic Compounds by GC

This is a GC method to determine selected volatile organic compounds (VOCs) in a variety of matrices. This method is applicable to nearly all types of samples including, but not limited to, ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, soils, and sediments. The principal target compounds for which this method is utilized are the BTEX compounds (i.e., benzene, toluene, ethylbenzene, and xylene) and trichlorobenzene. Purge and trap extraction is used to isolate VOCs from an aliquot of liquid samples or from aqueous or methanol/aqueous extracts of solid or highly contaminated samples. Temperature programmed capillary column chromatography is used for compound separation and photoionization detector (PID) for compound detection. Qualitative identifications are attained by analyzing reference standards under the same conditions used for samples and by comparing resultant GC retention times.

SE 2.3.10 Selected Organic Compounds by Direct Injection GC

This is a capillary column GC technique using flame ionization detector (FID) for identifying and measuring selected organic compounds (e.g., glycols) from aqueous or soil samples. This technique is principally used for compounds that are very water soluble and are therefore not efficiently extracted by the purge and trap technique. Qualitative identifications are attained by analyzing reference standards under the same conditions used for samples and comparing resultant GC retention times.

SE 2.3.11 Pesticides / PCBs

This is a GC method to determine selected organochlorine pesticides and polychlorinated biphenyls (PCBs) in a variety of matrices. This method is applicable to nearly all types of samples including, but not limited to, ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, soils, and sediments. Sample extracts are injected into a gas chromatograph for seperation and detection of analytes of interest Temperature programmed

capillary column chromatography is used for compound separation and electron capture detector for compound detection. Qualitative identifications are attained by analyzing reference standards under the same conditions used for samples and by comparing resultant GC retention times.

SE 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The Organics/GC Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SE 4.0 Instrument Calibration and Frequency

General calibration requirements for organic analyses by GC are summarized in Table SE-3. Calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Table SE-3 and corrective actions if requirements are not satisfied are applicable to all GC analytical methods.

Table SE-3. GC Calibration Requirements

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Three-point or five-point initial calibration plus blank	Initially and as needed	Individual response factors for standards must exhibit either ≤20% RSD or r≥0.99 for regression line.	Correct problem and repeat until acceptable.
Retention time windows	With every ICAL	RT windows must be centered on mid-concentration standard and established from three injections or other documented approach.	If analyte peaks are not within RT windows, reestablish RT windows or recalibrate.
Initial calibration verification	After each ICAL, prior to sample analysis	%R 85-115% for all analytes	Remake and reanalyze ICV standard once. If it is still unacceptable, repeat ICAL.
Calibration verification	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 85-115% for all analytes	Remake and reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until valid CV is obtained or ICAL is repeated. Samples analyzed since last acceptable CV must be reanalyzed.

CV = calibration verification
GC = gas chromatography
ICAL = initial calibration
ICV = initial calibration verification
RF = response factor
RSD = relative standard deviation
RT = retention time
%R = percent recovery

As previously stated, specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP and data validation checklist for each method.

SE 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all GC analyses. The QA Coordinators and Organics-GC Section Manager are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Organics-GC Section Manager is responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SE-4. Analytical QC samples are associated with field samples through the use of preparation batches. A preparation batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A preparation batch must not exceed 20 samples. Since most of the GC methods are multiple analyte methods, the acceptance criteria listed in Table SE-4 are general guidance values only because the specific criteria depend on the individual analyte and any special project requirements. More specific criteria are provided in the analytical method SOPs.

SE 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses and achieve precision and

accuracy equal to or better than the applicable reference method criteria (see DVC) for laboratory duplicates and laboratory control samples, respectively. In the absence of specific criteria, the general criteria listed in Table SE-4 are used.

SE 5.2 Analyte Identification

Target analytes must be identified by retention time (RT). RT windows for each target analyte peak must be centered on the RTs of the initial daily calibration verification. For a valid analyte identification, the RT for an analyte must be within the RT window. For second column confirmation, the analyte must be within the RT window on both columns.

SE 5.3 Blanks

A method blank (MB) is analyzed at the beginning of every analytical run and prior to the instrumental analysis of any samples. MB results are acceptable if the concentrations of all target analytes do not exceed the method detection limit (MDL) or reporting limit (RL).

If any target analyte concentration in the MB exceeds the MDL or RL, the source of contamination must be identified and eliminated. If contamination found in a MB is found in associated samples, the samples should be re-extracted. If it is not possible to re-extract the samples, the data must be appropriately qualified and the project manager notified. If contamination found in the method blank is not found in the associated samples, the samples' results may be reported, but the source of the contamination should still be investigated and eliminated.

Table SE-4. Summary of QC Requirements for GC Analysis

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration	Four (4) prepared samples analyzed prior to any sample analyses	Method criteria for LCS recovery and duplicate precision	Repeat until acceptable.
Retention times	For every analyte	Analyte peak within RT window	Compound identification is not valid if peaks are outside RT windows. If CV or LCS peaks are not in RT windows, system is out of control and must be corrected. Affected samples must be reanalyzed.
Method blank	Daily prior to sample analysis	Analytes < MDL or RL	Clean analytical system and repeat MB analysis. Identify and eliminate the source of contamination. Affected samples must be reanalyzed or the associated data flagged
Laboratory control sample	One (1) per preparation batch	Method criteria, Default: 70% $\leq$%R$\leq$130%	Investigate and identify the problem. If system is in control (e.g., MS acceptable and LCS result is isolated problem), no corrective action is needed. If system is out of control, repeat analysis of batch.
Matrix spike sample	One (1) per preparation batch	Method criteria, Default: 70% $\leq$% R$\leq$130%	Investigate problem. If system accuracy is in control, qualify results. If system accuracy is out of control, reanalyze entire batch.
Surrogate spike	In every sample for applicable methods	Method criteria Default: 70% $\leq$% R$\leq$130%	Repeat instrumental analysis. If it is still unacceptable, investigate for possible matrix effect or extraction or system problem.
Internal standard	In every sample for applicable methods	50-200% %R compared to IS of preceding CV	Repeat instrumental analysis. If it is still unacceptable, investigate for possible matrix effect or extraction or system problem.
Sample duplicate or matrix spike duplicate	One (1) per preparation batch	Method criteria, Default: RPD $\leq$20% if analytes > RL	Investigate problem. If system precision is in control, qualify results. If system precision is out of control, reanalyze entire batch.
Blind performance evaluation sample	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

CV = calibration verification
DVC = data validation checklist
GC = gas chromatography
IS = internal standard
LCS = laboratory control sample
MB = method blank
PE = performance evaluation
QC = quality control
%R = percent recovery
RPD = relative percent difference
RT = retention time

SE 5.5 Laboratory Control Samples

A laboratory control samples (LCS) is second-source to the calibration standards and must be analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The LCS results are acceptable if the percent recovery of the target compounds are within the acceptance ranges listed in the data validation checklist or project specified limits.

If the LCS results do not meet specifications, the cause and impact of the problem must be determined. If the LCS results appear anomalous (e.g., bad injection, isolated extraction problem) and the matrix spike results and other batch QC are acceptable, the batch's samples' results are acceptable. If both the LCS and MS results are unacceptable, then instrumental (i.e., GC) analysis of the sample batch must be repeated. If after instrumental reanalysis both the LCS and MS are still unacceptable, then the sample batch must be re-extracted. If it is not possible to re-extract, the project manager must be notified. The project manager will contact the client and possibly arrange for recollection of samples.

SE 5.6 Matrix Spikes

Spikes are run every 10 to 20 samples depending on the specific method or per project requirements. Spike recoveries must fall within the acceptance ranges listed in the data validation checklist or project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause and impact of the problem must be determined. If the associated LCS results are acceptable, then the MS results are reportable with the qualifier that a matrix effect was observed. If the problem adversely affected the entire analysis batch, such as LCS results also unacceptable (see LCS discussion in SE5.5), all samples in the batch must be reanalyzed.

SE 5.7 Surrogate Spikes

For every sample analyzed, surrogate spike recoveries must also fall within acceptance ranges listed in the data validation checklist. If a sample's surrogate result is outside the acceptance range, the following procedures are necessary:

1) Check for calculation errors. If errors are found, recalculate the data.
2) Check chromatogram for interfering peaks.
3) Check instrument performance. If a problem is identified, correct the problem and reanalyze the sample.
4) If no instrument problem is found, the sample should be re-extracted and re-analyzed. If no sample remains, the client must be notified of the situation.
5) If the sample has been duplicated or spiked check for indication of problem due to matrix.

SE 5.8 Internal Standard

Internal standard (IS) recoveries must be between 50% and 200% compared to the IS of the preceding CV. If a sample's IS recovery is outside the acceptance range, follow the general corrective action procedures used for surrogate compounds.

SE 5.9 Duplicates

A duplicate sample or duplicate matrix spike sample is analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD) must be within the acceptance ranges listed in the data validation checklist or project specified limits.

If the QC criteria for duplicate sample or duplicate spike analyses are not satisfied, the cause and impact of the problem must be determined. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SE 5.10 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results are received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem.

SE 6.0 Data Management

SE 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to QC requirements specified for each type of analysis (Section SE5.0).

SE 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis. The analyst then enters the results for both samples and QC measurements into the laboratory information management system (LIMS).

Deviations from the specified data reduction procedures are permitted only with approval of the Organics-GC Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SE 6.3 Data Validation

As stated in QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and

qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary, and completed data validation checklist
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented with a signed data validation checklist. The checklist is archived in the associated data package/file.

SE 6.4 Data Reporting

After peer review of the data is completed as described in Section SE6.3 and the results are approved a preliminary report is generated. The applicable Project Manager (PM) reviews the preliminary report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections, then a final report is produced. The final report (QAM Exhibit 7-2) is also reviewed and signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Work Order No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports as illustrated in QAM Table 7-1. For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 3 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long-term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. CTL's Information System personnel maintain the LIMS on-site. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement F: Organic Analysis by Gas Chromatography/Mass Spectrometry

This supplement to the CTL's Quality Assurance Manual (QAM) describes the quality control (QC) requirements, procedures, and measurements utilized in performing organic analyses by gas chromatography/mass spectrometry (GC/MS). These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SF 1.0 Data Quality Objectives

The general laboratory DQOs are listed in Section 1.2 of the CTL QAM. How each of the general DQO categories are assessed for organic analyses by GC/MS and what are the nominal QC acceptance criteria for associated QC specifications are described in the remainder of this section. Tables SF-1 and SF-2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical methods and/or in the project plan.

SF 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see QAM Section 4.4).

SF 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing matrix spike (MS) samples, laboratory control samples (LCSs), and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SF-1 and SF-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurement's results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SF 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of MS samples, and replicate analyses of LCSs. Results from these measurements are compared to the criteria listed in Tables SF-1 and SF-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

Table SF-1. DQOs for Organic Analyses by Gas Chromatography/Mass Spectrometry of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/L)	Completeness (%)
Petroleum hydrocarbons	70-130	70-130	≤20	0.5	100
Semi-volatile organic compounds (SV)	70-130	70-130	≤20	10	100
Volatile organic compounds (VOCs)	70-130	70-130	≤20	0.5	100

LCS = laboratory control sample
MS = matrix spike
% R = percent recovery
MDL = method detection limit
% RSD = percent relative standard deviation
RPD = relative percent difference

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

Table SF-2. DQOs for Organic Analyses by Gas Chromatography/Mass Spectrometry of Solid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/kg)	Completeness (%)
Petroleum hydrocarbons	70-130	70-130	≤20	10	100
Semi-volatile organic compounds (SV)	70-130	70-130	≤20	200	100
Volatile organic compounds (VOCs)	70-130	70-130	≤20	10	100

LCS = laboratory control sample
MS = matrix spike
% R = percent recovery
MDL = method detection limit
% RSD = percent relative standard deviation
RPD = relative percent difference

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

SF 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SF-1 and SF-2 or the project-specific MDLs.

SF 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SF 1.7 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SF 2.0 Method Requirements

SF 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g., Accu Standards, Absolute, Ultra Scientific, Chem Services). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in QAM Section 3.2. Other material must meet the minimum requirements outlined in the approved methodology.

SF 2.2 Criteria for Instruments

Each gas chromatograph/mass spectrometer used for organic analyses must meet all the requirements for the analytical method (see QAM Section 3.2.1) and must be equipped with the appropriate separation columns and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Operation of instruments must always be in accordance with manufacturers' and methods' instructions, and instrument performance criteria specified in a method must be met before analysis of any samples.

SF 2.3 Criteria for Analysis

GC-MS based organic analyses performed by the CTL laboratory include sample preparation/extraction methods, clean-up methods, and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section.

SF 2.3.1 Purge and Trap Extraction

Purge and trap extraction is used for extracting volatile organic compounds (VOCs) from water and soil samples, linked to analyses of VOCs by GC and GC/MS. The extraction is identical regardless of the measurement procedure. Helium is "purged" through the sample, stripping the volatiles and carrying them to a sorbent trap downstream. The analytes are thermally desorbed and backflushed into a GC where the components are separated and analyzed using a variety of detectors. Highly contaminated soil samples may be extracted with methanol prior to analysis. Highly contaminated water samples are often diluted prior to analysis.

SF 2.3.2 Liquid/Liquid Extraction-Separatory Funnel

Liquid/liquid extraction with separatory funnel is used to extract semivolatile organic compounds from liquid samples. The sample is pH-adjusted, if necessary, then extracted with methylene chloride in a separatory funnel. Residual water is removed from the extract with

sodium sulfate, then the extract is concentrated by evaporation. For analysis of pesticides and PCBs, the extract is solvent exchanged into hexane.

SF 2.3.3 Pressurized Fluid Extraction

Pressurized Fluid Extraction (PFE) is a procedure for extracting water insoluble or water slightly soluble semi-volatile organic compounds from clays, sediments, sludges and waste solids. The method uses an elevated temperature and pressure to achieve analyte recoveries equivalent to those from soxhlet extraction, using less solvent and taking significantly less time than the soxhlet procedure.

SF 2.3.4 TCLP / TCLP ZHE Preparation for Organics

Toxicity characteristic leading procedure (TCLP) utilizes either a standard or zero-headspace extraction vessel (ZHE) for determining the mobility of organic contaminants present in all types of environmental matrices. The ZHE device allows for liquid/solid separation, extraction, and final extract filtration without opening the vessel, so loss of volatiles is precluded. TCLP leachates are prepared from soil and solid waste samples containing minimal or no filterable fluids. Sample leachates are generated in an extraction vessel, using various extraction fluids, at amounts equal to 20 times the mass of the solid being leached. Following the 18 hour extraction, the TCLP extract is filtered, stored, and submitted for organics analysis.

SF 2.3.5 Volatile Organic Components

A GC/MS method used to determine volatile organic compounds (VOCs) in a variety of aqueous, soil, and solid waste matrices. Analaytes are separated on a capillary column in the GC and detected with a mass spectrometer (MS). The MS provides qualitative identifications through reference spectra or fingerprints unique to each compound. Identification is futher enhanced by comparing elution retention times to calibration standards. Compounds are quantitated by relating the relative mass spectrometer response for a selected unique ion to a corresponding response ion from an assigned internal standard. The method is often used as a substitute for GC methods without MS detection, such as for BTEX by GC-PID.

SF 2.3.6 Semi-volatile Organic Components

A GC/MS method used to determine semi-volatile organic compounds (SV) in a variety of aqueous, soil, and solid waste matrices. Analaytes are separated on a capillary column in the GC and detected with a mass spectrometer (MS). The MS provides qualitative identifications through reference spectra or fingerprints unique to each compound. Identification is futher enhanced by comparing elution retention times to calibration standards. Compounds are quantitated by relating the relative mass spectrometer response for a selected unique ion to a corresponding response ion from an assigned internal standard.

SF 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The Organics-GC/MS Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand to perform necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SF 4.0 Instrument Calibration and Frequency

General calibration requirements for organic analyses by GC/MS are summarized in Table SF-3. Calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process as described in Table SF-3 and corrective actions if requirements are not satisfied are applicable to all GC/MS analytical methods.

As previously stated, specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP for each method.

SF 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all GC/MS analyses. The QA Coordinators and Organics-GC/MS Section Manager are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Organics-GC/MS Section Manager is responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SF-4. Analytical QC samples are associated with field samples through the use of preparation batches. A preparation batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A preparation batch must not exceed 20 samples. Since most of the GC/MS methods are multiple analyte methods, the acceptance criteria listed in Table SF-4 are general guidance values only because the specific criteria depend on the individual analyte, individual method, and any special project requirements. More specific criteria are provided in the analytical method.

Table SF-3. GC/MS Calibration Requirements

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Mass spectrometer tuning	First step of every ICAL and CV	Satisfy method criteria	Correct problem and repeat until acceptable.
Three-point or five-point initial calibration plus blank	Initially and as needed	CCCs and SPCCs must satisfy method criteria. Individual response factors for calibration standards must exhibit either ≤15% RSD or r≥0.99 for regression line.	Correct problem and repeat until acceptable.
Retention time windows	With every ICAL	ISs should be selected so RRTs for most target analytes are 0.80-1.20 compared to appropriate ISs.	If analyte peaks are not within RT windows, recalibrate.
Calibration verification	Every 12 hours prior to sample analysis	RFs for SPCCs must satisfy method criteria. RFs for CCCs must exhibit <20% difference or drift from ICAL. Compared to ICAL mid-point standard, ISs' RTs must be within ±30 seconds and ISs' areas must be – 50% to +100%.	Remake and reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until valid CV obtained or ICAL is repeated. Must reanalyze samples analyzed since last acceptable CV.

CCC = calibration check compound
CV = calibration verification
GC/MS = gas chromatography/mass spectrometry
ICAL = initial calibration
ICV = initial calibration verification
%R = percent recovery
RF = response factor
RTT = relative retention time
RSD = relative standard deviation
RT = retention time
SPCC = system performance check compound

Table SF-4. Summary of QC Requirements for GC/MS Analysis

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration	Four (4) prepared samples analyzed prior to any sample analyses	Method criteria for LCS recovery and duplicate precision	Repeat until acceptable.
Retention times	For ISs and every analyte in every sample	ISs RTs within ±30 seconds of last CV RTs for targets ±0.06 RRT units compared to last CV	Compound identification is not valid if peak is outside RT window. If CV or LCS peaks are not in RT windows, system is out of control and must be corrected. Affected samples must be reanalyzed.
Method blank	Daily prior to sample analysis	Analytes < RL	Clean analytical system and repeat MB analysis. Identify and eliminate the source of contamination.
Laboratory control sample	One (1) per preparation batch	Method criteria default: 70% ≤%R≤130%	Investigate and identify the problem. If system in control (e.g., MS acceptable and LCS result is isolated problem), no corrective action is needed. If system is out of control, repeat analysis of batch.
Matrix spike sample	One (1) per preparation batch	Method criteria default: 70% ≤% R≤130%	Investigate problem. If system accuracy is in control, qualify results. If system accuracy is out of control, reanalyze entire batch.
Surrogate spike	In every sample for applicable methods	Method criteria default: 70% ≤% R≤130%	Repeat instrumental analysis. If it is still out, investigate for possible matrix effect or extraction or system problem.
Internal standard	In every sample for applicable methods	50-200% %R compared to IS of preceding CV	Repeat instrumental analysis. If it is still out, investigate for possible matrix effect or extraction or system problem
Sample duplicate or matrix spike duplicate	One (1) per preparation batch	Method criteria default: RPD ≤20% if analytes > RL	Investigate problem. If system precision is in control, qualify results. If system precision is out of control, reanalyze entire batch.
Blind performance evaluation sample	Samples and frequency determined by accrediting agencies and projects	Determined by PE provider	Investigate all unacceptable results.

CV = calibration verification
%R = percent recovery
GC/MS = gas chromatography/mass spectrometry
IS = internal standard
LCS = laboratory control sample
MB = method blank
PE = performance evaluation
QC = quality control
RL = reporting limit
RPD = relative percent difference
RRT = relative retention time
RT = retention time

SF 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses and achieve precision and accuracy equal to or better than the applicable reference method criteria for laboratory duplicates and laboratory control samples, respectively. In the absence of specific criteria, the general criteria listed in Table SF-4 are used.

SF 5.2 Analyte Identification

Target analytes must be identified by retention time (RT) and mass spectrum. The intensities of characteristic ions of an analyte in a sample's mass spectrum must maximize in the same scan or within one scan of each other. The relative intensities of characteristic ions for the analyte in a sample's mass spectrum must agree with 30% of the relative intensities of those ions in the reference spectrum.

SF 5.3 Blanks

A method blank (MB) is analyzed at the beginning of every analytical run and prior to the instrumental analysis of any samples. MB results are acceptable if the concentrations of all target analytes do not exceed the reporting limit (RL).

If any target analyte concentration in the MB exceeds the RL, the source of contamination must be identified and eliminated. If contamination found in a MB is found in associated samples, the samples should be re-extracted. If it is not possible to re-extract the samples, the data must be appropriately qualified and the project manager notified. If contamination found in the method blank is not found in the associated samples, the samples' results may be reported, but the source of the contamination should still be investigated and eliminated.

SF 5.4 Laboratory Control Samples

A laboratory control samples (LCS) is second-source to the calibration standards and must be analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The LCS results are acceptable if the percent recovery of the target compounds are within the acceptance ranges or project specified limits.

If the LCS results do not meet specifications, the cause and impact of the problem must be determined. If the LCS results appear anomalous (e.g., bad injection, isolated extraction problem) and the matrix spike results and other batch QC are acceptable, the batch's samples' results are acceptable. If both the LCS and MS results are unacceptable, then instrumental (i.e., GC/MS) analysis of the sample batch must be repeated. If after instrumental reanalysis both the LCS and MS are still unacceptable, then the sample batch must be re-extracted. If it is not possible to re-extract, the project manager must be notified. The project manager will contact the client and possibly arrange for recollection of samples.

SF 5.5 Matrix Spikes

Spikes are run every 10 to 20 samples depending on the specific method or per project requirements. Spike recoveries must fall within the acceptance ranges or project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause and impact of the problem must be determined. If the associated LCS results are acceptable, then the MS results are reportable with the qualifier that a matrix effect was observed. If the problem adversely affected the entire analysis batch,

such as LCS results also unacceptable (see LCS discussion in SF5.4), all samples in the batch must be reanalyzed.

SF 5.6 Surrogate Spikes

For every sample analyzed, surrogate spike recoveries must also fall within acceptance. If a sample's surrogate result is outside the acceptance range, the following procedures are necessary:

1) Check for calculation errors. If errors are found, recalculate the data.
2) Check chromatogram for interfering peaks.
3) Check instrument performance. If a problem is identified, correct the problem and reanalyze the sample.
4) If no instrument problem is found, the sample should be re-extracted and re-analyzed. If no sample remains, the client must be notified of the situation.
5) If the sample has been duplicated or spiked check for indication of problem due to matrix.

SF 5.7 Internal Standard

Internal standard (IS) recoveries must be between 50% and 200% compared to the IS of the preceding CV.

If a sample's IS recovery is outside the acceptance range, follow the general corrective action procedures used for surrogate compounds.

SF 5.8 Duplicates

A duplicate sample or duplicate matrix spike sample is analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD) must be within the acceptance ranges or project specified limits.

If the QC criteria for duplicate sample or duplicate spike analyses are not satisfied, the cause and impact of the problem must be determined. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SF 5.9 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results are received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem.

SF 6.0 Data Management

SF 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see Section SF5.0).

SF 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis

Deviations from the specified data reduction procedures are permitted only with approval of the Organics-GC/MS Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SF 6.3 Data Validation

As stated in QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented and archived in the associated data package/file.

SF 6.4 Data Reporting

After peer review of the data is completed as described in Section SF6.3 and the results are approved, the analyst approves the result in LIMS and a preliminary report is generated. The applicable Project Manager (PM) reviews the preliminary report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections, then a final report is produced. The final report (QAM Exhibit 7-2) is also reviewed and signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Work Order No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports as illustrated in QAM Table 7-1. For the levels II, III, and IV deliverables formats the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 3 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long-term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. CTL's Information System personnel maintain the LIMS on-site. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement G: Analysis of Air Contaminant Sampling Media

This supplement describes the quality control (QC) requirements, procedures, and measurements utilized in performing analysis of air sampling sorbent tubes, and surface wipes. These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SG 1.0 Data Quality Objectives

The general laboratory DQOs are listed in CTL QAM Section 1.2. How each of the general DQO categories are assessed for air contaminant media analysis, and what are the nominal QC acceptance criteria for associated QC specifications, are described in the remainder of this section. Tables SG1 summarizes the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical method and/or in the project plan.

SG 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, surfaces) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see CTL QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see CTL QAM Section 4.4).

SG 1.2 Accuracy

Accuracy as percent recovery (%R) must be assessed by analyzing LCSs and single-blind or double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Table SG1 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SG 1.3 Precision

Precision is assessed by analyzing field duplicates (when available) and replicate analyses of laboratory control samples (LCS). Results from these measurements are compared to the criteria listed in Table SG1 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

Table SG1. DQOs for Analysis of Air Contaminants on Prescribed Media

Medium and Analyte(s)	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)		Completeness (%)
Sorbent Tubes:					
Benzene	70 - 130	70 - 130	≤ 25	1 ppm[e]	100
Ethylbenzene	70 - 130	70 - 130	≤ 25	1 ppm[e]	100
Toluene	70 - 130	70 - 130	≤ 25	1 ppm[e]	100
Xylene (Total)	70 - 130	70 - 130	≤ 25	1 ppm[e]	100
Total VOCs (as product)	70 - 130	70 - 130	≤ 25	1 ppm[e]	100
Surface Wipes:					
Lead	90-110	80-120	≤ 20	2.5 ug/wipe[f]	100

a Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound.
c. Estimated RL in ug per medium; reported RLs are based on actual air volume sampled..
d. RL estimated assuming 8 hr. Sampling period, desorption volume of 2 ml, and achieving 90% desorption efficiency.
e. *RL estimated assuming 50/100mg tube desorbed with 1 ml eluent, achieving 95% desorption efficiency.*
f. *Estimated RL in ug per wipe; reported RLs are based on actual surface area sampled..*

LCS = laboratory control sample
% R = percent recovery
MS = matrix spike
% RSD = percent relative standard deviation
RPD = relative percent difference
MDL = method detection limit
RL = reporting limit

SG 1.4 Quantitation/Reporting Limits

Quantitation limits for air or surface monitoring are dependent on several factors, including air volume or surface area sampled, sorbent tube size, desorption eluent volume, and desorption efficiency. Desorption efficiency is dependent on the compound of interest, and may vary with charcoal lots. Estimates of reporting limit (RL) capability are listed in Table SG1. RLs in analytical reports are calculated to reflect all pertinent sampling information.

SG 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SG 1.6 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SG 2.0 Method Requirements

SG 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g., Solutions Plus, ChemService, Fisher Scientific). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials where possible. Secondary standards for calibration and QC measurements are prepared from primary standards or an alternative certified source. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in CTL QAM Section 3.2. Other material used must meet the minimum requirements outlined in the approved methodology.

SG 2.2 Criteria for Instruments

The laboratory instruments utilized for air analysis must meet all the requirements for the analytical methods to be conducted (see CTL QAM Section 3.2.1) and must be equipped with the appropriate nebulizers, columns, detectors, as required. The specific equipment components and set-up requirements are described in the CTL SOP for each analytical method. Instruments operation must always be in accordance with manufacturers' and methods' instructions, and performance criteria specified in the methods must be met before analysis of any samples.

SG 2.3 Criteria for Analysis

Air contaminant analyses performed by the CTL laboratory include sample preparation/extraction and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section.

SG 2.3.1 Sorbent Tubes

Sorbent tubes, routinely used for sampling gasses and vapors from air in designated areas, are analyzed by NIOSH methods. Samples collected by pulling air through the tube packed with sorbent media (e.g., charcoal) are desorbed with an appropriate solvent prior to analysis.

SG 2.3.2 Surface Wipes

The entire wipe is placed in a digestion vessel to be prepared by hot acid digestion using nitric and hydrochloric acids. The acid digestion solublizes trapped metals and stabilizes them in their oxidized form. The digestate is diluted before being analyzed by inductively-coupled plasma atomic emission spectroscopy. After correction for background and interferences, the net emission signals are compared to the net emission of known standards to determine a concentration value for each metal of interest. The calculated concentration can then be related back to sample collection data to provide a concentration based on the area of surface wiped.

SG 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The applicable Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs (e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SG 4.0 Instrument Calibration and Frequency

Specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method.

General calibration requirements of Metals analyses are summarized in Tables SG2a. General calibration requirements of Organics analyses are summarized in Table SG2b. As previously stated, calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Tables SG2a b, and corrective actions if requirements are not satisfied, are applicable to all analytical methods, as appropriate.

Table SG2a. General Metals Instrument Calibration Requirements: ICP

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Linear dynamic range study	Annually	r≥0.995 for regression line	Repeat until acceptable
Two-point initial calibration plus blank	Initially and as needed	r≥0.995 for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	%R 90-110% for all analytes	Reanalyze ICV standard once. If it is still unacceptable, repeat ICAL.
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	< MDL or RL	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Calibration verification (CV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 90-110% for all analytes	Reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until a valid CV is obtained or ICAL is repeated. Must reanalyze samples analyzed since last acceptable CV.
Calibration Blank (CB)	Daily, prior to sample analysis, after every 10 samples, and at end of run	< MDL or RL	Remake and reanalyze CB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or ICAL repeated.

%R = percent recovery
RSD = relative standard deviation
MDL or RL= method detection limit or reporting limit

Table SG2b. General Organics Instrument Calibration Requirements: GC

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Five-point initial calibration plus blank (ICAL)	Initially and as needed	≤ 20% RSD for individual response factors or r≥0.99 for regression line	Repeat until acceptable
Initial calibration verification (ICV)	After each ICAL, prior to sample analysis	%R 70-130% for all analytes	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Initial calibration blank (ICB)	After each ICAL, prior to sample analysis	< RL	Remake and reaanalyze ICV standard once, if still unacceptable repeat ICAL
Calibration verification (CV)	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 70-130% for all analytes	Remake and reanalyze CV once, if still unacceptable investigate and correct problem, cannot proceed until valid CV obtained or ICAL repeated
Calibration Blank (CB)	Daily, prior to sample analysis	< RL	Remake and reanalyze CB once, if still unacceptable investigate and correct problem, cannot proceed until valid CB obtained or ICAL repeated

%R = percent recovery
RSD = relative standard deviation

SG 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all applicable analyses. The QA Coordinators and Analytical Section Managers are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, and duplicates. The Analytical Section Managers are responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Tables SG3a-b. Analytical QC samples are associated with field samples through the use of analysis batches. An analysis batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. An analysis batch must not exceed 20 field samples. More specific criteria are provided in the individual analytical method.

Table SG3a. Summary of QC Requirements for Air Monitoring: Metals

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration sample (IDC)	Four (4) prepared standards that are analyzed one time prior to any sample analyses	In-house or method criteria for IDC recovery and precision	Repeat until acceptable
Method blank (MB)	Daily, using Corresponding sampling media, prior to sample analysis	Analytes < RL	Clean analytical system, repeat until MBs are in control
Sample duplicate (DUP), when available	One (1) per analytical batch	In-house derived limits Default: RPD $\leq$20% if analytes > RL	Investigate problem; if system precision out of control qualify results
Laboratory control sample (LCS)	Three (3) per analytical batch	90% $\leq$%R$\leq$110%	Halt analysis, fix problem, repeat associated sample analyses
Blind laboratory control sample (BLCS)	Three (3) per analytical batch	90% $\leq$%R$\leq$110%	Halt analysis, fix problem, repeat associated sample analyses

%R = percent recovery RPD = relative percent difference
RL = reporting limit

Table SG3b. Summary of QC Requirements for Air Monitoring: Organics

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Initial Demonstration of Capability (IDC)	Four (4) prepared standards (in CS_2) that are analyzed one time prior to any sample analyses	In-house determined criteria for LCS recovery and duplicate precision	Repeat until acceptable
Method blank (MB)	Daily, using Corresponding sampling media, prior to sample analysis	Analytes < RL	Clean analytical system, repeat until MBs are in control
Sample duplicate (DUP), when available	One (1) per analytical batch	In-house derived limits Default: RPD ≤20% if analytes > RL	Investigate problem; if system precision out of control qualify results
Laboratory control sample (LCS)	One (1) per analytical batch	70% ≤%R≤130%	Halt analysis, fix problem, repeat associated sample analyses
Blind laboratory control sample (BLCS)	Three (3) per analytical batch	90% ≤%R≤110%	Halt analysis, fix problem, repeat associated sample analyses
%R = percent recovery RPD = relative percent difference RL = reporting limit			

SG 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be acceptably demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses of a known standard and achieve precision and accuracy equal to or better than the most recent in-house determined acceptance ranges for laboratory duplicates and laboratory control samples, respectively. This demonstration should be done in the appropriate matrix where possible. In the absence of in-house determined criteria, the general criteria listed in Tables SG3a-b are used.

SG 5.2 Blanks

A method blank (MB) is prepared in the appropriate matrix at a frequency of one per 20 field samples depending on the specific method or project requirements. The MB is analyzed at the beginning of every instrumental analytical run and prior to the analysis of any samples. MB results are acceptable if the concentrations of the target analyte does not exceed the reporting limit (RL). If any target analyte concentration in the MB exceeds the RL, the source of contamination must be identified and eliminated. Analysis of samples cannot proceed until a compliant MB is obtained.

SG 5.3 Duplicates

A duplicate sample (DUP) can only be analyzed for an air or surface wipe sample if duplicate sampling has been conducted in the field. In the event that duplicate collections are available, duplicates are analyzed. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, must be within the in-house determined acceptance ranges listed in the CTL SOPs, or project specified limits.

If the QC criteria for duplicate sample analyses are not satisfied, the cause of the problem must be investigated. All data associated must be appropriately qualified in the data file and in the report. Sample recollection is at the discretion of the client.

SG 5.4 Laboratory Control Samples

A laboratory control sample (LCS) is second-source to the calibration standards and must be analyzed at a frequency of three per every 20 field samples depending on the specific method or project requirements. The LCS results are acceptable if the percent recovery of each analyte is within the in-house determined acceptance range or project specified limits. If the LCS results do not meet specification, the cause of the problem must be investigated, and all sample analyses in the associated batch must be appropriatedly qualified.

SG 5.5 Blind Laboratory Control Samples

A blind laboratory control sample (BLCS) is second-source to the calibration standards and must be analyzed at a frequency of three per every 20 field samples, depending on the specific method or project requirements. BLCS are blind (to the analysis) conducting the testing. The BLCS results are acceptable if the percent recovery of each analyte is within the in-house determined acceptance range or project specified limits. If the LCS results do not meet specification, the cause of the problem must be investigated, and all sample analyses in the associated batch must be appropriatedly qualified

SG 6.0 Data Management

SG 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to the QC requirements specified for each type of analysis (see SG 5.0).

SG 6.2 Data Reduction

Detailed procedures for converting raw data to final reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis.
Deviations from the specified data reduction procedures are permitted only with approval of the applicable Analytical Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SG 6.3 Data Validation

As stated in CTL QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data, calculations or calculation records, calibration data or records, QC measurement results, test results summary
- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented and archived in the associated data package/file.

SG 6.4 Data Reporting

After peer review of the data is completed as described in Section SG 6.3 and the results are approved, the analyst approves the result in LIMS and a report is generated. The applicable Project Manager (PM) reviews the report (CTL QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections. The final report (CTL QAM Exhibit 7-2) is signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Lab No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports (illustrated in QAM Table 7-1). For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 3 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. The LIMS is maintained on-site by CTL's Information System personnel. Full server backups are performed nightly. Other electronic data include instrument magnetic

tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

Supplement H: Organic Analysis by High Performance Liquid Chromatography

This supplement to the CTL's Quality Assurance Manual (QAM) describes the quality control (QC) requirements, procedures, and measurements utilized in performing organic analyses by high performance liquid chromatography (HPLC). These QC activities are designed to assess and monitor the quality of analytical data generated and the ability of that data to satisfy QC acceptance criteria and data quality objectives (DQOs).

SH 1.0 Data Quality Objectives

The general laboratory DQOs are listed in Section 1.2 of the CTL QAM. How each of the general DQO categories are assessed for organic analyses by HPLC and what are the nominal QC acceptance criteria for associated QC specifications are described in the remainder of this section. Tables SH-1 and SH-2 summarize the nominal QC acceptance criteria for the types of analyses performed. It should be noted that the listed QC acceptance criteria are nominal (i.e., default or interim) and may not apply to all individual compounds or projects. When the nominal criteria do not apply, the specific criteria are listed in the analytical and/or in the project plan.

SH 1.1 Representativeness

Measurements on a sample are made so the final results are as representative as possible of the media (e.g., air, soil, water) sampled and conditions being measured. Representativeness of the measurement in the laboratory is attained by conducting the analysis by the appropriate analysis method (see QAM Section 3.2.1) and completing the analysis within the applicable analysis holding time (see QAM Section 4.4).

SH 1.2 Accuracy

Accuracy as percent recovery (%R) is assessed by analyzing matrix spike (MS) samples, laboratory control samples (LCSs), and single-blind and double-blind performance evaluation (PE) samples. Results from these measurements are compared to the criteria listed in Tables SH-1 and SH-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

SH 1.3 Precision

Precision is assessed by analyzing laboratory duplicates, replicate analyses of MS samples, and replicate analyses of LCSs. Results from these measurements are compared to the criteria listed in Tables SH-1 and SH-2 or, if more specific criteria apply, to the criteria in the applicable method. These QC measurements' results are used to demonstrate acceptable method performance or to trigger corrective action when criteria are not satisfied.

Table SH-1. DQOs for Organic Analyses by HPLC of Liquid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/L)	Completeness (%)
Polynuclear aromatic hydrocarbons (PAHs)	70-130	70-130	≤ 20	0.01-1	100
Nitro-explosives	70-130	70-130	≤ 20	0.01-20	100

LCS = laboratory control sample
MS = matrix spike
% R = percent recovery
MDL = method detection limit
% RSD = percent relative standard deviation
RPD = relative percent difference

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

Table SH-2. DQOs for Organic Analyses by HPLC of Solid Samples

Type of Analysis	Accuracy[a] (LCS %R)	Accuracy[a] (MS %R)	Precision[a] (% RSD or RPD)	MDL[b] (µg/kg)	Completeness (%)
Polynuclear aromatic hydrocarbons (PAHs)	70-130	70-130	≤ 20	0.5-50	100
Nitro-explosives	70-130	70-130	≤ 20	0.3-3	100

LCS = laboratory control sample
MS = matrix spike
% R = percent recovery
MDL = method detection limit
% RSD = percent relative standard deviation
RPD = relative percent difference

a. Criteria listed are default values. Exact values depend on specific method, compound, and project. Criteria apply to concentrations ≥ RL.
b. Typical values listed. Exact values depend on specific method and compound and must be ≤ RL.
c. Typical values listed. Exact values depend on specific method, compound and project.

SH 1.4 Detectability

Method detection limits are determined or verified at least annually using the procedure and calculation described in QAM Section 7.2.4. The MDLs must be less than or equal to the values listed in Tables SH-1 and SH-2 or the project-specific MDLs.

SH 1.5 Completeness

Laboratory analysis completeness is expressed as the number of samples analyzed with valid results (i.e., data that meet all specifications) as a percent of the total number of samples submitted for analyses. One hundred percent of the total number of samples submitted for analysis must result in valid analytical data or the customer must be notified and consulted to determine the corrective action (e.g., recollection of sample).

SH 1.6 Comparability

The comparability of CTL data sets to those generated by different laboratories shall be achieved through use of standardized methods, traceable standards, and by participation in PEs.

SH 2.0 Method Requirements

SH 2.1 Criteria for Standards and Material

Primary standards are purchased from the best available source (e.g., Accu Standards, Absolute, Ultra Scientific, Chem Services). All commercially manufactured standards must be certified by the manufacturer to be traceable to National Institute of Standards and Technology (NIST) reference materials. Certified standards from at least two independent manufacturers must be on hand at all times. Secondary standards for calibration and QC measurements are prepared from primary standards. Detailed instructions for preparation of secondary standards are provided in the applicable analytical method SOPs. Traceability of the secondary standards is maintained by ensuring that equipment used for secondary standard preparation is maintained, operated and calibrated according to the requirements in QAM Section 3.2. Other material used must meet the minimum requirements outlined in the approved methodology.

SH 2.2 Criteria for Instruments

Each liquid chromatograph used for organic analyses must meet all the requirements for the analytical method (see QAM Section 3.2.1) and must be equipped with the appropriate separation columns and detectors. The specific equipment components and set up requirements are described in the CTL SOP for each analytical method. Operation of instruments must always be in accordance with manufacturers' and methods' instructions, and instrument performance criteria specified in a method must be met before analysis of any samples.

SH 2.3 Criteria for Analysis

HPLC-based organic analyses performed by the CTL laboratory include sample preparation/extraction methods, clean-up methods, and instrumental analysis methods. Detailed instructions for analysis of samples and reduction of data are provided in the applicable CTL SOPs. Brief descriptions of the methods utilized are listed in the remainder of this section.

SH 2.3.1 Liquid/Liquid Extraction-Separatory Funnel

Liquid/liquid extraction with separatory funnel is used to extract semivolatile organic compounds from liquid samples. The sample is pH-adjusted, if necessary, then extracted with methylene chloride in a separatory funnel. Residual water is removed from the extract with sodium sulfate, then the extract is concentrated by evaporation.

SH 2.3.2 Pressurized Fluid Extraction

Pressurized Fluid Extraction (PFE) is a procedure for extracting water insoluble or water slightly soluble semi-volatile organic compounds from clays, sediments, sludges and waste solids. The method uses an elevated temperature and pressure to achieve analyte recoveries equivalent to those from soxhlet extraction, using less solvent and taking significantly less time than the soxhlet procedure.

SH 2.3.3 Solid-Phase Extraction

Solid-phase extraction (SPE) is used to extract semivolatile and other extractable organic compounds from aqueous samples. A measured volume of sample is adjusted to a specified pH and then extracted using a SPE device. Target analytes are eluted from the solid-phase media using an appropriate solvent. The concentrated extract may be exchanged into a solvent compatible with determinative procedures employed for the measurement of the target analytes.

SH 2.3.4 Ultrasonic Extraction

Ultrasonic extraction is a procedure for extracting nonvolatile and semi-volatile organic compounds from solids, such as soils, sludges and solid wastes. A measured volume of sample is mixed with a drying agent to form a free flowing powder. This is solvent extracted three times using ultrasonic extraction. The resulting extract is ready for clean-up and/or analysis following concentration.SH 2.3.4

SH 2.3.5 Polynuclear Aromatic Hydrocarbons (PAHs) by HPLC

This is a HPLC method to determine selected PAHs based compounds in a variety of matrices. This method is applicable to nearly all types of samples including, but not limited to, ground water, waste solvents, soils, and sediments. solvent extracts are applied onto a column in a HPLC equipped with UV and fluorescence detectors. Qualitative identifications are attained by analyzing reference standards under the same conditions used for samples and by comparing resultant HPLC retention times.

For all USACOE proposals and quotations, the following statement must be provided to the Client:

US-ACOE Required Disclaimer for SW-846 Method 8310: *Analysis of PAHs by current EPA Method 8310 does not provide for the confirmation of analytes, and therefore may result in the detection of false positives.*

SH 2.3.6 Nitro-explosives by HPLC

This is a HPLC method to determine nitro based explosives (Nirtoaromatics, Nitramines and Nitroglycerine) in water and soil.. Extracts are applied onto a column in a HPLC equipped with UV detector. Qualitative identifications are attained by analyzing reference standards under the same conditions used for samples and by comparing resultant HPLC retention times.

SH 3.0 Instrument Testing, Inspection, and Maintenance Requirements

All maintenance is conducted in accordance with manufacturers' recommendations. These requirements are described in CTL standard operating procedures and appropriate instrument maintenance manuals. The Analytical Section Manager is responsible for ensuring that timely maintenance is conducted and that sufficient spare parts are on hand for necessary maintenance and repair procedures.

The frequency of maintenance performed depends on the equipment; laboratory maintenance is scheduled and conducted daily, monthly, weekly, quarterly, semiannually, and annually, as needed. A few maintenance needs

(e.g., accidental breakage, part failure) are not covered by the general maintenance schedule, and such maintenance is performed as needed.

SH 4.0 Instrument Calibration and Frequency

General calibration requirements for organic analyses by HPLC are summarized in Table SH-3. Calibration requirements for individual methods may differ slightly from the listed general requirements, but the components of the calibration process described in Table SH-3 and corrective actions if requirements are not satisfied are applicable to all HPLC analytical methods.

Table SH-3. HPLC Calibration Requirements

Procedure	Frequency of Procedure	Acceptance Criteria	Corrective Action if Unacceptable
Three-point or five-point initial calibration plus blank	Initially and as needed	Individual response factors for standards must exhibit either $\leq$20% RSD or r$\geq$0.99 for regression line.	Correct problem and repeat until acceptable.
Retention time windows	Initially and with every ICV	RT windows must be centered on ICV, established from three injections or other documented approach.	If analyte peaks are not within RT windows, reestablish RT windows or recalibrate.
Initial calibration verification	After each ICAL, prior to sample analysis	%R 85-115% for all analytes	Remake and reanalyze ICV standard once. If it is still unacceptable, repeat ICAL.
Calibration verification	Daily, prior to sample analysis, after every 10 samples, and at end of run	%R 85-115% for all analytes	Remake and reanalyze CV once. If it is still unacceptable, investigate and correct problem. Analysis cannot proceed until valid CV is obtained or ICAL is repeated. Samples analyzed since last acceptable CV must be reanalyzed.

CV = calibration verification
HPLC = gas chromatography
ICAL = initial calibration
ICV = initial calibration verification
RF = response factor
RSD = relative standard deviation
RT = retention time
%R = percent recovery

As previously stated, specific instrument calibration requirements can and do vary slightly depending on the particular method and the project and regulatory requirements for the project. Detailed descriptions of specific calibration requirements are provided in the CTL analytical method SOP.

SH 5.0 Quality Control

To ensure that data of known and documented quality are generated, the QC criteria described in this section must be met for all HPLC analyses. The QA Coordinators and Section Manager are responsible for monitoring and documenting procedure performance, including the analysis of control samples, blanks, matrix spikes, and duplicates. The Section Manager is responsible for implementing corrective actions when acceptable procedure performance, as described in this section, is not met.

Specific QC samples and frequencies are summarized in Table SH-4. Analytical QC samples are associated with field samples through the use of preparation batches. A preparation batch is defined as a suite of samples of a similar matrix that are processed as a unit within a specific time period. A preparation batch must not exceed 20 samples. Since most of the HPLC methods are multiple analyte methods, the acceptance criteria listed in Table

SH-4 are general guidance values only because the specific criteria depend on the individual analyte and any special project requirements. More specific criteria are provided in the analytical method SOPs.

SH 5.1 Demonstration of Capability

The capability to acceptably perform an analytical method must be demonstrated by each analyst prior to conducting sample analyses. The analyst must conduct four replicate analyses and achieve precision and accuracy equal to or better than the applicable reference method criteria for laboratory duplicates and laboratory control samples, respectively. In the absence of specific criteria, the general criteria listed in Table SH-4 are used.

SH 5.2 Analyte Identification

Target analytes must be identified by retention time (RT). RT windows for each target analyte peak must be centered on the RTs of the initial daily calibration verification. For a valid analyte identification, the RT for an analyte must be within the RT window. For second column confirmation, the analyte must be within the RT window on both columns.

SH 5.3 Blanks

A method blank (MB) is analyzed at the beginning of every analytical run and prior to the instrumental analysis of any samples. MB results are acceptable if the concentrations of all target analytes do not exceed the reporting limit (RL).

If any target analyte concentration in the MB exceeds the RL, the source of contamination must be identified and eliminated. If contamination found in a MB is found in associated samples, the samples should be re-extracted. If it is not possible to re-extract the samples, the data must be appropriately qualified and the project manager notified. If contamination found in the method blank is not found in the associated samples, the samples' results may be reported, but the source of the contamination should still be investigated and eliminated.

Table SH-4. Summary of QC Requirements for HPLC Analysis

QC Sample or Activity	Minimum Frequency	Acceptance Criteria	Corrective Action
Capability demonstration	Four (4) prepared samples analyzed prior to any sample analyses	Method criteria for LCS recovery and duplicate precision	Repeat until acceptable.
Retention times	For every analyte	Analyte peak within RT window	Compound identification is not valid if peaks are outside RT windows. If CV or LCS peaks are not in RT windows, system is out of control and must be corrected. Affected samples must be reanalyzed.
Method blank	Daily prior to sample analysis	Analytes < RL	Clean analytical system and repeat MB analysis. Identify and eliminate the source of contamination.
Laboratory control sample	One (1) per preparation batch	Method criteria default: 70% $\leq$%R$\leq$130%	Investigate and identify the problem. If system is in control (e.g., MS acceptable and LCS result is isolated problem), no corrective action is needed. If system is out of control, repeat analysis of batch.
Matrix spike sample	One (1) per preparation batch	Method criteria default: 70% $\leq$% R$\leq$130%	Investigate problem. If system accuracy is in control, qualify results. If system accuracy is out of control, reanalyze entire batch.
Surrogate spike	In every sample for applicable methods	Method criteria default: 70% $\leq$% R$\leq$130%	Repeat instrumental analysis. If it is still unacceptable, investigate for possible matrix effect or extraction or system problem.
Sample duplicate or matrix spike duplicate	One (1) per preparation batch	Method criteria default: RPD $\leq$20% if analytes > RL	Investigate problem. If system precision is in control, qualify results. If system precision is out of control, reanalyze entire batch.

CV = calibration verification
HPLC = high performance liquid chromatography
QC = quality control
IS = internal standard
LCS = laboratory control sample
MB = method blank
%R = percent recovery
RL = reporting limit
RPD = relative percent difference
RT = retention time

SH 5.5 Laboratory Control Samples

A laboratory control samples (LCS) is second-source to the calibration standards and must be analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The LCS results are acceptable if the percent recovery of the target compounds are within the acceptance ranges or project specified limits.

If the LCS results do not meet specifications, the cause and impact of the problem must be determined. If the LCS results appear anomalous (e.g., bad injection, isolated extraction problem) and the matrix spike results and other batch QC are acceptable, the batch's samples' results are acceptable. If both the LCS and MS results are unacceptable, then instrumental (i.e., HPLC) analysis of the sample batch must be repeated. If after instrumental reanalysis both the LCS and MS are still unacceptable, then the sample batch must be re-extracted. If it is not possible to re-extract, the project manager must be notified. The project manager will contact the client and possibly arrange for recollection of samples.

SH 5.6 Matrix Spikes

Spikes are run every 10 to 20 samples depending on the specific method or per project requirements. Spike recoveries must fall within the acceptance ranges or project specified limits.

If the QC criteria for the matrix spike analyses are not satisfied, the cause and impact of the problem must be determined. If the associated LCS results are acceptable, then the MS results are reportable with the qualifier that a matrix effect was observed. If the problem adversely affected the entire analysis batch, such as LCS results also unacceptable (see LCS discussion in SH 5.5), all samples in the batch must be reanalyzed.

SH 5.7 Surrogate Spikes

For every sample analyzed, surrogate spike recoveries must also fall within acceptance ranges. If a sample's surrogate result is outside the acceptance range, the following procedures are necessary:

1) Check for calculation errors. If errors are found, recalculate the data.
2) Check chromatogram for interfering peaks.
3) Check instrument performance. If a problem is identified, correct the problem and reanalyze the sample.
4) If no instrument problem is found, the sample should be re-extracted and re-analyzed. If no sample remains, the client must be notified of the situation.
5) If the sample has been duplicated or spiked check for indication of problem due to matrix.

SH 5.8 Duplicates

A duplicate sample or duplicate matrix spike sample is analyzed at a frequency of at least one per 20 samples depending on the specific reference method or project requirements. The relative percent difference (RPD) between duplicate samples, for samples having analyte concentrations greater than their respective reporting limit, or between a matrix spike (MS) and matrix spike duplicate (MSD) must be within the acceptance ranges or project specified limits.

If the QC criteria for duplicate sample or duplicate spike analyses are not satisfied, the cause and impact of the problem must be determined. If the problem adversely affected the entire analysis batch, all samples in the batch must be reanalyzed.

SH 5.10 Blind Performance Evaluation Samples

CTL participates in numerous performance evaluation (PE) studies to obtain an independent assessment of the accuracy of its analyses, to fulfill specific project requirements, and to maintain laboratory accreditations. All PE analyses performed by CTL are performed by the same analysts and using the same procedures that are used for routine sample analyses for the analyte(s) of interest. The PE results must satisfy the PE acceptance criteria specified by the PE provider or project. After an evaluation of the PE results are received, any results outside of acceptance limits are investigated and corrective actions taken to prevent recurrence of the problem.

SH 6.0 Data Management

SH 6.1 Data Generation

Sample analyses at the CTL laboratory are performed by qualified analysts and by using appropriate analytical methods to ensure the generated data are valid and legally defensible. Each laboratory analyst must successfully complete a prescribed sequence of training objectives before that individual is designated qualified and permitted to independently conduct any assignment or analyses (see QAM Section 2.3), and all analyses require strict adherence to QC requirements specified for each type of analysis (Section SH 5.0).

SH 6.2 Data Reduction

Detailed procedures for converting raw data to final, reportable results are provided in the analytical method SOPs. A hard copy printout of all raw data is reviewed, evaluated, edited if necessary, signed, and dated by the analyst who performed the analysis.

Deviations from the specified data reduction procedures are permitted only with approval of the Organics-HPLC Section Manager, and such deviations are to be recorded on the raw data recording forms. Normally a written description of the modification and the reason for it will be included in the final report.

SH 6.3 Data Validation

As stated in QAM Section 7.1.2, one hundred percent of the data must receive independent technical review. The reviewer must be a qualified individual other than the data generator (e.g., peer analyst or Analytical Section Manager). The independent technical reviewer must meet the minimum training and qualifications requirements for analysts. Individuals not qualified to perform data interpretation cannot perform independent technical review. The reviewer(s) must ensure that:

- Data generation and reduction were conducted in a technically correct manner in accordance with the methods used
- Data are reported in the proper units and with the correct number of significant figures
- Calculations were verified by a valid calculation program, a spot check of verified calculation programs, or 100% check of all hand calculations
- All variances from an accepted method and the rationale for the variations were documented and approved
- Data were reviewed for transcription errors
- Analytical data documentation (i.e., analysis data file or data package) is complete and includes sample preparation/extraction records, analysis sequence list, raw data,

calculations or calculation records, calibration data or records, QC measurement results, test results summary

- QC measurement results are within established program specification limits, or if not, the data are appropriately qualified
- Analytical sample holding times were met, or exceptions are documented

Independent technical review is required before any data are approved for release and submitted to the data reporting process. The independent technical review process is documented and archived in the associated data package/file.

SH 6.4 Data Reporting

After peer review of the data is completed as described in Section SH 6.3 the results are approved and a preliminary report is generated. The applicable Project Manager (PM) reviews the preliminary report (QAM Section 7.1.3), and works with necessary Analytical and Operations Sections' personnel to make any needed corrections, then a final report is produced. The final report (QAM Exhibit 7-2) is also reviewed and signed by the PM before it is submitted to the customer. Each final report has a unique identification number, which is the CTL Work Order No. listed in the upper right hand corner of the report.

The CTL laboratory offers four levels of data reports as illustrated in QAM Table 7-1. For the levels II, III, and IV deliverables formats, the applicable Analytical Sections provide the listed analysis portions and any related narrative comments to Project Management where the complete package is assembled. The PM reviews the complete package and writes the cumulative (i.e., case) analysis narrative. After final review, approval and signature by the PM, the report is paginated, copied, then mailed to the customer. The copy of the data package provided to the client and all associated raw data is kept for period of at least 3 years or longer if requested by the client. These records are stored in the laboratory for about six months then transferred to another company building for secure, long-term storage.

CTL provides electronic data deliverables (EDDs) in customer requested formats including Access, Excel, Quattro, dBaseIII+, and ASCII files. CTL's LIMS system stores information, from which the EDDs are prepared, for sample log-in, work status/tracking, sample results and associated QC results, report generation, and invoicing. CTL's Information System personnel maintain the LIMS on-site. Full server backups are performed nightly. Other electronic data include instrument magnetic tape media and are not overwritten. Backup copies of electronic media are prepared at least monthly and stored in a secure area off-site.

ATTACHMENT D
SUBCONTRACTOR LABORATORY STANDARD OPERATING PROCEDURES

Provided on CD

CT Laboratories
Baraboo Laboratory Divison

Title: **Inductively Coupled Plasma Emission—ICP-OES 6000 Series**

SOP Number:

Prepared by: _____
Date

Technical Review by: _____
Date

Reviewed by: _____
Quality Assurance ***Date***

_____
Laboratory Director ***Date***

SOP Manual Control Number:_____

1.0 Identification of Test Method

1.1 This procedure is used for the analysis of trace elements (metals) following EPA SW 846 Methods 6010B and/or 6010C (Inductively Coupled Plasma –Atomic Emission Spectrometry) and Method 200.7 (SDWA).

2.0 Applicable Matrix or Matrixes

2.1 This method is applicable to the determination of various metals in drinking water, surface water, groundwater, sludge, soils, and industrial wastes.

3.0 Detection Limits

3.1 Method detection limits (MDLs) are determined annually and results vary from element to element. For DOD-QSM, ACOE-LCG work MDL's and LOQ's are verified initially and quarterly thereafter. MDL checks are analyzed up to 3x the calculated MDL (to verify sensitivity). If MDL checks are not detected at the spiked level for any given element than increase the level of the spike until the element is detected (minimum 2 successful analyses). The level at which an element was successfully detected becomes the reported MDL. LOQ checks are used for accuracy verification and shall meet project or client specific control limits. Failing LOQ checks may also need elevation of the spike levels for a given element. The concentration that successfully meets control criteria is used as the reported LOQ. Procedures for conducting MDL studies can be found in CT Laboratories Initial Method Performance and Reporting SOP (CL-2, rev. 5).

4.0 Scope and Application

4.1 Metals in solution can be readily analyzed by atomic emission using an Inductively Coupled Plasma (ICP) spectrometer. All matrices, excluding filtered groundwater samples and drinking waters with a turbidity less than 1 NTU, will require a digestion prior to analysis.

5.0 Method Summary

5.1 If necessary, prior to analysis, samples are digested using an approved method. See SOPs 6205B, 6225B, 6230B, M200.2, and M-soluble for further information on sample digestion.

5.2 This method describes multielement determinations using an iCAP 6000 Series ICP-OES which use an Echelle optical design and a Charge Injection Device (CID) solid-state detector to provide elemental analysis. Most Samples are liquids that are pumped through a nebulizer to produce a fine spray. The large droplets are removed by a spray chamber and the small droplets then pass through to the plasma. The solvent is evaporated. The residual sample is decomposed to atoms and ions that become excited and emit characteristic light which is measured, giving measurement of the concentration of each element type in the original sample. Control of the spectrometer is provided by the PC based iTeva software (refer to the Thermo ICP-OES software manual). Samples are routinely analyzed using an internal standard solution of 50 mg/L Yttrium to eliminate certain matrix interference problems. Line switching is also used to extend the dynamic range of an element.

5.3 The data is exported to the LIMS system and reviewed by the analyst. Following analyst review, the data is given to a qualified reviewer for complete data review. After the data has been reviewed and it is determined that it is valid data, the reviewer sends the data to the "validated" mode in the LIMS system.

6.0 Definitions

6.1 Reagent Blank- A solution of de-ionized water, (containing in correct proportion, all reagents required by the method), used with the calibration standards to standardize the instrument, as a calibration blank, and for sample dilution.

6.2 Calibration Standards - A series of known standard solutions, which shall include the reagent blank, used for calibration of the instrument within the measurable linear range. Calibration standards shall contain, in correct proportion, all reagents required by the method. Acceptance of the calibration requires a correlation coefficient (r) of 0.995 or better. No samples shall be analyzed without acceptable calibration. For DOD-QSM data the low calibration standard shall be equal to or less than the MRL.

6.3 Calibration Verification Standard-Initial (ICV) & Continuing (CCV) - A midpoint calibration standard which is analyzed at the beginning of the run (ICV), at a frequency of 1 per 10 samples during a run (CCV), and at the end of a run to verify calibration throughout the run. The ICV must be from a second source different than that of the calibration standards.

Note for method 200.7 that limits for ICV are tighter than those for the CCV (see section 16).

6.4 Low-Level Calibration Check Standard – If a single point calibration is used (for DOD-QSM data) then a low level standard shall be analyzed. The acceptance criterion is +/- 20% of the expected value.

6.5 CB (Calibration Blanks- Initial and Continuing) - A reagent blank solution, which is analyzed immediately following the ICV (Initial Calibration Blank-ICB), at a frequency of 1 per 10 samples during a run (Continuing Calibration Blank-CCB), and at the end of a run to check for drifts in calibration, or possible analyte carry-over. Warning criteria include that the value be less than or equal to the three times the IDL for a given analyte for SW-846 work, less than the MDL for DOD-QSM data, or less than ½ the MRL for ACOE work. Control criteria consist of the CB value being less than or equal to 2 times the MDL for a given analyte for SW-846 and is determined by the QAPP for DOD/ACOE work. If this range is exceeded, a new calibration will be necessary.

6.6 LCS (Laboratory Control Sample) - A mid-range standard, prepared from a source different from that used for calibration standards, which is carried through the entire preparation and analytical method. The LCS is used to verify the accuracy of the preparation method. A minimum of one LCS is prepared per batch and is analyzed at the beginning of an analytical batch.

6.7 MB (Method Blank) - A Reagent Blank (see 3.1) which is carried through the entire preparation and analytical method. The method blank is used to detect possible contamination that may occur prior to or during the sample preparation. A minimum of one MB is prepared per batch and is analyzed at the beginning of an analytical batch. Blank recovery must be less than 2x the MDL for SW846, less than the MDL for SWDA samples, less than ½ the RL for DOD-QSM, and is determined by the QAPP for ACOE samples.

6.8 MS-MSD (Matrix Spike-Matrix Spike Duplicate): - Two separate sample aliquots to which a known concentration of analyte has been added which is carried through the entire preparation and analytical procedure. The purpose of a matrix spike is to reveal any matrix effect from the sample on the recovery of the analyte by the method being used. An MS-MSD pair is prepared for every 20 samples of a given matrix per day for 6010B and once for every 10 samples of a given matrix per day for 200.7. For ACOE work only an MS is prepared and a duplicate sample is prepared rather than an MSD. Failure to meet criteria may be due to poor recovery during the

preparation method or due to matrix interference within the digestate. To be considered acceptable, MSD must meet both the same % recovery criteria as an MS, and the same % RPD as a duplicate sample.

6.9 Duplicate sample- A separate sample aliquot which is carried through the entire preparation and analytical procedure. A duplicate is prepared for every 20 samples for ACOE/LCG work and per batch for DOD-QSM (in replacement of an MSD).

6.10 Method Reporting Limit (MRL) or Contract Required Detection Limit (CRDL) Standard: Detection level standard at a level near the reporting limit, or at a level specified by client contract. When required, it is to be analyzed following the ICB, and prior to the last CCV standard in the run.

6.11 Interelement Correction Factors (IEC) – These correction factors are determined by analyzing a concentration range of known interferents (Al, Ca, Co, Cr, Cu, Fe, Mg, Mn, Ni, V and Zn) and examining all other lines for a significant linear response. A line is considered to be significantly affected when the correlation coefficient for the interference is 0.99 or better and the correction factor multiplied by ten is greater than the MDL of the affected line. For interferents known to occur at high levels in environmental samples (Al, Ca, Cr, Cu, Fe, Mg and Zn) the interference will be considered to be significant when the correction factor multiplied by 100 is over the MDL of the affected line and the correlation coefficient in 0.99 or better. Interelement correction is used where applicable.

6.12 Linear Dynamic Range (LDR) – The upper limit of the linear dynamic range is established for each wavelength utilized by determining the signal responses from a minimum of three different concentration standards across the range. One of these will be near the upper limit of the range. The ranges used for the analysis of samples are judged by the analyst from the resulting data. The data and calculations are kept on file. The upper range limit is an observed signal no more than 10% below the level extrapolated from the lower standards. Determined analyte concentrations above the upper range limit are diluted and reanalyzed. New dynamic ranges are determined whenever there is a significant change in instrument response. For analytes that routinely approach the upper limit of the range, the range will be checked biannually. For analytes that are known interferents and exceed the dynamic range, the analyst will check that IEC's have been correctly applied. DOD-QSM requires that a LDR (or high level check standard) study be perform at least every six months.

Note: for ACOE/LCG work, analyte concentrations above the upper calibration limit are diluted and reanalyzed.

6.13 ICS-A (Interelement Correction Standard-A): A standard containing the elements Al, Ca, Fe, and Mg at 500mg/L. This standard is analyzed when using method 200.7 or performing ACOE work following the ICV at the beginning of the run to determine that interelement correction factors are correctly compensating for interference from these elements on other analyte lines. The ICSA may be required to be run before the last CCV of the run for ACOE work. Check the QAPP to determine if this is necessary.

Note: For ACOE work, the ICSA should be within the absolute value of two times the MDL for all analytes except Al, Ca, Fe and Mg unless a different requirement is specified within the contract.

6.14 ICS-AB (Interelement Correction Standard-AB): A standard containing the elements Al, Ca, Mg, and Fe at 500mg/L and all other elements at 500ug/L. This standard is analyzed following the ICV at the beginning of each run. It is analyzed to determine that the IEC are correctly preventing interference by these elements on the

measurement of other analytes. The ICSAB may be required to be run before the last CCV of the run for ACOE work. Check the QAPP to determine if this is necessary

6.15 PDS (Post Digestion Spike): When a serial dilution or matrix spike falls outside of the acceptance limits a post digestion spike is used to determine if the sample digestion matrix is interfering with the analysis of the analyte. The sample is spiked at a level similar to that of the matrix spike.

Note: For ACOE/LCG work, a PDS will be conducted at a minimum rate of one per prep batch per unique matrix.

6.16 SD (Serial Dilution Analysis): A sample is diluted 5x with method blank solution and analyzed. The diluted result and the undiluted result should agree within a limit of precision defined by the program (SW846, CLP, 200.7) or client QAPP.

Note: For ACOE/LCG work, a SD will be conducted at a minimum rate of one per prep batch per unique matrix.

6.17 Batch- A batch consists of 20 samples of the same matrix analyzed on the same day or 20 samples of the same medium that have been prepared together.

6.18 IDL (Instrument Detection Limit); A series of blanks analyzed during initial setup or after significant changes, or as per DOD-QSM requirements. The limits established shall be < LOD for any given element.

6.19 Method detection limit (MDL): The minimum concentration of an analyte that can be identified measured and reported with 99% confidence that the analyte concentration is greater than zero.

6.20 LOQ Check: An internally prepared standard at a level near the Limit of Quantitation (LOQ) or at a level specified by a specific program or contract. An LOQ Check is required after MDL studies and quarterly thereafter for QSM work. Recovery limits are required for LOQ Checks and are usually program/contract specific.

6.21 Method Detection Limit (MDL) Check: An internally prepared standard prepared at approximately 1-2 time the calculated MDL for a given analyte (1-4 times for multi-component analyses). The MDL check sample is used as verification of the calculated MDL's. Detection of the individual analytes in the MDL check is the only requirement. The MDL check is required after MDL studies and on an analytical run for LCG work when there are failures on the MRL spikes or quarterly for QSM.

7.0 Interferences

7.1 Background emission and stray light are corrected using background correction. See ICP 6000 Series operator's manual for further instructions on background correction application.

7.2 Spectral overlaps are corrected for using interelement correction factors (IEC). When IEC are used, the interfering elements must be analyzed along with the elements of interest. The accuracy of IEC shall be verified daily by analyzing the ICSAB. All IEC factors shall be updated every six months or when an instrumentation change occurs; such as, changing a torch, nebulizer, injector, or plasma conditions.

7.3 Physical interferences such as viscosity are minimized by using an internal standard. Post digestion spike and serial dilutions help to determine if physical interferences are present.

7.4 Chemical interferences include molecular compound formation, ionization effects, and solute vaporization effects. Chemical interferences are not normally seen during ICP analysis and are highly matrix dependent.

7.5 Memory interferences occur when a sample of high analyte concentration does not thoroughly rinse prior to the analysis of the next sample. This causes elevated

readings for that analyte in the subsequent sample. Memory effects can be minimized by rinsing at least 60 seconds between samples.

8.0 Safety

8.1 Gloves and protective clothing should be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure should utilize appropriate laboratory safety systems.

8.2 Insure that waste collection vessels contain enough room to accommodate all wastes that will be produced during the operation of the instrument.

9.0 Equipment and Supplies

9.1 ICP 6500, Cetac autosampler, computer, & network printer.
9.2 Argon (Airgas-liquid high purity or gaseous pre-purified grade or equivalent).
9.3 Class A volumetric flasks and pipettes (Chemglass or equivalent).
9.4 Disposable 15-mL polystyrene culture tubes.
9.5 100 uL pipette (Eppendorf or equivalent).
9.6 10-mL pipette (Eppendorf or equivalent).

10.0 Reagents and Materials

8.1 Reagents

8.2.1 Mixed and single element stock metals standards. See Section 9 and Appendix A, B, C and D for instructions on making the working standards.
8.2.2 Nitric acid, conc. (Fisher, Trace Metals grade or equivalent)
8.2.3 Hydrochloric acid, (Fisher, Trace Metals grade or equivalent)
8.2.4 Deionized water (Milli Q, > 10 mega ohm).

11.0 Sample Preservation and Storage

9.1 Samples must be preserved and analyzed within holding times stated in chart. Liquid samples are stored on shelves in the Laboratory warehouse and soil samples are stored in a walk-in refrigerator unit.

	Liquids	Solids
Preservative:	pH <2 with HNO_3	4^oC (+/-2)
Hold Time:	180 days	180 days

12.0 Quality Control

12.1 This SOP is designed to follow a variety of different projects and programs requirements. Table 3. is designed to illustrate the control steps and provisions required to adequately producing acceptable data.

12.2 Contract Specific Sample Analysis: For certain samples, limits are specified by the QAPP (Quality Assurance Project Plan) associated with a given project. For these samples follow the limits specified in the QAPP for that project.

12.3 For the routine analysis of groundwater, wastewater, leachate, surface water, soil, sludge, TCLP/SPLP extracts following method 6010B:
Required QC following instrument calibration is as follows :

12.1.1 ICV (initial calibration verification); The ICV is prepared from an alternate source standard whose concentrations are within the linear working range of the instrument. The results of the ICV should agree within 10% of the expected value for a given analyte. The relative standard deviation (RSD) between the replicate integrations should be <5%. If results are outside of this range, corrective action must be taken before samples can be analyzed.

12.1.2 ICB (initial calibration blank); analyze the calibration blank. The results of the initial calibration blank must be < 3x IDL for a given analyte. If the average of the replicates is not < 3x IDL, terminate the analysis, correct the problem and recalibrate or appropriately qualify the data. If the blank is less than $1/10^{th}$ the concentration of the action level of interest and no sample is within ten percent of the action limit, analyses need not be rerun and re-calibration is not necessary before continuing with the analysis.

12.1.3 ICSAB (interference check solution); analyze a solution containing 500 mg/L Al, Ca, Mg, and Fe and all other analytes of interest at 0.50 mg/L. Recovery for analytes of interest is +/- 20% true value. If recovery is outside this range, corrective action must be taken before samples can be analyzed. Check placement of background correction points and IECs as a place to start troubleshooting .

12.1.4 LCS (laboratory control sample); analyze an alternate source reference sample. Control limits are +/- 20% of true value or in-house limits, whichever is more restrictive, or as specified in a client QAPP or the DOD-QSM manual.

12.1.5 MB (method blank); analyze a reagent blank. The method blank is a reagent blank that has been taken through the preparations steps along side the samples being analyzed. Control limits are the MDL. If the average of the replicates is not < MDL terminate the analysis, correct the problem and recalibrate or appropriately qualify the data that falls within the MDL and twenty times the concentration of the analyte in the method blank.

12.1.5 CCV (continuing calibration verification); analyze a check standard after every ten samples and following the last sample in the run. This standard should be at a level approximately mid-scale. Control limits are +/- 10% of true value. If values fall outside this range, all samples back to the last acceptable ICV or CCV must be repeated.

12.1.6 CCB (continuing calibration blank); The results of the continuing calibration blank must be < 3x IDL for a given analyte. If the result falls outside this, reanalyze all samples back to the last acceptable CCB or qualify all sample <20 times the blank and greater than the MDL.

12.1.7 MS/MSD (matrix spike/matrix spike duplicate); for non-digested samples, prepare a bench spike in duplicate at a frequency of 5% or per analytical batch, whichever is more frequent. Control limits are +/- 25% of true value, and 20% RPD, or use calculated limits, whichever is tighter. See Sec. 18.0 for bench spike preparation. For digested samples, see "Predigestion Spike" chart in section 18.0. For digested samples, analyze the MS/MSD samples as they apply to each digestion set. Follow the above for control limits. For digested spikes with sample results greater than four times the digested spike level, prepare and analyze a PDS sample if the MS and/or MSD are outside the control limits. Prepare the PDS at a level approximately two times the sample level.

12.2 For SDWA analysis following method 200.7
Required QC following instrument calibration is as follows:

12.2.1 ICV: Referred to in 200.7 as LPC (laboratory performance check); analyze the mid-cal standard. Control limits are +/- 5% of true value. If values fall outside this range, recalibrate for the affected analytes.

12.2.2 ICB (initial calibration blank); analyze the calibration blank. The absolute value of the result should be below the MDL for the analyte(s) of interest. If

the blank result falls outside this, evaluate the effect on the sample results and/or recalibrate for the affected analytes. Samples with results >10x the associated blank value need not be reanalyzed.

12.2.3 ICSA (interference check solution: interference only) analyze a solution containing 500 mg/L Al, Ca, Mg, and Fe. This sample must be analyzed at the beginning of the analytical run before the ICSAB. Recovery for interfering analytes is +/- 20% true value. All other analytes need to be $\pm$ 2x the MDL. If recovery/result is outside the acceptable range, corrective action must be taken before samples can be analyzed. Check placement of background correction points and IECs as a place to start trouble shooting.

12.2.4 ICSAB (interference check solution); analyze a solution containing 500 mg/L Al, Ca, Mg, Fe and all other analytes of interest at 0.50 mg/L. Recovery for analytes of interest is +/- 20% true value. If recovery is outside this range, corrective action must be taken before samples can be analyzed. Check placement of background correction points and IECs as a place to start trouble shooting.

12.2.5 LCS (laboratory control sample); analyze an alternate source reference sample per batch of 20 samples of the same matrix. Control limits are +/- 10% of true value, or manufacturer's limits, whichever is tighter.

12.2.6 MB (method blank); analyze a reagent blank per 20 samples of the same matrix. The method blank is a reagent blank that has been taken through the preparations steps along side the samples being analyzed. If the average of the two replicates is not < MDL terminate the analysis, correct the problem and recalibrate or appropriately qualify the data that falls within the MDL and twenty times the concentration of the analyte in the method blank .

12.2.4 CCV: Referred to in 200.7 as LPC (laboratory performance check); analyze the mid-cal standard after every 10 samples. Control limits are +/- 10% of true value. If values fall outside this range, reanalyze all samples back to the last acceptable ICV or CCV.

12.2.5 CCB (continuing calibration blank); analyze the calibration blank immediately after each CCV. The value of the result should be below the MDL for the analyte(s)of interest. If the result falls outside this, evaluate the effect on the sample results. Sample results >10x the associated blank value need not be reanalyzed. Otherwise, reanalyze all samples back to the last acceptable CCB or qualify data that is >LOD and <10x the associated blank.

12.2.6 MS/MSD (matrix spike/matrix spike duplicate); for non-digested samples, prepare a bench spike in duplicate at a frequency of 5% or per analytical batch, whichever is more frequent. Control limits are +/- 25% of true value, and 20% RPD, or use calculated limits, whichever is tighter. See Sec. 18.0 for bench spike preparation. For digested samples, see "Predigestion Spike" chart in section 18.0. For digested samples, analyze the MS/MSD samples as they apply to each digestion set. Follow the above for control limits. For digested spikes with sample results greater than four times the digested spike level, prepare and analyze a PDS sample if the MS and/or MSD are outside the control limits. Prepare the PDS at a level approximately two times the sample level.

12.3 For the CLP-like level 4 analysis of groundwater, surface water, wastewater and soil

Note: A default of three replicate exposures per sample should be used for ACOE/LCG work unless specified differently in the QAPP.

Required QC following instrument calibration:

12.3.1 ICV (initial calibration verification): analyze the alternate source check standard immediately following calibration. Control limits +/- 10 % true value.

12.3.2 ICB (initial calibration blank): analyze the calibration blank. The absolute value of the result must be below the contract required detection limit (CRDL) or the limit stated within the QAPP for the project. The ICB results shall be less than the LOD/MDL for ACOE/ DOD-QSM data (or project specific). If a result falls outside this, reanalyze (recalibration may be necessary).

12.3.3 CRDL (contract required detection limit standard) or MRL (Method Required Limit): analyze a standard at a level two times the contract-required detection limits (CRDL) or at the level stated within the QAPP for the project. Follow limits stated within the QAPP as there are no EPA specified control limits for this standard. This sample must be analyzed at the beginning and the end of the run for ACOE samples.

12.3.4 ICSA (interference check solution: interference only) analyze a solution containing 500 mg/L Al, Ca, Mg, and Fe. This sample must be analyzed at the beginning of the analytical run prior to the ICSAB. Refer to QAPP for acceptability criteria. For ACOE work, the default criteria is the absolute value of two times the MDL for all analytes except Al, Ca, Mg and Fe which must have a recovery between 80-120%. Refer to QAPP to determine if the ICSA must also be analyzed at the end of the run.

12.3.5 ICSAB (interference check solution: interference plus analytes); analyze a solution containing 500 mg/L Al, Ca, Mg, and Fe, and all other analytes of interest at 0.50 mg/L. Recovery for analytes of interest is +/- 20% true value. If recovery is outside this range, corrective action must be taken before samples can be analyzed. Check placement of background correction points as a place to start troubleshooting. This sample must be analyzed at the beginning of the run. Refer to the QAPP to determine if the ICSAB must be analyzed at the end of the run.

12.3.6 Digested Sample set to include MB (S or W), LCS (S or W), MS, and DUP.

12.3.7 Serial Dilution: Analyze a x5 dilution of a sample from the digestion set. For sample results > 50x the MDL, the %RSD between the serial dilution result and the sample result must be $\leq$ 10.

12.3.8 Post digestion spike addition (bench spike): An analyte spike added to a portion of a prepared sample, or its dilution, should be recovered to within +/- 25% of the known value or as specified by the client QAPP. The spike addition should produce a minimum level of 10 times the instrumental detection limit. If the spike recovery falls outside the limits, a matrix effect should be suspected.

12.3.9 CCV (continuing calibration verification): Analyze a mid-level standard after every ten samples. The CRDL/MRL, ICSA, ICSAB and batch QC all count as samples. Control limits are +/- 10% of true value. If any result falls outside this, all samples back to the last acceptable ICV/CCV must be reanalyzed.

12.3.10 MB (method blank); analyze a reagent blank per 20 samples of the same matrix. The method blank is a reagent blank that has been taken through the preparations steps along side the samples being analyzed. If the average of the two replicates is not < MDL (< ½ the RL for ACOE/DOD-QSM, or <

project specified limits), terminate the analysis, correct the problem and recalibrate or appropriately qualify the data that falls within the MDL and ten times the concentration of the analyte in the method blank.

12.3.11 CCB (continuing calibration blank); Analyze the calibration blank after each CCV (or every ten samples). Refer to the QAPP for CCB acceptance limits. The CCB results shall be less than the LOD for DOD-QSM data and <1/2 the RL for ACOE data (or project specific). If any result falls outside these limits, all samples with results less 10 times the CCB must be reanalyzed back to the last acceptable CCB or appropriately qualified.

12.3.12 MS/DUP (matrix spike/matrix duplicate); for non-digested samples, prepare a bench spike and a duplicate at a frequency of 5% or per analytical batch, whichever is more frequent. Control limits are specified in client QAPP. or see "Predigestion Spikes"(Table 1). For digested samples, analyze the MS/DUP samples as they apply to each digestion set and follow Table 3 control limits.

12.4 New or unusual matrices: It is recommended that whenever a new or unusual sample matrix is encountered, a serial dilution and post digestion (bench) spike be performed prior to reporting results. These tests will ensure that neither positive nor negative interferences are affecting sample results.

Note: For ACOE work, a serial dilution and a post digestion spike will be performed at a rate of one per matrix with each prep batch.

12.4.1 Serial Dilution: If the analyte concentration is sufficiently high (minimally a factor of ten above the instrumental detection limit after dilution), an analysis of a 1:5 dilution should agree within +/- 10% of the original determination. If not, a chemical or physical interference effect should be suspected.

12.4.2 Post digestion/bench spike addition (Table 2): An analyte spike added to a portion of a prepared sample, or its dilution, should be recovered to within +/- 25% of the known value. The spike addition should produce a minimum level of 10 times and a maximum of 100 times the instrumental detection limit. If the spike recovery falls outside these limits, a matrix effect should be suspected..

13.0 Calibration and Standardization

13.1 The default calibration for TAL plus list (excluding Na and K) of metals for ACOE, LCG, DOD-QSM and routine work is a multi-point calibration method called 'DOD calibration' which uses 12 mixed standards and a calibration blank.

13.2 The default calibration for the metals Sodium and Potassium for ACOE/ LCG, DOD-QSM and routine work is a multi-point calibration method called 'Sodium and Potassium' which uses 8 mixed standards and a calibration blank.

13.3 The default calibration for the metal Boron for ACOE, LCG, DOD-QSM and routine work is a multi-point calibration method called 'Boron' which uses 5 standards and a calibration blank

13.4 The default calibration for the metal Lithium for ACOE, LCG, DOD-QSM and routine work is a multi-point calibration method called 'Lithium' which uses 7 standards and a calibration blank. Refer to section 11.0 for further instructions on how to perform the calibration.

Note: See Appendix A for preparations of calibration standards and blank for the DOD calibration method calibration. See Appendix B for the preparation of the calibration standards and blank for the Sodium and Potassium method

calibration. See Appendix C for the preparation of the calibration standards and blank for the Boron calibrations. See Appendix D for the preparation of the calibration standards and blank for the Lithium calibration. See Tables 4 (a, b, & c), 5, 6, and 7 for individual element calibration concentrations/ranges.

13.5 Calibration Blank: Into a 1 L. volumetric flask, add 750 mL of Milli-Q water and 10mL of conc. HNO3 and 10mL HCl. Mix, dilute to volume with Milli-Q H2O. Transfer to a clean 1 L. nalgene bottle. Prepare every 6 months or as needed.

13.6 Yttrium Internal std (Used for all methods) : Into a 2000mL volumetric flask, add 500mL of Milli-Q H2O, 10 ml 10,000 mg/L Yttrium standard dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean 2L Nalgene bottle. Prepare every 6 months or as needed. Concentration = 50 mg/L Yttrium solution.

13.7 Initial/Continuing Calibration Verification (ICV/CCV): Into a 1000mL volumetric flask, add 500mL of Milli-Q water, 10 mL of conc. HNO3 and 10mL HCl. Add the following:

10 mL SPEX Certiprep Spike Sample Standard 1 or Equivalent
0.5mL Mo 1000mg/L
0.05ml Ag 1000mg/L
2 ml Interferents-A-SPEX Certiprep or equivalent

Dilute to volume with Milli-Q water, mix and transfer to a clean 1 L Nalgene bottle. Make new every 6 months or as needed.

Concentration	Analyte
50ug/L	Cd, Be
100ug/L	Ag
200ug/L	Cr
250ug/L	Cu
500ug/L	Co, Mn, Mo, Ni, Pb, Sb, V, Zn
2000ug/L	Ba, As, Tl, Se
5,000ug/L	Fe
10,000ug/L	Ca, Mg
12,000ug/L	Al

13.8 Interference Check Solution (ICSA): Into a 500 mL volumetric flask, add 300 mL of Milli-Q H2O, 5 mL of conc. HNO3 and 5mL conc. HCl. Add the following stock solutions in the volumes listed:

50 mL Spex Certiprep Interferents A or equivalent
15 ml Fe 10,000mg/L or equivalent

Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean 500 mL Nalgene bottle. Prepare every 6 months or as needed.

Concentration	Analyte
500,000 ug/L	Al, Ca, Mg, Fe

13.9 Interference Check Solution (ICSAB): Into a 500 mL volumetric flask, add 300 mL of Milli-Q H2O, 5 mL of conc. HNO3 and 5 mL conc. HCl. Add the following stock solutions in the volumes listed:

50 mL Spex Certiprep Interferent A or equivalent
15 ml Spex Certiprep Fe 10,000 mg/L or equivalent
2.5 ml Spex Certiprep QC-21 or equivalent
0.25 ml Ultra Scientific Ag 1000 mg/L or equivalent
0.25 ml Ultra Scientific Ba 1000 mg/L or equivalent

Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean 500 mL Nalgene bottle. Prepare every 6 months or as needed.

Concentration	Analyte
500,000 ug/L	Al, Ca, Mg, Fe
500 ug/L	Ag, As, Ba, Be Cd, Co, Cr, Cu, Mn, Mo, Ni, Pb, Se, Sb, Tl, V, Zn

13.10 CRDL/MRL solution: Concentrations needed depend on the CRDL/MRL of a given contract.

14.0 Procedure

14.1 Instrument start-up procedure:

14.1.1 Open valve at argon tank, turn on chiller and instrument.. For best results, the instrument should be on and with an argon purge for at least 24 hours

14.1.2 Inspect pump tubing on instrument and on autosampler and change if necessary.

14.1.3 Fill DI rinse reservoir with DI water and preserve with HNO3 to1%.

14.1.4 Open up the ITeva software on the PC. Choose user, wait until instrument initializes.

14.1.5 Plasma startup and shutdown: Refer to the ICAP 6000 Series ICP-OES Spectrometer Operator manuals pages 11-1 thru 11-4. After plasma startup check the "Debug Wavelength Check" at the bottom of the ITeva control center. The absolute value of x and y #s should be less than 5, if not, stop and call Thermo service.

14.1.6 After a 30-minute warm-up period, check condition of nebulizer. Put pump tube into a 100mg/L solution Yttrium Std. With the lights off and after enough time has elapsed for the Yttrium standard to reach the plasma, a red cone should be noticeable in the center of the plasma. If the nebulizer is in good condition and the nebulizer gas flows are set properly, the red cone should project about 2mm beyond the coils. If not, check the settings, the pump tubes, and inspect the nebulizer under a microscope for any obstructions or breakage.

14.2 To create an autosampler sequence:

14.2.1 Refer to the ICAP 6000 Series ICP-OES Spectrometer Operator manuals pages 11-9 thru 11-11 to start an autosampler sequence.

14.2.2 Add all samples, LCS, Blanks, MS-MSD, etc. in order of program, agency or client request.

14.2.3 Print Autosampler Table: This will be used when preparing all samples and standards.

14.2.4 Using the printed autosampler table sheet, prepare all standards, QC samples, and samples in their designated positions in the autosampler. Prepare any bench spikes and place them in autosampler. Calibration standards, CCV, ICV, CCB, ICB and ICSAB all go into 50 ml vials in the designated S-# positions of the autosampler. All others are poured into 15 ml plastic vials into the designated areas within the 60 position racks.

14.3 Calibration and Analysis.

14.3.1 Once all calibration standards have been placed in the autosampler make sure the autosampler is initialized by clicking on the autosampler icon and the sequence is saved and then press the yellow arrow icon to start the calibration and prepare the remaining samples as the calibration is being carried out.

14.4 Instrument shutdown

14.4.1 If run will not be finished during work hours, program the instrument to shutdown at the end of the analytical run. When setting up on the sequence page click the "End Action (after all sequences) Box to "Shutdown Plasma". This will shut down the plasma.

14.4.2 For manual shutdown go to the flame icon in the bottom right corner and click, and then select the plasma off icon. After the plasma is shutdown loosen the pump tubes and shut off the chiller.

15.0 Calculations

15.1 Sample Calculations:

Liquid Concentration (ug/L) = A x C

$$\textit{Solid Concentrations (mg/kg)} = \frac{A \times B \times C}{D \times E},$$

Where: A = instrument reading for sample (ug/L)
B = total volume of digestion (L)
C= dilution factor, if necessary (ex. For a 1 to 10 dilution, C = 10)
D = amount of sample used in digestion (g)
E = percent solids/100, if necessary (fraction equivalent)

15.2 Spike Recovery Calculations:

$$\text{LCS Recovery (\%)} = \frac{\text{(Result obtained) x 100}}{\text{(Spike amount)}}$$

$$\textit{MS/MSD Spike Recovery (\%)} = \frac{\text{(Spiked sample conc. – Sample conc.) x 100}}{\text{(Spike amount)}}$$

$$\textit{\%RPD} = \frac{\text{(MS – MSD) x 100}}{\text{(MS + MSD)/2}},$$

Where: MS = Matrix spike concentration obtained
MSD = Matrix spike duplicate concentration obtained

15.2 "Total Hardness" (by calculation) can also be determined by using the values for calcium and magnesium obtained by this procedure. The "Total Hardness" value is calculated in the LIMS system using the following equation:

Total Hardness (mg/L) or Hardness equivalent $CaCo^3/L$ =

2.497[Ca mg/L} + 4.118[Mg mg/L]

16.0 Method Performance

16.1 Certified standard solutions, properly used instrumentation, and analyst experience and expertise are critical elements in producing accurate results. Standards and instrument performance are continually checked by analyzing external performance test samples provided by the appropriately accredited agencies. Internal blind spikes are also utilized to check analyst performance.

16.2 Initial demonstration of capability (IDC) is another technique used to ensure acceptable method performance. An analyst must demonstrate initial precision and

accuracy through the analysis of 4-5 laboratory control spikes for each matrix and sample type. After analysis, the analyst calculates the average recovery (AR) and the relative standard deviation (RSD) of the recoveries for each analyte. In the absence of specific criteria found in the EPA methods or project specific limits, the default criteria of 70-130% recovery and 20 % RSD are used until internal limits are generated.

16.3 Proper instrument maintenance is another means to ensure adequate method performance.

16.3.1 Pump tubing and rollers: Ensure that the pump rollers turn freely. Inspect pump tubing daily and replace when it starts failing to retain its shape.

16.3.2 Drain line: Spray chamber drain line must flow unimpeded directly into waste jug. Make sure line is draining properly.

16.3.3 Spray Chamber: If the spray chamber becomes dirty, the sample waste may not drain properly. Remove and wash with hot soapy water, then rinse with DI H_2O.

16.3.4 Torch and O-rings: The O-rings surrounding the torch may need to be replaced if the plasma becomes unstable or internal standard emission counts fall off. See ICP6000 manual for technique. Torch needs to be cleaned occasionally with aqua regia followed by sonication. See sections 5 and 6 in the "ICAP 6000 Series ICP-OES Spectrometer Operating Manuals" for further assistance if needed.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation.

17.2 The quantity of chemicals purchased should be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes should reflect anticipated usage and reagent stability.

18.0 Data Assessment and Acceptance Criteria for QC Measures

18.1 When the analysis of an analytical batch or sequence has been completed, the data is processed and prepared for reporting. The analyst will review the data to ensure QC is acceptable and that excceedances are addressed. Acceptable data is then captured into the LIMS system (See SOP ICP6000 Data Capture for instructions on data capture).

18.2 After data has been captured by LIMS, it is reviewed by the analyst for accuracy and completeness. See checklist (Table 8) for data review guidance.

18.3 Once analyst has reviewed and approved the data, it is given to a peer or supervisor for review.

18.4 After the second reviewer approves the data, the reviewer sends the data to "validated" status in LIMS.

18.5 A paper hard copy of the data is then filed or archived. The package includes the checklist, the sequence run log, and a copy of the bench sheet (if applicable), the LIMS run log, and verification of calibration data.

19.0 Corrective Measures for Out-of-Control Data

19.1 When data is out of control, a number of corrective actions may need implementing. If the nonconformities involve failing QC within the analytical sequence batch, then reanalysis of samples may eliminate any out of control data. If the out of control data

is the result of instrument malfunctions, then maintenance or repair of the downed instrument followed by reanalysis of affected data may correct the problem. If sample matrix affect or contamination is the reason for poor data, the instrument may need cleaning and decontamination. In all cases, when out of control data presents itself, the appropriate corrective measures need to be enacted to eliminate unusable data. The Quality Control Requirements chart can be used as a guide as to which corrective actions should be taken for different QC-type failures or nonconformities (Table 3.).

20.0 Contingencies for Handling Out-of-Control or Unacceptable Data

20.1 Due to limited sample volume, expiration of hold times, downed instrumentation, and analyst error, the sample data may be out of control or unacceptable to report. Since these potential instances can arise, contingency plans need to be in place to prevent and/or minimize their affect on data.

20.1.1 The first thing addressed is prevention of producing unacceptable data. When limited sample volume is the issue, the analyst should determine if splitting the sample into lesser volumes or weights is an option. To avoid sample hold time issues, the analyst's first responsibility is to plan accordingly. The analyst is responsible for budgeting enough time for sample analysis, so if a problem arises, reanalysis is an option. Analyst error is prevented by a second analyst confirmation and validation. If the initial analyst makes an analysis error or inadvertently reports unacceptable data, the second analyst is responsible for finding and/or correcting those errors.

20.1.2 When out of control or unacceptable data is produced and it is too late for corrective measures, a number of actions can be taken. The first and foremost is alerting the client service personnel of the problem. Client services will inform the client and/or responsible parties. In some instances, more samples can be made available or re-sampling can occur, so it is important to alert the appropriate personnel as soon as possible.

20.1.2.1 If the out of control data affects only specific analytes, it is important to let the appropriate person(s) know in case his or her site assessment is based on a specific target analyte list.

20.1.2.2 In all instances, if results are reported from data that is out of control or unacceptable, that data should be qualified accordingly. Once the client has been notified and he or she instructs us to report the data, flag the data indicating what type of nonconformity has occurred.

20.1.2.3 Out of control data is still retained by the laboratory and filed and archived along with acceptable data. The file folder should be labeled as such, indicating that the data is out of control.

20.1.2.4 A non-conformance/corrective action report (CAR) form must be filled out whenever these types of events occur. The information on the report includes the problem encountered, planned corrective actions, and corrective action follow-up. The form is then discussed with and signed by the analyst, the client representative, the QA officer, and the laboratory manager. The purpose of the form is to document problems in order to eliminate the possibility of repeating nonconformance and to ensure that the proper corrective actions are employed.

21.0 Waste Management

21.1 Samples are routinely held for up to six weeks from analysis date before they enter the waste stream. Waste disposal of samples and standards follows the procedures documented in the Laboratory Waste Disposal SOP (Quality Assurance Section, SOP NO. FO-8, Rev. 4).

22.0 REFERENCES

17.1 Test Methods for Evaluating Solid Waste, EPA, SW-846, Method 6010B, rev. 2, December 1996.

17.2 Test Methods for Evaluating Solid Waste, EPA, SW-846, Method 6010B, rev. 3, February, 2000.

17.3 Test Methods for Evaluating Solid Waste, EPA, SW-846, Method 6010C, rev. 3, February, 2007.

17.4 Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, Method 200.7, rev. 4.4, 1991.

17.5 USEPA - Contract Laboratory Program, Statement of Work for Inorganic Analysis, ILM04.0.

17.6 ICAP 6000 Series ICP-OES Spectrometer Operator's Manual, Thermo Electron (registration number 441506).

17.7 Department of Defense Quality Systems Manual for Environmental Laboratories, Versio4.1, Based on NELAC Voted Revision 5 June 2003, April 22, 2009.

17.8 Thermo Electron Corporation Training Manual iCAP 6000 Series.

17.9 Louisville Chemistry Guideline (LCG), US Army Corps of Engineers-Louisville District, June 2002.

17.10 Louisville DOD Quality Systems Manual Supplement (LS), US Army Corps of Engineers-Louisville District, March 2007.

Table1: Spike, LCS, & LFB Analysis- ICP
Pre-digestion Spikes

Element	Spike Amt. mL of	Spike Stock A, B, C	Stock Conc. mg/L	Final Vol. mL	Expected Conc. ug/L
Aluminum	1	**A**	200	50	4000
Antimony	1	**A**	50	50	1000
Arsenic	1	**A**	200	50	4000
Barium	1	**A**	200	50	4000
Beryllium	1	**A**	5	50	100
Cadmium	1	**A**	5	50	100
Calcium	0.5	**C**	20,000	50	200000
Chromium	1	**A**	20	50	400
Cobalt	1	**A**	50	50	1000
Copper	1	**A**	25	50	500
Iron	1	**A**	100	50	2000
Lead	1	**A**	50	50	1000
Manganese	1	**A**	50	50	1000
Magnesium	0.5	**C**	10,000	50	100000
Molybdenum*	0.1	**B**	1000	50	2000
Nickel	1	**A**	50	50	1000
Selenium	1	**A**	200	50	4000
Silver	1	**A**	5	50	100
Thallium	1	**A**	200	50	4000
Vanadium	1	**A**	50	50	1000
Zinc	1	**A**	50	50	1000

Spike Solutions ***		
Supplier	**Lot #/ std**	**Stock**
SPEX Certiprep or equiv.	SPIKE 1-500	**A**
Molybdenum * or equiv.	1000 mg/L	**B**
Custom Std***	SPEX	**C**

- * Addition of Boron, Lithium, Silicon, Tin, Strontium, Titanium, and Tungsten at 0.1 ml each of a 1000 mg/L solution from SPEX Certiprep or equivalent.
- ** Addition of Potassium at 0.5 ml of a 10,000 mg/L solution from SPEX Certiprep or equivalent.
- *** Sodium is also included in this standard at 10,000 mg/L

Table 2: Bench Spike Analysis-ICP
Post Digestion/ Bench Spikes

Element	Spike Amt. ML of	Spike Soln.	Stock Conc. mg/L	Final Vol. mL	Expected Conc. ug/L
Aluminum	0.2	**A**	200	10	4000
Antimony	0.2	**A**	50	10	1000
Arsenic	0.2	**A**	200	10	4000
Barium	0.2	**A**	200	10	4000
Beryllium	0.2	**A**	5	10	100
Cadmium	0.2	**A**	5	10	100
Calcium	0.2	**B**	20,000	10	400000
Chromium	0.2	**A**	20	10	400
Cobalt	0.2	**A**	50	10	1000
Copper	0.2	**A**	25	10	500
Iron	0.2	**A**	100	10	2000
Lead	0.2	**A**	50	10	1000
Manganese	0.2	**A**	50	10	1000
Magnesium	0.2	**B**	10,000	10	200000
Molybdenum	0.02	**C***	1000	10	2000
Nickel	0.2	**A**	50	10	1000
Selenium	0.2	**A**	200	10	4000
Silver	0.2	**A**	5	10	10
Thallium	0.2	**A**	200	10	4000
Vanadium	0.2	**A**	50	10	1000
Zinc	0.2	**A**	50	10	1000

Standard Source * **	
Supplier	
SPEX	**A**
SPEX Custom Std	**B**
Molybdenum-1,000 mg/L Std*	**C***

- * Addition of Boron, Lithium, Silicon, Tin, Strontium, Titanium, and Tungsten at 0.02 ml each of a 1000 mg/L solution from SPEX Certiprep or equivalent.
- ** Addition of Potassium and Sodium at 0.1 ml of a 10,000 mg/L solution from SPEX Certiprep or equivalent.

Table 3: Summary of Quality Control Requirements

QC Type	Frequency	Conc. Level	*Acceptance Criteria*	*Corrective Action*
Initial Calibration Verification(ICV)	1 per calibration	Mid. Calib. Range	SDWA: 95-105% SW846:90-110% or Project / Program Specific	Terminate run. Correct the problem before proceeding
Initial Calibration Blank (ICB)	Immediately after the ICV	<MDL	SW846: < 3x IDL SDWA: < MDL DOD-QSM < MDL LCG: <1/2 MRL or Project / Program Specific	Terminate analysis and correct the problem before proceeding.
Method Blank (MB)	1 per batch of 20 samples	<MDL	SDWA: < MDL SW846: < 2x MDL DOD-QSM / LCG: <1/2 MRL or Project / Program Specific	Access data and reanalyze/reprepare the MB and affected data or flag "B" analyte detected in Method Blank when insufficient sample remains
Laboratory Control Sample (LCS)	1 per batch of 20 samples	Mid. Calib. Range	In-house limits or, default 80-120% SDWA; 90-110% or Project / Program Specific	Terminate analysis: correct problem before proceeding.
Continuing Calibration Verification (CCV)	1 after every 10^{th} sample	Mid. Calib. Range	SW846: 90-110% SDWA: 90-110% CLP:90-110%	Recalibrate and reanalyze all samples back to the last acceptable CCV or ICV
Continuing Calibration Blank (CCB)	Immediately following each CCV	<MDL	SW846: < 3x IDL SDWA: < MDL DOD-QSM < MDL LCG: < 2x MDL or Project / Program Specific	Reanalyze all samples back to the last acceptable CCB or flag "B" analytes detected
Interference Check Solution A (ICSA)	Immediately After LCS (& before final CCV if required by program / project specific QAPP)		80-120% for Interference Elements ABS of analytes not included must be < 2X MRL or Project / Program Specific	Terminate analysis, correct problem & reanalyze all samples back to last good ICSA/ICSAB
Interference Check Solution AB (ICSAB)	Immediately After ICSA (& before final CCV if required by program / project specific QAPP)			Terminate analysis, correct problem & reanalyze all samples back to last good ICSA/ICSAB

MS	One per batch per matrix	See Table 1 spike chart	1. In-house limits: default 70-130 % Rec. 2. DOD-QSM: Use specified LCS limits. 3. LCG: 75-125 % Rec. when [matrix] is <4x[spike]	1. Reanalyze an alternative sample or perform a PDS, if MS and PDS fail qualify data as to matrix effect. 2. DOD-QSM: Used for matrix evaluation only. Determine source of difference (i.e. serial dilution/PDS). Reanalyze or qualify data as per client/ project requirement. 3. LCG: If MS fails and sample results are < 5x the MRL run a PDS. If sample results are > 5x the MRL perform a serial dilution.
MSD or Matrix Dup. (MD)	1. In-house & QSM-DOD: one MSD or MD per batch or matrix. 2. LCG: one MD per batch or matrix.	See Table 1 spike chart	1. In-house limits: default 70-130 % Rec. RPD = 20% 2. DOD-QSM: Use specified LCS limits for MSD. RPD = 20 % for MS/MSD or MD. 3. LCG: RPD = 20%	1. Perform PDS, if MSD and PDS fail qualify data as to matrix effect. 2. DOD-QSM: Used for matrix evaluation only. Determine source of difference (i.e. serial dilution/PDS). Reanalyze or qualify data as per client/ project requirement. 3. LCG: Qualify positive detects for precision failures between the sample and the MD.
Serial Dilution Analysis (SD)	1. In-house: Analyzed on the sample with a PDS failure. 2. DOD-QSM: Analyzed with each batch of samples. 3. LCG: After an MS failure with sample results > 5x the MRL.	5 fold dilution of chosen sample	RPD within 10% of value of diluted and undiluted sample, but only if sample conc. 1. In-house: > 10x LOQ 2. DOD-QSM: > 50x the MDL 3. LCG: > 5x the MRL	1. In-house: Qualify data only if sample result is > 10x the LOQ. 2. Analyze a PDS if sample result is > 50x the MDL. 3. Analyze a PDS if sample result is > 5x the MDL.
Post Digestion Spike (PDS)	1. In-house: Upon failure of MS or MSD. 2. DOD-QSM: When the SD test fails or all sample results < 50x the MDL and there is an MS or MSD failure. 3. LCG: When the MS fails and the sample result is <5x the MRL or when the SD test fails.	Between 10 and 100 times the MDL	1. In-house: 80-120% Rec. 2. DOD-QSM & LCG: 75-125% Rec.	1. In-house: Qualify for matrix interference or if requested analyze by MSA. 2. DOD-QSM: Run samples by MSA or ISA or qualify data using program/project specified criteria. 3. LCG: Run samples by MSA or qualify data using program/project specified criteria.
Method of Standard Additions (MSA) or Internal Standard Calibration (ISA)		Minimum of 3 standard levels and the unspiked sample	N/A	Document the use of an MSA or ISA

Table 4a. TAL list Concentrations/Ranges for ICP ug/L

Element, Wavelength and Order	Blank		CalibStd=0.25		CalibStd=0.5		CalibStd=1		CalibStd=5		CalibStd=10		C
	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?
Ag 328.068 {103}	☒	0	☐		☐		☐		☒	5	☒	10	☒
Ag 338.289 {100}	☒		☐		☐		☐		☐		☐		☐
Al 167.079 {502}	☒	0	☐		☐		☐		☐		☒	10	☒
Al 309.271 {109}	☒		☐		☐		☐		☐		☐		☐
Al 396.152 { 85}	☒		☐		☐		☐		☐		☐		☐
As 189.042 {479}	☒	0	☐		☐		☐		☐		☐	10	☐
As 193.759 {474}	☒		☐		☐		☐		☐		☒		☐
Ba 455.403 { 74}	☒	0	☐		☐		☒	1	☒	5	☒	10	☒
Ba 493.409 { 68}	☒		☐		☐		☐		☐		☐		☐
Be 234.861 {144}	☒	0	☐	0.25	☐	0.5	☐	1	☐	5	☐	10	☐
Be 313.042 {108}	☒		☒		☒		☒		☒		☒		☒
Ca 317.933 {106}	☒	0	☐		☐		☐		☐		☐	10	☐
Ca 393.366 { 86}	☒		☐		☐		☐		☐		☒		☒
Ca 396.847 { 85}	☒		☐		☐		☐		☐		☐		☐
Cd 226.502 {449}	☒	0	☒	0.25	☒	0.5	☒	1	☒	5	☐		☒
Cd 228.802 {447}	☒		☐		☐		☐		☐		☐		☐
Co 228.616 {447}	☒	0	☐		☐		☒	1	☒	5	☒	10	☐
Co 238.892 {141}	☒		☐		☐		☐		☐		☐		☐
Cr 205.552 {464}	☒	0	☐		☐		☐	1	☐	5	☐	10	☐
Cr 267.716 {126}	☒		☐		☐		☒		☒		☒		☒
Cu 224.700 {450}	☒	0	☐		☐		☐		☐	5	☐		☒
Cu 327.396 {103}	☒		☐		☐		☐		☒		☐		☒
Fe 234.349 {144}	☒	0	☐		☐		☐		☐		☐	10	☐
Fe 239.562 {141}	☒		☐		☐		☐		☐		☐		☐
Fe 259.940 {130}	☒		☐		☐		☐		☐		☒		☐
Mg 279.079 {121}	☒	0	☐		☐		☐		☐		☐	10	☐
Mg 279.553 {121}	☒		☐		☐		☐		☐		☒		☐
Mg 280.270 {120}	☒		☐		☐		☐		☐		☐		☐
Mn 257.610 {131}	☒	0	☐		☐		☐		☒	5	☒	10	☒
Mn 259.373 {130}	☒		☐		☐		☐		☐		☐		☐
Mo 202.030 {467}	☒	0	☐		☐		☒	1	☐		☒	10	☒
Mo 204.598 {465}	☒		☐		☐		☐		☐		☐		☐
Ni 221.647 {452}	☒	0	☐		☐		☐	1	☐		☐	10	☐
Ni 231.604 {445}	☒		☐		☐		☒		☐		☐		☐
Pb 216.999 {455}	☒	0	☐		☐		☐	1	☐		☐	10	☐
Pb 220.353 {453}	☒		☐		☐		☒		☐		☒		☒
Sb 206.833 {463}	☒	0	☐		☐		☐		☐	5	☐	10	☐
Sb 217.581 {455}	☒		☐		☐		☐		☒		☒		☒
Se 196.090 {472}	☒	0	☐		☐		☒	1	☐		☒	10	☐
Se 206.279 {463}	☒		☐		☐		☐		☐		☐		☐
Tl 190.856 {477}	☒	0	☐		☐		☐		☒	5	☒	10	☒
Tl 351.924 { 96}	☒		☐		☐		☐		☐		☐		☐
V 290.882 {116}	☒	0	☐		☐		☐	1	☐	5	☐	10	☐
V 292.402 {115}	☒		☐		☐		☒		☒		☒		☒
Y 360.073 { 94}*	☒	0	☐		☐		☐		☐		☐		☐
Zn 206.200 {463}	☒	0	☐		☐		☐	1	☐	5	☐	10	☐
Zn 213.856 {458}	☒		☐		☐		☒		☒		☒		☒

Table 4b. TAL list Concentrations/Ranges for ICP ug/L cont.

Element, Wavelength and Order	Calibration Standards													
	CalibStd=20		CalibStd=50		CalibStd=100		CalibStd=500		CalibStd=1000		CalibStd=5000		CalibStd=10000	
	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?
Ag 328.068 (103)	20	X	50	X	100		500		1000					
Ag 338.289 (100)														
Al 167.079 (502)	20	X	50	X	100	X	500	X	1000	X	5000		10000	
Al 309.271 (109)														
Al 396.152 (85)														
As 189.042 (479)			50		100		500	X	1000	X	5000	X	10000	
As 193.759 (474)														
Ba 455.403 (74)	20	X	50		100	X	500	X	1000	X	5000		10000	
Ba 493.409 (68)														
Be 234.861 (144)	20		50		100		500	X	1000	X	5000	X	10000	
Be 313.042 (108)														
Ca 317.933 (106)	20				100		500		1000	X	5000	X	10000	
Ca 393.366 (86)														
Ca 396.847 (85)														
Cd 226.502 (449)	20	X	50	X	100	X	500	X	1000		5000		10000	
Cd 228.802 (447)														
Co 228.616 (447)		X	50	X	100	X	500	X	1000	X	5000		10000	
Co 238.892 (141)														
Cr 205.552 (464)	20		50		100		500		1000	X	5000	X	10000	
Cr 267.716 (126)		X		X		X		X						
Cu 224.700 (450)	20	X	50	X	100	X	500	X	1000	X	5000			
Cu 327.396 (103)		X		X		X								
Fe 234.349 (144)			50		100		500		1000		5000	X	10000	
Fe 239.562 (141)														
Fe 259.940 (130)		X		X		X		X		X				
Mg 279.079 (121)			50		100		500		1000	X	5000	X	10000	
Mg 279.553 (121)		X		X		X		X		X				
Mg 280.270 (120)														
Mn 257.610 (131)	20	X	50	X	100	X	500	X	1000	X	5000		10000	
Mn 259.373 (130)														
Mo 202.030 (467)	20	X	50	X	100	X	500	X	1000		5000		10000	
Mo 204.598 (465)														
Ni 221.647 (452)	20		50		100		500		1000	X	5000	X	10000	
Ni 231.604 (445)		X		X		X		X		X				
Pb 216.999 (455)	20		50		100		500	X	1000	X	5000	X	10000	
Pb 220.353 (453)		X		X		X		X		X				
Sb 206.833 (463)	20				100		500	X	1000	X	5000	X	10000	
Sb 217.581 (455)														
Se 196.090 (472)		X	50	X	100	X	500	X	1000	X	5000		10000	
Se 206.279 (463)														
Tl 190.856 (477)	20	X	50	X	100	X	500	X	1000	X	5000	X	10000	
Tl 351.924 (96)														
V 290.882 (116)	20		50		100	X	500	X	1000	X	5000	X	10000	
V 292.402 (115)		X		X		X		X		X				
Y 360.073 (94)*														
Zn 206.200 (463)	20		50		100		500		1000	X	5000	X	10000	
Zn 213.856 (458)		X		X		X		X		X				

Table 4c. TAL list Concentrations/Ranges for ICP ug/L cont.

Element, Wavelength and Order	CalibStd-100k		CalibStd-100000		CalibStd-500000		CalibStd-1000k	
	?	Conc	?	Conc	?	Conc	?	Conc
Ag 328.068 {103}	☐		☐		☐		☐	
Ag 338.289 {100}	☐		☐		☐		☐	
Al 167.079 {502}	☐		☐	100000	☐	500000	☐	1e+006
Al 309.271 {109}	☐		☒		☐		☐	
Al 396.152 { 85}	☐		☒		☒		☒	
As 189.042 {479}	☐		☐		☐		☐	
As 193.759 {474}	☐		☐		☐		☐	
Ba 455.403 { 74}	☐		☐		☐		☐	
Ba 493.409 { 68}	☐		☐		☐		☐	
Be 234.861 {144}	☐		☐		☐		☐	
Be 313.042 {108}	☐		☐		☐		☐	
Ca 317.933 {106}	☐		☒	100000	☒	500000	☒	1e+006
Ca 393.366 { 86}	☐		☐		☐		☐	
Ca 396.847 { 85}	☐		☒		☐		☐	
Cd 226.502 {449}	☐		☐		☐		☐	
Cd 228.802 {447}	☐		☐		☐		☐	
Co 228.616 {447}	☐		☐		☐		☐	
Co 238.892 {141}	☐		☐		☐		☐	
Cr 205.552 {464}	☒	100000	☐		☐		☐	
Cr 267.716 {126}	☐		☐		☐		☐	
Cu 224.700 {450}	☒	100000	☐		☐		☐	
Cu 327.396 {103}	☐		☐		☐		☐	
Fe 234.349 {144}	☐		☒	100000	☒	500000	☒	1e+006
Fe 239.562 {141}	☐		☐		☐		☐	
Fe 259.940 {130}	☐		☐		☐		☐	
Mg 279.079 {121}	☐		☒	100000	☒	500000	☒	1e+006
Mg 279.553 {121}	☐		☐		☐		☐	
Mg 280.270 {120}	☐		☐		☐		☐	
Mn 257.610 {131}	☐	100000	☐		☐		☐	
Mn 259.373 {130}	☒		☐		☐		☐	
Mo 202.030 {467}	☐		☐		☐		☐	
Mo 204.598 {465}	☐		☐		☐		☐	
Ni 221.647 {452}	☐		☐		☐		☐	
Ni 231.604 {445}	☐		☐		☐		☐	
Pb 216.999 {455}	☒	100000	☐		☐		☐	
Pb 220.353 {453}	☐		☐		☐		☐	
Sb 206.833 {463}	☐		☐		☐		☐	
Sb 217.581 {455}	☐		☐		☐		☐	
Se 196.090 {472}	☐		☐		☐		☐	
Se 206.279 {463}	☐		☐		☐		☐	
Tl 190.856 {477}	☐		☐		☐		☐	
Tl 351.924 { 96}	☐		☐		☐		☐	
V 290.882 {116}	☐		☐		☐		☐	
V 292.402 {115}	☐		☐		☐		☐	
Y 360.073 { 94}*	☐		☐		☐		☐	
Zn 206.200 {463}	☒	100000	☐		☐		☐	
Zn 213.856 {458}	☐		☐		☐		☐	

Note: These metals are calibrated using a blank and minimum of three standards. It is not allowable to remove any mid levels to obtain an acceptable calibration; all points must used. Multi-level calibrations must be sequential.

Appendix A.

Element specific standard prep for multipoint calibration of ICP.

A1 Calibration Standard 0.25 (Be, & Cd): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 0.25 ul of SPEX Quality Control Standard 7 and 0.25 uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-

Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 0.25 ug/L.

A2 Calibration Standard 0.50 (Be & Cd): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 50uL of SPEX Quality Control Standard 7 and 50uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 0.50 ug/L.

A3 Calibration Standard 1.0 (Ba, Be, Cd, Co, Cr, Mn, Mo, Ni, Pb, Se, Sb, Tl, V, & Zn): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1 ml of conc. HNO3 and 1mL conc. HCl. Add 1.0 uL of SPEX Quality Control Standard 7 and 1.0 uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1 ug/L

A4 Calibration Standard 5.0 (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Mn, Sb, Tl, V, & Zn): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 5 uL of SPEX Quality Control Standard 7 and 5 uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 5 ug/L

A5 Calibration Standard 10.0 (Ag, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Sb, Tl, V, & Zn): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 10 uL of SPEX Quality Control Standard 7 and 10 uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 10 ug/L

A6 Calibration Standard 20 (Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe Mn, Mo, Ni, Pb, Sb, Tl, & V): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 20uL of SPEX Quality Control Standard 7 and 20uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 20 ug/L

A7 Calibration Standard 50 (Ag, As, Ba, Be, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Tl, V & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 50uL of SPEX Quality Control Standard 7 and 50uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 50 ug/L

A8 Calibration Standard 100 (Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, Tl, V, & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 100 uL of SPEX Quality Control Standard 7 and 100 uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100 ug/L

A9 Calibration Standard 500 (Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Tl, V & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 500uL of SPEX Quality Control Standard 7 and 500uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 ug/L

A10 Calibration Standard 1000 (Ag, Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Tl, V & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 1000uL of SPEX Quality Control Standard 7 and 1000uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1000 ug/L

A11 Calibration Standard 5000 (Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Tl, V & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 5000uL of SPEX Quality Control Standard 7 and 5000uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 5000 ug/L

A12 Calibration Standard 10000 (Al, As, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Se, Tl, V & Zn): Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 10000uL of SPEX Quality Control Standard 7 and 10000uL of SPEX Quality Control Standard 21. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 10000 ug/L

A13 Calibration Standard 100000 (Al, Ca, Fe, & Mg): Into a 100mL volumetric flask, add 5mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL of HCl. Add 1mL of 10,000 mg/L Al, 1mL of 10,000 mg/L Ca, 1mL of 10,000 mg/L Fe and 1mL of 10,000 mg/L Mg . Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100,000 ug/L Al, Ca, Fe, Mn, and Mg.

A14 Calibration Standard 100K (Cr, Cu, Co, Ni, Mn, & Pb): Into a 100mL volumetric flask, add 5mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL of HCl and add 10 mls of Cr 1000 mg/L, 10 mls Cu 1000 mg/L, 10 mls Pb 1000 mg/L, 10 mls Co 1000 mg/L,10 mls Ni 1000 mg/L and 10 ml of Mn 1000 mg/L and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration:100,000 ug/L Co, Cr, Cu, Ni, Mn, and Pb.

A15 Calibration Standard 500000 (Al, Ca, Fe, & Mg): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL of HCl. Add 5mL of 10,000 mg/L Al, 5mL of 10,000 mg/L Ca, 5mL of 10,000 mg/L Fe and 5mL of 10,000 mg/L Mg. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500,000 ug/L Al, Ca, Fe and Mg

A16 Calibration Standard 1000000 (Al, Ca, Fe, & Mg): Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL of HCl. Add 10mL of 10,000 mg/L Al, 10mL of 10,000 mg/L Ca, 10mL of 10,000 mg/L Fe and 10mL of 10,000 mg/L Mg. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1,000,000ug/L Al, Ca, Fe and Mg

A17 Calibration Blank: Into a 1 L. volumetric flask, add 750 mL of Milli-Q water and 10 mL of conc. HNO3 and 10mL HCl. Mix, dilute to volume with Milli-Q H2O. Transfer to a clean 1 L. nalgene bottle. Prepare every 6 months or as needed.

A18 ICV/CCV: Into a 1000mL volumetric flask, add 10mL Milli-Q water, 1mL of conc. HNO3 and 10mL of conc. HCl. Add 10.0mL Spex Certiprep Spike Sample Standard 1 or equivalent and 2.0mL Interference A or equivalent, 0.5 mls of 1000 ug/L Mo and 0.05 mls 1000 ug/L Ag . Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100 mg/L

A19 ICSAB: Into a 100mL volumetric flask, add 500mL Milli-Q water, 5mL of conc. HNO3 and 5mL of conc. HCl. Add 50 ml of SPEX Interferents A or equivalent, 15.0mLs of 10,000 mg/L Fe, 2.5mL Spex Certiprep QC 7 and 2.5 ml Spex Certiprep-QC 21 or equivalent. Dilute to volume with Milli-Q water and mix by inverting several times.

Table 5. Sodium and Potassium Concentrations/Ranges for ICP (mg/L)

Element, Wavelength and Order	Calibration Standards																	
	Blank		CalibStd-0.5		CalibStd-1.0		CalibStd-5.0		CalibStd-10.0		CalibStd-50.0		CalibStd-100		CalibStd-200		CalibStd-500000	
	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc
K 766.490 (44)	☒	0	☒	0.5	☒	1	☒	5	☒	10	☒	50	☒	100	☒	200	☐	
Na 330.237 (102)	☒	0	☐	0.5	☐	1	☐	5	☐	10	☒	50	☒	100	☒	200	☐	
Na 589.592 (57)	☒		☒		☒		☒		☒		☒		☐		☐		☐	
Al 309.271 (109)	☒	0	☐		☐		☐		☐		☐		☐		☐		☒	500
Ca 317.933 (106)	☒	0	☐		☐		☐		☐		☐		☐		☐		☒	500
Fe 259.940 (130)	☒	0	☐		☐		☐		☐		☐		☐		☐		☒	500
Mg 279.079 (121)	☒	0	☐		☐		☐		☐		☐		☐		☐		☒	500
Y 360.073 (94)*	☒	0	☐		☐		☐		☐		☐		☐		☐		☐	

Note: These metals are calibrated using a blank and minimum of three standards. It is not allowable to remove any mid levels to obtain an acceptable calibration; all points must be used. Multi-level calibrations must be sequential.

Appendix B

Standard Prep for Sodium and Potassium analysis.

B1 Calibration Standard 0.5: Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 2mL of conc. HNO3 and 2mL conc. HCl. Add 0.05mL Sodium 1000mg/L and 0.05mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 0.5 mg/L Na, K.

B2 Calibration Standard 1.0: Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 0.1mL Sodium 1000mg/L and 0.1mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer

to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1 mg/L Na, K.

B3. Calibration Standard 5.0: Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 0.5mL Sodium 1000mg/L and 0.5mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 5 mg/L Na, K.

B4. Calibration Standard 10: Into a 100mL volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 1mL Sodium 1000mg/L and 5mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 10 mg/L Na, K.

B5. Calibration Standard 50: Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 5mL Sodium 1000mg/L and 5mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 50 mg/L Na, K.

B6. Calibration Standard 100: Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 10mL Sodium 1000mg/L and 10mL Potassium 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100 mg/L Na, K.

B7. Calibration Standard 200: Into a 100mL volumetric flask, add H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 50mL Sodium 1000mg/L and 50mL Potassium 1000mg/L. Mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 mg/L Na, K.

B8. Calibration Standard 500 high std: Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 5mL Aluminum 10,000mg/L, 5mL, Calcium 10,000mg/L, 5mL, Magnesium 10,000mg/L and 5mL Iron 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 mg/L Al, Ca, Mg, and Fe.

B9. ICV/CCV: Into a 100mL volumetric flask, add 50mL Milli-Q water, 1mL of conc. HNO3 and 1mL of conc. HCl. Add 1.0mL 10,000mg/L Na and 1.0mL 10,000 K. Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100 mg/L Na an K.

B8. ICSAB: Into a 100mL volumetric flask, add 10mL Milli-Q water, 1mL of conc. HNO3 and 1mL of conc. HCl. Add 10 ml of SPEX Interferents A or equivalent, 3.0mLs of 10,000 mg/L Fe, 1.0mL 10,000mg/L Na and 1.0mL 10,000 K. Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100mg/L Na and K, 500,000ug/L Al, Ca, Fe and Mg.

Table 6. Boron and Silicon Concentrations/Ranges for ICP (ug/L)

Element, Wavelength and Order	Calibration Standards													
	Blank		CalibStd=50		CalibStd=50 &10		CalibStd=500 &1		CalibStd=10000&2		CalibStd=50000&1		CalibStd=500000	
	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc
B 249.773 {135}	☒	0	☒	50	☒	100	☒	1000	☒	2000	☒	10000	☐	
Si 251.611 {134}	☒	0	☐		☒	50	☒	500	☒	1000	☒	5000	☐	
Al 308.215 {109}	☒	0	☐		☐		☐		☐		☐		☒	500000
Ca 317.933 {106}	☒	0	☐		☐		☐		☐		☐		☒	500000
Fe 234.349 {144}	☒	0	☐		☐		☐		☐		☐		☒	500000
Mg 279.079 {121}	☒	0	☐		☐		☐		☐		☐		☒	500000
Y 360.073 {94}*	☒	0	☐		☐		☐		☐		☐		☐	

Note: Boron and Silicon are calibrated using a blank and a minimum three standards. It is not allowable to remove any mid levels to obtain an acceptable calibration; all points must be used. Multi-level calibrations must be sequential.

Appendix C

Standard Prep for Boron and Silicon Analysis

C1. Calibration Standard 50 ug/L B: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 0.05 ml Spex Certiprep QC std. 7 or equivalent. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed.Concentration: 50 ug/L B

C2. Calibration Standard 50 ug/L Si & 100 B ug/L: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 0.1 ml Spex Certiprep QC std. 7. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 50 ug/L Si & 100 ug/L B

C3. Calibration Standard 500 ug/L Si & 1000 B ug/L: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 1.0 ml Spex Certiprep QC std. 7. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 ug/L Si &1000 ug/L B.

C4. Calibration Standard 1000 ug/L Si & 2000 B ug/L: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 1.0 ml Spex Certiprep QC std. 7. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration:1000 ug/L Si &5000 ug/L B.

C5. Calibration Standard 5000 ug/L Si & 10000 B ug/L: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 1.0 ml Spex Certiprep QC std. 7. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 5000 ug/L Si &10000 ug/L B.

C6. Calibration Standard 500 high std: Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 1mL of conc. HNO3 and 1mL conc. HCl. Add 5mL Aluminum 10,000mg/L, 5mL, Calcium 10,000mg/L, 5mL, Magnesium 10,000mg/L and 5mL Iron 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 mg/L Al, Ca, Mg, and Fe.

C7. ICV/CCV: Into a 100mL **plastic** volumetric flask, add 50mL of Milli-Q water, 1 mL of conc HNO3 and 1mL conc. HCl. Add 0.1mL of 1000mg/L Boron and 0.1mL of 1000mg/L Silicon (alternate sources from calibration source). Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1000 ug/L Boron and Silicon.

C8. ICSAB: Into a 100mL volumetric flask, add 10mL Milli-Q water, 1mL of conc. HNO3 and 1mL of conc. HCl. Add 10 ml of SPEX Interferents A or equivalent, 3.0mLs of 10,000 mg/L Fe, 0.05 ml 1000 mg/L B and 0.5 ml 1000 mg /L Si. Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 ug/L B and Si, 500,000ug/L Al, Ca, Fe and Mg.

Table 7. Lithium, Tin, Strontium, Titanium, and Tungsten Concentrations/Ranges for ICP ug/L

Element, Wavelength and Order	Calibration Standards															
	Blank		1		10		100		1000		10000		500000	
	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc	?	Conc
Li 670.784 (50)	☒	0	☒	1	☒	10	☒	200	☒	1000	☒	10000	☐	
Sn 189.989 (477)	☒	0	☐		☐	10	☐	100	☒	1000	☒	10000	☐	
Sn 189.989 (478)	☒		☐		☐		☐		☐		☐		☐	
Sr 407.771 (83)	☒	0	☒	1	☐	10	☐	100	☒	1000	☐	10000	☐	
Sr 421.552 (80)	☒		☐		☐		☐		☐		☐		☐	
Ti 334.941 (101)	☒	0	☐	1	☐	10	☐	100	☐	1000	☒	10000	☐	
Ti 337.280 (100)	☒		☒		☐		☐		☐		☐		☐	
W 224.875 (450)	☒	0	☐		☐	10	☐	100	☐	1000	☐	10000	☐	
W 239.709 (141)	☒		☐		☐		☐		☒		☒		☐	
Al 309.271 (109)	☒	0	☐		☐		☐		☐		☐		☒	500000
Ca 317.933 (106)	☒	0	☐		☐		☐		☐		☐		☒	500000
Fe 259.940 (130)	☒	0	☐		☐		☐		☐		☐		☒	500000
Mg 279.553 (121)	☒	0	☐		☐		☐		☐		☐		☒	500000
Y 360.073 (94)*	☒	0												

Appendix D

Standard prep for Lithium, Tin, Titanium, Strontium, and Tungsten

D1. Calibration Standard 1: Into a 1000mLvolumetric flask, add 50mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 0.01 ml Spex Certiprep QC std. 21 or equivalent and .001 1000mg/L Sn and W . Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1 ug/L

D2. Calibration Standard 10: Into a 1000mLvolumetric flask, add 50mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 0.1 ml Spex Certiprep QC std. 21 or equivalent and .01 1000mg/L Sn and W . Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 10 ug/L Li, Sr, Sn, Ti, and W.

D3. Calibration Standard 100: Into a 1000mLvolumetric flask, add 50mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 1.0 ml Spex Certiprep QC std. 21 or equivalent and 0.1 1000mg/L Sn and W . Dilute to volume with Milli-Q H2O and mix by inverting

several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 100 ug/L Li, Sr, Sn, Ti, and W.

D4. Calibration Standard 1000: Into a 1000mLvolumetric flask, add 50mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 10.0 ml Spex Certiprep QC std. 21 or equivalent and 1.0 1000mg/L Sn and W . Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 1000 ug/L Li, Sr, Sn, Ti, and W.

D5. Calibration Standard 10000: Into a 1000mLvolumetric flask, add 50mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 100.0 ml Spex Certiprep QC std. 21 or equivalent and 10.0 1000mg/L Sn and W . Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 10000 ug/L Li, Sr, Sn, Ti, and W.

D6. Calibration Standard 500000 high std: Into a 100mL volumetric flask, add 10mL of Milli-Q H2O, 10mL of conc. HNO3 and 10mL conc. HCl. Add 5mL Aluminum 10,000mg/L, 5mL, Calcium 10,000mg/L, 5mL, Magnesium 10,000mg/L and 5mL Iron 1000mg/L. Dilute to volume with Milli-Q H2O and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 mg/L Al, Ca, Mg, and Fe.

D7. ICV/CCV: Into a 1000mL volumetric flask, add 50mL of Milli-Q water, 10 ml of conc. HNO3 and 10mL conc. HCl. Add 0.5mL of 1000mg/L Li, 0.5mL of 1000ug/L Sn, 0.5mL of 1000ug/L Sr, 0.5 ml of 1000mg/L Silicon, 0.5 ml 1000mg/L Tungsten and 0.5 ml of 1000mg/L Titanium. (all alternate sources from calibration source). Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 ug/L Li, Sr, Sn, Ti, and W.

D8. ICSAB: Into a 100mL volumetric flask, add 10mL Milli-Q water, 1mL of conc. HNO3 and 1mL of conc. HCl. Add 10 ml of SPEX Interferents A or equivalent, 3.0mLs of 10,000 mg/L Fe, 0.05 ml of 1000 mg/L Sr, 0.05 ml 1000 mg /L of Li, 0.05 ml 1000 mg /L of Sn, 0.05 ml 1000 mg /L of Ti, 0.05 ml 1000 mg /L of W. Dilute to volume with Milli-Q water and mix by inverting several times. Transfer to a clean Nalgene bottle. Prepare every 6 months or as needed. Concentration: 500 ug/L Li, Sr, Sn, Ti, and W and 500,000ug/L Al, Ca, Fe and Mg.

Note: For DOD-QSM data the lowest level (Calib. Level # 1) on a multi point curve is prepared at concentrations equal to or less than the MRL for any given project and these levels are subject to change.

Table 8: Data Review Checklist

ICP6500 OES Data Review Checklist	Analysis Date:		Data File:		Date review:
Cal Std ID: LIMS # :	Analyst:		Reviewer:		Approved? Yes No
Calibration Parameters - 6010 200.7	**YES**	**NO**	**YES**	**NO**	**Comments:**
1) Calibration linearity - r > 0.995					
2) ICV 90-110% 95-105%					
3) ICB ABS 3X DL ABS DL					
4) ICSAB 80-120% True Value					
5) ICSA +/- 2X RL or LOD					
6) MRL - (2X RL or LOD) 70-130%					
7) CCV1/CCB1-90-110% / 3X DL ABS DL					
8) CCV2/CCB2					
9) CCV3/CCB3					
10) CCV4/CCB4					
11) CCV5/CCB5					
12) CCV6/CCB6					
13) CCV7/CCB7					
14) CCV8/CCB8					
15) CCV9/CCB9					
16) CCV10/CCB10					
Preparation Batch Parameters	**YES**	**NO**	**YES**	**NO**	**Comments:**
Prep Batch ID#:_____ Dig. Meth._____					
Prep. Blank - <LOD or RL					
LCS - generated limits; attached list					
Spiked samples in batch:					
a)_____ matrix = _____					
b)_____ matrix = _____					
c)_____ matrix = _____					
d)_____ matrix = _____					
e)_____ matrix = _____					
PDS 75-125% sample#_____					
Prep Batch ID#:_____ Dig. Meth._____					
Prep. Blank - <LOD or RL					
LCS - generated limits;attached list					
Spiked samples in batch:					
a)_____ matrix = _____					
b)_____ matrix = _____					
c)_____ matrix = _____					
d)_____ matrix = _____					
e)_____ matrix = _____					
PDS 75-125% sample#_____					
Prep Batch ID#:_____ Dig. Meth._____					
Prep. Blank - <LOD or RL					
LCS - generated limits; attached list					
Spiked samples in batch:					
a)_____ matrix = _____					
b)_____ matrix = _____					
c)_____ matrix = _____					
d)_____ matrix = _____					
e)_____ matrix = _____					

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CT Laboratories

Title: **Mercury Cold Vapor Atomic Absorption**

SOP Number: **6120B**

Prepared by: _____
Date

Technical Review by: _____
Date

Reviewed by: _____
Quality Assurance ***Date***

_____
Laboratory Director ***Date***

SOP Manual Control Number:_____

1.0 SCOPE AND APPLICATION

This method is appropriate for measuring mercury concentrations in groundwater, wastewater, drinking water, TCLP extracts, soils, sediments, and sludge-type materials.

2.0 METHOD SUMMARY

2.1 Prior to analysis, the samples must be prepared according to the procedures discussed in this SOP.

2.2 This is a cold-vapor atomic absorption technique, based on the absorption of radiation at 254-nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrophotometer. Absorbance (peak height) is measured as a function of mercury concentration.

3.0 DEFINITIONS

3.1 Reagent Blank - A solution of deionized water, (containing in correct proportion, all reagents required by the method), used with the calibration standards to standardize the instrument, as a calibration blank, and for sample dilution.

3.2 Calibration Standards - A series of known standard solutions used for calibration of the instrument within the measurable linear range. Calibration standards shall contain, in correct proportion, all reagents required by the method. A total of 5 calibration points are used for Mercury calibration. Acceptance of the calibration requires a correlation coefficient of 0.995 or better. No samples shall be analyzed without acceptable calibration.

3.3 Calibration Verification Standards-Initial (ICV) & Continuing (CCV) - A midpoint calibration standard which is analyzed at the beginning of the run (ICV), at a frequency of 1 per 10 samples during a run (CCV), and at the end of a run to verify calibration throughout the run. The ICV must be from a second source different than that of the calibration standards, while the CCV may be from the same source as the calibration standards. Note that limits for ICV are tighter than those for CCV (see section 16).

3.4 CB (Calibration Blanks- Initial and Continuing) - A reagent blank solution, which is analyzed immediately following the calibration standards (Initial Calibration Blank-ICB), at a frequency of 1 per 10 samples during a run (Continuing Calibration Blank-CCB), and at the end of a run to check for drifts in calibration or possible analyte carry-over. Control criteria consist of the highest of the following: the absolute value being less than or equal to the MDL for a given analyte for routine work, <2x the MDL for DOD-QSM, or <½ the MRL for ACOE work. . If these ranges are exceeded, correct the problem and reanalyze affected data. A new calibration may be necessary to correct the problem.

3.5 LCS (Laboratory Control Sample)- A mid-range standard prepared from a source different from that used for calibration standards. The LCS is used to verify the accuracy of the digestion and is analyzed at the beginning of the analytical batch.

3.6 MB (Method Blank) - A Reagent Blank which is carried through the entire preparation and analytical method. The method blank is used to detect possible contamination that may occur prior to or during the sample preparation. A minimum of one MB is prepared per batch, and is analyzed at the beginning of an analytical batch. Method blank value should be lower than the highest of the following: the absolute value being less than or equal to the MDL for a given analyte, five percent of the regulatory limit of five percent of the measure concentration in the sample. The MB results shall also be < ½ the MRL for DOD-QSM/ACOE data.

3.7 MS-MSD (Matrix Spike-Matrix Spike Duplicate): - Two separate sample aliquots to which a known concentration of analyte has been added which is carried through the entire preparation and analytical procedure. The purpose of a matrix spike is to reveal any matrix effect from the sample on the recovery of the analyte by the method being used. An MS-MSD pair is prepared for every 20 samples per matrix of routine samples or for ACOE a DUP/MS pair is prepared for every 20 samples of a given matrix per day. Failure to meet criteria may be due to poor recovery during the preparation method or due to matrix interference within the digestate. To be considered acceptable, MSD must meet both the same % recovery criteria as an MS, and the same % RPD as a duplicate sample. MS/MSD %RPD and may be used as acceptance criteria for duplicate analysis.

3.8 Method Reporting Limit (MRL) or Contract Required Detection Limit (CRDL) Standard: Detection level standard at a level near but below the reporting limit, or at a level specified by client contract. When required, it is to be analyzed following the ICB, and prior to the last CCV standard in the run.

3.9 Duplicate (DUP)- A separate aliquot of sample which has been carried through the entire preparation and analytical procedure the same as the original sample. One duplicate per batch is prepared for ACOE work.

3.10 SD (Serial Dilution Analysis): A sample is diluted 1:5 with method blank solution and analyzed. The diluted result and the undiluted result should agree within a limit of precision defined by the program (SW846, CLP, 200.7) or client QAPP. **For ACOE/QSM work, a SD will be conducted at a minimum rate of one per prep batch per unique matrix.**

4.0 HEALTH AND SAFETY

4.1 Gloves and protective clothing shall be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure shall utilize appropriate laboratory safety systems.

5.0 CAUTIONS

5.1 Mercury is a toxic substance and care should be taken to avoid contact with it. This includes wearing gloves and using ventilation devices when working with Mercury.

5.2 This method allows for detection of small quantities of Mercury. All potential sources of Mercury contamination should be avoided. This would include sources of Mercury present in other lab areas.

6.0 INTERFERENCES

6.1 Potassium permanganate is added to eliminate possible interference from sulfide. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from reagent water.

6.2 Copper has also been reported to interfere; however, copper concentrations as high as 10 mg/L had no effect on recovery of mercury from spiked samples.

6.3 Seawaters, brines, and industrial effluents high in chlorides require additional permanganate (as much as 25 mL) because, during the oxidation step, chlorides are converted to free chlorine, which also absorbs radiation of 254 nm. Care must therefore be taken to ensure that free chlorine is absent before the mercury is reduced and swept into the cell. This may be accomplished by using an excess of hydroxylamine sulfate reagent (25 mL).

6.4 Certain volatile organic materials that absorb at this wavelength mayalso cause interference. A preliminary run without reagents should determine if this type of interference is present.

7.0 PERSONNEL QUALIFICATIONS

7.1 Personnel operating the CVAA shall have background knowledge of the scientific principles used during this application. All operators shall perform an initial demonstration of capability (IDC) prior to analyzing any samples. It is preferable for the operator to have at least two semesters of college chemistry.

8.0 APPARATUS AND MATERIALS

8.1 APPARATUS & MATERIALS

8.1.1 Cetac M-6000A Mercury Analyzer with ASX-500 autosampler.

8.1.2 Argon gas, HP grade.

8.1.3 50 mL disposable centrifuge tubes and caps. (Fisher p/n 05-539-9 or equivalent)

8.1.4 25 mL Class A volumetric pipettes

8.1.5 100 mL volumetric flasks

8.1.6 25 mL glass Class A, TD, graduated cylinders

8.1.7 1, 2, 3, 4, 5 mL Class A volumetric pipettes.

8.1.8 Eppendorf pipette, 0.100 to 1.000 mL range.

8.1.9 Environmental Express Hot Blocks set at 90-95 ^{0}C.

8.2 REAGENTS

8.2.1 Sulfuric acid, H_2SO_4, concentrated: Trace metal grade (Fisher p/n A300C-212)

8.2.2 Nitric acid, HNO_3, concentrated: Trace metal grade. (Fisher p/n A509-212 or equivalent)

8.2.3 Hydrochloric acid, HCl, concentrated: Trace metal grade. (Fisher p/n A508SK212 or equivalent)

8.2.4 Potassium permanganate solution, 5% w/v: Prepared by dissolving 50g Potassium Permanganate (Fisher p/n P279-212 or equivalent) in 1000 ml of deionized water. Prepare as needed. Expires 6 months from date of preparation. Store at room temperature in metals lab.

8.2.5 Potassium persulfate solution, 5% w/v: Prepared by dissolving 50 g Potassium Persulfate (Fisher p/n P282-500 or equivalent)in 1000 ml of DI water. Prepare as needed. Expires 6 months from date of preparation. Store at room temperature in metals lab.

8.2.6 Sodium chloride-hydroxylamine sulfate solution, 12% w/v: Prepared by dissolving 60 g Sodium Chloride (Fisher p/n) and 60 g of Hydroxylamine Sulfate in 500 ml of DI water. Prepare as needed. Expires 6 months from date of preparation. Store at room temperature in metals lab.

8.2.7 Stannous chloride (10% $SnCl_2$ w/v in 7% HCl v/v): to a 1000mL volumetric flask dissolve 100 gm Stannous Chloride(VWR part number MK817604) in 70mL conc. HCl. Stir until $SnCl_2$ is completely dissolved. Additional heat may be necessary to get complete dissolution. Once dissolved, dilute to line and cool. Prepare as needed. Expires 6 months from date of preparation. Store at room temperature in metals lab.

8.2.8 Aqua regia: In a fume hood, carefully add three volumes of concentrated HCl to one volume of concentrated HNO_3. Prepare fresh daily.

8.3 Stock Standards

8.3.1 Mercury stock standards, 1000 mg/L certified solutions, two sources. One is to be used for the calibration standards and the other for the LCS. (Ultra Scientific ICP-080 and JT Baker 6934-04 or equivalents). Store at room temperature in the metals lab. Expiration dates are given by the manufacturer.

8.4 Calibration Standards:

8.4.1 Intermediate Stock #1 (10,000 ug/L): To a 100 ml volumetric flask add 50 ml DI water and 0.2 ml conc. HNO_3 and 0.2 mL HCl. Transfer 1.0mL of 1000 mg/L Hg stock standard. Dilute to 100 ml with DI water and mix. Prepare fresh daily.

8.4.2 Intermediate Stock #2 (100 ug/L): To a 100 ml volumetric flask add 50 ml DI water and 0.2 ml conc. HNO_3 and 0.2 mL HCl. Transfer 1.0mL of 10,000 ug/L intermediate stock #1. Dilute to 100 ml and mix. Prepare fresh daily.

8.4.3 Use 100mL volumetric flasks. To each, add 50 mL DI water and 0.2mL conc. HNO3 and 0.2 mL conc. HCl. Add the following volumes of 100ug/L intermediate, dilute to volume with DI water, and mix well.

Std Conc. ug/L	Vol. 100ug/L Intermediate #2 Std	Final Volume
0.5	0.5 mL	100 mL
1.0	1.0 mL	100 mL
2.0	2.0 mL	100 mL
4.0	4.0 mL	100 mL
5.0	5.0 mL	100 mL

Using a 25 mL volumetric pipette, transfer 25 mL of each to 50 mL centrifuge tubes. Add 25 mL reagent water to another centrifuge tube for the calibration blank.

8.5 ICV/LCS and CCV: (ICV/LCS from second source, CCV from same source as standards)

8.5.1 Intermediate Stock #1 (10,000 ug/L): To a 100 ml volumetric flask add 50 ml DI water and 0.2 ml conc. HNO_3 and 0.2 mL HCl. Transfer 1.0mL of 1000 mg/L Hg stock standard. Dilute to 100 ml and mix. Prepare fresh daily.

8.5.2 Intermediate Stock #2 (100 ug/L): To a 100 ml volumetric flask add 50 ml DI water and 0.2 ml conc. HNO_3 and 0.2 mL HCl. Transfer 1.0mL of 10,000 ug/L intermediate stock #1. Dilute to 100 ml and mix. Prepare fresh daily.

8.5.3 Check Standard/LCS: To a 100 mL volumetric flask add 50 mL DI and 0.2 ml conc. HNO_3 and 0.2 mL HCl . Add 3.0 mL of the 100 ug/L intermediate stock from the second source standard, dilute to the line and mix.

8.5.4 Using a 25 mL volumetric pipette, transfer 25 mL of each to 50 mL centrifuge tubes.

8.5.4.1 Note: Due to different digestion matrices for aqueous and solid samples, two sets of standards must be prepped to match the matrix for each digestion.

9.0 INSTRUMENT CALIBRATION

In the upper window menu bar select Instrument then calibrate. Enter the calibration information which consists of the standard number and standard concentration in ug/L and press continue. The calibration data will now be available for sample analysis. See section 11.0 for futher calibration instructions.

10.0 SAMPLE COLLECTION, HANDLING AND PRESERVATION

	Water	Soil
Preservative:	pH < 2 with HNO_3	4 ^{o}C
Hold Time:	28 days	28 days

11.0 SAMPLE PREPARATION AND ANALYSIS

11.1 Turn on the Hot Block and allow it to heat to 95^0 C while the samples are being prepared.

11.2 Sample Preparation-Aqueous:

11.2.1 Waters: Using a 25 mL graduated cylinder, transfer 25 mL of sample to a 50 mL polyethylene centrifuge tube. For drinking water analysis, a 25 mL Class A pipette must be used.

11.2.1.1 MS-MSD Prep: Add 0.50 mL of the 100 ug/L intermediate to a 25 mL final volume for a spike concentration of 2.0 ug/L.

11.2.1.2 To each of the samples, MS-MSD, LCS, standards, and blanks add the following (under a hood):1.25 mL conc. H_2SO_4. 0.625 mL conc. HNO_3

11.2.1.3 To all samples, standards, and blanks add 3.75 mL Potassium permanganate ($KMnO_4$) solution.

11.2.1.4 Tightly cap the samples and mix by inverting several times.

11.2.1.5 The purple permanganate color should remain for at least 15 minutes. If it does not, add additional permanganate in 1 mL aliquots until the purple color remains for at least 15 minutes. Record any extra permanganate added in the logbook. The same amount of extra permanganate will have to be added to all other samples and standards.

11.2.1.6 To all samples, standards, and blanks add 2.0 mL Potassium persulfate solution.

11.2.1.7 Place the samples and standards in the Hot Block. Heat at 90-95^0C for 2 hours. Record initial and final Hot Block temperatures in the logbook.

11.2.1.8 Following digestion, remove the samples and place under a hood to cool. Alternately, the racks may be placed in a sink of cold water to hasten the cooling.

11.2.1.9 When the samples are cool, add 1.5 mL Sodium chloride-hydroxylamine sulfate solution to all samples, standards, and blanks. Tightly cap and mix by inverting until samples are clear. Samples are now ready for analysis.

11.3 Sample Preparation-Solids

11.3.1 Weigh triplicate 0.2 gram (approximate) portions from separate areas of the sample container of the untreated sample into a 50 mL polyethylene centrifuge tube with a plastic spatula. Do not use metal spatulas. Record the weight in the mercury prep book. See the subsampling SOP FO-10 for futher instructions on how to obtain a subsample for analysis.

11.3.2 Method Blank and LCS Prep: Weigh 0.50 g of sand blank into each of two 50 mL polyethylene centrifuge tubes. For the LCS, add 0.5 mL of the 100 ug/L second source intermediate stock solution #2.

11.3.3 MS-MSD Prep: Add 0.50 mL of the 100 ug/L intermediate to a 25 mL final volume for a spike concentration of 2.0 ug/L.

11.3.4 To all tubes, add 1.25 mL aqua regia reagent, and heat for 2 minutes in Hot Block at 95 ^{o}C.

11.3.5 Cool, and then add 25 mL of DI water and 3.75 mL of Potassium Permanganate solution to each vial.

11.3.6 Tightly cap all vials and mix by inverting several times.

11.3.7 The purple permanganate color should remain for at least 15 minutes. If it does not, add additional permanganate in 1 mL aliquots until the purple color remains for at least 15 minutes. Record any extra permanganate added in the logbook. The same amount of extra permanganate must be added to all other samples and standards.

11.3.8 Place the samples and standards in the Hot Block. Heat at 90-95 ^{0}C for 30 minutes. Record initial and final Hot Block temperatures in the logbook.

11.3.9 Cool, and then add 1.5 mL of Sodium Chloride-hydroxylamine sulfate to each sample and mix by inverting. The samples should turn clear.

11.4 Instrument Set-up

11.4.1 Power up the M-6000A and autosampler and allow to warm up for one hour.

11.4.2 Turn on lamp and gas supply and allow to warm up for 15 minutes.

11.4.3 Place autosampler tubing into rinse water (1%hydrochloric acid/1%nitric acid solution)

11.4.4 Verify that the sample capillary (inlet insert) is 0.5mm above the gas/liquid separator center post.

11.4.5 Open vents on waste container

11.4.6 Inspect peristaltic pump tubing for wear and flat spots and replace if necessary.

11.4.7 Place the peristaltic pump tubing in their appropriate holes and holder clips. Do not lock shoe clamps at this time.

11.4.8 Initiate M-6000A program by clicking on the M6000 icon, then controls then autosampler page.

11.4.9 Start the autosampler rinse pump by clicking the pump on and the probe down.

11.4.10 Place reagent capillary in a beaker of DI water and start the peristaltic pump in a clockwise rotation.

11.4.11 Lock down the peristaltic shoe clamps.

11.4.12 Inspect liquid flows. The GLS drain should be flowing smoothly with no build up or pulsing of liquid. The waste line from the peristaltic pump to the waste container should be liquid/gas with no vibration. If this is not the case upon inspection, stop

11.4.13 Immediately and change the GLS drain line and/or waste line.

11.4.14 Wet the GLS center post. Pinch the drain line prior to the tee of the peristaltic pump drain tubing. Let two or three liquid bubbles go to the top of the GLS center post and release the drain line. If the liquid does not bubble, then fill the GLS to the top of the center post and release the drain line.

11.4.15 Attach GLS exhaust tube to the GLS

11.4.16 Place reagent capillary in the reagent bottle

11.4.17 Open the appropriate worksheet and verify that the gas flow of the worksheet matches what is listed in the controls, if the flow is not the same make the necessary change and click set gas.

11.4.18 Zero the M-6000A using the autozero. This is under Instrument and then Zero Instrument.

11.4.19 Peak profile the high standard and verify baseline and sample integration times. Do this by clicking on Analysis and then read then standard and then choose the highest standard. If there are any adjustments needed to the peak, refer to the M6000A software manual 5.6.12.

11.5 Analysis

11.5.1 Insert sample labels by clicking on labels and then entering the sample ID numbers.

11.5.2 Right click to enter the QC standards after all the samples are entered. Choose "QC standard" for the CCV and "QC blank for the CCB.

11.5.3 Click on Analysis and then Click on start.

11.5.4 Choose the appropriate box and then click OK.

11.5.5 After analysis, click on file and choose return to main index.

11.5.6 Choose reports

11.5.7 Click on the data tab and choose the data that you want to report

11.5.8 Click on the Reports tab

11.5.9 Click on Write test to file and then enter the LIMS run number and make sure it is saved in the Cetac folder on the I drive.

11.6 Shutdown

11.6.1 Place the reagent capillary in a beaker of 10% nitric acid and cap the reagent bottle. Rinse the system for a minimum of ten minutes.

11.6.2 Place the reagent capillary in a beaker of DI water and rinse the system for one minute

11.6.3 Raise sample probe by clicking on controls then autosampler and click probe up and pump off.

11.6.4 Remove reagent capillary from DI water.

11.6.5 Allow the drain and waste lines to run completely dry

11.6.6 Turn off peristaltic pump

11.6.7 Release peristaltic shoe clamps and release the pump tubing from their holder clips.

11.6.8 Close vents on waste container.

11.6.9 Remove GLS exhaust line from GLS

11.6.10 Turn off gas and lamp

11.6.11 Exit software and run off the autosampler and instrument

12.0 TROUBLESHOOTING

12.1 See Cetac operator's manual for further troubleshooting instructions.

12.2 Preventative maintenance is recorded in the logbook located with the instrument. Follow the recommendations listed in the maintenance section of the Cetac M6000 Operators manual.

13.0 DATA ACQUISITION, CALCULATION AND DATA REDUCTION

Sample Calculations:

Liquid Concentration (ug/L) = A x C

Solid Concentrations (mg/kg) = $\frac{A \times B \times C}{}$

$$\frac{A \times B \times C}{D \times E}$$

where A = instrument reading for sample (ug/L)
B = total volume of digestion (L)
C= analyst dilution factor, if necessary (ex. For a 1 to 10 dilution, C = 10)
D = amount of sample used in digestion (g)
E = percent solids/100, if necessary

$$\textit{Spike Recovery (\%)} = \frac{\text{(Spiked sample concentration – Sample concentration)} \times 100}{\text{(Spike amount)}}$$

$$\textit{\%RSD} = \frac{\text{(MS – MSD)} \times 100}{\text{(MS + MSD)/2}},$$

where MS = Matrix spike concentration
MSD = Matrix spike duplicate concentration

14.0 COMPUTER HARDWARE AND SOFTWARE

14.1 Computer

14.2 LIMS software

14.3 M6000A software

15.0 DATA MANAGEMENT AND RECORD MANAGEMENT

15.1 After data has been captured by LIMS, it is reviewed by the analyst for accuracy and completeness. See checklist for data review guidance.

15.2 Once analyst has reviewed and approved the data, it is given to a peer or supervisor for review.

15.3 After the second reviewer approves the data, the reviewer sends the data to "validated" status in LIMS.

15.4 The original data is filed by test in the file cabinet and periodically the contents of the file cabinet are archived.

16.0 QUALITY CONTROL AND QUALITY ASSURANCE

16.1 Non-CLP (Solid Waste and Wastewater-7470A &7471A):

16.1.1 For every analytical run, calibrate with the blank and 0.50, 1.00, 2.00, 4.00, and 5.00 ug/L standards.

16.1.2 ICV (initial calibration verification): Following instrument calibration, analyze the 3.0 ug/L ICV/CCV standard. Control limits are +/-10%. If the recovery exceeds this, terminate the run and correct the problem before proceeding.

16.1.3 CCV (Continuing Calibration Verification): Anazlyzed after every 10 samples and at end of run. A 3.0 ug/L standard. Control limits are +/- 20%.

16.1.4 ICB/CCB (initial and continuing calibration blank): After the ICV and any CCV, analyze a blank. The absolute value of the result for the blank must be below the highest of the following: the absolute value being less than or equal to the MDL for a given analyte, five percent of the regulatory limit or five percent of the measure concentration in the sample. If the result exceeds this, terminate the analysis and correct the problem before proceeding or appropriately qualify the data.

16.1.5 LCS (laboratory control sample): An alternate source standard from the same digestion set as the samples. It is prepared for every 20 samples per medium. Control limits are generated in-house control limits or as specified by client QAPP. If the recovery exceeds this, terminate the run, reprep, and reanalyze all samples.

16.1.6 MB (method blank): From the same digestion set as the samples. Blank recovery should be less than the highest of the following: the absolute value being less than or equal to the MDL for a given analyte, five percent of the regulatory limit or five percent of the measure concentration in the sample. For Army Core of Engineers (ACOE) or Deparment of Defense Quality Systems Manual (QSM) data the criteria is < ½ the reporting limit. If the result is exceeded, reanalyze. If still exceeded, isolate and correct problem, reprep and reanalze the blank and samples associated with the blank, or appropriately qualify results.

16.1.7 MS/MSD (matrix spike/matrix spike duplicate): A MS/MSD is required every analytical run at a frequency of 5% per digestion batch for 7000 series or at a frequency of 10% per digestion batch for 200 series To be considered acceptable, MSD must meet both the same % recovery criteria as an MS, and the same % RPD as a duplicate sample. For routine work, use in-house generated limits for the recovery and RPD limits

16.2 CLP-Like Protocol (DOD-QSM/ACOE work):

16.2.1 For every analytical run, calibrate with the blank and 0.50, 1.00, 2.00, 4.00, and 5.00 ug/L standards..

16.2.2 ICV (initial calibration verification): Following instrument calibration, analyze the 3.0 ug/L ICV/CCV standard. Control limits are +/-10%. If the recovery exceeds this, terminate the run and correct the problem before proceeding.

16.2.3 ICB (initial calibration blank): Following the ICV, analyze a blank. The absolute value of the result for the ICB must be below ½ the MRL ACOE data, and <2x the MDL for DOD-QSM data. If the result exceeds this, terminate the analysis and correct the problem before proceeding.

16.2.4 LCS (laboratory control sample): Following the calibration verification standard and the calibration verification blank, and every 20 samples thereafter, analyze the 3.0 ug/L alternate source standard. Control limits are specified within the client QAPP or use default limits of 80-120%. If the recovery exceeds this, terminate the run, reprep, and reanalyze all samples.

16.2.5 MRL/CRDL standard (Method Reporting limit/contract required detection limit standard): Analyze a standard at the MRL or the CRDLas specified by the client QAPP. Limits are listed within the client QAPP or use a default of 70-130%.

16.2.6 MB (method blank): From the digestion set. If the result exceeds the ½ the MRL, re-digest all samples associated with the MB or appropriately qualify associated results.

16.2.7 CCV (continuing calibration verification): Analyze the 3.0 ug/L calibration standard following every ten samples, and at the end of the analysis. Control limits are +/-20% true value. If the recovery exceeds this, recalibrate and reanalyze all samples back to the last acceptable CCV.

16.2.8 CCB (continuing calibration blank): Analyze a blank following every CCV. The absolute value of the result for the CCB must be below ½ the MRL ACOE data, and <2x the MDL for DOD-QSM data.. If the result exceeds this, reanalyze all samples back to the last acceptable CCB or appropriately qualify results.

16.2.9 Matrix Spike: A matrix spike is required every for every sample delivery group of 20 samples or less. The matrix spike shall be prepared at the time of digestion. Default control limits are +/- 25% true value or or as specified in the projects QAPP, or within limits established by the DOD-QSM . . If recovery is outside of limits, refer to project QAPP or DOD-QSM for further instruction.

16.2.10 Duplicate: A duplicate is required for every sample delivery group of 20 samples or less and is prepared at the time of digestion. For results exceeding five times the MRL, the default control limit is 20% RPD, or as specified in the projects QAPP, or within limits established by the DOD-QSM . For results that are less than five times the MRL, the default control limit is +/- MRL. If precision is outside of limits, refer to project QAPP or DOD-QSM for further instruction.

16.3 SDWA Protocol (245.1)

16.3.1 For every analytical run, calibrate with the blank and 0.50, 1.00, 2.00, 4.00, and 5.00 ug/L standards

16.3.2 ICV (initial calibration verification): Following instrument calibration, analyze the 3.0ug/L ICV/CCV standard. Control limits are +/-5%. If the recovery exceeds this, terminate the run and correct the problem before proceeding.

16.3.3 ICB (initial calibration blank): Following the ICV, analyze a blank. The absolute value of the result for the ICB must be below the MDL for the method. If the result exceeds this, terminate the analysis and correct the problem before proceeding or appropriately qualify the data.

16.3.4 LCS (laboratory control sample): Following the calibration verification standards, and every 20 samples thereafter, analyze the 3.0 ug/L alternate source standard. Control limits are generated control limits. If the recovery exceeds this, terminate the run, reprep, and reanalyze all samples associated with the LCS.

16.3.5 MB (method blank): From the same digestion set as the samples. Limits: the highest of the MDL, 5% of the measured concentration in the sample, or 5% of the regulatory limit for that analyte. If the results exceed this, terminate the run, reprep and reanalyze all samples associated with MB or appropriately qualify the data.

16.3.6 CCV (continuing calibration verification): Analyze the 3.0ug/L calibration standard following every ten samples, and at the end of the analysis. Control limits are +/-10% true value. If the recovery exceeds this, recalibrate and reanalyze all samples back to the last acceptable CCV.

16.3.7 CCB (continuing calibration blank): Analyze a blank following every CCV. The absolute value of the result for the CCB must be below the highest of the MDL, 5% of the measured concentration in the sample, or 5% of the regulatory limit for that analyte. If the result exceeds this, reanalyze all samples back to the last acceptable CCB or appropriately qualify results.

16.3.8 MS/MSD (matrix spike/matrix spike-duplicate): A MS/MSD is required every analytical run at a frequency of 10% per matrix type. For digested samples, appropriate samples are designated and spiked at the time of the digestion. Control limits are in-house limits.

16.4 Data Review Prior to Shutdown: Check results for the following criteria. It may be possible to correct some problems within the same analytical run.

16.4.1 ICV/CCV, LCS, MB, MRL acceptance. See above for corrective action.

16.4.2 Results over the calibration range of 5 ug/L. Dilute affected samples within calibration range with dilution blank.

16.4.3 MS-MSD recovery outside of acceptance range. If both are out of range, but all other CCV, CCB, and LCS associated with the MS/MSD are within specs, then the problem is matrix related-not instrument related. Sample data may be reported but flagged with the appropriate comment.

16.5 Analysis data review checklist- the checklist will be completed by the analyst and the data reviewer and attached to the analytical data package.

17.0 REFERENCES

17.1 Test Methods for Evaluating Solid Waste, EPA, SW-846, Methods 7470A, 7471A.
17.2 Statement of Work for Inorganic Analysis, USEPA Contract Laboratory Program,. ILM04.0.
17.3 Methods for the Determination of Metals in Environmental Samples. EPA/600/R94/111, Method 245.1

17.4 Department of Defense Quality Systems Manual for Environmental Laboratories, Version 3, January, 2006.

17.5 Cetac-M6000A operations manual and software manual.

18.0 TABLES

18.1.1 Mercury Spike Prep

COLD VAPOR Element	Spike Amt. mL	Spike Solution Supplier	Stock Conc. ug/L	Final Vol. mL	Expected Conc. ug/L
Hg	0.50	Ultra 1000 mg/L	100.0	25.0	2.0

Standard Quality Control Requirements and Corrective Action

QC Type	Frequency	Conc. Level	*Acceptance Criteria*	*Corrective Action*
ICal	Each time the instrument is set up. The ICal consists of five standards and a blank.	0 + 0.5 – 5.0 ug/L	Correlation coefficient of .995 or greater	Terminate analysis, correct problem and recalibrate.
ICV	Immediately after the ICal	3 ug/L	Second source standard, SDWA: 95-105% SW846:90-110% ACOE- see client QAPP	Reanalyze once, if still unacceptable terminate analysis, correct problem and recalibrate
ICB	Immediately after the ICV	0	Routine work: < MDL, 5% of the Reg. Limit or 5% of the sample concentration. ACOE: ½ the MRL DOD-QSM: < 2x the MDL	Reanalyze once, if still unacceptable terminate analysis, correct problem and recalibrate.
LCS	1 per batch of ≤ 20 samples per matrix per day	mid cal. Range		Reanalyze once, if still unacceptable terminate analysis, correct problem and reanalyze all associated samples. High bias is acceptable for associated samples that have results less than the MDL for routine work or the MRL for ACOE work.
CCV	After every 10^{th} sample and at the end of the analytical sequence	mid cal range	SDWA; 90-110% SW846; 80-120% ACOE- see client QAPP	Reanalyze once, if still unacceptable recalibrate and reanalyze all samples back to the last acceptable CCV or ICV. High bias is acceptable for associated samples that have results less than the MDL for routine work or the MRL for ACOE work.
CCB	Immediately following each CCV	0	Routine work: < MDL, 5% of the Reg. Limit or 5% of the sample concentration. ACOE: ½ the MRL DOD-QSM: < 2x the MDL	Reanalyze once, if still unacceptable reanalyze all samples back to the last acceptable CCB or appropriately qualify results.

MS-MSD (routine work) or MS-DUP (ACOE)	5% of samples per matrix per day	See attached spike chart	≤ ± 20%, Applicable when spike level is >25% of original analyte level in the sample and RPD ≤ ± 20% or as specified in DOD-QSM or ACOE QAPP	Perform PDS
Post Digestion Spike (PDS)	Upon failure of MS or per batch for ACOE work	Same level as MS	85-115%	Qualify data as matrix interference or perform MSA
Method Blank	1 per batch of 20 samples	0	Routine work: < MDL, 5% of the Reg. Limit or 5% of the sample concentration. DOD-QSM/ACOE: <1/2 the MRL	Investigate and isolate possible source and correct problem; then reanalyze all associated samples, if possible, or qualify data (B)

GFAA / FLAA / CVAA Data Review checklist	Method: 200.9 7000 series AA 245.1 7470/7471				
Instrumentation: PE SIMAA 6000	VARIAN SPECTRAA10				CETAC HG ANALYZER
Analysis Date:	Data File:		Date Review:		**Analyte:**___________
Cal Std ID: LIMS # :	Analyst:		Reviewer:		Approved? Yes No
Calibration Parameters -	**YES**	**NO**	**YES**	**NO**	**Comments:**
1) Calibration linearity - r > 0.995					
2) ICV 90-110% 95-105%					
3) ICB ABS of LOD or RL					
6) CRA - (2X CRDL or LOD) 80-120%					
7) CCV1/CCB1- 90-110% / 80-120%					
8) CCV2/CCB2 ABS of LOD or RL					
9) CCV3/CCB3					
10) CCV4/CCB4					
11) CCV5/CCB5					
12) CCV6/CCB6					
Preparation Batch Parameters	**YES**	**NO**	**YES**	**NO**	**Comments:**
Prep Batch ID#:_______ Dig. Meth.______					
Prep. Blank - <LOD or RL					
LCS - generated limits;attached list					
Spiked samples in batch:					
a)_____________ matrix = ________					
b)_____________ matrix = ________					
c)_____________ matrix = ________					
d)_____________ matrix = ________					
e)_____________ matrix = ________					
PDS 85-115% sample#_____________					
MSA Performed? Yes No					
Prep Batch ID#:_______ Dig. Meth.______					
Prep. Blank - <LOD or RL					
LCS - generated limits;attached list					
Spiked samples in batch:					
a)_____________ matrix = ________					
b)_____________ matrix = ________					
c)_____________ matrix = ________					
d)_____________ matrix = ________					
e)_____________ matrix = ________					
PDS 85-115% sample#_____________					
MSA Performed? Yes No					
Prep Batch ID#:_______ Dig. Meth.______					
Prep. Blank - <LOD or RL					
LCS - generated limits;attached list					
Spiked samples in batch:					
a)_____________ matrix = ________					
b)_____________ matrix = ________					
c)_____________ matrix = ________					
d)_____________ matrix = ________					
e)_____________ matrix = ________					
PDS 85-115% sample#_____________					
MSA Performed? Yes No					
Prep Batch ID#:_______ Dig. Meth.______					
Prep. Blank - <LOD or RL					
LCS - generated limits;attached list					
Spiked samples in batch:					
a)_____________ matrix = ________					
b)_____________ matrix = ________					
c)_____________ matrix = ________					
d)_____________ matrix = ________					
e)_____________ matrix = ________					
PDS 85-115% sample#_____________					
MSA Performed? Yes No					

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CT Laboratories

Title: **Analysis of Semivolatile Organic Compounds by GC/MS 8270**

SOP Number: **8270**

Prepared by: _____

Technical Review by: _____

Approved by: _____
Quality Assurance Manager

Approved by: _____
Laboratory Director

SOP Manual Control Number: _____

Table of Contents

1.0 Identification of Test Method

This method is designed to follow procedures and QC requirements found in EPA SW-846 methods 3510, 3545, 3546, 3580, 8000 and 8270 in order to determine quantities of semivolatile organic compounds found in a variety of different sample matrices.

2.0 Applicable Matrix or Matrices

Semivolatile organic compounds are quantitated from a variety of matrices. This method is applicable to nearly all types of samples regardless of water content, including ground water, surface water, wastewater, soils and sediments, as well as other matrices noted in SW-846 method 8270C.

3.0 Detection Limits

Method detection limits (MDLs) are determined annually and results vary from compound to compound. Water MDLs are typically between 0.10 and 10 ug/L. Soil MDLs are typically between 0.01 and 0.50 mg/kg. Water MDLs for PAH compounds analyzed in SIM mode are typically between 0.005 ug/L and 0.015 ug/L. Soil MDLs for PAH compounds analyzed in SIM mode are typically between 1.0 and 5.0 ug/kg. Procedures for conducting MDL studies can be found in CT Laboratories Initial Method Performance and Reporting SOP CL-2 Rev 7.

4.0 Scope and Application

4.1 Method SW-846 8270 is used to quantify solvent-extractable semivolatile organic compounds in water and soil. Most base-neutral and acidic organic compounds which are soluble in methylene chloride and capable of being eluted in a gas chromatograph without derivatization can be quantitated. See Table 1.0 for typical target analyte list (TAL).

4.2 Examples of other compounds which have been analyzed by this method are listed in Table 1.1. SW846 method 8270 notes a number of other compounds amenable to this test.

4.3 The following compounds require special treatment when being determined by this method.

4.3.1 Benzidine is subject to oxidative losses during solvent concentration and exhibits poor chromatographic behavior.

4.3.2 Hexachlorocyclopentadiene is subject to thermal decomposition in the inlet of the gas chromatograph, chemical reaction in acetone solution, and photochemical decomposition.

4.3.3 Pentachlorophenol, 2,4-Dinitrophenol, 4-Nitrophenol, Benzoic Acid, N-Nitrosodimethylamine, 2-Naphthylamine, 4,6-Dinitro-2-Methylphenol, 4-Chloro-3-Methylphenol, 2-Nitroaniline, 3-Nitroaniline, 4-Chloroaniline, Pyridine, and Benzyl Alcohol are subject to erratic chromatographic behavior.

4.3.4 The analytes listed above are flagged when there are limitations caused by sample preparation and/or chromatographic problems.

4.3.5 N-nitrosodiphenylamine decomposes in the gas chromatograph and cannot be separated or differentiated from Diphenylamine. Both analytes are reported as a pair.

4.3.6 Azobenzene & 1,2-Diphenylhydrazine, 3&4-Methylphenol and 3&4-Chlorophenol are reported as a pair.

5.0 Method Summary

5.1 This method describes procedures for isolating organic compounds through sample preparation from aqueous and soil matrices (reference methods SW846-3510, 3580, 3545 and 3546), concentration techniques that are suitable for preparing the extract, and the quantitative/qualitative analysis for the determination of target analytes by method SW846-8270.

5.2 A sample of a known volume or weight is extracted with solvent or diluted with solvent. Method applies to aqueous samples extracted by liquid-liquid separatory funnel (SW846-3510). Method applies to soil/sediment, and solid waste samples extracted by standard solvent extraction methods utilizing pressurized extraction techniques as heated pressurized fluid extraction (SW846-3545) and using microwave energy to produce elevated temperature and pressure conditions in a closed vessel containing extraction solvent (SW846-3546). This method includes the extraction for waste dilution samples (SW846-3580).

5.3 The resultant extract is chemically dried and concentrated in a Kuderna-Danish (K-D) apparatus in preparation for instrumental analysis.

5.4 Extracts for 8270 analysis may be subjected to cleanup measures, depending on the nature of the matrix interferences and target analytes. The suggested method of cleanup is Gel-Permeation Chromatography (GPC) cleanup (SW846 3640A, see attachment I). After cleanup, the extract is analyzed by injecting a known aliquot into a gas chromatograph equipped with a mass spectrometer detector.

5.5 Identification of target analytes is accomplished by comparing their mass spectra with the spectra of certified commercially-prepared stock standards. Quantitation is accomplished by comparing the response of a major quantitation ion relative to an internal standard using a five point (minimum) calibration curve.

5.6 The PAH compounds may be analyzed using SIM (selected ion monitoring) signals for quantitation in order to achieve lower detection limits. This is referred to in this SOP as SIM+SCAN.

6.0 Definitions

6.1 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

6.2 Laboratory Control Spike (LCS): Milli-Q water (for water) or Organic-Free Soil (for soil) is spiked with the target analytes and carried through the complete sample preparation and analytical procedure. The control spike is used to document the ability of an analyst to generate acceptable precision and bias, to verify the analytical system performance, and to document method accuracy for each matrix.

6.3 Matrix Spike (MS): An aliquot of sample spiked with a known concentration of target analytes. The spiking occurs prior to sample preparation and analysis. It is used to document the precision and bias of a method in a given sample matrix.

6.4 Matrix Spike Duplicate (MSD): Intra-laboratory split samples spiked with identical concentration of target analytes. The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

6.5 Method Reporting Limit (MRL): The method reporting limit is a threshold value below which the laboratory reports a result as a non-detect or estimated value. The highest value reported for the method reporting limit is dependant upon project-specific action or decision levels. Method reporting limits are adjusted based on the sample matrix and any sample dilution/concentrations when necessary.

6.6 Method Detection Limit (MDL): The minimum concentration of an analyte that can be identified measured and reported with 99% confidence that the analyte concentration is greater than zero.

6.7 Method Reporting Limit (MRL) Spike or LOQ Check: An internally prepared standard at a level near the Limit of Quantitation (LOQ) or at a level specified by a specific program or contract. For LCG work MRL's are analyzed following the CCV and at the end of the 12 hour analytical sequence. An LOQ check is required after MDL studies and quarterly thereafter for QSM work. Recovery limits are required for MRL's and are usually program/contract specific. The MRL is also referred to as a CRDL (Contract Required Detection Limit).

6.8 Method Detection Limit (MDL) Check: An internally prepared standard prepared at approximately 1-4 times the calculated MDL for a given analyte. The MDL check sample is used as verification of the calculated MDL's. Detection of the individual analytes in the MDL check is the only requirement. The MDL check is required after MDL studies and after an MRL check for LCG samples. An acceptable MDL standard check must produce signals for the qualifier ions. An MDL standard injection must be made after each major instrument repair to verify the sensitivity of the instrument.

6.9 Surrogate (SURR): Organic compound which is similar to the target analytes in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Its use is to monitor the performance of the extraction, cleanup (as needed), the analytical system, and the effectiveness of the method. The acid

surrogates are at twice the concentration of the Base/Neutral surrogates. The acid surrogate compounds are: 2-Fluorophenol, Phenol d_5, and 2,4,6-Tribromophenol. The base/neutral surrogates are: Nitrobenzene d_5, 2-Fluorobiphenyl, and p-Terphenyl d_{14}. o-Terphenyl d_{14} is also added when the samples are analyzed for PAHs in selected ion monitoring (SIM) mode.

6.10 Initial Calibration (ICAL): An analytical instrument is said to be calibrated when an instrumental response can be related to the concentration of an analyte. This relationship is depicted graphically and referred to as a "calibration curve". Initial calibration curves must be established based upon the requisite number of standards identified within the method for each target analyte.

6.11 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standard involves the analysis of all target analytes each time the initial calibration is performed.

6.12 Continuing Calibration Verification Standard (CCV): A standard solution that is used to check the validity of a calibration curve on a daily basis. It also provides information on satisfactory maintenance and adjustment of the instrument during sample analysis. A CCV must be analyzed at the beginning of each 12 hour shift.

6.13 DFTPP: Decafluorotriphenylphosphine. This compound is used to verify that the GC/MS is properly tuned and ready for calibration and sample analysis. To acquire the mass spectrum of DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction to eliminate column bleed or instrument background noise is accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Benzidine and Pentachlorophenol must have tailing factors less than 2. Breakdown of DDT to DDD and DDE must be less than 20%.

6.14 Internal standard (ISTD): Internal Standard quantitation involves the comparison of instrument responses from the target compounds in the sample to the responses of specific standards added to the sample extract prior to injection. The ratio of the peak area of the target compound in the sample extract to the peak area of the internal standard in the sample extract is compared to a similar ratio derived for each calibration standard. The internal standards are; 1,4-Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12} and Perylene d_{12}. In addition, Benzo[a]anthracene d_{12} is added when the samples are analyzed for PAHs in selected ion monitoring (SIM) mode.

6.15 System Performance Check Compounds (SPCC): SPCCs are system performance compounds that are a part of the Continuing Calibration Verification standard (CCV). The SPCCs must meet a minimum response factor of 0.050. The SPCC criteria also apply to the average response factor of the initial calibration curve.

6.16 Calibration Check Compounds (CCC): CCCs are calibration check compounds that are a part of the Continuing Calibration Verification standard (CCV). The CCC percent difference must be less than or equal to 20%.

6.17 Instrument Blanks (IB): Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. Whenever an

unusually concentrated sample is encountered, it can be followed by the analysis of an instrument blank (methylene chloride + Internal Standards) to check for cross-contamination.

7.0 Interferences

7.1 Solvents, reagents, glassware, and other sample processing hardware can yield artifacts and /or interferences to sample analysis. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and/or purification of solvents by distillation in all-glass systems will be necessary. Refer to each method for specific guidance on quality control procedures.

7.2 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials.

7.3 Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, will cause degradation of certain analytes.

7.4 Interferences co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interference, further cleanup of the sample or dilution of the sample will be necessary.

7.5 Mass spectrometer sensitivity, column degradation, and contamination can also contribute to background interferences. The presence of semivolatile hydrocarbons in the sample extracts may require an appropriate post analysis bake-out time to be incorporated in the method.

8.0 Safety

8.1 Gloves and protective clothing shall be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure must utilize appropriate laboratory safety systems.

8.2 The toxicity and carcinogenicity of chemicals used in this method are not precisely defined. Each chemical and sample shall be treated as a potential health hazard. Care must be taken to prevent undue exposure to these chemicals and samples.

9.0 Equipment and Supplies

9.1 Apparatus**.**

9.1.1 GC-MS system - Hewlett Packard 6890 GC/7683 autosampler/5973 MSD - An analytical system complete with gas chromatograph suitable for split-splitless injection and all required accessories including syringes, analytical column, mass spectrometer detector, auto sampler, electronic pressure control, vacuum pumps, and HP Chemstation data acquisition system. The data acquisition system consists of an IBM compatible PC with an operating system of Windows XP Professional and Agilent Environmental Chemstation (MSD Chemstation Rev. D.03.00.611).

9.1.2 8270 GC Conditions

Carrier Gas: He at 1.6 mL/min , hold 5.0 min
Ramped to 1.2 ml/min (10 ml/min), hold 3.0 min
Ramped to 1.8 ml/min (10 ml/min), hold 4.96 min

Injector Temperature: 250º C
Mode: Pulsed Splitless
Inj. Volume: 0.5 uL
Pressure: 8.9 psi
Pulse Pressure: 30.0 psi
Pulse Time: 0.4 min
Purge Flow: 50.0 ml/min
Purge Time: 0.38 min
Total Flow: 53.5 ml/min
Gas Saver On: 20ml/min at 2 min
Oven: Initial – 20º (hold for 0.5 min)
Ramp – 45º/min
Final –70º (hold for 0 min)
Ramp – 14º/min
Final – 120º (hold for 0 min)
Ramp – 45º/min
Final – 220º (hold for 0 min)
Ramp – 40º/min
Final – 280º (hold for 0 min)
Ramp – 30º/min
Final – 325º (hold for 1.6 min)

9.1.3 8270 MS Conditions

MS Interface: 300º
MS Source: 280º
Mass range: 35-500 amu
Scan time: 0.317 sec/scan

9.1.4 SIM+SCAN GC Conditions

Carrier Gas: He at 1.6 mL/min
Ramped to 1.8 ml/min (10ml/min) at 14 min
Injector Temperature: 250º C
Mode: Pulsed Splitless
Inj. Volume: 0.5 uL
Pressure: 8.9 psi
Pulse Pressure: 30.0 psi
Pulse Time: 0.4 min
Purge Flow: 50.0 ml/min
Purge Time: 0.38 min
Total Flow: 53.5 ml/min
Gas Saver On: 20ml/min at 2 min
Oven: Initial – 20º (hold for 0.55 min)
Ramp – 45º/min
Final –70º (hold for 0 min)
Ramp – 14º/min
Final –120º (hold for 0 min)
Ramp – 35º/min
Final – 255º (hold for 0 min)
Ramp – 15º/min
Final – 290º (hold for 0 min)
Ramp – 4º/min
Final – 300º (hold for 0 min)

Ramp – 30º/min
Final – 325º (hold for 0.1 min)

9.1.5 SIM+SCAN MS Conditions
MS Interface: 300º
MS Source: 280º
See Table 1.3

9.1.6 GC column: 30m x 0.25 mm ID, 0.25 um. (J&W DB-5.625 or equivalent).

9.1.7 Note: Instrument operating parameters are subject to change to improve chromatography. Changes are noted in the Instrument Maintenance Log

9.2 Water bath- heated and capable of accepting a Kuderna-Danish apparatus. (GlasCol 6 position heating mantle 100DRX30424 or equivalent)

9.3 Dionex ASE 200.

9.3.1 The Dionex ASE 200 extraction cycle:

Oven temperature: 100 º C Pressure: 1500 psi
Prepurge time: 0 minutes
Static time: 5 minutes
Heat: 5 minutes
Flush volume: 60%
Nitrogen purge: 60 sec. At 150 psi
Solvent A: 100%
Method rinse: ON
Static Cycles: 1
Extraction Fluid: (7:3) Methylene Chloride:Acetone

9.4 CEM Microwave Accelerated Reaction System (MARS Xpress) extraction unit with Synergyprep software

9.4.1 The CEM Mars extraction cycle:

Method 1
8-16 samples
Power: 100% at 800 watts
Ramp Time: 15 min
Pressure:0
Temp:110 C
Hold Time: 15 min

Method 2
17-48 samples
Power: 100% at 1600 watts
Ramp Time: 15 min
Pressure:0
Temp:110 C
Hold Time: 15 m

9.5 Organomation Nitrogen blow down concentrator. (N-Evap)

9.6 Analytical balance capable of accurately weighing to the nearest 0.01 gram (Fischer Scientific XD 2200 or equivalent)

9.7 Oven, muffle and drying.

9.8 Separatory funnel - 2000 mL glass with Teflon coated caps and Teflon stopcocks. (VWR 6099-2 or equivalent)

9.9 Aluminum foil

9.10 Separatory funnel platform shaker, variable speed (Lab-Line VWR #6000-1 or equivalent)

9.11 Kuderna-Danish (K-D) apparatus:

- 9.11.1 Concentrator tube, 10.0 mL, graduated. (Fisher # K570051-1025).
- 9.11.2 Evaporation flask- 500 mL or 250 ml (Fisher # K570035-0250).
- 9.11.3 Synder column- Three-ball macro (Fisher # K503000-0121).
- 9.11.4 Teflon clamps to attach concentrator tube to evaporation.

9.12 Graduated cylinder (Class A TC) - 1000 mL. (Fisher 08-559G).

9.13 Beaker - 250 mL and 600 mL.

9.14 Vials - 2.0mL (National Scientific – C4000) 12mL (Kimble #60815-1965), and 60 mL screw cap vials with Teflon lined caps (C&G #LX64-A030-A01A) or equivalents.

9.15 Pasteur Pipets; 5 ¾" and 9" (VWR #14672-200 and -300).

9.16 Funnels – glass. (VWR #154-08 or equivalent)

9.17 Volumetric flask – (Class A TC) 2, 5, 10, 25, 50, and 100 mL.

9.18 Syringes 10 uL, 100 uL, 500 uL, and 1,000 uL. (Hamilton or equivalent)

9.19 Boiling chips, carborundum, approximately 10/40 mesh (methylene chloride rinsed) (Fisher # 09-191-12) equivalent.

9.20 Dionex ASE 200 Filters (Restek #269190).

9.21 ASE 200 33mL extraction cells with caps (Dionex # 048763 or equivalent)

9.22 Filter- Glass Microfiber 12.5 cm (Ahlstrom, MG # F136-1250).

9.23 CEM-MARS Microwave extraction tubes with plugs and caps, 75mL (CEM #574127)

9.24 Spatulas- stainless steel. (VWR #57952-253 or equivalent)

9.25 pH indicator paper- pH 0-14. (Whatman #2613991) or equivalent. Stored in general lab storage area.

10.0 Reagents and Materials

10.1 Deionized water (Milli-Q processed), analyte free or equivalent.

10.2 Sodium sulfate (granular, anhydrous 60/120 mesh, JT Baker # 3375-05) or equivalent. If sodium sulfate passes in house lot check, it can be used as is and stored in air tight glass jar. Otherwise condition sodium sulfate by heating to 400^{o}C for 4 hours in a shallow glass tray loosely covered with foil and recheck for purity. Sodium sulfate will be stored in airtight glass jars in the cabinets of the Semi-volatile extractions lab and used within one year of opening or before the manufacturer's expiration date.

10.3 Silica sand- hydrocarbon free. Purify by heating to 400^{o}C for 4 hours in a shallow glass tray, loosely covered with foil. Silica sand will be stored in airtight glass jars located on the shelves in the Semi-volatiles extraction lab and used within 1 year of purifying

10.4 Methylene chloride, pesticide grade, analyte free. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date. Or stored in large carboy tank provided by manufacturer and used by the manufacturer's expiration date.

10.5 Acetone, pesticide grade, analyte free. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date.

10.6 Methanol, pesticide grade. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date.

10.7 Sulfuric Acid (Certified ACS)/Deionzied Water-1:1(v/v). ACS grade. Store in lab at room temperature, use within one year of mixing or before manufacturers expiration date for any reagent used. Log number recorded in Semivolatiles log book.

10.8 Sodium Hydroxide- 10 N (Certified ACS). Store in lab at room temperature, use within one year of mixing or before manufacturers expiration date for any reagent used. Log number recorded in Semivolatiles log book.

10.9 Diatomaceous earth, pelletized (Dionex # 062819) or equivlent. Stored in the cabinets of the Semi Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date

10.10 Nitrogen (4.8 rating).

10.11 Helium (4.7 rating)

11.0 Sample Collection, Preservation, and Storage

11.1 Aqueous samples are collected in 1-L amber glass containers with Teflon lined lids. Aqueous samples are to be collected in duplicate. Solid samples are collected in 250-mL wide mouth glass containers with Teflon-lined lids. All samples are preserved by cooling to 4ºC. The soil samples must be extracted within 14 days and water samples must be extracted within 7 days from the date of collection.

11.2 Sample extracts are to be stored under refrigeration in the dark and analyzed within 40 days of extraction.

11.3 All soil samples are weighed on the top loading balance which is connected to a computer so that all weights can be automatically entered into an Excel spread sheet. The spreadsheets are saved so the data can be transferred electronically to the LIMS system.

12.0 Quality Control

This SOP is designed to follow a variety of different projects and programs requirements. Table 3. is designed to illustrate the control steps and provisions required to adequately produce acceptable data.

13.0 Calibration & Standardization

13.1 Standards and spikes

13.1.1 Preparation of standards is documented in the GC/MS standards logbook. Each standard is labeled by prep date to allow for tracking. Opened stock standards expire in six months or sooner if comparison with quality control check samples indicates a problem. Leftover stock standards are saved in a capped vial in the original box in the freezer. Any subsequent dilutions made from the opened vial expire six months from the original opening. The cracking date of the stock standard vial will be recorded on the label along with the six month expiration date.

13.1.2 Stock Standards – Stock Standards are purchased from vendors who provide certified solutions. Standards are stored at –10ºC in a freezer reserved for standard solutions. Unopened standard shall have the manufactures suggested expiration date. Opened stock standards expire in six months or sooner if comparison with quality control check samples indicates a problem (Not to exceed the manufactures expiration date).The following list of stock standards are commercially prepared standards, which are certified by the manufacturer, such as;

BIG BN-2: Protocol Part # BIG BN-2 at 2000 ug/ml
HICAL-ACIDS: Protocol Part # HICAL-ACIDS at 2000 ug/ml
Benzidines: Protocol Part # 605X at 2000 ug/ml
Balance Mix A: Protocol Part # SV-X at 2000 ug/ml
Custom Balance Mix A: Protocol Part # XCT- CM-1 at 2000 ug/ml
Custom Balance Mix B: Protocol Part # XCT-CM-2 at 2000 ug/ml
8270 Surrogate Mix BN: Restek Part #31062 5000 ug/ml
8270 Surrogate Mix AE: Restek Part #31063 10000 ug/ml
8270 Mega Mix: Restek Part #31850 at 500/1000 ug/ml
8270 Benzidine Mix: Restek Part #31834 at 2000 ug/ml
8270 Extra Analyte List: Protocol Part # CT-SV-12 at 2000 ug/ml
TCLP B/N Mix: Restek Part # 31028 at 2000 ug/ml
TCLP Acid Mix: Restek Part # 31027 at 2000 ug/ml
8040 Phenol Mix #1: Restek Part # 31088 at 2000 ug/ml
8040 Phenol Mix #2: Restek Part # 31089 at 2000 ug/ml
PAH Mix: Restek Part # 31622 at 2000 ug/ml
DFTPP: Restek Part # 31615 at 1000 ug/ml
o-Terphenyl-d14 Chem Service Part# FD1054-1,neat

13.1.3 Intermediate Stock Standards: These standards are diluted stock standards so that the concentration levels are manageable for the preparation of working standards. The 8270 intermediate standard is prepared at an optimum level for the preparation of the working stock standard. Each 8270 target compound (or Surrogate) is at a concentration of 100.0 ug/ml. in methylene chloride with the following exceptions: compounds that co-elute (listed in sec 4.3.6) are at a concentration of 200.0 ug/mL. For example, Azobenzene and 1,2-Diphenylhydrazine are each in the stock solution at 100.0 ug/mL. They are reported as a pair (Azobenzene&1,2-Diphenylhydrazine) with a concentration of 200.0 ug/mL. See Tables 2.0 and 2.1.

13.1.4 Calibration standards: An initial calibration of the listed analytes in Table 1.0 is performed using a minimum of 5 points. The following concentrations correspond to the expected range of concentrations found in real samples and bracket the linear range of the detector. Standards are made by taking aliquots of the intermediate standard and diluting to volume in methylene chloride or by making dilutions directly from the stock standards (see Tables 2.2 and 2.3). The following levels are repeated across all 8270 compounds. Note: due to low instrument response the following compounds are not calibrated from level 1: Benzoic acid, 2,4-Dinitrophenol, 4-Nitrophenol, 4,6-Dinitro-2-methylphenol and Pentachlorophenol.

8270 Initial Calibration

Level 1	1.00 ug/ml
Level 2	5.00 ug/ml
Level 3	10.0 ug/ml
Level 4	20.0 ug/ml
Level 5	30.0 ug/ml
Level 6	40.0 ug/ml
Level 7	50.0 ug/ml

The PAH compounds may be analyzed using SIM (selected ion monitoring) signals for quantitation. In this case, two additional levels composed of PAH compounds only are acquired in the initial calibration at 0.02 ug/ml and 0.1 ug/mL. See Table 2.4.

8270 SIM+SCAN Initial Calibration

Level 1(PAHs)	0.020 ug/ml
Level 2(PAHs)	0.100 ug/ml
Level 3	1.00 ug/ml
Level 4	5.00 ug/ml
Level 5	10.0 ug/ml
Level 6	20.0 ug/ml
Level 7	30.0 ug/ml
Level 8	40.0 ug/ml
Level 9	50.0 ug/ml

13.1.5 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standards involve the analysis of all target compounds at 20.0 ug/ml and 40.0 ug/mL (40.0 ug/mL and 80.0 ug/mL for Azobenzene&1,2-Diphenylhydrazine

and N-nitrosodiphenylamine&Diphenylamine) each time the initial calibration is performed. Standards are made by taking aliquots of the ICV intermediate standard or the purchased stock standards and diluting to volume in methylene chloride The ICV stock standard is prepared in the same manner as the primary intermediate stock standard. The ICV working standards will be prepared at the time of initial calibration and have a shelf life of one week. See Tables 2.5 and 2.6.

13.1.6 Calibration Verification Standard (CCV): A working standard solution for 8270 at a concentration of 20.0 ug/ml and is used to check the validity of a calibration curve on a daily basis. Standard is made by taking an aliquot of the intermediate standard and diluting it to volume in methylene chloride. The CCV is prepared weekly and stored at -10ºC. The CCV for SIM+SCAN is the same as for normal 8270. See Table 2.7.

13.1.7 Surrogate standard: Commercially prepared certified solutions of 2-Fluorophenol, Phenol $d_{5,}$ and 2,4,6-Tribromophenol at 10000 ug/ml (AE Surrogates) and Nitrobenzene $d_{5,}$ 2-Fluorobiphenyl, and p-Terphenyl d_{14} (BN Surrogates) are diluted in acetone or methanol to produce a working surrogate solution of 40/20 ug/ml (AE/BN). 1.0 mL is added to each sample. The surrogate concentration is normalized to 100% from the spiking solution in the initial calibration. This will provide percent recoveries that transfer directly to LIMS. For SIM+SCAN analyses o-Terphenyl d_{14} is added at a final concentration of 1.0 ug/ml. See Tables 2.8 and 2.9.

13.1.8 Internal standard solution: A Commercially prepared certified solution of 1,4-Dichlorobenzene $d_{4,}$ Naphthalene $d_{8,}$ Acenaphthene $d_{10,}$ Phenanthrene $d_{10,}$ Chrysene d_{12} and Perylene d_{12} at 2000 ug/mL in methylene chloride. 5 uL is added to each 500 uL aliquot of sample extract for a final concentration of 20 ug/mL. In addition, Benzo[a]anthracene d_{12} is added when the samples are analyzed for PAHs in selected ion monitoring (SIM) mode. See Table 2.10 for SIM+SCAN internal standard concentrations.

13.1.9 Spiking standards (matrix and control samples): Prepare a spiking solution in acetone or methanol that contains target compounds for water and sediment / soil samples. 1.0 ml is added to quality control and matrix spike samples. The concentration of these compounds are five times higher for waste samples. If other compounds of interest are to be monitored they can be added at an appropriate level and noted in the standard preparation log. If client requests, spiking solution can be altered to match the target analytes of interest.

13.1.10 DFTPP: Decafluorotriphenylphosphine solution in methylene chloride (See Table 2.12). This compound is used in tuning the GC/MS. To acquire the mass spectrum of DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness.

NOTE: All standards are stored at -10ºC. Opened stock standards expire in six months or sooner if comparison with quality control check samples indicates a problem. An intermediate stock standard or working standard shall not exceed expiration date criteria. All subsequent standards made from the intermediate stock standards expire on the same date as the stock standard. If

more than one standard is added to a solution the expiration date will be the same as the stock standard with the earliest expiration date.

13.2 Calibration

13.2.1 The initial calibration for SW-846 chromatographic methods involves the analysis of standards containing the target compounds at a minimum of five different concentrations covering the working range of the instrument

13.2.2 For each compound and surrogate of interest, prepare calibration standards at a minimum of five different concentrations by adding volumes of one or more stock standards to a volumetric flask and diluting to volume with methylene chloride.

13.2.3 The lowest concentration calibration standard that is analyzed during an initial calibration curve establishes the method's quantitation limit based on the final volume of the sample extract described in the preparative method or employed by the laboratory.

13.2.4 Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the response of specific standards added to the sample or sample extract prior to injection. The ratio of the peak area or height of the internal standard in the sample or sample extract is compared to a similar ratio derived for each calibration standard. The ratio is termed the response factor (RF), and is also known as a relative response factor in other methods.

13.2.4.1 Internal standards are recommended in SW846-8270. These internal standards are: 1,4-Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12}, and Perylene d_{12}. In addition, Benzo[a]anthracene d_{12} is added when the samples are analyzed for PAHs in selected ion monitoring (SIM) mode. The use of MS detectors makes internal standard calibration practical because the masses of the internal standards can be resolved from those of the target compounds even when chromatographic resolution cannot be achieved.

13.2.4.2 In preparing calibration standards for use with internal standard calibration, add the same amount of the internal standard solution to each calibration standard, such that the concentration of each internal standard is constant across all of the calibration standards, whereas the concentrations of the target analytes will vary. 5 uL of a solution containing the internal standards at a concentration of 2,000 ug/mL is added to each 500 uL of standard or sample extract. This results in an internal standard concentration of 20.0 ug/mL in the extract. For SIM+SCAN analysis the internal standard solution is at 1,000 ug/mL resulting in a concentration of 10.0 ug/mL in the extract, except for Benz[a]anthracene-d12 which is at half of this concentration (500 ug/mL in the IS solution, 5.0 ug/mL in the extract. The mass of each internal standard added to each sample extract immediately prior to injection into the instrument must be the same as the mass of the internal standard in each calibration standard. The volume of the solution spiked into sample extracts is such that minimal dilution of the extract occurs (e.g., 5 ul of

solution added to a 500 ul final extract results in only a negligible 0.1% change in the final extract volume which can be ignored in the calculations).

13.2.4.3 An ideal internal standard concentration would yield a response factor of 1 for each analyte. However, this is not practical when dealing with more than a few target analytes. Therefore, as a general rule, the amount of internal standard shall produce an instrument response (area counts) that is no more than 100 times that produced by the lowest concentration of the least responsive target analyte associated with the internal standard. This results in a minimum response factor of approximately 0.01 for the least responsive target compound.

13.2.5 For each of the initial calibration standards, calculate the RF values for each target compound relative to one of the internal standards as follows;

$$RF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

A_s = Peak area of the analyte or surrogate.

A_{is} = Peak area of the internal standard.

C_s = Concentration of the analyte or surrogate in ug/mL.

C_{is} = Concentration of the internal standard in ug/mL.

13.2.6 Linear calibration using the average response factor. Response factors are a measure of the slope of the calibration relationship and assume that the curve passes through the origin. Under ideal conditions, the factors will not vary with the concentration of the standard that is injected into the instrument. In practice, some variation is to be expected. However, when the variation, measured as the relative standard deviation (RSD), is less than or equal to 15%, the use of the linear model is generally appropriate, and calibration curve can be assumed to be linear and to pass through the origin. To evaluate the linearity of the initial calibration, calculate the RF, the standard deviation, and the relative standard deviation.

$$\text{Mean RF} = \overline{RF} = \frac{\sum_{i=1}^{n} RF_i}{n}$$

$$SD = \sqrt{\left(\frac{\sum_{I=1}^{n} (RF_I - \overline{RF})^2}{n-1}\right)}$$

$$RSD = \frac{SD}{\overline{RF}} \times 100$$

13.2.7 The average response factor (ARF) for all calibration levels is used when determining sample concentration and is calculated (along with the standard deviation) to evaluate the linearity of the curve (SW-846 Method 8000C sec. 11.5). When ARFs are not acceptable, results are sometimes calculated using linear (1st order) regression curves and/or quadratic (2nd order) curves. Internal standard quantitation is also used when generating linear and non-linear calibrations. All equations and acceptance criteria follow the examples in SW-846, Method 8000C (sec. 11.5).

13.2.8 Linear Calibration: If the RSD of the calibration factor is greater than 15% over the calibration range, then linearity though the origin cannot be assumed. If this is the case, the analyst can employ a regression equation that does not pass through the origin. This approach can also be employed based on the past experience of the instrument response. The regression will produce the slope and intercept terms for a linear equation in the form:

$$y = mx + b$$

y = instrument response (peak area or height)
m = Slope of the line
x = Concentration of the calibration standard
b = The intercept

13.2.9 The use of origin (0,0) as a calibration point is not allowed. However, most data systems and many commercial software packages will allow the analyst to "force" the regression through zero. This is not the same as including the origin as a fictitious point in the calibration. It can be appropriate to force the regression through zero for some calibrations (SW-846 Method 8000C sec. 11.5.2.1). The use of linear regression cannot be used as a rationale for reporting results below the calibration range.

13.2.10 Non-Linear Calibration: In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches described here have not met the acceptance criteria, a non-linear calibration model can be employed. When using a calibration model for quantitation, the curve must be continuous, continuously differentiable and monotonic over the calibration range. The model chosen shall have no more than four parameters, i.e., if the model is polynomial, it can be no more than third order as in the equation:

$$y = ax^3 + bx^2 + cx + d$$

13.2.11 The statistical considerations in developing a non-linear calibration model require more data than the more traditional linear approaches described above. Linear regression employs five calibration standards for the linear model, a quadratic model requires a minimum of six calibration standards. The coefficient of determination (COD) is calculated as follows:

$$\text{n} \quad \_\_ \quad \text{n-1} \quad \text{n}$$

$$COD = \frac{\sum_{i=1} (y_{obs} - y)^2 - \left(\frac{\sum_{i=1} (y_{obs} - Y_i)^2}{n-p} \right)}{\sum_{i=1}^{n} (y_{obs} - \bar{y})^2}$$

y_{obs} = Observed response (area) for each concentration of the calibration curve.

$\bar{y}$ = Mean observed response from the initial calibration.

Y_I = Calculated response at each concentration from the initial calibrations.

n = Total number of calibration points (6 points for quadratic equation).

p = Number of adjustable parameters in the polynomial.

13.2.12 Under ideal conditions, with a "perfect" fit of the model to the data, the coefficient of the determination will equal 1.0 In order to be an acceptable non-linear calibration, the COD must be greater than or equal to 0.99. Weighting in a calibration model can significantly improve the ability of the least squares regression to fit the data calibrations (SW-846 Method 8000C sec. 11.5.3).

13.3 Calibration Criteria

13.3.1 Before analysis of any samples or standards can begin, the GC/MS system must be hardware tuned so a 25 ng injection of Decafluorotriphenylphosphine (DFTPP) passes the tuning criteria listed in Table 3. These criteria must be demonstrated each 12-hour shift during which samples are analyzed.

13.3.2 To acquire the mass spectrum of DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction to eliminate column bleed or instrument background noise is accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP.

13.3.3 The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD must not exceed 20%. Benzidine and Pentachlorophenol shall be present at their normal responses and peak tailing shall be evaluated. Benzidine and Pentachlorophenol must have tailing factors less than 2.

13.3.4 Calibration Standards - Calibration standards are prepared at a minimum of five concentration levels and are prepared from the intermediate stock standards. One of the concentration levels shall be at a concentration near, but above, the detection limit and at or below the reporting limit. The remaining concentration levels shall correspond to the expected range of concentrations found in real samples and shall contain each analyte for detection by this method. If the measured relative standard deviation (RSD) is less than or equal to 15%, the use of the linear model is generally appropriate, and calibration curve can be assumed to be linear and to pass through the origin. Linear Calibration: If the RSD of the calibration factor is

greater than 15% over the calibration range, then linearity though the origin cannot be assumed. In this case, the analyst can employ a regression equation that does not pass through the origin. This approach can also be employed based on the past experience of the instrument response. The regression will produce the slope and intercept terms for a linear equation. In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches described here have not met the acceptance criteria, a non-linear calibration model can be employed. When using a calibration model for quantitation, the curve must be continuous, continuously differentiable and monotonic over the calibration range.

13.3.5 System Performance Check Compounds (SPCC) are part of the initial calibration and the continuing calibration verification standard (CCV). A CCV must be made during each 12 hour shift. The SPCCs in the CCV must meet a minimum response factor of 0.050. The SPCCs criteria also apply to the average response factor of the initial calibration curve.

13.3.6 Calibration Check Compounds (CCC) are part of the Initial calibration and the continuing calibration verification standard (CCV). In the initial calibration curve, the percent RSD of the CCCs must be less than or equal to 30%. A CCV must be analyzed during each 12 hour shift. The CCCs in the CCV must have a percent drift less than or equal to 20%.

13.3.7 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standard involves the analysis of all target analytes each time the initial calibration is performed. The SPCCs must meet minimum response factor of 0.050. The percent drift of the CCCs must be less than or equal to 20%.

13.3.8 Calibration Verification Standard (CCV): A standard solution that is used to check the validity of a calibration curve on a daily basis. It also provides information on satisfactory maintenance and adjustment of the instrument during sample analysis. The SPCCs must meet minimum response factor of 0.050. The percent difference of the CCCs must be less than or equal to 20%.

13.3.9 The relative retention time (RRT) of each compound in each calibration standard shall agree within 0.06 RRT units.

14.0 Procedure

14.1 Water Extraction (Method SW-846,3510)

14.1.1 Pre-rinse all glassware to be used in the extraction with methylene chloride (Pesticide Grade).

14.1.2 Mark the meniscus on the bottle for later determination of sample volume (see sec. 11.1). From the glass sample collection bottle, quantitatively transfer sample into a 2 liter separatory funnel.

14.1.3 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare each by adding one liter of Milli-Q water to a 2

liter separatory funnels.

14.1.4 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). In order of preference:

1) Select the sample where two full volume extra matrix was provided; use the extra volume supplied for a full volume MS and MSD.

2) Select a sample where one extra sample bottle was provided; quantitatively transfer half of the extra sample into a 2 liter separatory funnel and label MS. Transfer the other half of the sample into another 2 liter separatory funnel and label MSD.

3) Select a sample where no extra sample but the amount of sample used is 1/3 of the normal volume; quantitatively transfer 1/3 of the sample into a separatory funnel, 1/3 into a second separatory funnel and label MS, and lastly transfer the last 1/3 of the sample into another separatory funnel and label MSD.

For the last two situations concerning sacrificing a sample volume versus the inability to run a MS/MSD contact the project manager for proper procedure.

14.1.5 Check and adjust the pH to <2 by with 1:1 sulfuric acid.

14.1.6 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the surrogate standard mix by using a 1.0 ml syringe. In addition, add 1.0 mL of the 8270 spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.1.7 Add 60 mLs of methylene chloride to the sample's separatory funnel. Extract the sample shaking vigorously for two minutes, venting frequently.

14.1.8 Allow the organic layer to separate from the water phase for a minimum of 10 minutes. Decant the lower layer into a 500 ml beaker. If the emulsion interface between layers is more than one-third the size of the solvent layer, the analyst must employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample and can include stirring, filtration of the emulsion through glass wool, centrifugation, or other physical methods. Check sample pH to insure acidic conditions.

14.1.9 Repeat the extraction two more times using fresh 60 mL portions of methylene chloride

14.1.10 After the third extraction of the acidified sample, adjust the pH >12 with 10N sodium hydroxide

14.1.11 Repeat steps 14.1.7 through 14.1.9

14.1.12 Determine the sample volume by filling the sample bottle to the mark (14.1.2) with water and transferring it to a "Class A" 1 liter graduated cylinder for

measurement. Note all sample volumes on the extraction bench sheet (see Table 6)

14.1.13 Record all lot numbers, prepping analyst, times and dates on prep bench sheet (see Table 6)

14.1.14 Refer to section 14.5 for sample concentration

14.2 **Soil Extraction (Method SW-846, 3545) ASE Extraction**

14.2.1 Preparing the extraction cell for use: Wash extraction tube with soap and DI water, rinse with methanol. Then dip extraction tube in Methylene chloride to remove any remaining residue. Rinse caps with Methanol, place in 100°C oven overnight, cool and sonicate; first in Acetone for 20 minutes and then in Methylene Chloride for 20 minutes. Attach the matching screw fit tube cap of the soil extraction vessel to the end of the tube. Using a filter rod, push 1 Dionex ASE filter through the open end of the tube until they reside flush on the bottom of the screwed end.

14.2.2 Decant and discard any water layer on a sediment sample. Mix sample thoroughly, especially composite samples. Discard any foreign objects such as sticks, leaves, and rocks.

14.2.3 Dry sediment/soil and dry waste samples amenable to grinding: Grind or otherwise reduce the particle size of the waste so that it either passes through a 1mm sieve or can be extruded through a 1mm hole. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make sample more amenable to grinding.

14.2.4 Gummy, fibrous, or oily materials not amenable to grinding shall be cut, shredded, or otherwise reduced in size to allow mixing and maximum exposure of the sample surfaces for the extraction. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make sample easier to mix. Wipe samples can be placed directly into the cells.

14.2.5 (Refer to SOP FO-10 for subsampling guidance). Weigh approximately 10 g of sample to the nearest 0.01 g into a 250-mL beaker and record the final weight on prep bench sheet (see table 6). Add 2.5 g of diatomaceous earth to the sample. Mix well. The samples shall be a free flowing powder. If sample is not free flowing add more diatomaceous earth until the sample has a dry texture. This powder is so mixed that it will allow the sample to pass through a 2 mm sieve.

14.2.6 Transfer the ground sample to an extraction cell of appropriate size for the aliquot.

14.2.7 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare by adding 10g of sand and 2.5g of diatomaceous earth to a clean 250 ml beaker. Transfer sample to extraction cell.

14.2.8 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). Select the

sample and transfer approximately 40 grams to a 250 ml beaker. Mix well. Weigh three individual 10 grams aliquots of sample. Add drying agent. Transfer each 10 gm aliquot to separate sample extraction cells. If there is no sample available to perform a matrix spike/matrix spike duplicate, contact project management. The default QC is a laboratory control spike duplicate.

14.2.9 Fill the void in each of the extraction cells with clean sand. (Dionex Operator's Manual 3-6.3).

14.2.10 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the 8270 surrogate standard solution by using a 1.0 ml syringe. In addition, add 1.0 mL 8270 spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.2.11 Attach the other cap to the other end of the extractor cell, making sure the tube is sitting flush on a hard surface so that no particulates get caught in the threads of the tube cap.

14.2.12 Place the extractor tube, filtered end down, on the Dionex ASE top wheel. Place an appropriately labeled empty 60 mL VOA collection vial on the matching position on the bottom wheel. Schedule the Dionex ASE 200 and begin the cycle.

14.2.13 Record all lot numbers, prepping analyst, times and dates on prep bench sheet (see Table 6)

14.2.14 Refer to section 14.5 for sample concentration.

14.3 **Soil Extraction (Method SW-846, 3546) Microwave extraction**

14.3.1 Preparing the extraction tubes for use: extraction tubes, caps and plugs are washed in the dishwasher, rinsed with Methanol and baked in 110 C oven for 1 hour. After they have cooled, rinse the extraction cell (tubes, plugs and caps) with Methylene chloride.

14.3.2 Decant and discard any water layer from sediment sample. Mix sample thoroughly, especially composite samples. Discard any foreign objects such as sticks, leaves, and rocks.

14.3.3 Dry sediment/soil and dry waste samples amenable to grinding: Grind or otherwise reduce the particle size of the waste so that it either passes through a 1-mm sieve or can be extruded through a 1-mm hole. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make the sample more amenable to grinding. Dry samples as much as possible, as water will cause un-even heating of the tubes.

14.3.4 Gummy, fibrous, or oily materials not amenable to grinding, shall be cut, shredded, or otherwise reduced in size to allow mixing and maximum exposure of the sample surfaces for the extraction. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make the sample easier to mix. Wipe samples can be placed directly into the cell.

14.3.5 Weigh approximately 10 g of sample to the nearest 0.01 g in a 250-mL beaker and record the final weight on prep bench sheet (see table 6). Add 2.5 g of diatomaceous earth to the sample. Mix well. The samples shall be a free flowing powder. If sample is not free flowing, add more diatomaceous earth and/or sodium sulfate until the sample has a dry texture. This powder is mixed so that it will allow the sample to pass through a 1 mm sieve.

14.3.6 Transfer the ground sample in a 75 mL extraction cell. There should be a minimum head space of 25%.

14.3.7 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare by adding 10g of sand and 2.5g of diatomaceous earth to a clean 250 ml beaker. Transfer sample to extraction cell.

14.3.8 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). Select the sample and transfer approximately 40 grams to a 250 ml beaker. Mix well. Weigh three individual 10 grams aliquots of sample. Add drying agent. Transfer each sample aliquot to separate extraction cells. If there is no sample available to perform a matrix spike/matrix spike duplicate, contact project management. Default QC is a laboratory control spike duplicate.

14.3.9 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the 8270 surrogate standard mix by using a 1.0 ml syringe. In addition, add 1.0 mL of the 8270 spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.3.10 Add 20 ml of (1:1) methylene chloride: acetone extraction solution to each tube. Insert tube plug and attach the cap to the extractor cell, making sure the cap is straight, screw on and torque with wrench. **Shake each tube for 30 seconds to ensure the soil is mixed with the extraction solvent.**

14.3.11 Place the extractor tube on the carousel in the appropriate slots for the number of tubes being used. Less than 16 use inside ring, greater than 16, use the outside ring then fill in the inside ring. Schedule CEM Mars and begin the cycle. (NOTE: There must be a minimum of 8 samples, if less, use sand/solvent blanks to make up the shortage.)

14.3.12 Record all lot numbers, prepping analyst, times and dates on prep bench sheet (see Table 6)

14.3.13 Samples need to be shaken for 30 seconds to ensure sample residue is removed from tube wall prior to being poured out for concentration. Refer to section 14.5 for sample concentration.

14.4 **Waste Dilution Extraction (SW846-3580)**

14.4.1 (Refer to SOP FO-10 for subsampling guidance). Samples consisting of multiphase separations.

14.4.2 Pre-rinse "Class A" 10 ml volumetric with Methylene chloride.

14.4.3 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD).

14.4.4 Place the 10 ml volumetric on analytical balance (capable of accurately recording weight to the 0.001 g). Using a Pasteur pipet, transfer 1.0 g (to the nearest 0.1 g) to the volumetric. Record the weight on bench sheet (see table 6).

14.4.5 Fill the volumetric half way with methylene chloride.

14.4.6 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the surrogate standard mix by using a 1.0 ml syringe. In addition, add 1.0 mL of the 8270 spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.4.7 Bring samples up to volume with methylene chloride and cap for storage.

14.4.8 Add 2.0 grams of conditioned sodium sulfate to a 15ml amber vial with a Teflon cap. Transfer sample from the 10 ml volumetric flask to the 15ml vial.

14.4.9 Record all lot numbers, prepping analyst, times and dates on prep bench sheet (see Table 6)

14.4.10 Shake sample for two minutes.

14.4.11 Loosely pack disposable Pasteur pipets with 2-3 cm glass wool plugs. Filter the extracts through the glass wool and collect 5ml of the extract in a tube or vial.

14.4.12 No concentration step is need for this extraction. Sample will potentially require cleanup prior to analysis. Refer to attachment 1, 2, and 3 for sample cleanup options.

14.5 **Sample Concentration**

14.5.1 Place glass microfiber filter paper into a glass funnel. Fill the filter paper two-thirds of the depth with Na_2SO_4. Rinse filter paper, Na_2SO_4, funnel, K-D apparatus, and concentrator tube with methylene chloride.

14.5.2 Quantitatively pour the extract through the filter and funnel seated on a 500 ml Kuderna-Danish (K-D) for water samples or a 250mL Kuderna-Danish (K-D) for soil samples, apparatus complete with concentrator tube. For Microwave extraction, shake tube for 30 seconds then pour both the extraction solution and sample matrix from the microwave tube into the funnel and filter paper seated on the K-D apparatus, being careful to not allow the extract to splash out of the funnel as the sample matrix pours into it. Rinse the beaker, VOA vial or Microwave tube three times with methylene chloride. Add these rinses through the filter and funnel into the K-D apparatus. Add a boiling chip to the K-D flask

prior to placing it on the heated water bath. Wet a three ball Synder column with approximately 2-mL of methylene chloride. Attach the Synder column.

14.5.3 Place the K-D in the heated water bath so the concentrator tube is immersed in the water and the lower rounded surface of the K-D is bathed in steam. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood (set the knob of the temperature control to ~5 or 60ºC). It is critical that the analyst watch the extract as it distills. THE EXTRACT MUST NOT GO TO DRYNESS.

14.5.4 When the extract volume reaches approximately 5-7 mL, remove the K-D from the bath. Slightly tilt the apparatus and rotate to aid in solvent drainage from the Snyder column. Allow it to cool completely

14.5.5 Remove the Snyder column, rinse the ground glass joints with a small amount of methylene chloride and then remove the K-D flask. Turn on the heating unit for the Organomation. The water bath shall be about 35ºC. Place sample concentrator tube into the nitrogen blow down apparatus. Allow a gentle stream of nitrogen to interact with the extract. There shall be no splashing or excessive movement upon the surface of the extract. Allow the extract to evaporate down to 0.8 ml. Remove concentrator tube from water bath and by using a Pasteur pipet, bring sample extract up to 1.0 ml volume with methylene chloride.

14.5.6 Transfer the 1 mL of the extract to a labeled amber screw-cap injection vial. Record the final extract on the injection extraction bench sheet (see table 6).

14.5.7 Record all lot numbers, prepping analyst, times and dates on prep bench sheet (see Table 6)

14.5.8 The sample extract is now ready for analysis. If samples are not analyzed immediately store the sample extract in a freezer.

14.5.9 Sample will potentially require cleanup prior to analysis. Refer to attachment I.

15.0 Data analysis and Calculations

15.1 Sample Sequence

15.1.1 It is highly recommended that sample extracts be screened on a GC/FID to protect the GC/MS system from unexpectedly high concentrations of organic compounds.

15.1.2 Allow the sample extract to warm to room temperature. Just prior to analysis, add 5 ul of the internal standard solution to 0.5 ml of the concentrated sample extract obtained from sample preparation. Alternatively, 2 uL of internal standard solution is added to 0.2 mL of sample extract in a vial insert.

15.1.3 Before initial calibration or sample analysis a priming standard can be injected at a level up to twice the highest linearity point.

15.1.4 Before analysis of any samples or standards can begin, the GC/MS system must be hardware tuned so an injection (50 ng or less) of

Decafluorotriphenylphosphine (DFTPP) passes the tuning criteria listed in Table 3. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD must not exceed 20%. Benzidine and Pentachlorophenol shall be present at their normal responses and peak tailing evaluated. Benzidine and Pentachlorophenol must each have tailing factors less than 2. These criteria must be demonstrated each 12-hour shift during which samples are analyzed.

15.1.5 Verify calibration each twelve hour shift by injecting a Continuing Calibration Verification standard (CCV), containing target analytes, prior to conducting any sample analysis. A CCV must be injected at the begining of each twelve hour shift following the DFTPP tune. The SPCCs must meet a minimum response factor of 0.050. The percent drift of the CCCs must be less than or equal to 20%. If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid. Due to the large number of compounds that are analyzed by this method, it is expected that some compounds will fail to meet the criterion. In cases where compounds fail, they can still be reported as non-detects if it can be demonstrated that there was adequate sensitivity to detect the compound at the applicable quantitation limit. For situations where the failed compound is present, the concentrations must be reported as estimated values.

15.1.6 The internal standard responses and retention times in the CCV standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the last calibration check, the chromatographic system must be inspected for malfunctions and corrections must be made, as required. If the extracted ion chromatographic profile area for any of the internal standards changes by a more than a factor of two (-50% to +100%), when compared to the CCV level from the calibration, then the mass spectrometer must be inspected for malfunctions and corrections must be made. Reanalysis of CCVs and associated samples while the system was malfunctioning is necessary. The retention times and standard reference spectra in the method are updated from the CCV for each 12 hour sequence.

15.1.7 Samples can be directly injected after the successful analyses of the initial calibration curve, ICV, DFTPP, and CCV. There can be up to 20 samples in an analytical batch. A matrix spike/matrix spike duplicate and laboratory control spike must be analyzed with every analytical batch. Recoveries shall be compared to laboratory generated QC limits or client specified limits for all surrogate, matrix spike/matrix spike duplicate and laboratory control spike injections. Some sample extracts will potentially require clean-up procedures. Refer to attachment I.

15.2 Sample Calculations

15.2.1 Re-arranging the equation from sec. 10.1.5 to calculate the "as-analyzed" value yields: $A_s \times C_{is}$

$$C_s = \frac{A_s}{A_{is} \times RF}$$

RF = Average Response Factor

A_s = Peak area of the analyte or surrogate.

A_{is} = Peak area of the internal standard.

C_s = Concentration of the analyte or surrogate in ug/mL.

C_{is} = Concentration of the internal standard in ug/mL.

15.2.2 Once the target components of the extract have been identified and quantitated, the "as-analyzed" value is converted to the "as-received" concentration as follows:

Water Matrix:

$$\frac{(ug/mL\ injected) \times (mL\ extract\ \ final\ volume) \times (dilution factor)}{(volume\ of\ \ sample\ extracted, in\ L)} = \mu g/L$$

Soil Matrix:

$$\frac{(ug/mL\ injected) \times (mL\ extract\ \ final\ volume) \times (dilution factor)}{(weight\ of\ \ sample\ extracted, in\ g)} = ug/g$$

16.0 Method Performance

16.1 Certified standard solutions, properly maintained instrumentation, and analyst experience and expertise are critical elements in producing accurate results. Standards and instrument performance are continually checked by analyzing external performance test samples provided by the appropriately accredited agencies. Internal blind spikes are also utilized to check analyst performance.

16.2 Initial demonstration of capability (IDC) is another technique used to ensure acceptable method performance. An analyst must demonstrate initial precision and accuracy through the analysis of 4 laboratory control spikes for each matrix and sample type. After analysis, the analyst calculates the average recovery (x) in µg/L and the relative standard deviation (RSD) of the recovery 8270 target compounds. In addition to each set of IDCs, a blind laboratory spike will be performed. In the absence of specific criteria found in the SW-846 methods or project specific limits, the default criteria of 70-130% recovery and 20 % RSD are used until internal limits are generated (Method 8000, sec. 8.4.9).

16.2.1 The procedure for the preparation of IDCs is found in SOP FO-11.

16.3 Many programs (i.e. USACOE) require the analysis of method reporting limit (MRL) standards and method detection limit (MDL) check samples as another means of checking method performance. The MRLs are analyzed at the beginning and end of each 12 hour shift and are typically prepared at concentrations equal to the lowest standard on the calibration curve. Recovery limits are program specific but are usually set at 70-130%. The MDL check sample is usually spiked at approximately 2x the method detection limit. The MDL check sample is analyzed quarterly (as a minimum) to confirm instrument sensitivity (e.g. to verify that the method detection limits are still achievable). The MDL check samples are taken through all preparation and extraction steps used for actual samples (e.g. spiking/preserving control sand for soil samples). In most instances, a method detection limit check sample is analyzed at the end of each sequence requiring an MRL standard. The recovery criteria for

MDL check samples are the ability to detect all compounds. If any given compound is not detected, the MDL check is spiked at a higher level and analyzed again. Detection limits for those compounds not detected on the initial MDL check analysis need to be raised to match the MDL check analysis at which they were detected. For some programs (i.e. LCG) the MDL check that is analyzed after an MRL standard is not extracted.

16.4 Creating and monitoring control charts is also important for maintaining and improving method performance. Currently all SURR, MS, MSD, and LCS recoveries are monitored with the use of the LIMS system. Note: Information on in-house recovery limits and RPDs are generated through StarLIMS. The information tables are stored in H:\Quality Systems\QC\charting. The data collected is used to recognize trends in recovery performance, as well as for generating new in-house QC limits. Default accuracy limits of 70-130 % recovery and a precision limit 20 % RSD are used until enough data points are generated to provide usable internal limits. Client and/or Project specific limits are also used frequently in sample analyses. The Quality Control Requirements chart (Table 4) also lists recovery limits specific to the method/project/program.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Whenever feasible, laboratory personnel shall use pollution prevention techniques to address their waste generation.

17.2 The quantity of chemicals purchased shall be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes shall reflect anticipated usage and reagent stability.

18.0 Data Assessment & Acceptance Criteria for QC Measures

18.1 If the response for any quantitation ion exceeds the initial calibration range of the GC/MS, the sample extract must be diluted and reanalyzed. Additional internal standards must be added to the diluted extract to maintain the same concentration as in the calibration standards.

18.1.1 Samples suspected of containing high levels of contamination or samples with known historical data may need to be diluted prior to analysis. Multiple dilutions may be needed to cover the entire working range of the current calibration.

18.2 The qualitative identification of compounds determined by this method is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method (SW-846-8270). The mass spectral library is updated with each new calibration and is continually updated with the mass spectra from CCVs. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. Compounds are identified when the following criteria are met.

18.2.1 The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a

target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

18.2.2 The relative retention time (RRT) of each compound in each calibration standard agree within 0.06 RRT units.

18.2.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

18.2.4 Structural isomers that produce very similar spectra are identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomeric peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. Diastereomeric pairs that are separable by the GC are identified, quantitated and reported as the sum of both compounds by the GC.

18.2.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra are important. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra and in qualitative identification of compounds. When analytes co elute (i.e., only one chromatographic peak is apparent), the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the co eluting compound.

18.3 For samples containing components that are not a part of the normal target list, a library search may be required for the purpose of tentative identification. Tentatively identified compounds (TICs) are needed only when requested or required by a particular project or program. Data system library search routines shall not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Use the following as guidance for reporting TICs.

18.3.1 Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) shall be present in the sample spectrum.

18.3.2 The relative intensities of the major ions agree within ± 30%.

18.3.3 Molecular ions present in the reference spectrum shall be present in the sample spectrum

18.3.4 Ions present in the sample spectrum but not in the reference spectrum shall be checked for possible background contamination. They shall also be reviewed for possible co elution with another compound.

18.3.5 Ions present in the reference spectrum but not in the sample spectrum shall be checked against the possibility of subtraction from the sample spectrum due to background contamination or co-eluting peaks. Some data reduction programs can create these discrepancies

18.4 Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary characteristic ion from the extracted ion chromatographic profile. Quantitation is performed by the data system using the internal standard technique. The internal standard used shall be the one listed in Table 1.2. Quantitation is performed using the RF averages from the initial calibration and not the continuing calibration check (CCV).

18.4.1 Where applicable, the concentration of any non-target analytes (TICs) identified in the sample shall be estimated. The same formulas that are used for targe comounds are used with the following modifications: The areas A_x and A_{is} are from the total ion chromatograms, and the RF for the compound is assumed to be one.

18.4.2 The resulting TIC concentration is reported indicating: (1) that the value is an estimate, and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

18.5 **Reporting Quantitative Analysis**

18.5.1 When the analysis of an analytical batch or sequence has been completed, the data is processed and prepared for reporting. Once the standard retention times and mass ions are compared to the sample retention times, the sample data can be reported. Assessments of all spiked and calibration control samples and standards shall also be finalized before reporting the data.

18.5.2 When the analyst has finished processing the analytical batch, the results are electronically transferred to the LIMS system where weight to volume corrections, dilution factors and percent solids adjustments are made. Once the final results have been verified, a checklist (Table 4) is filled out and signed confirming that all the data has been thoroughly scrutinized. At this point the data is turned over to another qualified analyst for final validation. The second analyst confirms the results and electronically marks them validated and signs the checklist. Finally, the validated results are made available to the client services personnel in order for the data to be given to the client or appropriate agencies.

18.5.3 An electronic copy of the data is then filed and archived. The package includes; the sequence run log, checklist, bench sheet copy, the LIMS run log, verification of calibration data and chromatograms/quant reports. All the data is e-initialed and dated by the analyst. Each sequence file header is labeled with the date of sequence.

19.0 Corrective Measures for Out-of-Control Data

When data is out of control, a number of corrective actions may need implementing. If the nonconformities involve failing QC within the analytical sequence batch, then reanalysis of samples may eliminate any out of control data. If the out of control data is the result of instrument malfunctions, then maintenance or repair of the downed instrument followed by reanalysis of affected data may correct the problem. If sample matrix affect or contamination is the reason for poor data, the instrument may need cleaning and decontamination, and the sample may need diluting to reduce matrix affect. In all cases, when out of control data presents itself, the appropriate corrective measures need to be enacted to eliminate unusable data. The Quality Control Requirements chart can be used as a guide as to which corrective actions are to be taken for different QC-type failures or nonconformities (Table 4).

20.0 Contingencies for Handling Out-of-Control or Unacceptable Data

20.1 Due to limited sample volume, expiration of hold times, downed instrumentation, and analyst error, the sample data has the potential to be out of control or unacceptable to report. Since these potential instances can arise, contingency plans need to be in place to prevent and/or minimize their effect on data.

20.2 The first thing addressed is prevention of producing unacceptable data. When limited sample volume is the issue, the analyst shall determine if splitting the sample into lesser volumes or weights is an option. To avoid sample hold time issues, the analyst's first responsibility is to plan accordingly. The analyst is responsible for budgeting enough time for sample analysis, so if a problem arises, reanalysis is an option. Loss of data due to downed or malfunctioning instrumentation can be addressed with the use of backup instrumentation. If an instrument becomes unusable, the samples shall be analyzed on a different instrument system. Analyst error is prevented by a second analyst confirmation and validation. If the initial analyst makes an analysis error or inadvertently reports unacceptable data, the second analyst is responsible for finding and/or correcting those errors

20.3 When out of control or unacceptable data is produced and it is too late for corrective measures, a number of actions can be taken. The first and foremost is alerting the client service personnel of the problem. Client services will inform the client and/or responsible parties. In some instances, more sample can be made available or re-sampling can occur, so it is important to alert the appropriate personnel as soon as possible.

20.4 If the out of control data affects only specific analytes, it is important to let the appropriate person(s) know in case his or her site assessment is based on a specific target analyte list.

20.5 In all instances, if results are reported from data that is out of control or unacceptable, that data must be qualified accordingly. Once the client has been notified and he or she instructs us to report the data, then flag the data indicating what type of nonconformity has occurred.

20.6 Out of control data is still retained by the laboratory and filed and archived along with acceptable data. The file folder shall be labeled as such, indicating that the data is out of control.

20.7 A non-conformance/corrective action report (CAR) form must be filled out whenever these types of events occur. The information on the report includes the problem encountered, planned corrective actions, and corrective action follow-up. The form is then discussed with and signed by the analyst, the client representative, the QA officer, and the laboratory manager. The purpose of the form is to document problems in order to eliminate the possibility of repeating nonconformance and to ensure that the proper corrective actions are employed.

21.0 Waste Management

Samples are routinely held (refrigerated) for up to six weeks from analysis date before they enter the waste stream. Waste disposal of samples and standards follows the procedures documented in the Laboratory Waste Disposal SOP (Quality Assurance Section, SOP NO. FO-8, Rev. 4).

22.0 Equipment/Instrument Maintenance, Computer Hardware & Software & Troubleshooting

22.1 All maintenance and troubleshooting is documented in a Maintenance Logbook designated

for a particular instrument setup. Documentation shall include problem encountered and corrective action or maintenance performed (including replacement of parts). If outside service is required a copy of the maintenance invoice is to be included in the Maintenance Logbook. Date of maintenance or repair along with analyst initials is also documented.

22.1.1 Check the specific instrument's Maintenance Logbook to determine if the current problem has occurred in the past. If the problem has previously occurred, the workaround or fix should have been documented. Follow the instructions for repairing the problem, document and proceed with the analysis.

22.1.2 If review of the Maintenance Logbook yields no resolution to the problem, review the specific instrument/software manual for repair/ workaround options. If a solution is presented in the manual, proceed with the repair, document in the Instrument Run/Maintenance log book and continue with the analysis.

22.1.3 If neither the Maintenance Logbook nor the specific instrument/software manual results in a solution to the problem, contact your supervisor for help in resolving the issue. This may involve contacting the vendor. Refer to the specific instrument/software manual for contact information.

22.2 Troubleshooting – Computers

22.2.1 Computers cannot be diagnosed or repaired in the laboratory. If it has been previously determined that the current problem cannot be resolved with a hardware or software fix, contact your IS representative for repair or replacement. Document the problem resolution in the Instrument Maintenance log book.

23.0 References

23.1 USEPA, SW-846, Method 8000C, Rev. 3, March 2003.
23.2 USEPA, SW-846, Method 8270C, Rev. 3, December 1996.
23.3 USEPA SW-846, Method 3510C, Rev 3, December 1996.
23.4 USEPA SW-846 Method 3545A, Rev 1, February 2007.
23.5 USEPA SW-846 Method 3546, Rev 0, February 2007.
23.6 USEPA SW-846 Method 3580, Rev 1, July 1992
23.7 USEPA SW-846 Method 3640A, Rev 1, September 1994.
23.8 USEPA SW-846 Method 3650B, Rev 2, December 1996.
23.9 USEPA SW-846 Method 3620C Rev 3, February 2007.
23.10 USEPA SW-846 Method 3630C Rev 3, December 1996.
23.11 Department of Defense, Quality Systems Manual for Environmental Laboratories, DoD Environmental Data Quality Workgroup, Department of Navy, Lead Service, Based on NELAC Voted Revision 5 June 2003, Version 4.1, April 22,2009.
Louisville Chemistry Guideline (LCG), US Army Corps of Engineers-Louisville District, June 2002.

24.0 Tables, Diagrams, Flowcharts And Validation Data

Table 1.0
8270 Compound List
Codes (Tables 1):
S = Surrogates
I = Internal Standards
TM= Target Compounds
CCC= Calibration Check Compounds
SPCC= System Performance Check Compounds

Table 1.0						
PK#	***Compound Name***	***Retention Time***	***Relative RT***	***Primary Ion***	***Secondary Ion(s)***	***Code***
1	1,4-Dichlorobenzene d_4	3.881	1.00	152	115,78	I
2	N-Nitrosodimethylamine	2.011	0.52	74	42,43	TM
3	Pyridine	2.023	0.52	79	52	TM
4	2-Fluorophenol	2.736	0.70	112	64,57,92	S
5	Aniline	3.546	0.91	93	66,65	TM
6	Bis(2-chloroethyl) ether	3.614	0.93	93	95	TM
7	Phenol d_5	3.517	0.91	99	42,71,100	S
8	Phenol	3.529	0.91	94	65,66	CCC
9	2-Chlorophenol	3.659	0.94	128	130	TM
10	1,3-Dichlorobenzene	3.819	0.98	146	148,113	TM
11	1,4-Dichlorobenzene	3.901	1.01	146	148	CCC
12	1,2-Dichlorobenzene	4.066	1.05	146	148,113	TM
13	Benzyl alcohol	4.054	1.04	108	79,77,91	TM
14	Bis(2-chloroisopropyl) ether	4.216	1.09	45	121	TM
15	2-Methylphenol	4.194	1.08	108	107	TM
16	N-Nitrosopyrrolidine	4.350	1.12	100	41,42	TM
17	Acetophenone	4.367	1.13	105	77,51	TM
18	Hexachloroethane	4.466	1.15	117	201,199	TM
19	N-Nitrosodi-n-propylamine	4.381	1.13	70	42,130	SPCC
20	3 & 4-Methylphenol	4.398	1.13	108	107	TM
21	Naphthalene d_8	5.540	1.00	136	68,108,54	I
22	Nitrobenzene d_5	4.546	0.82	82	128,54,98	S
23	Nitrobenzene	4.572	0.83	77	123,65	TM
24	Isophorone	4.901	0.88	82	138	TM
25	2-Nitrophenol	4.992	0.90	139	109,65	CCC
26	2,4-Dimethylphenol	5.106	0.92	107	122,121	TM
27	Bis(2-chloroethoxy) methane	5.253	0.95	93	95,123,63	TM
28	2,4-Dichlorophenol	5.370	0.97	162	164,98	CCC
29	1,2,4-Trichlorobenzene	5.475	0.99	180	182,145	TM
30	Benzoic Acid	5.336	0.96	105	122,77,51	TM
31	Naphthalene	5.569	1.01	128	129,127	TM
32	4-Chloroaniline	5.680	1.03	127	129,65,92	TM
33	2,6-Dichlorophenol	5.677	1.02	162	164,98	TM
34	Hexachloropropene	5.688	1.03	213	211,215	TM
35	Hexachlorobutadiene	5.756	1.04	225	223,227	CCC
36	4-Chloro-3-methylphenol	6.262	1.13	107	144,142	CCC
37	2-Methylnaphthalene	6.353	1.15	141	142	TM

Table 1.0

PK#	*Compound Name*	*Retention Time*	*Relative RT*	*Primary Ion*	*Secondary Ion(s)*	*Code*
38	1-Methylnaphthalene	6.441	1.16	141	142	TM
39	Acenaphthene d_{10}	7.188	1.00	164	162,160	I
40	Hexachlorocyclopentadiene	6.504	0.90	237	235,272	SPCC
41	1,2,4,5-Tetrachlorobenzene	6.509	0.91	216	214,179	CCC
42	2,4,6-Trichlorophenol	6.623	0.92	196	198,200	TM
43	2,4,5-Trichlorophenol	6.651	0.93	196	198	TM
44	2-Fluorobiphenyl	6.694	0.93	172	171,170	S
45	2-Chloronaphthalene	6.774	0.94	162	127,164	TM
46	2-Nitroaniline	6.873	0.96	65	92,138,80	TM
47	Acenaphthylene	7.086	0.99	152	151,153	TM
48	Dimethylphthate	7.027	0.98	163	194,164	TM
49	2,6-Dinitrotoluene	7.063	0.98	165	89	TM
50	Acenaphthene	7.214	1.00	153	152	CCC
51	3-Nitroaniline	7.180	1.00	138	92	TM
52	2,4-Dinitrophenol	7.254	1.01	184	63,154	SPCC
53	Dibenzofuran	7.331	1.02	168	139	TM
54	2,4-Dinitrotoluene	7.339	1.02	165	89	TM
55	4-Nitrophenol	7.313	1.02	109	139,65	SPCC
56	2,3,4,6-Tetrachlorophenol	7.390	1.03	232	194,234,230	TM
57	2,3,4,6-Tetrachlorophenol	7.419	1.03	143	115,116	TM
58	Fluorene	7.558	1.05	166	165,167	TM
59	4-Chlorophenyl phenyl ether	7.561	1.05	204	206,141	TM
60	Diethyl phthalate	7.501	1.04	149	177,150	TM
61	4-Nitroaniline	7.592	1.06	138	108,92,139	TM
62	2,4,6-Tribromophenol	7.714	1.07	330	332,141,222	S
63	Phenanthrene d_{10}	8.140	1.00	188	94,80,187	I
64	4,6-Dinitro-2-methylphenol	7.603	0.93	198	51,105	TM
65	N-Nitrosodiphenylamine & Diphenylamine	7.643	0.94	169	168,167	CCC
66	Azobenzene & 1,2-Diphenylhydrazine	7.666	0.94	182	152,77	TM
67	4-Bromophenyl phenyl ether	7.868	0.97	248	250,141	TM
68	Hexachlorobenzene	7.902	0.97	284	142,249	TM
69	Pentachlorophenol	8.027	0.99	266	264,268	CCC
70	Phenanthrene	8.155	1.00	178	179,176	TM
71	Anthracene	8.186	1.01	178	176,179	TM
72	Carbazole	8.271	1.02	167	166,139	TM
73	Di-n-butyl phthalate	8.430	1.04	149	150,104	TM
74	Fluoranthene	8.748	1.07	202	101	CCC
75	Chrysene d_{12}	9.567	1.00	240	120,236,106	I
76	Benzidine	8.814	0.92	184	183,185	TM
77	Pyrene	8.868	0.93	202	100,101	TM
78	Terphenyl d_{14}	8.944	0.93	244	122,212,245	S
79	Butyl benzyl phthalate	9.217	0.96	149	91,206	TM
80	3,3-Dichlorobenzidine	9.541	1.00	252	254	TM
81	Benzo (a) anthracene	9.558	1.00	228	229,226	TM
82	Chrysene	9.581	1.00	228	226,229	TM

Table 1.0						
PK#	***Compound Name***	***Retention Time***	***Relative RT***	***Primary Ion***	***Secondary Ion(s)***	***Code***
83	Bis (2-ethylhexyl) phthalate	9.564	1.00	149	167,279	TM
84	Di-n-octyl phthalate	9.973	1.04	149	150	CCC
85	Perylene d_{12}	10.456	1.00	264	260,265,263,	I
86	Benzo (b) fluoranthene	10.223	0.98	252	253,125	TM
87	Benzo (k) fluoranthene	10.240	0.98	252	253,125	TM
88	Benzo (a) pyrene	10.422	1.00	252	253,125	CCC
89	Indeno (1,2,3-cd) pyrene	11.164	1.07	276	138	TM
90	Dibenz (a,h) anthracene	11.175	1.07	278	139,279	TM
91	Benzo (g,h,i) perylene	11.368	1.09	276	138,277	TM

Table 1.1
Additional Analytes

Table 1.1						
PK#	***Compound***	***Retention Time***	***Relative RT***	***Primary Ion***	***Secondary Ion***	***Code***
92	N-Nitrosodiethylamine	3.468	0.76	102	57,56	TM
93	2-Chloro-5-Methylphenol	5.360	0.87	107	142,77	TM
94	2,5-Dichlorophenol	6.045	0.98	162	164,63,99	TM
95	2,3-Dichlorophenol	6.085	0.98	162	126,63,164,	TM
96	3&4-Chlorophenol	6.176	1.00	128	130,65,100	TM
97	N-Nitroso-di-n-butylamine	6.627	1.07	57	84,41,99	TM
98	2-Methyl-4-Chlorophenol	6.661	1.08	107	142,77	TM
99	3,4-Dichlorophenol	7.343	0.96	162	164,99,63	TM
100	2,5-Dinitrophenol	7.579	0.99	184	63,53,39	TM
101	Pentachlorobenzene	7.787	1.01	250	251,252,108	TM
102	2-Naphthylamine	7.895	1.03	143	115,116	TM
103	Benzaldehyde	4.287	0.90	106	105,77	TM
104	Caprolactam	6.793	1.06	55	113,85	TM
105	Biphenyl	7.430	0.95	154	153,152	TM
106	Atrazine	8.518	0.98	200	215,58	TM
107	Benzo(a)anthracene-d12	10.329	1.00	240		I
108	o-Terphenyl-d14	8.550	0.83	244		S

Note: Retention time shifts can occur when instrument maintenance is performed.
Shifts in the retention times are reflected in the analytical method.

Table 1.2
Internal Standard For Each Target Compound

Table 1.2					
1,4-Dichlorobenzene d_4	**Naphthalene d_8**	**Acenaphthene d_{10}**	**Phenanthrene d_{10}**	**Chrysene d_{12}**	**Perylene d_{12}**
N-Nitrosodimethylamine	Nitrobenzene d_5	Hexachlorocyclopentadiene	4,6-Dinitro-2-methylphenol	Benzidine	Benzo (b) fluoranthene
Pyridine	Nitrobenzene	1,2,4,5-Tetrachlorobenzene	N-Nitrosodiphenylamine & Diphenylamine	Pyrene	Benzo (k) fluoranthene
2-Fluorophenol	Isophorone	2,4,6-Trichlorophenol	Azobenzene & 1,2-Diphenylhydrazine	Terphenyl d_{14}	Benzo (a) pyrene
Aniline	2-Nitrophenol	2,4,5-Trichlorophenol	4-Bromophenyl phenyl ether	Butyl benzyl phthalate	Indeno (1,2,3-cd) pyrene
Bis(2-chloroethyl) ether	2,4-Dimethylphenol	2-Fluorobiphenyl	Hexachlorobenzene	3,3-Dichlorobenzidine	Dibenz (a,h) anthracene
Phenol d_5	Bis(2-chloroethoxy) methane	2-Chloronaphthalene	Pentachlorophenol	Benzo (a) anthracene	Benzo (g,h,i) perylene
Phenol	2,4-Dichlorophenol	2-Nitroaniline	Phenanthrene	Chrysene	
2-Chlorophenol	1,2,4-Trichlorobenzene	Acenaphthylene	Anthracene	Bis (2-ethylhexyl) phthalate	
1,3-Dichlorobenzene	Benzoic Acid	Dimethylphthate	Carbazole	Di-n-octyl phthalate	
1,4-Dichlorobenzene	Naphthalene	2,6-Dinitrotoluene	Di-n-butyl phthalate		
1,2-Dichlorobenzene	4-Chloroaniline	Acenaphthene	Fluoranthene		
Benzyl alcohol	2,6-Dichlorophenol	3-Nitroaniline	Atrazine		
Bis(2-chloroisopropyl) ether	Hexachloropropene	2,4-Dinitrophenol			
2-Methylphenol	Hexachlorobutadiene	4-Nitrophenol			
N-Nitrosopyrrolidine	4-Chloro-3-methylphenol	2-Naphthylamine			
Acetophenone	2-Methylnaphthalene	Fluorene			
N-Nitrosodi-n-propylamine	1-Methylnaphthalene	4-Chlorophenyl phenyl ether			
3 & 4-Methylphenol	2-Chloro-5-methylphenol	Diethyl phthalate			
Hexachloroethane	2,5-Dichlorophenol	Dibenzofuran			
N-Nitrosodiethylamine	2,3-Dichlorophenol	2,4-Dinitrotoluene			
Benzaldehyde	3&4-Chlorophenol	4-Nitroaniline			
	N-Nitroso-di-n-butylamine	2,4,6-Tribromophenol			
	2-Methyl-4-chlorophenol	2,3,5,6-Tetrachlorophenol			
	Caprolactam	2,3,4,6-Tetrachlorophenol			
		3,4-Dichlorophenol			
		2,5-Dinitrophenol			
		Pentachlorobenzene			
		Biphenyl			

Table 1.3
SIM+SCAN MS PARAMETERS

Table 1.3								
	START TIME	DWELL	LABEL	CYC LES/ SEC	ION 1	ION 2	ION 3	ION 4
1	0	1	Auto_1	47.6	128			
2	5.26	50	NP	8.3	127	128		
3	5.66	1	Auto_2	47.6	142			
4	6.12	50	2MN,1MN	8.3	141	142		
5	6.38	1	Auto_3	47.6	152			
6	6.90	40	ACY,ACNE	7.1	1515	152	153	
7	7.27	1	Auto_4	47.6	166			
8	7.50	50	FLE	8.3	165	166		
9	7.90	1	Auto_5	47.6	178			
10	8.24	50	PHE,AN	8.3	176	178		
11	8.52	100	O-TER	8.3	244			
12	8.64	1	Auto_7	47.6	202			
13	9.05	50	FLA,PYR	8.2	101	202		
14	9.60	1	Auto_8	47.6	228			
15	10.20	40	BA,CHRY	7.1	226	228	240	
16	10.80	1	Auto_9	47.6	252			
17	11.40	40	BB,BK	7.0	125	252	264	
18	12.40	1	Auto_10	47.6	276			
19	13.00	40	IN,DB,BG	5.4	138	139	276	278

Retention time shifts can occur when instrument maintenance is performed. Shifts in the retention times are reflected in the analytical method.

Table 2.0
Intermediate Stock Standard

Stock Standard	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 MegaMix	2000	0.500	10.0	100.0
Benzidines	2000	0.500	10.0	100.0
Balance Mix A	2000	0.500	10.0	100.0
8270 Surr Mix BN	5000	0.200	10.0	100.0
8270 Surr Mix AE	10000	0.100	10.0	100.0

Table 2.1
PAH Intermediate Stock Standard

Stock Standard	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 Cal Mix#6	2000	0.100	10.0	20.0
8270 BN SURR	5000	0.040	10.0	20.0

Table 2.2
8270 Initial Calibration

Linearity Points	Spike Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
1	100.0	0.100	10	1.0
2	100.0	0.500	10	5.0
3	100.0	1.000	10	10
4	100.0	2.000	10	20
5	100.0	1.500	5	30
6	100.0	2.000	5	40
7	100.0	2.500	5	50

Table 2.3
8270 Calibration Working Standards

Working Std	Name	Cat. #	Conc. ug/mL	Volume uL	Final Vol mL	Final Conc. ug/mL
ICAL 7	Mega Mix	31850	1000	500	10	50
	Benzidines	31834	2000	250		
	XCT-CM-1	XCT-CM-1	2000	250		
	Acid Surr	31063	10000	50		
	B/N Surr	31062	5000	100		
ICAL 6	Mega Mix	31850	1000	400	10	40
	Benzidines	31834	2000	200		
	XCT-CM-1	XCT-CM-1	2000	200		
	Acid Surr	31063	10000	40		
	B/N Surr	31062	5000	80		
ICAL 5	Mega Mix	31850	1000	300	10	30
	Benzidines	31834	2000	150		
	XCT-CM-1	XCT-CM-1	2000	150		
	Acid Surr	31063	10000	30		
	B/N Surr	31062	5000	60		
ICAL 4	Mega Mix	31850	1000	200	10	20
	Benzidines	31834	2000	100		
	XCT-CM-1	XCT-CM-1	2000	100		
	Acid Surr	31063	10000	20		
	B/N Surr	31062	5000	40		
ICAL 3	Mega Mix	31850	1000	100	10	10
	Benzidines	31834	2000	50		
	XCT-CM-1	XCT-CM-1	2000	50		
	Acid Surr	31063	10000	10		
	B/N Surr	31062	5000	20		
ICAL 2	Mega Mix	31850	1000	50	10	5
	Benzidines	31834	2000	25		
	XCT-CM-1	XCT-CM-1	2000	25		
	Acid Surr	31063	10000	5		
	B/N Surr	31062	5000	10		
ICAL 1	ICAL 7		50	200	10	1

Working Std	Name	Cat. #	Conc. ug/mL	Volume uL	Final Vol mL	Final Conc. ug/mL
ICV 1	Mega Mix	31850	1000	200	10	20
	Benzidines	31834	2000	100		
	XCT-CM-1	XCT-CM-1	2000	100		
	Acid Surr	31063	10000	20		
	B/N Surr	31062	5000	40		
ICV 2	Mega Mix	31850	1000	400	10	40
	Benzidines	31834	2000	200		
	XCT-CM-1	XCT-CM-1	2000	200		
	Acid Surr	31063	10000	40		
	B/N Surr	31062	5000	80		
CCV	Mega Mix	31850	1000	200	10	20
	Benzidines	31834	2000	100		
	XCT-CM-1	XCT-CM-1	2000	100		
	Acid Surr	31063	10000	20		
	B/N Surr	31062	5000	40		

Table 2.4
8270 SIM+SCAN Initial Calibration

Linearity Points	Spike Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
1*	20.0	0.010	10	0.020
2*	20.0	0.050	10	0.10
3	100.0	0.100	10	1.0
4	100.0	0.500	10	5.0
5	100.0	1.000	10	10
6	100.0	2.000	10	20
7	100.0	1.500	5	30
8	100.0	2.000	5	40
9	100.0	2.500	5	50

* SIM+SCAN linearity points 1 and 2 contain PAH compounds only. See Tables 2.0 and 2.1.

Table 2.5
8720 ICV Working Standards

Working ICV Standards	Intermediate Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
ICV 1	100.0	1.000	5.0	20.0
ICV 2	100.0	2.000	5.0	40.0

Table 2.6
8270 ICV SIM+SCAN Working Standards

Working ICV Standards	Intermediate Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
ICV 1*	20.0	0.250	10.0	0.50
ICV 2	100.0	0.500	5.0	10.0
ICV 3	100.0	1.500	5.0	30.0

* SIM+SCAN ICV 1 contains PAH compounds only. See Tables 2.0 and 2.1

Table 2.7
8270 CCV Working Standard

Working CCV Standard	Intermediate Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270	100.0	1.00	5.0	20.0

Table 2.8
8270 Surrogate Spiking Solution

Surrogate Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 Surr. Mix BN	5000.0	0.400	100.0	20.0
8270 Surr. Mix AE	10000.0	0.400	100.0	40.0

Table 2.9
8270 SIM+SCAN Surrogate Spiking Solution

Surrogate Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 Surr. Mix BN	5000	0.400	100.0	20.0
8270 Surr. Mix AE	10000	0.400	100.0	40.0
o-Terphenyl-d14	1000	0.100	100.0	1.0

Table 2.10
8270 SIM+SCAN Internal Standard Solution

Internal Standard Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 IS Mix	2000	0.5	1.0	1000
Benz[a]anthracene-d12	1000	0.5	1.0	500

Table 2.11
Analyte Spiking Solution

Spiking Solution	Stock Standard Conc. (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
MegaMix	1000	1.000	50.0	20.0
Benzidines	2000	0.500	50.0	20.0
Balance Mix A	2000	0.500	50.0	20.0

Table 2.12
DFTPP Standard Solution

Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
DFTPP	1000	0.500	10.0	50.0

Table 3
DFTPP Tuning Criteria

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
69	<100% of mass 198
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	> 1.0% of mass 198
441	Present but less than mass 443
442	> 40% of mass 198
443	17-23% of mass 442

Table 4
Semivolatile Organic Compounds - Method 8270 Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Tune Check (50ng or less DFTPP)	Every 12 hours.	Ensure correct mass assignment. DFTPP % Relative abundance criteria as specified in Table 3. Pentachlorophenol tailing < 2, Benzidine tailng < 2 DDT breakdown < 20%.	Retune. Do not proceed with analysis until DFTPP spectrum meets criteria.
Initial Calibration	Each time the instrument is set up and when CCCs and SPCCs in the continuing calibration verification (CCV) do not meet criteria.	1. Average relative response factors (RRFs) for SPCCs ≥0.05 2. % RSD for RRFs for each CCC ≤30%. 3. % RSD for RRFs for all target compounds ≤15%. IF RF % RSD >15% use linear curve, r >=.995, r2 > = .990. or quadratic curve. 4 LCG, NELAC, QSM, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria shall be followed as stated in their documents.)	Correct system and recalibrate. Criteria must be met before sample analysis can begin. Any samples reported from data not meeting these criteria must be qualified (Z).
Initial Calibration Verification standards (ICV)	Immediately following the ICAL.	1. Second source (different lot or manufacturer than ICAL). 2. RRF for SPCCs ≥0.05 3. % Deviation. for RRFs of each CCC <20%. 3 Non-CCCs - <20% Deviation for RRFs, <20 % Drift for linear curve and non linear curves- 4 LCG,QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria shall be followed as stated in their documents.	Correct system and recalibrate. Criteria must be met before sample analysis can begin. If %drift >20% then confirm the integrity of the second source standard by reanalysis, and/or determine if it's a sporadic problem involving compounds that are typically poor performers. Sample results reported that have %drift failures must be qualified (Z). QSM allows no tolerances for % D. Problem compounds need to be addressed on a project to project basis.

Table 4 (Continued)
Semivolatile Organic Compounds - Method 8270 Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification standards(CCV)	Every 12 hours.	1. RRF for SPCCs ≥0.05. 2. % Deviation for RRFs of each CCC <20%. 3. Non-CCCs - <20% Deviation for RRFs, <20 % Drift for linear curve and non linear curves- 4. LCG, QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria are followed as stated in their documents.	Correct system and recalibrate. Criteria must be met before sample analysis can begin. If% drift >20% correct problem if determinable then reanalyze, and/or determine if it's a sporadic problem involving compounds that are typically poor performers. Sample results reported that have %D failures must be qualified (Z). QSM allows no tolerance for % D. Problem compounds need to be addressed on a project to project basis
Internal Standards (ISTD)	Added to all blanks, standards, and samples.	1. Peak area within -50% to +100% of area in CCV level of ICAL. 2. Retention time (RT) within 30 sec of RT for associated CCV standard. 3. LCG, QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria are followed as stated in their documents.	Inspect instrument for malfunctions; correct identified malfunctions, then reanalyze samples. If no instrument malfunction identified proceed as follows: * Reextract and reanalyze sample. * If reanalysis is outside limits the data is qualified (S). Follow specified criteria as stated in Shell or other documentation.
Method Blank (MB)	One per prep batch/20 samples per matrix. The MB is used to document contamination resulting in the analytical process and is carried through the complete sample preparation and analytical procedure.	1. Concentration of analytes of concern are to be less than the highest of either: Method detection limit, five percent of the regulatory limit for that analyte, or five percent of the measured concentration in the sample. 2. ACOE/QSM: <1/2 MRL. 3. Follow criteria according to specific program/agency.	Reanalyze to determine if instrument or laboratory background contamination was the cause. If the method blank is still non-compliant, re-prepare and reanalyze blank and samples. For ACOE/QSM data, if <1/2 MRL no action required. If no sample remains for re-prepping, or if re-prepped data still contains contamination, flag data with (B) qualifier.

Table 4 (Continued)
Semivolatile Organic Compounds - Method 8270 Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Sample (LCS)	One per prep batch of 20 samples. Must undergo all sample preparation procedures. Spiking solution are to contain all target compounds with concentrations at or near the mid-point of the calibration range.	1. Client specified limits. 2. QSM – use LCS criteria. 3. In-house limits..	If LCS recoveries are within control limits then no action is required. If the LCS exceeds control limits, reanalyze the LCS. If LCS recoveries are still outside control limits, reextract and reanalyze samples. If sample is not available for re-extraction then qualify data for the failing analytes with a (Q). Exception: If the LCS recoveries are high with no associated positives then no further action is taken.
MRL Level Verification Check standard at Reporting Limit. – (LCG only)	Program/contract specific Typically bracketing samples for every 12 hr. analysis window.	1. 70-130% or project specific/client limit	Note failures in case narrative. If MDL check was analyzed at the end and is acceptable do not reject data.
Matrix Spike/Matrix Spike Duplicate	One set per prep batch of 20 samples. Must undergo all sample preparation procedures. Must be spiked with target compounds with concentrations at or near the mid-point of the calibration range.	1. Client specified limits. 2. QSM – use LCS criteria. 3 .In-house limits..	If LCS is acceptable, then report probable matrix interference. Qualify data if the recoveries are low (M). If recoveries are high and there are no detects in the unspiked sample then that data does not require flagging. Qualify data for RPD failures (Y) when there is a detect for the failing compounds (non-detected compounds are not qualified). Exception: If a compound is already qualified for a LCS failure then no RPD qualifier is applied.

Table 4 (Continued)
Semivolatile Organic Compounds - Method 8270 Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Qualitative/Quantitative Issues SOP No:	If detection level of any compound in a sample exceeds the detection level of that compound in the highest level standard, the sample must be diluted to approximately mid-level of the calibration range and reanalyzed.	The instrument level of all compounds must be within the calibration range for all samples. Rev. 9 The sample analyzed immediately after a high level sample must display concentrations of the high level target compounds less than the RL or greater than 5X the RL	Dilute the sample to bring the level of the highest concentration of target compounds within the calibration range. If any data is reported with any results over range then those results are to be flagged (X). A sample displaying concentrations of target compounds between the RL and 5x the RL that was analyzed immediately after a high level sample must be re-analyzed. If the results do not agree within the RL, report only the second analysis.
Surrogate	1. Calibrated as target compounds. 2. Added to all blanks, samples, and QC samples, as a part of the internal standard-surrogate spiking mixture.	1. Client specified limits. 2. QSM – use LCS criteria. 3. In-house limits.	Rerun sample. If no apparent matrix interference is noticed, re-extract sample. If no sample is available, qualify the surrogate with "S". QSM – For QC and field samples, correct problem, reprep and re-analyze all samples with failed surrogates in the associated batch, if sufficient sample material is available.
Retention Time Window (RTW)	Retention Times will be set using the midpoint of the calibration curve or the RTs in the CCV run at the beginning of the analytical sequence.	RTs of analytes must be within +/-.06 RRT units of the RRT of the CCV.	.

Table 5
8270 Analysis Data Review Checklist

Sequence Date	Analyst / Data Interpreter	Independent Reviewer	Date of Review	Approved
				Yes or No

Instructions: Complete one checklist per analytical run. Enter the appropriate response for each question. Each "No" response requires an explanation in the Comments section, and may require the initiation of a Nonconformance Report.

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
1. INITIAL CALIBRATION (ICAL)						
a. Was the initial calibration performed using a minimum of five standard concentration levels?	Lowest standard at or near MRL					
b. SPCC responses.	Avg. RRF ≥ 0.05					
c. Linearity.	RSD≤ 15%, ≤ 30% for CCCs, or r ≥ 0.995, r2 ≥ 0.990 for regression.					
d. Were the standards used for the ICAL uniquely identified?						
e. Was there a DFTPP standard analyzed prior to the ICAL?						
2. INITIAL CALIBRATION VERIFICATION (ICV)						
a. Were there a second source ICVs for all target analytes analyzed after the initial calibration and prior to analysis of any samples?	Second source					
b. Were the SPCC within QC limits	RRF ≥ 0.05					
c. Were the CCCs within QC limits	%D ≤ 20%					
d. Were the ICVs uniquely identified (i.e. Standard Number)?						
3. CONTINUING CALIBRATION VERIFICATION (CCV)						
a. Were CCVs for target analytes analyzed at the beginning of the sequence and after every 12 hours.						
b. Were SPCC compounds acceptable?	RRF ≥ 0.050					

Table 5
8270 Analysis Data Review Checklist (Continued)

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
c. Were the CCCs compounds acceptable?	%D ≤ 20%					
d. Were the recoveries for the CCVs acceptable?	%D≤20%,					
e. Was each CCV uniquely identified (i.e. Standard Number)?						
4. DFTPP						
a. Was a DFTPP tune check ran at the beginning of every twelve hour shift?						
b. Were the relative abundance criteria met?						
c. Was the peak tailing acceptable for Pentachlorophenol and Benzidine?	Tailing factor < 2					
d. Was the breakdown of DDT to DDE and DDD acceptable	< 20%					
5. BLANKS						
a. Was method blank (MB) analyzed prior to the analysis of samples?						
b. Were the MB results less than the detection limit (MDL)?	< MDL					
If no, were positive hits in the samples < 20x the amount in the blank flagged with a "B".	< 20x (qualify data) > 20x (no action)					
c. Was a MB prepped and analyzed at a frequency of one per Prep Batch?	Batch ≤ 20 samples					
6. LABORATORY CONTROL SAMPLE (LCS)						
a. Was a LCS analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were the LCS recoveries in each LCS within the acceptance criteria?	In-house limits or client specified limits					
If no, and the recoveries were low, flag those analytes "Q". If the recoveries were high, only flag the detects (>RL) for those analytes "Q".						
7. MATRIX SPIKES						
a. Was a matrix spiked (MS) sample analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were MS recoveries in each MS within the acceptance criteria?	In-house limits or client specified limits					

Table 5
8270 Analysis Data Review Checklist (Continued)

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
8. LABORATORY CONTROL SPIKE / MATRIX SPIKE DUPLICATE						
a. Was a duplicate matrix spike or laboratory control spike sample analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were MSD or LCSD recoveries within the acceptance criteria?	In-house limits or client specified limits					
c. Is the relative percent difference (RPD) for each analyte between a matrix spike (MS) and matrix spike duplicate (MSD) within the acceptance criteria? (same criteria for LCS and LCSD)	In-house limits or client specified limits					
9. SAMPLES (INCLUDING BLANKS, STANDARDS, AND QC SAMPLES)						
a. Are chromatogram characteristics, including peak shapes and areas, consistent with those of the CCV?						
b. Are surrogate recoveries for all samples, blanks, standards, and QC samples within acceptance criteria?						
c. Were all samples having analytes detected in amounts exceeding the calibration range diluted and reanalyzed?						
d. Were all samples extracted within holding times and analyzed within 40 days of extracting?	Analysis within 40 days of extraction					
e. Did the samples require additional cleanup steps? (i.e.GPC)	GPC, Treatments					
10. RECORDS AND REPORTING						
a. Are Run, Prep Batch and Extraction sheets, Summary sheets, Sequence file, initial and rerun raw and process data present in the data file?						
b. Are all chromatograms dated and initialed?						
c. Are reported results whose amounts exceeded the acceptance criteria flagged with an appropriate qualifier and, if needed, a NCR completed?						
d. Do all values, dilution factors and qualifiers listed on the raw reports match the LIMS data?						
e. Is the ICAL method referenced on the Raw Data?						

Table 6
Semivolatiles Extraction Bench Sheet

METHOD 8270-SV GC/MS Extraction Bench Sheet
SOP Reference Number 8270, 8270 SIM Explosives, 8270SIM PAH

EPA Method references: 8270 (Semivolatiles) **Prep Batch Number _____**
3510 (Separatory funnel extraction)
3545 (Pressurized Fluid Extraction)
3580 (Waste Dilution)
3546 (Microwave Extraction)

***Spike and Surrogate Information*:**
Spike amount and concentration (Matrix Spike and LCS): _____
Spike Reference: __**SVMS**_____ADDED:_____
Surrogate amount and concentration: _____
Surrogate Reference: _**SVMS**_____ADDED:_____
Reagent lot # **$MeCl_2$_____ Na_2SO_4_____ Acetone_____**
Sulfuric Acid_SVMS_____ NaOH_SVMS_____ Diatomaceous earth_____
Dionex_**DI**_____ Scale_____ GPC Start_____ GPC End_____

***Extraction by*:** _____Date____/____/____ Start Time _____ End_____
***Initial Concentration by*:**_____Date____/____/_____
***Final Concentration by*:** _____Date____/____/_____

Cell #	Client	Sample Number	Sample Amt. (gm or L)	Final Vol (mL)	pH <2	pH >11	Comments
	Method Blank	MB					
	Control Spike	**LCS**					
	Control Spike Dup.	*LCSD*					
	Matrix Spike	MS					
	Matrix Spike Dup.	***MSD***					

Footnotes:

Final extract
Relinquished by:_____ Date:_____ Relinquished to:_____ Date:_____

Reviewed By: _____

ATTACHMENT I
GEL-PERMEATION CLEANUP
METHOD 3640A

1.0 Identification Of The Test Method

This method is designed to follow procedures and QC requirements found in SW-846 method 3640A. Gel-permeation chromatography (GPC) is a size exclusion cleanup procedure using organic solvents and hydrophobic gels in the separation of synthetic macromolecules.

2.0 Applicable Matrix Or Matricices

This method is applicable to nearly all types of methylene chloride extractable matrices regardless of water content, including ground water, surface water, wastewater, soils and sediments, as well as other matrices.

3.0 Detection Limits

None applicable

4.0 Scope And Application

4.1 General cleanup application – GPC is recommended for the elimination from the sample of lipids, polymers, copolymers, proteins, natural resins and polymers, cellular components, viruses, steroids, and dispersed high-molecular-weight compounds. GPC is appropriate for both polar and non-polar analytes; therefore, it can be effectively used to cleanup extracts containing a broad range of analytes.

4.2 Normally, this method is most efficient for removing high boiling materials that condense in the injection port area of a gas chromatograph (GC) or in the front of the GC column. This residue will ultimately reduce the chromatographic separation efficiency or column capacity because of adsorption of the target analytes on the active sites. Pentachlorophenol is especially susceptible to this problem. GPC, operating on the principal of size exclusion, will not usually remove interference peaks that appear in the chromatogram since the molecular size of these compounds is relative similar to the target analytes. Separation cleanup techniques, based on other molecular characteristics (i.e. polarity), must be used to eliminate this type of interference.

4.3 This method is restricted for use by or under the supervision of trained analyst. Each analyst must demonstrate the ability to generate acceptable results with this method.

5.0 Method Summary

5.1 This method is used to cleanup extracted samples with unwanted light and/or heavy compounds that interfere with final analysis of methods 8041, 8081, 8082, 8270, 8330 and 8310.

5.2 Samples are extracted then concentrated and prepared for GPC cleanup.

5.3 Determinations for which samples that are candidates for GPC cleanup are based on client specific, site specific and project specific requirements, specific characteristics of initial extract (e.g. color or odor) or interference determined by initial extract analysis.

5.4 The column is calibrated and then loaded with the sample extract to be cleaned up. Elution is effected with a suitable solvent(s) and collection times are adjusted based on desired analysis. The collected fractions are then concentrated per guidelines for methods 8041, 8081, 8082, 8270, 8330 and 8310.

6.0 Definitions

6.1 Reagent Blank: an analyte free reagent on which all processes will be performed. Create GPC blank by loading 5 ml of methylene chloride into the GPC. Concentrate the methylene chloride that passes through the system during the collect cycle using a Kuderna-Danish (KD) evaporator. Analyze the concentrate by whatever detectors will be used for the analysis of future samples.

6.2 GPC Calibration Solution: a solution that contains compounds with known retention times used to determine if the GPC column is calibrated to elute the compounds of interest at the set times.

6.3 Stock Standards -Stock Standards are purchased from vendors who provide certified solutions. Standards are stored at -10ºC in a freezer reserved for standard solutions. Unopened standard shall have the manufactures suggested expiration date. Stock standards once opened expire in six months and not to exceed the manufactures expiration date.

6.4 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

6.5 Laboratory Control Spike (LCS): Milli-Q water (for water) and Organic-Free Soil (for soil) is spiked with the target analytes and carried through the complete sample preparation and analytical procedure. The control spike is used to document the ability of an analyst to generate acceptable precision and bias, to verify the analytical system performance, and to document method accuracy for each matrix.

7.0 Interferences

7.1 A reagent blank should be analyzed for the compound of interest prior to the use of this method. The level of interferences must be below the estimated quantitation limits (EQL's) of the analytes of interest before this method is performed on actual samples.

7.2 More extensive procedures than those outlined in this method may be necessary for reagent purification.

7.3 Solvents, reagents, glassware, and other sample processing hardware can yield artifacts and /or interferences to sample analysis. All these materials must be demonstrated to be free

from interferences under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and/or purification of solvents by distillation in all-glass systems will be necessary. Refer to each method for specific guidance on quality control procedures.

7.4 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials.

7.5 Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, will cause degradation of certain analytes.

7.6 Interferences co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interference, further cleanup of the sample or dilution of the sample will be necessary.

8.0 Safety

8.1 Protective clothing: safety glasses, gloves, apron and/or lab coat, long pants, and protective shoes, shall be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure must utilize appropriate laboratory safety systems.

8.2 The toxicity of chemicals used in this method has not been precisely defined. Each chemical shall be treated as a potential health hazard, and exposure to these chemicals shall be minimized.

9.0 Equipment And Supplies

9.1 Gel-permeation chromatography system - Gilson GV-271 ASPEC, Gilson, INC or equivalent. All systems, whether automated or manual, must meet the calibration requirements.

9.1.1 Chromatographic column -350mm x 21.20 mm 0 micron, Phenomenex p/n 00W-3035-PO or equivalent.

9.1.2 Guard column – (optional) 60mm x 21.20 mm 0 micron, Phenomenex p/n 03R-3035-PO or equivalent.

9.1.3 Ultraviolet detector –fixed wavelength (254 nm) with a semi-prep flow-through cell, Gilson 112 UV/VIS detector, Gilson, INC, or equivalent.

9.1.4 Strip chart recorder, recording integrator or laboratory data system, (Trilution and LIMS) or equivalent.

9.1.5 Syringe – 10ml with Luerlok fitting.

9.1.6 Syringe filter assembly, disposable – Puradisc 25TF sample filter assembly Whatman #6784-2510, 25mm and 1.0 micron filter discs or equivalent. Check each batch for contaminants. Rinse each filter assembly (prior to use) with methylene chloride if necessary.

9.2 Analytical balance – 0.00 g (Fisher Scientific XD2200 or equivalent)

9.3 Volumetric flasks, Class A (TC) 5ml to 100ml

9.4 Graduated cylinders (TC)

9.5 Disposable glass culture tubes 13mm x 100mm, Kimble 73500-13100 or equivalent.

9.6 Disposable glass collection tubes- Kimax 51 25mm x 200mm, Kimble 45060-25200 or equivalent.

9.7 Pasteur pipets- 5 ¾" and 9" (VWR #14672-200 and -300).

9.8 Appropriate concentration and extraction apparatuses; refer to method specific SOP section 9 for equipment and supplies for methods 8041, 8081, 8082, 8270, 8330 and 8310.

10.0 Reagents And Materials

10.1 Methylene chloride, CH_2Cl_2. Pesticide grade or equivalent. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date. Or stored in large carboy tank provided by manufacturer and used by the manufacturer's expiration date.

10.1.1 Some brands of methylene chloride may contain unacceptably high levels of acid (HCl). Check the pH by shaking equal portions of methylene chloride and water, and then check the pH of the water layer.

10.1.1.1 If the pH of the water layer is ≤5, filter the entire supply of solvent through a 2 in x 15 in glass column containing activated basic alumina. This column should be sufficient for processing approximately 20-30 liters of solvent. Alternatively, find a different supply of methylene chloride.

10.2 Cyclohexane, C_6H_{12}. Pesticide grade or equivalent, stored under hood in semivolatiles extraction lab and used within one year of opening or before the manufacturer's expiration date.

10.3 N-Butyl chloride. $CH_3CH_2CH_2CH_2Cl$. Pesticide grade or equivalent stored under hood in semivolatiles extraction lab and used within one year of opening or before the manufacturer's expiration date.

10.4 GPC Calibration Solution. Prepare a calibration solution in methylene chloride containing the following analytes (in elution order):

Compound	mg/L
Corn oil	25,000
Bis (2-ethylhexyl) phthalate	1,000
Methoxychlor	200
Perylene	20
Sulfur	80

Note: Sulfur is not very soluble in methylene chloride; however, it is soluble in warm corn oil. Therefore, one approach is to weigh out the corn oil, warm it and transfer the weighed amount of sulfur into the warm corn oil. Mix it and then transfer into a volumetric flask with methylene chloride, along with the other calibration compounds.

Store the calibration solution in an amber glass bottle with a teflon lined screw-cap at 4°C, and protect from light. (refrigeration may cause the corn oil to precipitate. Before use, allow the calibration solution to stand at room temperature until the corn oil dissolves.) Replace the calibration standard solution every 6 months or more frequently if necessary.

10.5 Corn oil spike for Gravimetric Screen. Prepare a solution of corn oil in methylene chloride (5g/100ml).

10.6 Reagents and materials necessary for concentration and exchanges as listed in method specific SOP section 10.0 Reagents and Materials for methods 8041, 8081, 8082, 8270, 8330 and 8310.

11.0 Sample Collection, Preservation, And Storage.

Follow guidelines listed in the method specific SOPs section 11 Sample Collection, Preservation and Storage for methods 8041, 8081, 8082, 8270, 8330 and 8310 for sample collection, preservation and storage.

12.0 Quality Control

12.1 The analyst should demonstrate that the compound(s) of interest are being quantitatively recovered before applying this method to actual samples.

12.2 For sample extracts that are cleaned up using this method, the associated quality control samples must also be processed through this clean up method.

12.3 This SOP is designed to follow a variety of different projects and programs requirements.

12.4 Refer to section 12.0 Quality Control for method specific quality control guidelines.

13.0 Calibration And Standardization

13.1 Preparation of standards is documented in the GPC standard logbook. Each standard is labeled with a unique standard number to allow for tracking. Stock standards once opened expire within six months or sooner if routine QC indicates a problem and not to exceed the manufactures expiration date. Stock standards are saved in a capped vial in the original box in the freezer.

13.2 The following is the stock standard that is commercially prepared standard, which is certified by the manufacturer;

GPC Calibration Mix: Restek Part # 32019. (1ml ampul)
GPC Calibration Mix: Restek Part # 32023. (5ml ampul)

13.3 GPC Calibration Solution is a certified prepared standard in methylene chloride containing the following analytes (in elution order):

Compound	mg/mL
Corn oil	250
Bis (2-ethylhexyl) phthalate	10
Methoxychlor	2.0
Perylene	0.2
Sulfur	0.8

Table 1.0 GPC Calibration Standard

Standard	Component Name	Conc. (mg/ml)	STD Volume (ml)	Final Volume (ml)	Final Conc. (ug/ml)
GPC STD	Corn Oil	250	5.0	50.0	25000.0
	Bis(2-ethylhexyl)pht.	10	5.0	50.0	1000.0
	Methoxychlor	2.0	5.0	50.0	200.0
	Perylene	0.2	5.0	50.0	20.0
	Sulfur	0.8	5.0	50.0	80.0

13.4 Calibration of the GPC Column

13.4.1 Place approximately 6 to 7 ml's of the calibration solution in a disposable culture tube. Place tube in position 1 on the sample tray. Set Trilution to run a calibration method with an inject volume of 5.50ml.

13.4.1.1 Following are criteria for evaluation of the UV chromatogram for column condition

13.4.1.1.1 Peaks must be observed and should be symmetrical for all compounds in the calibration solution.

13.4.1.1.2 Corn oil and phthalate peaks must exhibit >85% resolution.

13.4.1.1.3 Phthalate and methoxychlor peaks must exhibit >85% resolution.

13.4.1.1.4 Methoxychlor and perylene peaks must exhibit >85% resolution.

13.4.1.1.5 Perylene and sulfur peaks must not be saturated and must exhibit >90% baseline resolution

13.4.1.1.6 Nitroaromatic compounds are particularly prone to adsorption. For example 4-nitrophenol recoveries may be low due to a portion of the analyte being discarded after the end of collection time. Columns should be tested with the semivolatiles matrix spiking solution. GPC elution should continue until after perylene has elute or long enough to recover at least 85% of the analytes, whichever time is longer.

13.4.1.2 Calibration for methods 8270, 8041 and 8330

13.4.1.2.1 Using the information from the UV trace, establish appropriate collect and dump time periods to ensure collection of all target analytes. Initiate column eluate collection just before elution of bis (2-ethylhexyl) phthalate and after the elution of the corn oil. Stop eluate collection shortly after the elution of perylene. Collection should be stopped before sulfur elutes.

13.4.1.2.1.1 Elution of corn oil starts at approximately 11.0 minutes

13.4.1.2.1.2 Elution of bis (2-ethylhexyl) phthalate starts at approximately 13.0 minutes

13.4.1.2.1.3 Elution of methoxychlor starts at approximately 14.5 minutes

13.4.1.2.1.4 Elution of perylene starts at approximately 20.0 minutes

13.4.1.2.1.5 Elution of sulfer starts at approximately 23.5 minutes

13.4.1.2.1.6 Collection time for 8270 and 8041 is 11 minutes to 23 minutes

13.4.1.2.1.7 Collection time for 8330 is 12 minutes to 22 minutes

13.4.1.3 Calibration for Organochlorine Pesticides/PCBs – Determining the elution times for the phthalate, methoxychlor, perylene and sulfur. Choose a dump time which removes >85% of the phthalate, but collects >95% of the methoxychlor. Stop collection after the elution of perylene, but before sulfur elutes.

13.4.1.3.1 Collection times for 8081 and 8082 are from 13.5 minutes to 22 minutes

13.4.1.4 Calibration for Polynuclear Aromatic Hydrocarbons – Determine the elution times for corn oil, phthalate and perylene. Start elution collections just before the elution of bis (2-ethylhexyl) phthalate and end collection at the peak of the elution of perylene.

13.4.1.4.1 Collection time for 8310 is from 12 minutes to 22 minutes

14.0 Procedure

14.1 It is very important to have consistent laboratory temperatures during and entire GPC run, which could be 24 hours or more. If temperatures are not consistent, retention times will shift and the dump and collect times determined by the calibration standard will no longer be appropriate. The ideal laboratory temperature to prevent outgassing of the methylene chloride is 72°F.

14.2 GPC Setup

14.2.1 Column Preparation

14.2.1.1 Using manual control options in Trilution set the system to equilibrate for at least 30 minutes prior to starting a run or priming.

14.2.1.2 If system has not been used on a regular basis, prime all lines and pumps either manually or using the automated system following guidelines listed in the Trilution help manual.

14.2.1.3 Verify the flow rate by collecting column eluate for 10 minutes in a graduated cylinder and measure the volume which should be 45-55ml (4.5-5.5 ml/min). If flow rate is outside of this range, corrective action must be taken. Once flow rate is within the ranges of 4.5-5.5 ml/min, record the column pressure (should be 6-10 psi) and room temperature in GPC run log (see table 2). Changes in pressure, solvent flow rate, and temperature conditions can affect analyte retention times and must be monitored. If flow rate and/or column pressure do not fall within the above ranges the column should be replaced. A UV trace

that does not meet the criteria in section 13.5.1.1 would also indicate that a new column should put in place.

14.2.1.4 Re-inject the calibration solution after appropriate collect and dump cycles have been set and the solvent flow and column pressure have been established.

14.2.1.4.1 Measure and record the volume of collected GPC eluate in a graduated cylinder. The volume of GPC eluate collected for each sample extract processed may be used to indicate problems with the system during sample processing.

14.2.1.4.2 The retention times for bis (2-ethylhexyl) phthalate and perylene must not vary more than ± 5% between calibrations. If the retention time shift is >5%, take corrective action. Excessive retention time shifts are caused by:

14.2.1.4.2.1 Poor laboratory temperature control or system leaks.

14.2.1.4.2.2 An unstabilized column that requires pumping methylene chloride through it for several more hours.

14.2.1.4.2.3 Excessive laboratory temperatures, causing outgassing of the methylene chloride.

14.2.2.7.3 Analyze a GPC blank by loading 5 ml of methylene chloride into the GPC. Concentrate the methylene chloride that passes through the system during the collect cycle using a Kuderna-Danish (KD) evaporator. Analyze the concentrate by whatever detectors will be used for the analysis of future samples. Exchange the solvent if necessary. If the blank exceeds the estimated quantitation limit of the analytes, pump additional methylene chloride through the system for 1 to 2 hours. Analyze another GPC blank to ensure the system is sufficiently clean. Repeat the methylene chloride pumping if necessary.

14.3 Extract Preparation

14.3.1 Adjust the extract volume to 5 ml. The solvent extract must be primarily methylene chloride. All other solvents, e.g. 1:1 methylene chloride/acetone, must be concentrated to 1 ml (or as low as possible if a precipitate forms) and diluted to 5 ml with methylene chloride. Thoroughly mix the extract before proceeding.

14.3.2 Filter the extract through a 1 micron filter disc by attaching a syringe filter assembly containing the filter disc to a 10 ml syringe. Draw the sample

extract through the filter assembly and into the 10 ml syringe. Disconnect the filter assembly before transferring the sample extract into a small glass container, e.g. a 15 ml culture tube. Alternatively, draw the extract into a syringe without the filter assembly, attach the filter assembly and force the extract through the filter and into the glass container. The latter is the preferred technique for viscous extracts or extracts with a lot of solids. Particulate larger than 5 microns may scratch the valve, which may result in a system leak and cross-contamination of sample extracts in the sample loops.

NOTE: Viscosity of a sample extract should not exceed the viscosity of 1:1 water/glycerol. Dilute samples that exceed the viscosity.

14.4 Screening the Extract

14.4.1 Screen the extract to determine the weight of dissolved residue by evaporating a 100 µL aliquot to dryness and weighing the residue. The weight of dissolved residue loaded on the GPC column cannot exceed 0.500 g. Residues exceeding 0.500 g will very likely result in incomplete extract cleanup and contamination of the GPC switching valve (which results in cross-contamination of sample extracts).

14.4.1.1 Transfer 100µL of the filtered extract from section 14.3.2 to a tared aluminum weighing dish.

14.4.1.2 A suggested evaporation technique is to use a heat lamp. Set up a 250 watt heat lamp in a hood so that it is 8 ± 0.5cm from a surface covered with a clean sheet of aluminum foil. Surface temperature should be 80-100°C (check temperature by placing a thermometer on the foil and under the lamp). Place the weighing dish under the lamp using tongs. Allow it to stay under the lamp for 1 minute. Transfer the weighing dish to an analytical balance or a micro balance and weigh to the nearest 0.1mg. If the residue weight is less than 10mg/100µL, then further weighings are not necessary. If the residue weight is greater than 10mg/100µL then determine if constant weight has been achieved by placing the weighing dish and residue back under the heat lamp for 2 or more additional 0.5 minute intervals. Reweigh after each interval. Constant weight is achieved when three weights agree within ±10%.

14.4.1.3 Repeat the above residue analysis on a blank and a spike. Add 100µL of the same methylene chloride used for the sample extraction to a weighing dish and determine residue as above. Add 100µL of a corn oil spike (5g/100ml) to another weighing dish and repeat the residue determination.

14.4.2 A residue weight of 10mg/100µL of extract represents 500mg in 5ml of extract. Any sample extracts that exceed the 10mg/100µL residue weight must be diluted so that the 5ml loaded on the GPC column does not

exceed 0.500g. Following is a calculation that may be used to determine what dilution is necessary if the residue exceeds 10mg.

$$\text{Y ml taken for dilution} = 5 \text{ ml final volume} \times \frac{10\text{mg maximum}}{\text{X mg of residue}}$$

Example

$$\text{Y ml taken for dilution} = 5 \text{ ml final volume} \times \frac{10\text{mg maximum}}{15 \text{ mg of residue}}$$

Y ml taken for dilution = 3.3 ml

Therefore, taking 3.3 ml of sample extract from 14.3.2 and diluting it to 5ml with methylene chloride will result in 5 ml of diluted extract loaded on the GPC column that contains 0.500 g of residue.

NOTE: This dilution factor must be included in the final calculation of analyte concentrations.

14.5 GPC CLEANUP

14.5.1 Calibrate the GPC at least once per week following the procedure outlined in section 13.5.1. Ensure that UV trace requirements, flow rate and column pressure criteria are acceptable. Also, retention time shift must be <5% when compared to retention times in the last calibration UV trace.

14.5.1.1 If these criteria are not met, follow appropriate maintenance methods to try to regain resolution.

14.5.2 Load sample vials with 5 ml of filtered extract from section 14.3. The Method Blank (MB) and Laboratory Control Standard (LCS) must be run through the GPC process from each prep batch that the samples originated from.

NOTE: The number of samples from each prep batch that are put through GPC will vary by client, location and project specifications.

14.5.3 Set the GPC up to run cleanup of the samples, verifying that collection and dump times correlate with the calibration times for each analysis specified in section 13.5.1.2 through 13.5.1.4. Multiple methods may be used on each GPC run. Follow software specific guidelines for setting up a GPC run.

NOTE: It may be necessary to run multiple rinse methods between samples to ensure no cross-contamination between particularly dirty samples.

14.5.4 Monitor sample volumes collected. Changes in sample volumes collected may indicate one or more of the following problems:

14.5.4.1 Change in solvent flow rate caused by channeling in column or changes in column pressure.

14.5.4.2 Increase in column operating pressure due to the absorption of particles or gel fines onto either the guard column or the analytical column gel, if a guard column is not used.

14.5.4.3 Leaks in the system or significant variances in room temperature.

14.6 Concentrate the extract by following the methods listed in the sections for Sample Concentration for methods 8041, 8081, 8082, 8270, 8330 and 8310.

15.0 Data Analysis And Calculations

Refer to method specific SOP for information

16.0 Method Performance

Refer to method specific SOP for information

17.0 Pollution Prevention

Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Whenever feasible, laboratory personnel shall use pollution prevention techniques to address their waste generation.

18.0 Data Assessment And Acceptance Criteria For Qc Measures

Refer to method specific SOP for information.

19.0 Corrective Measures Of Handling Out Of Control Or Unacceptable Data

Refer to method specific SOP for information

20.0 Contingencies For Handling Out Of Control Or Unacceptable Data

Refer to method specific SOP for information

21.0 Waste Management

Samples are routinely held (refrigerated) for up to six weeks from analysis date before they enter the waste stream. Waste disposal of samples and standards follows the procedures documented in the Laboratory Waste Disposal SOP (Quality Assurance Section, SOP NO. FO-8, Rev. 4).

22.0 Equipment/Instrument Maintenance, Computer Hardware And Software And Trouble Shooting

Refer to method specific SOP for information

23.0 References

23.1 Wise, R.H.; Bishop, D.F.; Williams, R.T.; Austern, B.M. "Gel Permeation Chromatography in the GC/MS Analysis of Organics in Sludges"; U.S. EPA Municipal Environmental Research Laboratory: Cincinnati, Ohio 45268.

23.2 Czuczwa, J.; Alford-Stevens, A. "Optimized Gel Permeation ChromatographicCleanup for Soil, Sediment, Waste and Waste Oil Sample Extracts for GC/MS Determination of Semivolatile Organic Pollutants, JAOAC, submitted April 1989.

23.3 Marsden, P.J.; Taylor, V.; Kennedy, M.R. "Evaluation of Method 3640 Gel Permeation Cleanup"; Contract No. 68-03-3375, U.S. Environmental Protection Agency, Cincinnati, Ohio, pp. 100, 1987.

23.4 USEPA, SW-846 Method 3640A, Rev 1. September 1994.

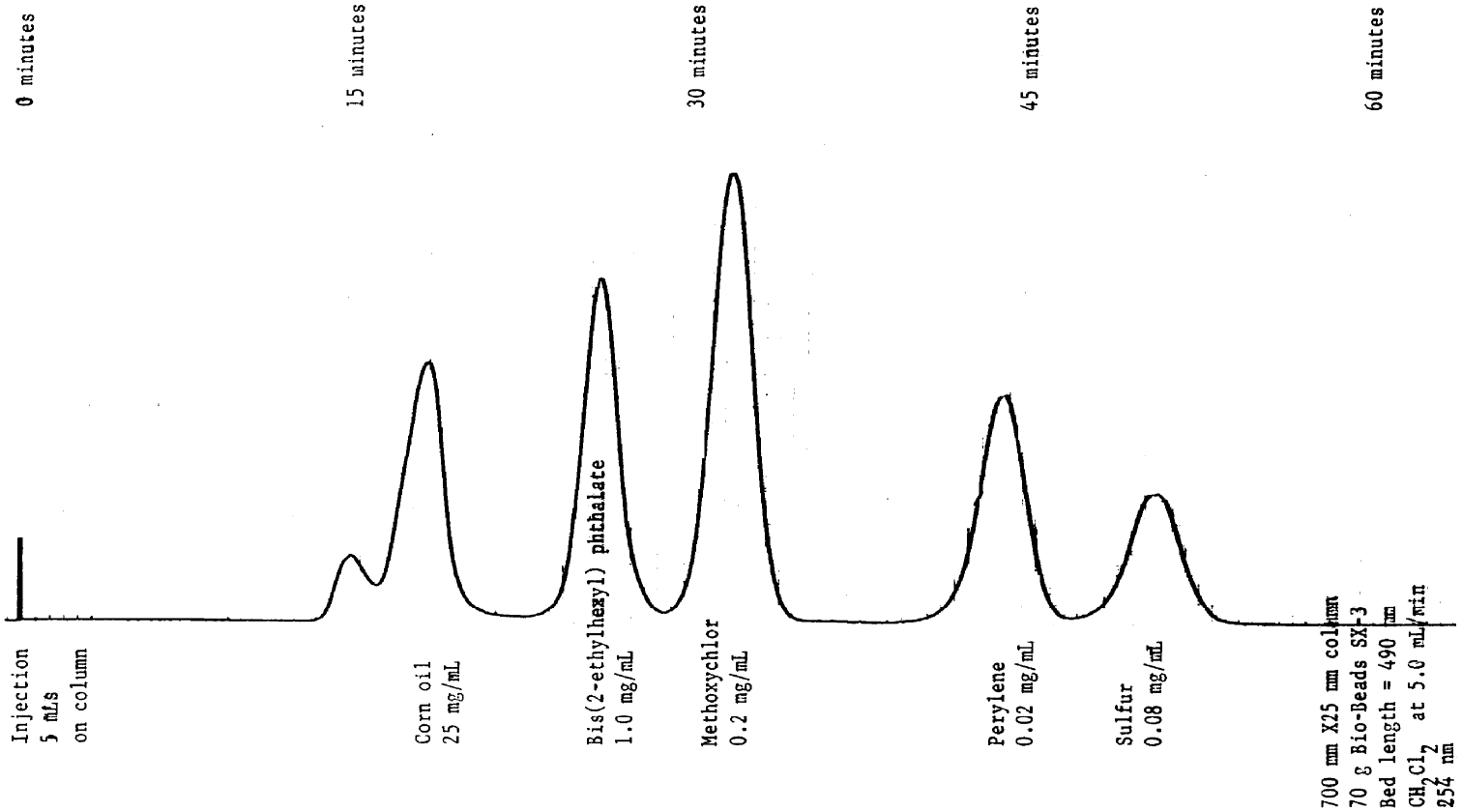
23.5 Gilson, Inc. “Gilson GX-271 Liquid Handlers User’s Guide”, 2006.

24.0 Tables, Diagrams, Flowcharts And Validation Data

Table 2
GPC Log Book

Run Date	Prep Batch	Time Start	Time Stop	Temp °F	Flow mL/min	Calibration Date	Analyst	Comments
								Page 1

Table 3
UV Chromatogram of GPC Calibration Solution



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CT Laboratories
Baraboo Laboratory Division

Title: **Analysis of PAHs by GC/MS SIM**

SOP Number: 8270 SIM PAHs

Written by: _____

Technical Review by: _____

Approved by: _____
Quality Assurance Manager

Approved by: _____
Laboratory Director

SOP Manual Control Number: _____

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1.0 Identification of the Test Method

This method is designed to follow procedures and QC requirements found in EPA SW-846 methods 3510, 3545, 3546, 8000 and 8270 in order to determine quantities of semivolatile organic polycyclic aromatic hydrocarbons (PAHs) in a variety of different sample matrices.

2.0 Applicable Matrix or Matrices

PAHs are quantitated from a variety of matrices. This method is applicable to nearly all types of samples, including ground water, surface water, wastewater, soils and sediments, as well as other matrices noted in SW-846 method 8270.

3.0 Detection Limits

Method detection limits (MDLs) are determined annually and results vary from compound to compound. Water MDLs for PAH compounds analyzed in SIM mode are typically between 0.005 ug/L and 0.015 ug/L. Soil MDLs for PAH compounds analyzed in SIM mode are typically between 1.0 and 5.0 ug/kg. Procedures for conducting MDL studies can be found in CT Laboratories Initial Method Performance and Reporting SOP CL-2 Rev 7

4.0 Scope & Application

Method SW-846 8270 is used to determine the quantitation of various Polynuclear Aromatic Hydrocarbons (PAHs) in extracts from solid and aqueous matrixes. Gas Chromatography/Mass Spectrometry (GC/MS) is employed with the mass spectrometer operated in selected ion monitoring mode (SIM) in order to achieve lower detection limits. Target compounds determined by this method are listed in Table 1.0

5.0 Method Summary

5.1 This method describes procedures for isolating organic compounds through sample preparation from aqueous and soil matrices (reference methods SW846-3510, 3545 and 3546), concentration techniques that are suitable for preparing the extract, and the quantitative/qualitative analysis for the determination of target analytes by method SW846-8270.

5.2 A sample of a known volume or weight is extracted with solvent or diluted with solvent. Method applies to aqueous samples extracted by liquid-liquid separatory funnel (SW846-3510). Method applies to soil/sediment and solid waste samples extracted by standard solvent extraction methods utilizing pressurized extraction techniques as heated pressurized fluid extraction (SW846-3545) and using microwave energy to produce elevated temperature and pressure conditions in a closed vessel containing extraction solvent (SW846-3546).

5.3 The resultant extract is chemically dried and concentrated in a Kuderna-Danish (K-D) apparatus in preparation for instrumental analysis.

5.4 Extracts for PAH analysis may be subjected to cleanup measures, depending on the nature of the matrix interference and target analytes. The suggested method of cleanup is Gel

Permeation Chromatography (GPC) cleanup (Method-3640A, see attachment I). After cleanup, the extract is analyzed by injecting a known aliquot into a gas chromatograph equipped with a mass spectrometer detector operated in selected ion monitoring (SIM) mode.

5.5 Identification of target analytes is accomplished by comparing their mass spectra with the spectra of certified commercially-prepared stock standards. Quantitation is accomplished by comparing the response of a major quantitation ion relative to an internal standard using a minimum of a five point calibration curve.

6.0 Definitions

6.1 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

6.2 Laboratory Control Spike (LCS): Milli-Q water (for water) or Organic-Free Soil (for soil) is spiked with the target analytes and carried through the complete sample preparation and analytical procedure. The control spike is used to document the ability of an analyst to generate acceptable precision and bias, to verify the analytical system performance, and to document method accuracy for each matrix.

6.3 Matrix Spike (MS): An aliquot of sample spiked with a known concentration of target analytes. The spiking occurs prior to sample preparation and analysis. It is used to document the precision and bias of a method in a given sample matrix.

6.4 Matrix Spike Duplicate (MSD): Intra-laboratory split samples spiked with identical concentration of target analytes. The spiking occurs prior to sample preparation and analysis. It is used to document the precision and bias of a method in a given sample matrix.

6.5 Method Reporting Limit (MRL): The method reporting limit is a threshold value below which the laboratory reports a result as a non-detect or estimated value. The highest value reported for the method reporting limit is dependant upon project-specific action or decision levels. Method reporting limits are adjusted based on the sample matrix and any sample dilution/concentrations when necessary.

6.6 Method Detection Limit (MDL): the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero.

6.7 Method Reporting Limit (MRL) Spike or LOQ Check: An internally prepared standard at a level near the Limit of Quantitation (LOQ) or at a level specified by a specific program or contract. For LCG work MRL's are analyzed following the CCV and at the end of the 12 hour analytical sequence. An LOQ check is required after MDL studies and quarterly thereafter for QSM work. Recovery limits are required for MRL's and are usually program/contract specific. The MRL is also referred to as a CRDL (Contract Required Detection Limit).

6.8 Method Detection Limit (MDL) Check: An internally prepared standard prepared at approximately 1-4 times the calculated MDL for a given analyte. The MDL check sample

is used as verification of the calculated MDL's. Detection of the individual analytes in the MDL check is the only requirement. The MDL check is required after MDL studies and after an MRL check for LCG samples. An acceptable MDL standard check must produce signals for the qualifier ions. An MDL standard injection must be made after each major instrument repair to verify the sensitivity of the instrument.

6.9 Surrogate (SURR): Organic compound which is similar to the target analytes in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples. Its use is to monitor the performance of the extraction, cleanup (as needed), the analytical system, and the effectiveness of the method. The surrogates are: Nitrobenzene-d_5, 2-Fluorobiphenyl, and Terphenyl-d_{14}.

6.10 Initial Calibration (ICAL): An analytical instrument is said to be calibrated when an instrumental response can be related to the concentration of an analyte. This relationship is depicted graphically, and referred to as a "calibration curve". Initial calibration curves must be established based upon the requisite number of standards identified within the method for each target analyte.

6.11 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standard involves the analysis of all target analytes each time the initial calibration is performed.

6.12 Continuing Calibration Verification Standard (CCV): A standard solution that is used to check the validity of a calibration curve on a daily basis. It also provides information on satisfactory maintenance and adjustment of the instrument during sample analysis. A CCV must be analyzed at the beginning of each 12 hour shift.

6.13 DFTPP: Decafluorotriphenylphosphine. This compound is used to verify that the GC/MS is properly tuned and ready for calibration and sample analysis. To acquire the mass spectrum of DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction to eliminate column bleed or instrument background noise is accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Benzidine and Pentachlorophenol must have tailing factors less than 2. Breakdown of DDT to DDD and DDE must be less than 20%.

6.14 Internal standard (ISTD): Internal Standard quantitation involves the comparison of instrument responses from the target compounds in the sample to the responses of specific standards added to the sample extract prior to injection. The ratio of the peak area of the target compound in the sample extract to the peak area of the internal standard in the sample extract is compared to a similar ratio derived for each calibration standard. The internal standards are; 1,4-Dichlorobenzene-d_4, Naphthalene-d_8, Acenaphthene-d_{10}, Phenanthrene-d_{10}, Chrysene-d_{12} and Perylene-d_{12}.

6.15 Calibration Check Compounds (CCC): Calibration check compounds are a part of the Continuing Calibration Verification standard (CCV). The CCCs percent difference must be less than or equal to 20%.

6.16 Instrument Blanks (IB): Contamination by carryover can occur whenever high-concentration and low-concentration samples are sequentially analyzed. Whenever an

unusually concentrated sample is encountered, it should be followed by the analysis of an instrument blank (methylene chloride + Internal Standards) to check for cross-contamination.

7.0 Interferences

7.1 Solvents, reagents, glassware, and other sample processing hardware may yield artifacts and /or interferences to sample analysis. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks. Specific selection of reagents and purification of solvents by distillation in all-glass systems may be necessary. Refer to each method for specific guidance on quality control procedures.

7.2 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials

7.3 Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, may cause degradation of certain analytes.

7.4 Interferences co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interference, further cleanup of the sample may be necessary.

7.5 Mass spectrometer sensitivity, column degradation, and contamination can also contribute to background interferences. The presence of semivolatile hydrocarbons in the sample extracts may require an appropriate post analysis bake-out time to be incorporated in the method.

8.0 Safety

8.1 Safety glasses, gloves, and protective clothing: long pants, leather shoes and lab coat or apron should be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure should utilize appropriate laboratory safety systems. Follow all items in the in-house Chemical Hygiene Plan and Health and Safety Manual.

8.2 The toxicity of chemicals used in this method has not been precisely defined. Each chemical should be treated as a potential health hazard, and exposure to these chemicals should be minimized.

9.0 Equipment and Supplies

9.1 GC-MS system - Hewlett Packard 6890 GC/7683 autosampler/5973 MSD - An analytical system complete with gas chromatograph suitable for split-splitless injection and all required accessories including syringes, analytical column, mass spectrometer detector, auto sampler, electronic pressure control, vacuum pumps, and HP Chemstation data acquisition system. The data acquisition system consists of an IBM compatible PC with an operating system of Windows XP Professional and Agilent Environmental Chemstation (MSD Chemstation Rev D.03.00.611).

9.1.1 Carrier Gas: He at 1.6 mL/min, Constant Flow

Injector Temperature: 250º C
Mode: Pulsed Splitless
Inj. Volume: 0.5 uL
Pressure: 13.2 psi
Pulse Pressure: 30.0 psi
Pulse Time: 0.4 min
Purge Flow: 50.0 ml/min
Purge Time: 0.38 min
Total Flow: 53.9 ml/min
Gas Saver On: 20ml/min at 2.0 min
Oven: Initial – 45º (hold for 0.4 min)
Ramp – 35º/min
Final – 290º
Ramp – 4º/min
Final – 300º
Ramp – 30º/min
Final – 325º (hold for 2.0 min)

9.1.2 MS Interface: 300º
MS Source: 280º
SIM Parameters: See Table 1.2

9.1.3 GC Column: 30m x 0.25 mm ID, 0.25 um. (J&W DB-5.625 or equivalent).

9.2 Water bath – heated and capable of accepting a Kuderna-Danish apparatus.(GlasCol 6 position heating mantle 100DRX30424 or equivalent)

9.3 Dionex ASE 200.

9.3.1 The Dionex ASE 200 extraction cycle:

Oven temperature: 100 º C Pressure: 1500 psi
Prepurge time: 0 minutes
Static time: 5 minutes
Heat: 5 minutes
Flush volume: 60%
Nitrogen purge: 60 sec. At 150 psi
Solvent A: 100%
Method rinse: ON
Static Cycles: 1
Extraction Fluid: (7:3) Methylene Chloride:Acetone

9.4 CEM Microwave Accelerated Reaction System (MARS Xpres) extraction unit with Synergyprep software

9.4.1 The CEM Mars extraction cycle:

Method 1
8-16 samples
Power: 100% at 800 watts
Ramp Time: 15 min
Pressure: 0
Temp: 110 c
Hold Time: 15 min

Method 2
17-48 samples
Power: 100% at 1600 watts
Ramp Time: 15 min
Pressure: 0
Temp: 110 C
Hold Time: 15 min

9.5 Organomation Nitrogen blowdown concentrator. (N-Evap)

9.6 Analytical balance capable of accurately weighing to the nearest 0.01 gram (Fischer Scientific XD 2200 or equivalent).

9.7 Oven, muffle and drying.

9.8 Separatory funnel - 2000 mL glass with Teflon coated caps and Teflon stopcocks. (VWR 6099-2 or equivalent)

9.9 Aluminum foil

9.10 Separatory funnel platform shaker, variable speed (Lab-Line VWR #6000-1 or equivalent)

9.11 Kuderna-Danish (K-D) apparatus:
- 9.11.1 Concentrator tube, 10.0 mL, graduated. (Fisher # K570051-1025).
- 9.11.2 Evaporation flask- 500 mL or 250 ml (Fisher # K570035-0250).
- 9.11.3 Snyder column- Three-ball macro (Fisher # K503000-0121).
- 9.11.4 Teflon clamps to attach concentrator tube to evaporation.

9.12 Graduated cylinder (Class A TC) - 1000 mL. (Fisher 08-559G).

9.13 Beaker - 250 mL and 600 mL.

9.14 Vials - 2.0mL (National Scientific – C4000) 12mL (Kimble #60815-1965), and 60 mL screw cap vials with Teflon lined caps (C&G #LX64-A030-A01A) or equivalent

9.15 Pasteur Pipets 5 ¾" and 9" (VWR #14672-200 and -300).

9.16 Funnels – glass (VWR #154-08 or equivalent)

9.17 Volumetric flask – (Class A TC) 2, 5, 10, 25, 50, and 100 mL.

9.18 Syringes 10 uL, 25 uL, 100 uL, 500 uL, and 1,000 uL. (Hamilton or equivalent)

9.19 Boiling chips, carborundum, approximately 10/40 mesh (methylene chloride rinsed) (Fisher # 09-191-12) equivalent.

9.20 Dionex ASE 200 Filters (Restek #269190).

9.21 ASE 200 33mL extraction cells with caps (Dionex # 048763 or equivalent)

9.22 Filter- Glass Microfiber 12.5 cm (Ahlstrom, MG # F136-1250).

9.23 CEM-MARS Microwave extraction tubes with plugs and caps, 75mL (CEM #574127)

9.24 Spatulas- stainless steel. (VWR #57952-253 or equivalent)

9.25 pH indicator paper- pH 0-14. (Whatman #2613991) or equivalent. Stored in general lab storage area

10.0 Reagents and Materials

10.1 Deionized water (Milli-Q processed), analyte free or equivalent.

10.2 Sodium sulfate (granular, anhydrous 60/120 mesh, JT Baker # 3375-05) or equivalent. If sodium sulfate passes in house lot check, it can be used as is and stored in air tight glass jar. Otherwise condition sodium sulfate by heating to 400^{o}C for 4 hours in a shallow glass tray loosely covered with foil and recheck for purity. Sodium sulfate will be stored in airtight glass jars in the cabinets of the Semi-volatile extractions lab and used within one year of opening or before the manufacturer's expiration date.

10.3 Silica sand- hydrocarbon free. Purify by heating to 400^{o}C for 4 hours in a shallow glass tray, loosely covered with foil. Silica sand will be stored in airtight glass jars located on the shelves in the Semi-volatile extraction lab and used within one year of purifying

10.4 Methylene chloride, pesticide grade, analyte free. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date. Or stored in large carboy tank provided by manufacturer and used by the manufacturer's expiration date.

10.5 Acetone, pesticide grade, analyte free. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date.

10.6 Methanol, pesticide grade. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date.

10.7 Sulfuric Acid (Certified ACS)/Deionzied Water-1:1(v/v). ACS grade. Store in lab at room temperature, use within one year of mixing or before manufacturers expiration date for any reagent used. Log number recorded in Semivolatiles log book.

10.8 Sodium Hydroxide- 10 N (Certified ACS). Store in lab at room temperature, use within one year of mixing or before manufacturers expiration date for any reagent used. Log number recorded in Semivolatiles log book.

10.9 Diatomaceous earth, pelletized (Dionex # 062819) or equivlent. Stored in the cabinets of the Semi Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date

10.10 Nitrogen (4.8 rating).

10.11 Helium (4.7 rating).

11.0 Sample Collection, Preservation, and Storage

11.1 Aqueous samples are collected in 1-L amber glass containers with Teflon lined lids. Aqueous samples are to be collected in duplicate. Solid samples are collected in 250-mL wide mouth glass containers with Teflon-lined lids. All samples are preserved by cooling to 4ºC. The soil samples must be extracted within 14 days and water samples must be extracted within 7 days from the date of collection.

11.2 Sample extracts are to be stored under refrigeration in the dark and analyzed within 40 days of extraction.

11.3 All soil samples are weighed on the top loading balance which is connected to a computer so that all weights can be automatically entered into an Excel spread sheet. The spreadsheets are saved so the data can be transferred electronically to the LIMS system.

12.0 Quality Control

This SOP is designed to follow a variety of different projects and programs requirements. Table 3. is designed to illustrate the control steps and provisions required to adequately produce acceptable data.

13.0 Calibration & Standardization

13.1 Standards and spikes

13.1.1 Preparation of standards is documented in the GC/MS standards logbook. Each standard is labeled by prep date to allow for tracking. Opened stock standards expire one year or sooner if comparison with quality control check samples indicate a problem. Leftover stock standards are saved in a capped vial in the original box in the freezer. Any subsequent dilutions made from the opened vial expire six months from the original opening. The cracking date of the stock standard vial will be recorded on the label along with the six month expiration date.

13.1.2 Stock Standards – Stock Standards are purchased from vendors who provide certified solutions. Standards are stored at –10ºC in a freezer reserved for standard solutions. Unopened standard shall have the manufactures suggested expiration date. Opened stock standards expire one year or sooner if comparison with quality control check samples indicate a problem (Not to exceed the manufacturer's expiration date).The following list of stock standards are commercially prepared standards, which are certified by the manufacturer, such as;

8270 Cal Mix#6 : Restek #31622 at 2000 ug/ml
8270 Surrogate Mix BN: Restek # 31062 at 5000 ug/ml
DFTPP: Restek Part # 31615 at 1000 ug/ml

13.1.3 Intermediate Stock Standards: These standards are diluted stock standards so that the concentration levels are manageable for the preparation of working standards. The PAH intermediate standard is prepared at an optimum level for the preparation of the working stock standard. Each PAH target compound is at a concentration of 20.0 ug/ml with surrogate concentration at 20.0 ug/ml in methylene chloride. See Table 2.1.

13.1.4 Calibration standards: An initial calibration of the listed analytes in Table 1.0 is

performed using a minimum of 5 points. The following concentrations correspond to the expected range of concentrations found in real samples and should bracket the linear range of the detector. Standards are made by taking aliquots of the intermediate standard and diluting to volume in methylene chloride. The following levels are repeated across all compounds. See Table 2.2.

Level 1	20 ng/ml
Level 2	50 ng/ml
Level 3	100 ng/ml
Level 4	500 ng/ml
Level 5	1000 ng/ml
Level 6	1500 ng/ml
Level 7	2000 ng/ml

13.1.5 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standard involves the analysis of all target compounds at 500 ng/ml and at 1500 ng/mL each time the initial calibration is performed. Standards are made by taking aliquots of the ICV intermediate standard and diluting to volume in methylene chloride. The ICV stock standard is prepared in the same manner as the primary intermediate stock standard. The ICV working standard will be prepared at the time of initial calibration and should have a shelf live of one week. See Table 2.3.

13.1.6 Calibration Verification Standard (CCV): A working standard solution for 8270 at a concentration of 500 ng/ml. It is used to check the validity of a calibration curve on a daily basis. Standard is made by taking an aliquot of the intermediate standard and diluting it to volume in methylene chloride. The CCV should be prepared weekly and stored at 4ºC. See Table 2.4.

13.1.7 Internal standard solution: A Commercially prepared certified solution of 1,4-Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12} and Perylene d_{12} at 2000 ug/mL is diluted in methylene chloride to a concentration of 100 ug/mL. 5 uL is added to each 500 uL aliquot of sample extract for a final concentration of 1000 ng/mL. See Table 2.5.

13.1.8 . Surrogate standard: A commercially prepared certified solution of Nitrobenzene-d_5, 2-Fluorobiphenyl, and Terphenyl-d_{14} is diluted in methanol to produce a working surrogate solution of 1000 ng/mL. 1.0 mL is added to each sample. The surrogate concentration is normalized to 100% from the spiking solution in point 5 of the initial calibration. This will provide percent recoveries that transfer directly to LIMS. See Table 2.6.

13.1.9 Spiking standards (matrix and control samples): Prepare a spiking solution in methanol that contains target compounds for water and sediment / soil samples at a concentration of 1000 ng/mL. 1.0 ml is added to quality control and matrix spike samples. See Table 2.7.

13.1.10 DFTPP: Decafluorotriphenylphosphine solution in methylene chloride. This compound is used in tuning the GC/MS. To acquire the mass spectrum of

DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. See Table 2.8.

NOTE: All standards are stored at -10ºC. Opened stock standards expire one year or sooner if comparison with quality control check samples indicated a problem An intermediate stock standard or working standard shall not exceed expiration date criteria. All subsequent standards made from the intermediate stock standards expire on the same date as the working stock standard. If more than one standard is added to a solution the expiration date will be the same as the stock standard with the earliest expiration date

13.2 Calibration

13.2.1 The initial calibration for SW-846 chromatographic methods involves the analysis of standards containing the target compounds at a minimum of five different concentrations covering the working range of the instrument

13.2.2 For each compound and surrogate of interest, prepare calibration standards at a minimum of five different concentrations by adding volumes of one or more stock standards to a volumetric flask and diluting to volume with methylene chloride.

13.2.3 The lowest concentration calibration standard that is analyzed during an initial calibration curve establishes the method's quantitation limit based on the final volume of the sample extract described in the preparative method or employed by the laboratory.

13.2.4 Internal standard calibration involves the comparison of instrument responses from the target compounds in the sample to the response of specific standards added to the sample or sample extract prior to injection. The ratio of the peak area or height of the internal standard in the sample or sample extract is compared to a similar ratio derived for each calibration standard. The ratio is termed the response factor (RF), and is also known as a relative response factor in other methods.

13.2.4.1 Internal standards are recommended in SW846-8270. These internal standards are: 1,4-Dichlorobenzene d_4, Naphthalene d_8, Acenaphthene d_{10}, Phenanthrene d_{10}, Chrysene d_{12}, and Perylene d_{12}. The use of MS detectors makes internal standard calibration practical because the masses of the internal standards can be resolved from those of the target compounds even when chromatographic resolution cannot be achieved.

13.2.4.2 In preparing calibration standards for use with internal standard calibration, add the same amount of the internal standard solution to each calibration standard, such that the concentration of each internal standard is constant across all of the calibration standards, whereas the concentrations of the target analytes will vary. 5 uL of a solution containing the internal standards at a concentration of 100 ug/mL is added to each 500 uL of standard or sample extract. This results in an internal standard concentration of 1,000 ng/mL in the extract. The mass of each internal standard added to each sample extract immediately prior

to injection into the instrument must be the same as the mass of the internal standard in each calibration standard. The volume of the solution spiked into sample extracts is such that minimal dilution of the extract occurs (e.g., 5 ul of solution added to a 500 ul final extract results in only a negligible 0.1% change in the final extract volume which can be ignored in the calculations).

13.2.4.3 An ideal internal standard concentration would yield a response factor of 1 for each analyte. However, this is not practical when dealing with more than a few target analytes. Therefore, as a general rule, the amount of internal standard shall produce an instrument response (area counts) that is no more than 100 times that produced by the lowest concentration of the least responsive target analyte associated with the internal standard. This results in a minimum response factor of approximately 0.01 for the least responsive target compound.

13.2.5 For each of the initial calibration standards, calculate the RF values for each target compound relative to one of the internal standards as follows;

$$RF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

A_s = Peak area of the analyte or surrogate.

A_{is} = Peak area of the internal standard.

C_s = Concentration of the analyte or surrogate in ug/mL.

C_{is} = Concentration of the internal standard in ug/mL.

13.2.6 Linear calibration using the average response factor. Response factors are a measure of the slope of the calibration relationship and assume that the curve passes through the origin. Under ideal conditions, the factors will not vary with the concentration of the standard that is injected into the instrument. In practice, some variation is to be expected. However, when the variation, measured as the relative standard deviation (RSD), is less than or equal to 15%, the use of the linear model is generally appropriate, and calibration curve can be assumed to be linear and to pass through the origin. To evaluate the linearity of the initial calibration, calculate the RF, the standard deviation, and the relative standard deviation.

$$\text{Mean RF} = \overline{RF} = \frac{\sum_{j=1}^{n} RF_i}{n}$$

$$SD = \sqrt{\left(\frac{\sum_{I=1}^{n} (RF_I - \overline{RF})^2}{n-1}\right)}$$

$$RSD = \frac{SD}{\overline{RF}} \times 100$$

13.2.7 The average response factor (ARF) for all calibration levels is used when determining sample concentration and is calculated (along with the standard deviation) to evaluate the linearity of the curve (SW-846 Method 8000C sec. 11.5). When ARFs are not acceptable, results are sometimes calculated using linear (1^{st} order) regression curves and/or quadratic (2^{nd} order) curves. Internal standard quantitation is also used when generating linear and non-linear calibrations. All equations and acceptance criteria follow the examples in SW-846, Method 8000C (sec. 11.5).

13.2.8 Linear Calibration: If the RSD of the calibration factor is greater than 15% over the calibration range, then linearity though the origin cannot be assumed. If this is the case, the analyst can employ a regression equation that does not pass through the origin. This approach can also be employed based on the past experience of the instrument response. The regression will produce the slope and intercept terms for a linear equation in the form:

$$y = mx + b$$

y = instrument response (peak area or height)
m = Slope of the line
x = Concentration of the calibration standard
b = The intercept

13.2.9 The use of origin (0,0) as a calibration point is not allowed. However, most data systems and many commercial software packages will allow the analyst to "force" the regression through zero. This is not the same as including the origin as a fictitious point in the calibration. It can be appropriate to force the regression through zero for some calibrations (SW-846 Method 8000C sec. 11.5.2.1). The use of linear regression cannot be used as a rationale for reporting results below the calibration range.

13.2.10 Non-Linear Calibration: In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches described here have not met the acceptance criteria, a non-linear calibration model can be employed. When using a calibration model for quantitation, the curve must be continuous, continuously differentiable and monotonic over the calibration range. The model chosen shall have no more than four parameters, i.e., if the model is polynomial, it can be no more than third order as in the equation:

$$y = ax^3 + bx^2 + cx + d$$

13.2.11 The statistical considerations in developing a non-linear calibration model require more data than the more traditional linear approaches described above. Linear regression employs five calibration standards for the linear model, a quadratic model requires a minimum of six calibration standards. The coefficient

of determination (COD) is calculated as follows:

$$COD = \frac{\sum_{i=1}^{n} (y_{obs} - \bar{y})^2 - \left(\frac{n-1}{n-p} \right) \sum_{i=1}^{n} (y_{obs} - Y_i)^2}{\sum_{i=1}^{n} (y_{obs} - \bar{y})^2}$$

y_{obs} = Observed response (area) for each concentration of the calibration curve.

$\bar{y}$ = Mean observed response from the initial calibration.
Y_I = Calculated response at each concentration from the initial calibrations.
n = Total number of calibration points (6 points for quadratic equation).
p = Number of adjustable parameters in the polynomial.

13.2.12 Under ideal conditions, with a "perfect" fit of the model to the data, the coefficient of the determination will equal 1.0 In order to be an acceptable non-linear calibration, the COD must be greater than or equal to 0.99. Weighting in a calibration model can significantly improve the ability of the least squares regression to fit the data calibrations (SW-846 Method 8000C sec. 11.5.3).

13.3 Calibration Criteria

13.3.1 Before analysis of any samples or standards can begin, the GC/MS system must be hardware tuned so an injection of Decafluorotriphenylphosphine (DFTPP, 50 ng or less) passes the tuning criteria listed in Table 3. These criteria must be demonstrated each 12-hour shift during which samples are analyzed.

13.3.2 To acquire the mass spectrum of DFTPP, three scans (the peak apex scan and the scans immediately preceding and following the apex) are acquired and averaged. Background subtraction to eliminate column bleed or instrument background noise is accomplished using a single scan acquired no more than 20 scans prior to the elution of DFTPP.

13.3.3 The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD must not exceed 20%. Benzidine and Pentachlorophenol shall be present at their normal responses and peak tailing shall be evaluated. Benzidine and Pentachlorophenol must have tailing factors less than 2.

13.3.4 Calibration Standards - Calibration standards are prepared at a minimum of five concentration levels and are prepared from the intermediate stock standards. One of the concentration levels shall be at a concentration near, but above, the detection limit and at or below the reporting limit. The remaining concentration levels shall correspond to the expected range of concentrations found in real samples and shall

contain each analyte for detection by this method. If the measured relative standard deviation (RSD) is less than or equal to 15%, the use of the linear model is generally appropriate, and calibration curve can be assumed to be linear and to pass through the origin. Linear Calibration: If the RSD of the calibration factor is greater than 15% over the calibration range, then linearity though the origin cannot be assumed. In this case, the analyst can employ a regression equation that does not pass through the origin. This approach can also be employed based on the past experience of the instrument response. The regression will produce the slope and intercept terms for a linear equation. In situations where the analyst knows that the instrument response does not follow a linear model over a sufficiently wide working range, or when the other approaches described here have not met the acceptance criteria, a non-linear calibration model can be employed. When using a calibration model for quantitation, the curve must be continuous, continuously differentiable and monotonic over the calibration range.

13.3.5 Calibration Check Compounds (CCC) are part of the Initial calibration and the continuing calibration verification standard (CCV). In the initial calibration curve, the percent RSD of the CCCs must be less than or equal to 30%. A CCV must be analyzed during each 12 hour shift. The CCCs in the CCV must have a percent drift less than or equal to 20%.

13.3.6 Initial Calibration Verification (ICV): The initial calibration verification standard (different lot # or manufacturer from the initial calibration standard) shall verify the initial calibration curve. The initial calibration verification standard involves the analysis of all target analytes each time the initial calibration is performed. The percent drift of the CCCs must be less than or equal to 20%.

13.3.7 Calibration Verification Standard (CCV): A standard solution that is used to check the validity of a calibration curve on a daily basis. It also provides information on satisfactory maintenance and adjustment of the instrument during sample analysis. The percent difference of the CCCs must be less than or equal to 20%.

13.3.8 The relative retention time (RRT) of each compound in each calibration standard shall agree within 0.06 RRT units.

14.0 Procedure

14.1 Water Extraction (Method SW-846, 3510)

14.1.1 Pre-rinse all glassware to be used in the extraction with methylene chloride (Pesticide Grade).

14.1.2 Mark the meniscus on the bottle for later determination of sample volume (see sec 11.1.11). From the glass sample collection bottle, quantitatively transfer sample into a 2 liter separatory funnel.

14.1.3 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare each by adding one liter of Milli-Q water to 2 liter separatory funnel.

10.1.1 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). In order of preference:

1) Select the sample where two full volume extra matrix was provided; use the extra volume supplied for a full volume MS and MSD.

2) Select a sample where one extra sample bottle was provided; quantitatively transfer half of the extra sample into a 2 liter separatory funnel and label MS. Transfer the other half of the sample into another 2 liter separatory funnel and label MSD.

3) Select a sample where no extra sample but the amount of sample used is 1/3 of the normal volume; quantitatively transfer 1/3 of the sample into a separatory funnel, 1/3 into a second separatory funnel and label MS, and lastly transfer the last 1/3 of the sample into another separatory funnel and label MSD.

If there is insufficient sample to perform a matrix spike/matrix spike duplicate, the associated samples must be qualified. For the last two situations concerning sacrificing a sample volume versus the inability to run a MS/MSD contact the project manager for proper procedure.

14.1.4 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the 8270 SIM surrogate standard mix by using a 1.0 ml syringe. In addition, add 1.0 mL of the 8270 SIM. spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.1.5 Add 60 mLs of methylene chloride to the sample's separatory funnel. Extract the sample shaking vigorously for two minutes, venting frequently.

14.1.6 Allow the organic layer to separate from the water phase for a minimum of 10 minutes. Decant the lower layer into a 250 ml beaker. If the emulsion interface between layers is more than one-third the size of the solvent layer, the analyst must employ mechanical techniques to complete the phase separation. The optimum technique depends upon the sample and may include stirring, filtration of the emulsion through glass wool, centrifugation, or other physical methods.

14.1.7 Repeat the extraction two more times using fresh 60 mL portions of methylene chloride.

14.1.8 Determine the sample volume by filling the sample bottle to the mark (11.1.2) with water and transferring it to a "Class A" 1 liter graduated cylinder for measurement. Note all sample volumes on the extraction bench sheet.

14.1.9 Refer to section 11.4 for sample concentration.

14.2 **Soil Extraction (Method SW-846, 3545) ASE Extraction**

14.2.1 Preparing the extraction cell for use: Wash extraction tube with soap and DI water, rinse with methanol. Then dip extraction tube in Methylene chloride to

remove any remaining residue. Rinse caps with Methanol, place in 100°C oven overnight, cool and sonicate; first in Acetone for 20 minutes and then in Methylene Chloride for 20 minutes. Attach the matching screw fit tube cap of the soil extraction vessel to the end of the tube. Using a filter rod, push 1 Dionex ASE filter through the open end of the tube until they reside flush on the bottom of the screwed end.

14.2.2 Decant and discard any water layer on a sediment sample. Mix sample thoroughly, especially composite samples. Discard any foreign objects such as sticks, leaves, and rocks.

14.2.3 Dry sediment/soil and dry waste samples amenable to grinding: Grind or otherwise reduce the particle size of the waste so that it either passes through a 1mm sieve or can be extruded through a 1mm hole. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make sample more amenable to grinding.

14.2.4 Gummy, fibrous, or oily materials not amenable to grinding should be cut, shredded, or otherwise reduced in size to allow mixing and maximum exposure of the sample surfaces for the extraction. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make sample easier to mix.

14.2.5 (Refer to SOP FO-10 for subsampling guidance). Weigh approximately 10 g of sample to the nearest 0.01 g into a 250-mL beaker and record the final weight. Add 2.5 g of diatomaceous earth to the sample. Mix well. The samples should be a free flowing powder. If sample is not free flowing add more diatomaceous earth until the sample has a dry texture. This powder is so mixed that it will allow the sample to pass through a 2 mm sieve.

14.2.6 Transfer the ground sample to an extraction cell of appropriate size for the aliquot.

14.2.7 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare by adding 10g of sand and 2.5g of diatomaceous earth to a clean 250 ml beaker. Transfer sample to extraction cell.

14.2.8 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). Select the sample and transfer approximately 40 grams to a 250 ml beaker. Mix well. Weigh two individual 10 grams aliquots of sample. Add drying agent. Transfer each 10 gm aliquot to separate sample extraction cells. If there is no sample available to perform a matrix spike/matrix spike duplicate, contact project management. The default QC is a laboratory control spike duplicate.

14.2.9 Fill the void in each of the extraction cells with clean sand.

14.2.10 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the 8270 SIM surrogate standard solution by using a 1.0 ml syringe. In addition, add 1.0 mL 8270 SIM spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.2.11 Attach the other cap to the other end of the extractor cell, making sure the tube is sitting flush on a hard surface so that no particulates get caught in the threads of the tube cap.

14.2.12 Place the extractor tube, filtered end down, on the Dionex ASE top wheel. Place an appropriately labeled empty 60 mL VOA collection vial on the matching position on the bottom wheel. Schedule the Dionex ASE 200 and begin the cycle.

14.2.13 The Dionex ASE 200 extraction cycle:

Oven temperature: 100 º C Pressure: 1500 psi
Prepurge time: 0 minutes
Static time: 6 minutes
Heat: 5 minutes
Flush volume: 65%
Nitrogen purge: 60 sec. At 150 psi
Solvent A: 100%
Method rinse: ON
Static Cycles: 1
Extraction Fluid: (70:30) methylene chloride : acetone

14.2.14 Refer to section 11.4 for sample concentration.

14.3 **Soil Extraction (Method SW-846, 3546) Microwave extraction**

14.3.1 Preparing the extraction tubes for use: extraction tubes, caps and plugs are washed in the dishwasher, rinsed with Methanol and baked in 110 C oven for 1 hour. After they have cooled, rinse the extraction cell (tubes, plugs and caps) with Methylene chloride.

14.3.2 Decant and discard any water layer from sediment sample. Mix sample thoroughly, especially composite samples. Discard any foreign objects such as sticks, leaves, and rocks.

14.3.3 Dry sediment/soil and dry waste samples amenable to grinding: Grind or otherwise reduce the particle size of the waste so that it either passes through a 1-mm sieve or can be extruded through a 1-mm hole. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make the sample more amenable to grinding. Dry samples as much as possible, as water will cause un-even heating of the tubes.

14.3.4 Gummy, fibrous, or oily materials not amenable to grinding, shall be cut, shredded, or otherwise reduced in size to allow mixing and maximum exposure of the sample surfaces for the extraction. The addition of a drying agent (e.g. sodium sulfate or diatomaceous earth) can make the sample easier to mix. Wipe samples can be placed directly into the cell.

14.3.5 Weigh approximately 10 g of sample to the nearest 0.01 g in a 250-mL beaker and record the final weight. Add 2.5 g of diatomaceous earth to the sample. Mix well. The samples shall be a free flowing powder. If sample is not free flowing, add more diatomaceous earth and/or sodium sulfate until the sample has a dry

texture. This powder is mixed so that it will allow the sample to pass through a 1 mm sieve.

14.3.6 Transfer the ground sample in a 75 mL extraction cell. There should be a minimum head space of 25%.

14.3.7 One method blank and laboratory control spike must be prepared with each batch of 20 samples or less. Prepare by adding 10g of sand and 2.5g of diatomaceous earth to a clean 250 ml beaker. Transfer sample to extraction cell.

14.3.8 One sample from each batch of 20 samples or less must be selected for use in the preparation of a matrix spike (MS) and matrix spike duplicate (MSD). Select the sample and transfer approximately 40 grams to a 250 ml beaker. Mix well. Weigh two individual 10 grams aliquots of sample. Add drying agent. Transfer each sample aliquot to separate extraction cells. If there is no sample available to perform a matrix spike/matrix spike duplicate, contact project management. Default QC is a laboratory control spike duplicate.

14.3.9 To the method blank, matrix spike/matrix spike duplicate, laboratory control spike, and all samples add 1.0 mL of the 8270 SIM surrogate standard mix by using a 1.0 ml syringe. In addition, add 1.0 mL of the 8270 SIM spiking solution to the matrix spike/matrix spike duplicate and laboratory control spike (laboratory control spike duplicate).

14.3.10 Add 20 ml of (1:1) methylene chloride: acetone extraction solution to each tube. Insert tube plug and attach the cap to the extractor cell, making sure the cap is straight, screw on and torque with wrench. **Shake each tube for 30 seconds to ensure the soil is mixed with the extraction solvent.**

14.3.11 Place the extractor tube on the carousel in the appropriate slots for the number of tubes being used. Less than 16 use inside ring, greater than 16, use the outside ring then fill in the inside ring. Schedule CEM Mars and begin the cycle. (NOTE: There must be a minimum of 8 samples, if less, use sand/solvent blanks to make up the shortage.)

14.3.12 The CEM Mars extraction cycle:

Method 1
8-16 samples
Power: 100% at 800 watts
Ramp Time: 15 min
Pressure:0
Temp:110 C
Hold Time: 15 min

Method 2
17-48 samples
Power: 100% at 1600 watts
Ramp Time: 15 min
Pressure:0
Temp:110 C
Hold Time: 15 m

14.3.13 Samples need to be shaken for 30 seconds to ensure sample residue is removed from tube wall prior to being poured out for concentration. Refer to section 11.4 for sample concentration.

14.4 **Sample Concentration**

14.4.1 Place glass microfiber filter paper into a glass funnel. Fill the filter paper two-thirds of the depth with Na_2SO_4. Rinse filter paper, Na_2SO_4, funnel, K-D apparatus, and concentrator tube with methylene chloride.

14.4.2 Quantitatively pour the extract through the filter and funnel seated on a 250mL Kuderna-Danish (K-D) apparatus complete with concentrator tube. For Microwave extraction, shake tube for 30 seconds then pour both the extraction solution and sample matrix from the microwave tube into the funnel and filter paper seated on the K-D apparatus, being careful to not allow the extract to splash out of the funnel as the sample matrix pours into it. Rinse the beaker, VOA vial or Microwave tube three times with methylene chloride. Add these rinses through the filter and funnel into the K-D apparatus. Add a boiling chip to the K-D flask prior to placing it on the heated water bath. Wet a three ball Synder column with approximately 2-mL of methylene chloride. Attach the Synder column.

14.4.3 Place the K-D in the heated water bath so the concentrator tube is immersed in the water and the lower rounded surface of the K-D is bathed in steam. At the proper rate of distillation the balls of the column will actively chatter, but the chambers will not flood (set the knob of the temperature control to 5~6). It is critical that the analyst watch the extract as it distills. THE EXTRACT SHOULD NOT GO TO DRYNESS.

14.4.4 When the extract volume reaches approximately 5-7 mL, remove the K-D from the bath. Slightly tilt the apparatus and rotate to aid in solvent drainage from the Snyder column. Allow it to cool completely.

14.4.5 Remove the Snyder column, rinse the ground glass joints with a small amount of methylene chloride and then remove K-D flask. Turn on the heating unit for the Organomation. The water bath should be about 35ºC. Place sample concentrator tube into the nitrogen blow down apparatus. Allow a gentle stream of nitrogen to interact with the extract. There should be no splashing or excessive movement upon the surface of the extract. Allow the extract to evaporate down to 0.8 ml. Remove concentrator tube from water bath and by using a Pasteur pipet, bring sample extract up to 1.0 ml volume with methylene chloride.

14.4.6 Transfer the 1 mL of the extract to a labeled amber screw-cap injection vial. Record the final extract on the injection extraction bench sheet.

14.4.7 The sample extract is now ready for analysis. If samples are not analyzed immediately store the sample extract in a freezer.

14.4.8 Sample may require cleanup prior to analysis. Refer to attachments I, II, or III for sample cleanup options.

15.0 Data analysis and Calculations

15.1 Sample Sequence

15.1.1 It is highly recommended that sample extracts be screened on a GC/FID to protect the GC/MS system from unexpectedly high concentrations of organic compounds.

15.1.2 Allow the sample extract to warm to room temperature. Just prior to analysis, add 5 ul of the internal standard solution to 0.5 ml of the concentrated sample extract obtained from sample preparation. Alternatively, 2 uL of internal standard solution is added to 0.2 mL of sample extract in a vial insert.

15.1.3 Before initial calibration or sample analysis a priming standard can be injected at a level up to twice the highest linearity point.

15.1.4 Before analysis of any samples or standards can begin, the GC/MS system must be hardware tuned so an injection (50 ng or less) of Decafluorotriphenylphosphine (DFTPP) passes the tuning criteria listed in Table 3. The DFTPP standard must also contain Pentachlorophenol, Benzidine, and DDT to assess GC column performance and injection port inertness. Degradation of DDT to DDE and DDD must not exceed 20%. Benzidine and Pentachlorophenol shall be present at their normal responses and peak tailing evaluated. Benzidine and Pentachlorophenol must each have tailing factors less than 2. These criteria must be demonstrated each 12-hour shift during which samples are analyzed.

15.1.5 Verify calibration each twelve hour shift by injecting a Continuing Calibration Verification standard (CCV), containing target analytes, prior to conducting any sample analysis. A CCV must be injected at the begining of each twelve hour shift following the DFTPP tune. The percent drift of the CCCs must be less than or equal to 20%. If the percent difference or percent drift for a compound is less than or equal to 20%, then the initial calibration for that compound is assumed to be valid.

15.1.6 The internal standard responses and retention times in the CCV standard must be evaluated as soon as is practical after data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the last calibration check, the chromatographic system must be inspected for malfunctions and corrections must be made, as required. If the extracted ion chromatographic profile area for any of the internal standards changes by a more than a factor of two (-50% to +100%), when compared to the CCV level from the calibration, then the mass spectrometer must be inspected for malfunctions and corrections must be made. Reanalysis of CCVs and associated samples while the system was malfunctioning is necessary. The retention times and standard reference spectra in the method are updated from the CCV for each 12 hour sequence.

15.1.7 Samples can be directly injected after the successful analyses of the initial calibration curve, ICV, DFTPP, and CCV. There can be up to 20 samples in an analytical batch. A matrix spike/matrix spike duplicate and laboratory control spike must be analyzed with every analytical batch. Recoveries shall be compared to laboratory generated QC limits or client specified limits for all surrogate, matrix spike/matrix spike duplicate and laboratory control spike

injections. Some sample extracts will potentially require clean-up procedures. Refer to attachment I.

15.2 Sample Calculations

15.2.1 Re-arranging the equation from sec. 10.1.5 to calculate the "as-analyzed" value yields:

$$C_s = \frac{A_s \times C_{is}}{A_{is} \times RF}$$

RF = Average Response Factor
A_s = Peak area of the analyte or surrogate.
A_{is} = Peak area of the internal standard.
C_s = Concentration of the analyte or surrogate in ug/mL.
C_{is} = Concentration of the internal standard in ug/mL.

15.2.2 Once the target components of the extract have been identified and quantitated, the "as-analyzed" value is converted to the "as-received" concentration as follows:

Water Matrix:

$$\frac{(ug/mL\ injected)\ x\ (mL\ extract\ \ final\ volume) x (dilution factor)}{(volume\ of\ \ sample\ extracted, in\ L)} = \mu g/L$$

Soil Matrix:

$$\frac{(ug/mL\ injected)\ x\ (mL\ extract\ \ final\ volume) x (dilution factor)}{(weight\ of\ \ sample\ extracted, in\ g)} = ug/g$$

16.0 Method Performance

16.1 Certified standard solutions, properly maintained instrumentation, and analyst experience and expertise are critical elements in producing accurate results. Standards and instrument performance are continually checked by analyzing external performance test samples provided by the appropriately accredited agencies. Internal blind spikes are also utilized to check analyst performance.

16.2 Initial demonstration of capability (IDC) is another technique used to ensure acceptable method performance. An analyst must demonstrate initial precision and accuracy through the analysis of 4 laboratory control spikes for each matrix and sample type. After analysis, the analyst calculates the average recovery (x) in µg/L and the relative standard deviation (RSD) of the recovery 8270 target compounds. In addition to each set of IDCs, a blind laboratory spike will be performed. In the absence of specific criteria found in the SW-846 methods or project specific limits, the default criteria of 70-130% recovery and 20 % RSD are used until internal limits are generated (Method 8000, sec. 8.4.9).

16.2.1 The procedure for the preparation of IDCs is found in SOP FO-11.

16.3 Many programs (i.e. USACOE) require the analysis of method reporting limit (MRL) standards and method detection limit (MDL) check samples as another means of checking method performance. The MRLs are analyzed at the beginning and end of each 12 hour shift

and are typically prepared at concentrations equal to the lowest standard on the calibration curve. Recovery limits are program specific but are usually set at 70-130%. The MDL check sample is usually spiked at approximately 2x the method detection limit. The MDL check sample is analyzed quarterly (as a minimum) to confirm instrument sensitivity (e.g. to verify that the method detection limits are still achievable). The MDL check samples are taken through all preparation and extraction steps used for actual samples (e.g. spiking/preserving control sand for soil samples). In most instances, a method detection limit check sample is analyzed at the end of each sequence requiring an MRL standard. The recovery criteria for MDL check samples are the ability to detect all compounds. If any given compound is not detected, the MDL check is spiked at a higher level and analyzed again. Detection limits for those compounds not detected on the initial MDL check analysis need to be raised to match the MDL check analysis at which they were detected. For some programs (i.e. LCG) the MDL check that is analyzed after an MRL standard is not extracted.

16.4 Creating and monitoring control charts is also important for maintaining and improving method performance. Currently all SURR, MS, MSD, and LCS recoveries are monitored with the use of the LIMS system. Note: Information on in-house recovery limits and RPDs are generated through StarLIMS. The information tables are stored in H:\Quality Systems\QC\charting. The data collected is used to recognize trends in recovery performance, as well as for generating new in-house QC limits. Default accuracy limits of 70-130 % recovery and a precision limit 20 % RSD are used until enough data points are generated to provide usable internal limits. Client and/or Project specific limits are also used frequently in sample analyses. The Quality Control Requirements chart (Table 4) also lists recovery limits specific to the method/project/program.

17.0 Pollution Prevention

17.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Whenever feasible, laboratory personnel shall use pollution prevention techniques to address their waste generation.

17.2 The quantity of chemicals purchased shall be based on expected usage during its shelf life and disposal cost of unused material. Actual reagent preparation volumes shall reflect anticipated usage and reagent stability.

18.0 Data Assessment & Acceptance Criteria for QC Measures

18.1 If the response for any quantitation ion exceeds the initial calibration range of the GC/MS, the sample extract must be diluted and reanalyzed. Additional internal standards must be added to the diluted extract to maintain the same concentration as in the calibration standards.

18.1.1 Samples suspected of containing high levels of contamination or samples with known historical data may need to be diluted prior to analysis. Multiple dilutions may be needed to cover the entire working range of the current calibration.

18.2 The qualitative identification of compounds determined by this method is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. The reference mass spectrum must be generated by the laboratory using the conditions of this method (SW-846-8270). The mass spectral library is updated with each new calibration and is continually updated with the mass spectra from CCVs. The characteristic ions from the reference mass spectrum are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. Compounds are identified when the following criteria are met.

18.2.1 The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other. Selection of a peak by a data system target compound search routine where the search is based on the presence of a target chromatographic peak containing ions specific for the target compound at a compound-specific retention time will be accepted as meeting this criterion.

18.2.2 The relative retention time (RRT) of each compound in each calibration standard agree within 0.06 RRT units.

18.2.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum.

18.2.4 Structural isomers that produce very similar spectra are identified as individual isomers if they have sufficiently different GC retention times. Sufficient GC resolution is achieved if the height of the valley between two isomeric peaks is less than 25% of the sum of the two peak heights. Otherwise, structural isomers are identified as isomeric pairs. Diastereomeric pairs that are separable by the GC are identified, quantitated and reported as the sum of both compounds by the GC.

18.2.5 Identification is hampered when sample components are not resolved chromatographically and produce mass spectra containing ions contributed by more than one analyte. When gas chromatographic peaks obviously represent more than one sample component (i.e., a broadened peak with shoulder(s) or a valley between two or more maxima), appropriate selection of analyte spectra and background spectra are important. Examination of extracted ion current profiles of appropriate ions can aid in the selection of spectra and in qualitative identification of compounds. When analytes co elute (i.e., only one chromatographic peak is apparent), the identification criteria can be met, but each analyte spectrum will contain extraneous ions contributed by the co eluting compound.

18.3 For samples containing components that are not a part of the normal target list, a library search may be required for the purpose of tentative identification. Tentatively identified compounds (TICs) are needed only when requested or required by a particular project or program. Data system library search routines shall not use normalization routines that would misrepresent the library or unknown spectra when compared to each other. Use the following as guidance for reporting TICs.

18.3.1 Relative intensities of major ions in the reference spectrum (ions greater than 10% of the most abundant ion) shall be present in the sample spectrum.

18.3.2 The relative intensities of the major ions agree within ± 30%.

18.3.3 Molecular ions present in the reference spectrum shall be present in the sample spectrum

18.3.4 Ions present in the sample spectrum but not in the reference spectrum shall be checked for possible background contamination. They shall also be reviewed for possible co elution with another compound.

18.3.5 Ions present in the reference spectrum but not in the sample spectrum shall be checked against the possibility of subtraction from the sample spectrum due to background contamination or co-eluting peaks. Some data reduction programs can create these discrepancies

18.4 Once a compound has been identified, the quantitation of that compound will be based on the integrated abundance of the primary characteristic ion from the extracted ion chromatographic profile. Quantitation is performed by the data system using the internal standard technique. The internal standard used shall be the one listed in Table 1.2. Quantitation is performed using the RF averages from the initial calibration and not the continuing calibration check (CCV).

18.4.1 Where applicable, the concentration of any non-target analytes (TICs) identified in the sample shall be estimated. The same formulas that are used for targe comounds are used with the following modifications: The areas A_x and A_{is} are from the total ion chromatograms, and the RF for the compound is assumed to be one.

18.4.2 The resulting TIC concentration is reported indicating: (1) that the value is an estimate, and (2) which internal standard was used to determine concentration. Use the nearest internal standard free of interferences.

18.5 **Reporting Quantitative Analysis**

18.5.1 When the analysis of an analytical batch or sequence has been completed, the data is processed and prepared for reporting. Once the standard retention times and mass ions are compared to the sample retention times, the sample data can be reported. Assessments of all spiked and calibration control samples and standards shall also be finalized before reporting the data.

18.5.2 When the analyst has finished processing the analytical batch, the results are electronically transferred to the LIMS system where weight to volume corrections, dilution factors and percent solids adjustments are made. Once the final results have been verified, a checklist (Table 4) is filled out and signed confirming that all the data has been thoroughly scrutinized. At this point the data is turned over to another qualified analyst for final validation. The second analyst confirms the results and electronically marks them validated and signs the checklist. Finally, the validated results are made available to the client services personnel in order for the data to be given to the client or appropriate agencies.

18.5.3 An electronic copy of the data is then filed and archived. The package includes; the sequence run log, checklist, bench sheet copy, the LIMS run log, verification of calibration data and chromatograms/quant reports. All the data is e-initialed and dated by the analyst. Each sequence file header is labeled with the date of sequence.

19.0 Corrective Measures for Out-of-Control Data

When data is out of control, a number of corrective actions may need implementing. If the nonconformities involve failing QC within the analytical sequence batch, then reanalysis of samples may eliminate any out of control data. If the out of control data is the result of instrument malfunctions, then maintenance or repair of the downed instrument followed by reanalysis of affected data may correct the problem. If sample matrix affect or contamination is the reason for poor data, the instrument may need cleaning and decontamination, and the sample may need diluting to reduce matrix affect. In all cases, when out of control data presents itself, the appropriate corrective measures need to be enacted to eliminate unusable data. The Quality Control Requirements chart can be used as a guide as to which corrective actions are to be taken for different QC-type failures or nonconformities (Table 4).

20.0 Contingencies for Handling Out-of-Control or Unacceptable Data

20.1 Due to limited sample volume, expiration of hold times, downed instrumentation, and analyst error, the sample data has the potential to be out of control or unacceptable to report. Since these potential instances can arise, contingency plans need to be in place to prevent and/or minimize their effect on data.

20.2 The first thing addressed is prevention of producing unacceptable data. When limited sample volume is the issue, the analyst shall determine if splitting the sample into lesser volumes or weights is an option. To avoid sample hold time issues, the analyst's first responsibility is to plan accordingly. The analyst is responsible for budgeting enough time for sample analysis, so if a problem arises, reanalysis is an option. Loss of data due to downed or malfunctioning instrumentation can be addressed with the use of backup instrumentation. If an instrument becomes unusable, the samples shall be analyzed on a different instrument system. Analyst error is prevented by a second analyst confirmation and validation. If the initial analyst makes an analysis error or inadvertently reports unacceptable data, the second analyst is responsible for finding and/or correcting those errors

20.3 When out of control or unacceptable data is produced and it is too late for corrective measures, a number of actions can be taken. The first and foremost is alerting the client service personnel of the problem. Client services will inform the client and/or responsible parties. In some instances, more sample can be made available or re-sampling can occur, so it is important to alert the appropriate personnel as soon as possible.

20.4 If the out of control data affects only specific analytes, it is important to let the appropriate person(s) know in case his or her site assessment is based on a specific target analyte list.

20.5 In all instances, if results are reported from data that is out of control or unacceptable, that data must be qualified accordingly. Once the client has been notified and he or she instructs us to report the data, then flag the data indicating what type of nonconformity has occurred.

20.6 Out of control data is still retained by the laboratory and filed and archived along with acceptable data. The file folder shall be labeled as such, indicating that the data is out of control.

20.7 A non-conformance/corrective action report (CAR) form must be filled out whenever these types of events occur. The information on the report includes the problem encountered, planned corrective actions, and corrective action follow-up. The form is then discussed with and signed by the analyst, the client representative, the QA officer, and the laboratory manager. The purpose of the form is to document problems in order to eliminate the possibility of repeating nonconformance and to ensure that the proper corrective actions are employed.

21.0 WASTE MANAGEMENT

Samples are routinely held (refrigerated) for up to six weeks from analysis date before they enter the waste stream. Waste disposal of samples and standards follows the procedures documented in the Laboratory Waste Disposal SOP (Quality Assurance Section, SOP NO. FO-8, Rev. 4).

22.0 Equipment/Instrument Maintenance, Computer Hardware & Software & Troubleshooting

22.1 All maintenance and troubleshooting is documented in a Maintenance Logbook designated for a particular instrument setup. Documentation shall include problem encountered and corrective action or maintenance performed (including replacement of parts). If outside service is required a copy of the maintenance invoice is to be included in the Maintenance Logbook. Date of maintenance or repair along with analyst initials is also documented.

22.1.1 Check the specific instrument's Maintenance Logbook to determine if the current problem has occurred in the past. If the problem has previously occurred, the workaround or fix should have been documented. Follow the instructions for repairing the problem, document and proceed with the analysis.

22.1.2 If review of the Maintenance Logbook yields no resolution to the problem, review the specific instrument/software manual for repair/ workaround options. If a solution is presented in the manual, proceed with the repair, document in the Instrument Run/Maintenance log book and continue with the analysis.

22.1.3 If neither the Maintenance Logbook nor the specific instrument/software manual results in a solution to the problem, contact your supervisor for help in resolving the issue. This may

involve contacting the vendor. Refer to the specific instrument/software manual for contact information.

22.2 Troubleshooting – Computers

22.2.1 Computers cannot be diagnosed or repaired in the laboratory. If it has been previously determined that the current problem cannot be resolved with a hardware or software fix, contact your IS representative for repair or replacement. Document the problem resolution in the Instrument Maintenance log book.

23.0 References

23.1 USEPA, SW-846, Method 8000C, Rev. 3, March 2003.
23.2 USEPA, SW-846, Method 8270C, Rev. 3, December 1996.
23.3 USEPA SW-846, Method 3510C, Rev 3, December 1996.
23.4 USEPA SW-846 Method 3545A, Rev 1, February 2007.
23.5 USEPA SW-846 Method 3546, Rev 0, February 2007.
23.6 USEPA SW-846 Method 3640A, Rev 1, September 1994.
23.7 USEPA SW-846 Method 3650B, Rev 2, December 1996.
23.8 USEPA SW-846 Method 3620C Rev 3, February 2007.
23.9 USEPA SW-846 Method 3630C Rev 3, December 1996.
23.10 Department of Defense, Quality Systems Manual for Environmental Laboratories, DoD Environmental Data Quality Workgroup, Department of Navy, Lead Service, Based on NELAC Voted Revision 5 June 2003, Version 4.1, April 22,2009.
23.11 Louisville Chemistry Guideline (LCG), US Army Corps of Engineers-Louisville District, June 2002.

24.0 Tables, Diagrams, Flowcharts, and Validation Data

Table 1.0
8270 SIM PAH Compound List

Codes (Tables 1):
S = Surrogates
I = Internal Standards
TM= Target Compounds
CCC= Calibration Check Compounds

PK#	Compound	Retention Time	Relative RT	Primary Ion	Secondary Ion	Code
1	1,4-Dichlorobenzene d_4	3.310	1.00	152		I
2	Naphthalene d_8	4.128	1.00	136		I
3	Nitrobenzene d_5	3.654	0.885	82		S
4	Naphthalene	4.143	1.001	128	127	TM
5	2-Methylhaphthalene	4.613	1.117	142	141	TM
6	1-Methylnaphthalene	4.682	1.134	142	141	TM
7	Acenaphthene d_{10}	5.344	1.00	164		I
8	2-Fluorobiphenyl	4.865	0.910	172		S
9	Acenaphthylene	5.247	0.982	152	151,153	TM
10	Acenaphthene	5.366	1.004	153	152	CCC
11	Fluorene	5.732	1.072	166	165	TM
12	Phenanthrene d_{10}	6.400	1.00	188		I
13	Phenanthrene	6.414	1.002	178	176	TM
14	Anthracene	6.451	1.008	178	176	TM
15	Fluoranthene	7.256	1.134	202	101	CCC
16	Chrysene d_{12}	8.411	1.00	240		I
17	Pyrene	7.423	0.882	202	101	TM
18	Terphenyl d_{14}	7.519	0.894	244		S
19	Benzo(a)anthracene	8.400	0.999	228	226	TM
20	Chrysene	8.438	1.003	228	226	TM
21	Perylene-d_{12}	10.148	1.000	264		I
22	Benzo(b)fluoranthene	9.626	0.948	252	125	TM
23	Benzo(k)fluoranthene	9.633	0.949	252	125	TM
24	Benzo(a)pyrene	10.072	0.993	252	125	CCC
25	Indeno(1,2,3-cd)pyrene	11.407	1.124	276	138	TM
26	Dibenz(a,h)anthracene	11.429	1.126	278	139	TM
27	Benzo(g,h,i)perylene	11.735	1.156	276	138	TM

Table 1.1
Internal Standard For Each Target Compound

1,4-Dichlorobenzene d_4	**Naphthalene d_8**	**Acenaphthene d_{10}**	**Phenanthrene d_{10}**	**Chrysene d_{12}**	**Perylene d_{12}**
	Nitrobenzene d_5	2-Fluorobiphenyl	Phenanthrene	Pyrene	Benzo(b)fluoranthene
	Naphthalene	Acenaphthylene	Anthracene	Terphenyl d_{14}	Benzo(k)fluoranthene
	2-Methylnaphthalene	Acenaphthene	Fluoranthene	Benzo(a)anthracene	Benzo(a)pyrene
	1-Methylnaphthalene	Fluorene		Chrysene	Indeno(1,2,3-cd)pyrene
					Dibenz(a,h)anthracene
					Benzo(g,h,i)perylene

Table 1.2
Method SIM MS Parameters

	Compounds	Start Time	m/z	dwell
1	1,3	2.20	82,152	50
2	2,4	3.95	82,127,128,136	50
3	5,6,8	4.40	141,142,172	100
4	9,7,12	5.10	151,152,153,164	50
5	11	5.55	165,166	100
6	12,13,14	6.00	176,178,188	50
7	15,17,18	6.80	101,202,244	100
8	19,16,20	7.90	226,228,240	100
9	22,23,24,21	9.00	125,252,264	100
10	25,26,27	10.80	138,139,276,278	50

Retention time shifts can occur when instrument maintenance is performed.
Shifts in the retention times are reflected in the analytical method.

Table 2.1
Intermediate Stock Standard

Intermediate Standard	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 Cal Mix#6	2000	0.100	10.0	20.0
8270 BN SURR	5000	0.040	10.0	20.0

Table 2.2
8270 SIM PAH Initial Calibration Points

Linearity Points	Spike Concentration (ug/ml)	Standard Volume (ul)	Final Volume (ml)	Final Concentration (ng/ml)
1	20.0	10	10.0	20
2	20.0	25	10.0	50
3	20.0	50	10.0	100
4	20.0	250	10.0	500
5	20.0	500	10.0	1000
6	20.0	750	10.0	1500
7	20.0	1000	10.0	2000

Table 2.3
8270 SIM PAH ICV Working Standards

Working ICV Standard	Intermediate Standard Concentration (ug/ml)	Standard Volume (ul)	Final Volume (ml)	Final Concentration (ng/ml)
ICV 1	20.0	250	10.0	500
ICV 2	20.0	750	10.0	1500

Table 2.4
8270 SIM PAH CCV Working Standard

Working CCV Standard	Intermediate Standard Concentration (ug/ml)	Standard Volume (ul)	Final Volume (ml)	Final Concentration (ng/ml)
8270 SIM PAH	20.0	250	10.0	500

Table 2.5
8270 SIM PAH Internal Standard Solution

Internal Standard Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 IS Mix	2000	0.10	2.0	100

Table 2.6
8270 SIM PAH Surrogate Spiking Solution

Surrogate Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ul)	Final Volume (ml)	Final Concentration (ug/ml)
8270 BN SURR	5000	20.0	100.0	1.0

Table 2.7
8270 SIM PAH Analyte Spiking Solution

Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
8270 SIM PAH	2000	0.050	100	1.0

Table 2.8
DFTPP Standard Solution

Spiking Solution	Stock Standard Concentration (ug/ml)	Standard Volume (ml)	Final Volume (ml)	Final Concentration (ug/ml)
DFTPP	1000	0.500	10.0	50.0

Table 3
DFTPP Tuning Criteria

Mass	Ion Abundance Criteria
51	30-60% of mass 198
68	<2% of mass 69
69	<100% of mass 198
70	<2% of mass 69
127	40-60% of mass 198
197	<1% of mass 198
198	Base peak, 100% relative abundance
199	5-9% of mass 198
275	10-30% of mass 198
365	> 1.0% of mass 198
441	Present but less than mass 443
442	> 40% of mass 198
443	17-23% of mass 442

Table 4
Semivolatile Organic Compounds - Method 8270 SIM PAH Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Tune Check (50ng or less DFTPP) SOP No: 8270 SIM PAHs	Every 12 hours.	Ensure correct mass assignment. DFTPP % Relative abundance criteria as specified in Table 3. Pentachlorophenol tailing < 2, Benzidine tailing < 2 DDT breakdown < 20%	Retune. Do not proceed with analysis until DFTPP spectrum meets criteria.
Initial Calibration	Each time the instrument is set up and when CCCs in the continuing calibration verification (CCV) do not meet criteria.	1. % RSD for RRFs for each CCC ≤30%. 2. % RSD for RRFs for all target compounds ≤15%. IF RF % RSD >15% use linear curve, r >=.995, r2 > = .990. or quadratic curve. LGC, NELAC, QSM, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria should be followed as stated in their documents.	Correct system and recalibrate. Criteria must be met before sample analysis may begin. Any samples reported from data not meeting these criteria must be qualified (Z).
Initial Calibration Verification standards (ICV)	Immediately following the ICAL.	1. Second source (different lot or manufacturer than ICAL). 2. % Deviation. for RRFs of each CCC <20%. 3. Non-CCCs - <20% Deviation for RRFs, <20 % Drift for linear curve and non linear curves- 4. 3.LCG, QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria shall be followed as stated in their documents.	Correct system and recalibrate. Criteria must be met before sample analysis may begin. If %drift >20% then confirm the integrity of the second source standard by reanalysis. QSM allows no tolerances for % D. Problem compounds need to be addressed on a project to project basis.

Table 4 (Continued)
Semivolatile Organic Compounds - Method 8270 SIM PAH Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification standards(CCV) SOP No: 8270 SIM PAHs	Every 12 hours.	1. % Deviation for RRFs of each CCC <20%. 2. Non-CCCs - <20% Deviation for RRFs, <20 % Drift for linear curve and non linear curves. 3. LCG, QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria are followed as stated in their documents.	Correct system and recalibrate. Criteria must be met before sample analysis may begin. If %drift >20% correct problem if determinable then reanalyze. Sample results reported that have %D failures must be qualified (Z). QSM allows no tolerance for % D. Problem compounds need to be addressed on a project to project basis
Internal Standards (ISTD)	Added to all blanks, standards, and samples.	1. Peak area within -50% to +100% of area in CCV level of ICAL. 2. Retention time (RT) within 30 sec of RT for associated CCV standard. 3. LCG, QSM, NELAC, or other programs/agencies may require different criteria than stated here. Program and/or project specific criteria should be follow as stated in their documents.	Inspect instrument for malfunctions; correct identified malfunctions, then reanalyze samples. If no instrument malfunction identified proceed as follows: * Reextract and reanalyze sample. * If reanalysis is outside limits the data should be qualified (S). Follow specified criteria as stated in Shell or other documentation.
Method Blank (MB)	One per prep batch of 20. The MB is used to document contamination resulting in the analytical process and should be carried through the complete sample preparation and analytical procedure.	1. Concentration of analytes of concern should be less than the highest of either : Method detection limit, 5% of the regulatory limit for that analyte, or 5% of the measured concentration in the sample. 2. ACOE/QSM ≤ ½ MRL 3. Follow criteria according to specific program/agency.	Reanalyze to determine if instrument or laboratory background contamination was the cause. If method blank is still noncompliant, re-extract and reanalyze blank and samples. For QSM data if less than ½ MRL no action required. If no sample remains for re-prepping, or if re-prepped data still contains contamination, flag data with "B" qualifier.

Table 4 (Continued)
Semivolatile Organic Compounds - Method 8270 SIM PAH Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Laboratory Control Sample (LCS) SOP No: 8270 SIM PAHs	One per prep batch of 20 samples. Must undergo all sample preparation procedures. Spiking solution should contain all target compounds with concentrations at or near the mid-point of the calibration range.	1. Client specified limits. 2. QSM – use LCS criteria. 3. In-house limits.	If LCS recoveries are within control limits then no action is required. If the LCS exceeds control limits, reanalyze the LCS.If LCS recoveries are still outside control limits, re-extract and reanalyze samples. If sample is not available for re-extraction then qualify data for the failing analytes with a "Q". Exception: If the LCS recoveries are high with no associated positives then no further action is taken.
MRL Level Verification Check standard at Reporting Limit – (LCG only).	Program/contract specific Typically bracketing samples for every 12 hour analysis window.	1. 70-130% or project specific/client limits	Note failures in case narrative. If MDL check was analyzed at the end and is acceptable do not reject data.
Matrix Spike/Matrix Spike Duplicate	One set per prep batch of 20 samples. Must undergo all sample preparation procedures. Must be spiked with target compounds with concentrations at or near the mid-point of the calibration range.	1. Client specified limits. 2. QSM – use LCS criteria. 3. In-house limits.	If LCS is acceptable, then report probable matrix interference. Qualify data if the recoveries are low (M) If recoveries are high and there are no detects in the unspiked sample then that data does not require flagging. Qualify data for RPD failures (Y) when there is a detect for the failing compounds (non-detected compounds are not qualified). Exception: If a compound is already qualified for a LCS failure then no RPD qualifier is applied.

Table 4 (Continued)

Semivolatile Organic Compounds - Method 8270 SIM PAH Quality Control Requirements

Quality Control Item	Frequency	Acceptance Criteria	Corrective Action
Qualitative/Quantitative Issues SOP No: 8270 SIM PAHs	If detection level of any compound in a sample exceeds the detection level of that compound in the highest level standard, the sample must be diluted to approximately mid-level of the calibration range and reanalyzed.	The instrument level of all compounds must be within the calibration range for all samples. The sample analyzed immediately after a high level sample must display concentrations of the high level target compounds less than the RL or greater than 5X the RL.	Dilute the sample to bring the level of the highest concentration of target compounds within the calibration range. If any data is reported with any results over range then those results should be flagged (X). A sample displaying concentrations of target compounds between the RL and 5X the RL that was analyzed immediately after a high level sample must be re-analyzed. If the results do not agree within the RL, report only the second analysis.
Surrogate	1. Calibrated as target compounds. 2. Added to all blanks, samples, and QC samples, as a part of the internal standard-surrogate spiking mixture.	1. Client specified limits. 2. QSM – use LCS criteria 3. In-house limits.	Rerun sample. If no apparent matrix interference is noticed, re-extract sample. If no sample is available, qualify the surrogate with "S" QSM – For QC and field samples, correct problem, reprep and reanalyze all samples with failed surrogates in the associated batch, if sufficient sample material is available
Retention Time Window (RTW)	Retention Times will be set using the mid-point of the calibration curve or the RTs in the CCV at the beginning of the analytical sequence.	RTs of analytes must be within +/-.06 RRT units of the RRT of the CCV.	

Table 5
8270 SIM PAH.Analysis Data Review Checklist

Sequence Date	Analyst / Data Interpreter	Independent Reviewer	Date of Review	Approved
				Yes or No

Instructions: Complete one checklist per analytical run. Enter the appropriate response for each question. Each "No" response requires an explanation in the Comments section, and may require the initiation of a Nonconformance Report.

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
1. INITIAL CALIBRATION (ICAL)						
a. Was the initial calibration performed using a minimum of five standard	Lowest standard at or near MRL					
concentration levels? b. Linearity.	RSD≤ 15%, ≤ 30% for CCCs, r ≥ 0.995 , r2 > 0.990 for regression.					
c. Were the standards used for the ICAL uniquely identified?						
d. Was there a DFTPP standard analyzed prior to the ICAL?						
2. INITIAL CALIBRATION VERIFICATION (ICV)						
a. Were there a second source ICVs for all target analytes analyzed after the initial calibration and prior to analysis of any samples?	Second source					
b. Were the CCCs within QC limits	%D ≤ 20%					
c. Were the ICVs uniquely identified (i.e. Standard Number)?						
3. CONTINUING CALIBRATION VERIFICATION (CCV)						
a. Were CCVs for target analytes analyzed at the beginning of the sequence and after every 12 hours.						

Table 5
8270 SIM PAH Analysis Data Review Checklist (Continued)

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
SOP No: 8270 SIM PAHs b. Were the recoveries for the CCVs acceptable?	%D≤20%,					
c. Was each CCV uniquely identified (i.e. Standard Number)?						
4. DFTPP						
a. Was a DFTPP tune check ran at the beginning of every twelve hour shift?						
b. Were the relative abundance criteria met?						
c. Was the peak tailing acceptable for Pentachlorophenol and Benzidine?	Tailing Factor < 2					
d. Was the breakdown of DDT to DDE and DDD acceptable?	<20%					
5. BLANKS						
a. Was method blank (MB) analyzed prior to the analysis of samples?						
b. Were the MB results less than the reporting limit (RL)?	< MDL					
If no, were positive hits in the samples <20x the amount in the blank flagged with a "B".	<20x (qualify data) >20x (no action)					
c. Was a MB prepped and analyzed at a frequency of one per Prep Batch?	Batch ≤ 20 samples					
6. LABORATORY CONTROL SAMPLE (LCS)						
a. Was a LCS analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were the LCS recoveries in each LCS within the acceptance criteria?	In-house limits or client specified limits					
If no, and the recoveries were low, flag those analytes "Q". If the recoveries were high, only flag the detects (>RL) for those analytes "Q".						
7. MATRIX SPIKES						
a. Was a matrix spiked (MS) sample analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were MS recoveries in each MS within the acceptance criteria?	In-house limits or client specified limits					

Table 5
8270 SIM PAH Analysis Data Review Checklist (Continued)

Requirement:	Acceptance Criteria	Analyst Review		Independent Review		Comments: (indicate reference to an attachment if necessary)
		Yes	No	Yes	No	
8. MATRIX SPIKE DUPLICATE						
a. Was a duplicate matrix spike sample analyzed at a frequency one per Prep Batch?	Batch ≤ 20 samples					
b. Were MSD recoveries within the acceptance criteria?	In-house limits or client specified limits					
c. Is the relative percent difference (RPD) for each analyte between a matrix spike (MS) and matrix spike duplicate (MSD) within the acceptance criteria?	In-house limits or client specified limits					
9. SAMPLES (INCLUDING BLANKS, STANDARDS, AND QC SAMPLES)						
a. Are chromatogram characteristics, including peak shapes and areas, consistent with those of the CCV?						
b. Are surrogate recoveries for all samples, blanks, standards, and QC samples within acceptance criteria?						
c. Were all samples having analytes detected in amounts exceeding the calibration range diluted and reanalyzed?						
d. Were all samples extracted within holding times and analyzed within 40 days of extraction?	Analysis within 40 days of extraction					
e. Did the samples require additional cleanup steps? (i.e. GPC)	GPC					
10. RECORDS AND REPORTING						
a. Are Run, Prep Batch and Extraction sheets, Summary sheets, Sequence file, initial and rerun raw and process data present in the data file?						
b. Are all chromatograms dated and initialed?						
c. Are reported results whose amounts exceeded the acceptance criteria flagged with an appropriate qualifier and, if needed, a NCR completed?						
d. Do all values, dilution factors and qualifiers listed on the raw reports match the LIMS data?						
e. Is the ICAL method referenced on the Raw Data?						

Table 6
Semivolatiles Extraction Bench Sheet

METHOD 8270-SV GC/MS Extraction Bench Sheet
SOP Reference Number 8270, 8270 SIM Explosives, 8270SIM PAH

EPA Method references: 8270 (Semivolatiles) **Prep Batch Number _____**
3510 (Separatory funnel extraction)
3545 (Pressurized Fluid Extraction)
3580 (Waste Dilution)
3546 (Microwave Extraction)

***Spike and Surrogate Information*:**
Spike amount and concentration (Matrix Spike and LCS): _____
Spike Reference: __**SVMS**_____ADDED:_____
Surrogate amount and concentration: _____
Surrogate Reference: _**SVMS**_____ADDED:_____
Reagent lot # **$MeCl_2$_____ Na_2SO_4_____ Acetone_____**
Sulfuric Acid_SVMS_____ NaOH_SVMS_____ Diatomaceous earth_____
Dionex_**DI**_____ Scale_____ GPC Start_____ GPC End_____

***Extraction by*:** _____Date____/____/____ Start Time _____ End_____
***Initial Concentration by*:**_____Date____/____/_____
***Final Concentration by*:** _____Date____/____/_____

Cell #	Client	Sample Number	Sample Amt. (gm or L)	Final Vol (mL)	pH <2	pH >11	Comments
	Method Blank	MB					
	Control Spike	**LCS**					
	Control Spike Dup.	*LCSD*					
	Matrix Spike	MS					
	Matrix Spike Dup.	***MSD***					

Footnotes:
Final extract
Relinquished by:_____ Date:_____ Relinquished to:_____ Date:_____

ATTACHMENT I
GEL-PERMEATION CLEANUP
METHOD 3640A

1.0 Identification Of The Test Method

This method is designed to follow procedures and QC requirements found in SW-846 method 3640A. Gel-permeation chromatography (GPC) is a size exclusion cleanup procedure using organic solvents and hydrophobic gels in the separation of synthetic macromolecules.

2.0 Applicable Matrix Or Matricices

This method is applicable to nearly all types of methylene chloride extractable matrices regardless of water content, including ground water, surface water, wastewater, soils and sediments, as well as other matrices.

3.0 Detection Limits

None applicable

4.0 Scope And Application

4.1 General cleanup application – GPC is recommended for the elimination from the sample of lipids, polymers, copolymers, proteins, natural resins and polymers, cellular components, viruses, steroids, and dispersed high-molecular-weight compounds. GPC is appropriate for both polar and non-polar analytes; therefore, it can be effectively used to cleanup extracts containing a broad range of analytes.

4.2 Normally, this method is most efficient for removing high boiling materials that condense in the injection port area of a gas chromatograph (GC) or in the front of the GC column. This residue will ultimately reduce the chromatographic separation efficiency or column capacity because of adsorption of the target analytes on the active sites. Pentachlorophenol is especially susceptible to this problem. GPC, operating on the principal of size exclusion, will not usually remove interference peaks that appear in the chromatogram since the molecular size of these compounds is relative similar to the target analytes. Separation cleanup techniques, based on other molecular characteristics (i.e. polarity), must be used to eliminate this type of interference.

4.3 This method is restricted for use by or under the supervision of trained analyst. Each analyst must demonstrate the ability to generate acceptable results with this method.

5.0 Method Summary

5.1 This method is used to cleanup extracted samples with unwanted light and/or heavy compounds that interfere with final analysis of methods 8041, 8081, 8082, 8270, 8330 and 8310.

5.2 Samples are extracted then concentrated and prepared for GPC cleanup.

5.3 Determinations for which samples that are candidates for GPC cleanup are based on client specific, site specific and project specific requirements, specific characteristics of initial extract (e.g. color or odor) or interference determined by initial extract analysis.

5.4 The column is calibrated and then loaded with the sample extract to be cleaned up. Elution is effected with a suitable solvent(s) and collection times are adjusted based on desired analysis. The collected fractions are then concentrated per guidelines for methods 8041, 8081, 8082, 8270, 8330 and 8310.

6.0 Definitions

6.1 Reagent Blank: an analyte free reagent on which all processes will be performed. Create GPC blank by loading 5 ml of methylene chloride into the GPC. Concentrate the methylene chloride that passes through the system during the collect cycle using a Kuderna-Danish (KD) evaporator. Analyze the concentrate by whatever detectors will be used for the analysis of future samples.

6.2 GPC Calibration Solution: a solution that contains compounds with known retention times used to determine if the GPC column is calibrated to elute the compounds of interest at the set times.

6.3 Stock Standards -Stock Standards are purchased from vendors who provide certified solutions. Standards are stored at -10ºC in a freezer reserved for standard solutions. Unopened standard shall have the manufactures suggested expiration date. Stock standards once opened expire in six months and not to exceed the manufactures expiration date.

6.4 Method Blank (MB): An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in the sample processing. The method blank is carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

6.5 Laboratory Control Spike (LCS): Milli-Q water (for water) and Organic-Free Soil (for soil) is spiked with the target analytes and carried through the complete sample preparation and analytical procedure. The control spike is used to document the ability of an analyst to generate acceptable precision and bias, to verify the analytical system performance, and to document method accuracy for each matrix.

7.0 Interferences

7.1 A reagent blank should be analyzed for the compound of interest prior to the use of this method. The level of interferences must be below the estimated quantitation limits (EQL's) of the analytes of interest before this method is performed on actual samples.

7.2 More extensive procedures than those outlined in this method may be necessary for reagent purification.

7.3 Solvents, reagents, glassware, and other sample processing hardware can yield artifacts and /or interferences to sample analysis. All these materials must be demonstrated to be free from interferences under the conditions of the analysis by analyzing method blanks.

Specific selection of reagents and/or purification of solvents by distillation in all-glass systems will be necessary. Refer to each method for specific guidance on quality control procedures.

7.4 Phthalate esters contaminate many types of products commonly found in the laboratory. Plastics, in particular, must be avoided because phthalates are commonly used as plasticizers and are easily extracted from plastic materials.

7.5 Soap residue (e.g. sodium dodecyl sulfate), which results in a basic pH on glassware surfaces, will cause degradation of certain analytes.

7.6 Interferences co-extracted from the samples will vary considerably from source to source. If analysis of an extracted sample is prevented due to interference, further cleanup of the sample or dilution of the sample will be necessary.

8.0 Safety

8.1 Protective clothing: safety glasses, gloves, apron and/or lab coat, long pants, and protective shoes, shall be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure must utilize appropriate laboratory safety systems.

8.2 The toxicity of chemicals used in this method has not been precisely defined. Each chemical shall be treated as a potential health hazard, and exposure to these chemicals shall be minimized.

9.0 Equipment And Supplies

9.1 Gel-permeation chromatography system - Gilson GV-271 ASPEC, Gilson, INC or equivalent. All systems, whether automated or manual, must meet the calibration requirements.

9.1.1 Chromatographic column -350mm x 21.20 mm 0 micron, Phenomenex p/n 00W-3035-PO or equivalent.

9.1.2 Guard column – (optional) 60mm x 21.20 mm 0 micron, Phenomenex p/n 03R-3035-PO or equivalent.

9.1.3 Ultraviolet detector –fixed wavelength (254 nm) with a semi-prep flow-through cell, Gilson 112 UV/VIS detector, Gilson, INC, or equivalent.

9.1.4 Strip chart recorder, recording integrator or laboratory data system, (Trilution and LIMS) or equivalent.

9.1.5 Syringe – 10ml with Luerlok fitting.

9.1.6 Syringe filter assembly, disposable – Puradisc 25TF sample filter assembly Whatman #6784-2510, 25mm and 1.0 micron filter discs or

equivalent. Check each batch for contaminants. Rinse each filter assembly (prior to use) with methylene chloride if necessary.

9.2 Analytical balance – 0.00 g (Fisher Scientific XD2200 or equivalent)

9.3 Volumetric flasks, Class A (TC) 5ml to 100ml

9.4 Graduated cylinders (TC)

9.5 Disposable glass culture tubes 13mm x 100mm, Kimble 73500-13100 or equivalent.

9.6 Disposable glass collection tubes- Kimax 51 25mm x 200mm, Kimble 45060-25200 or equivalent.

9.7 Pasteur pipets- 5 ¾" and 9" (VWR #14672-200 and -300).

9.8 Appropriate concentration and extraction apparatuses; refer to method specific SOP section 9 for equipment and supplies for methods 8041, 8081, 8082, 8270, 8330 and 8310.

10.0 Reagents And Materials

10.1 Methylene chloride, CH_2Cl_2. Pesticide grade or equivalent. Stored under the hood in the Semi-Volatiles Extractions lab and used within one year of opening or before the manufacturers expiration date. Or stored in large carboy tank provided by manufacturer and used by the manufacturer's expiration date.

10.1.1 Some brands of methylene chloride may contain unacceptably high levels of acid (HCl). Check the pH by shaking equal portions of methylene chloride and water, and then check the pH of the water layer.

10.1.1.1 If the pH of the water layer is ≤5, filter the entire supply of solvent through a 2 in x 15 in glass column containing activated basic alumina. This column should be sufficient for processing approximately 20-30 liters of solvent. Alternatively, find a different supply of methylene chloride.

10.2 Cyclohexane, C_6H_{12}. Pesticide grade or equivalent, stored under hood in semivolatiles extraction lab and used within one year of opening or before the manufacturer's expiration date.

10.3 N-Butyl chloride. $CH_3CH_2CH_2CH_2Cl$. Pesticide grade or equivalent stored under hood in semivolatiles extraction lab and used within one year of opening or before the manufacturer's expiration date.

10.4 GPC Calibration Solution. Prepare a calibration solution in methylene chloride containing the following analytes (in elution order):

Compound	mg/L
Corn oil	25,000
Bis (2-ethylhexyl) phthalate	1,000
Methoxychlor	200
Perylene	20
Sulfur	80

Note: Sulfur is not very soluble in methylene chloride; however, it is soluble in warm corn oil. Therefore, one approach is to weigh out the corn oil, warm it and transfer the weighed amount of sulfur into the warm corn oil. Mix it and then transfer into a volumetric flask with methylene chloride, along with the other calibration compounds.

Store the calibration solution in and amber glass bottle with a teflon lined screw-cap at 4°C, and protect from light. (refrigeration may cause the corn oil to precipitate. Before use, allow the calibration solution to stand at room temperature until the corn oil dissolves.) Replace the calibration standard solution every 6 months or more frequently if necessary.

10.5 Corn oil spike for Gravimetric Screen. Prepare a solution of corn oil in methylene chloride (5g/100ml).

10.6 Reagents and materials necessary for concentration and exchanges as listed in methos specific SOP section 10.0 Reagents and Materials for methods 8041, 8081, 8082, 8270, 8330 and 8310.

11.0 Sample Collection, Preservation, And Storage.

Follow guidelines listed in the method specific SOPs section 11 Sample Collection, Preservation and Storage for methods 8041, 8081, 8082, 8270, 8330 and 8310 for sample collection, preservation and storage.

12.0 Quality Control

12.1 The analyst should demonstrate that the compound(s) of interest are being quantitatively recovered before applying this method to actual samples.

12.2 For sample extracts that are cleaned up using this method, the associated quality control samples must also be processed through this clean up method.

12.3 This SOP is designed to follow a variety of different projects and programs requirements.

12.4 Refer to section 12.0 Quality Control for method specific quality control guidelines.

13.0 Calibration And Standardization

13.1 Preparation of standards is documented in the GPC standard logbook. Each standard is labeled with a unique standard number to allow for tracking. Stock standards once opened expire within six months or sooner if routine QC indicates a problem and not to exceed the manufactures expiration date. Stock standards are saved in a capped vial in the original box in the freezer.

13.2 The following is the stock standard that is commercially prepared standard, which is certified by the manufacturer;

GPC Calibration Mix: Restek Part # 32019. (1ml ampul)
GPC Calibration Mix: Restek Part # 32023. (5ml ampul)

13.3 GPC Calibration Solution is a certified prepared standard in methylene chloride containing the following analytes (in elution order):

Compound	mg/mL
Corn oil	250
Bis (2-ethylhexyl) phthalate	10
Methoxychlor	2.0
Perylene	0.2
Sulfur	0.8

Table 1.0 GPC Calibration Standard

Standard	Component Name	Conc. (mg/ml)	STD Volume (ml)	Final Volume (ml)	Final Conc. (ug/ml)
GPC STD	Corn Oil	250	5.0	50.0	25000.0
	Bis(2-ethylhexyl)pht.	10	5.0	50.0	1000.0
	Methoxychlor	2.0	5.0	50.0	200.0
	Perylene	0.2	5.0	50.0	20.0
	Sulfur	0.8	5.0	50.0	80.0

13.4 Calibration of the GPC Column

13.4.1 Place approximately 6 to 7 ml's of the calibration solution in a disposable culture tube. Place tube in position 1 on the sample tray. Set Trilution to run a calibration method with an inject volume of 5.50ml.

13.4.1.1 Following are criteria for evaluation of the UV chromatogram for column condition

13.4.1.1.1 Peaks must be observed and should be symmetrical for all compounds in the calibration solution.

13.4.1.1.2 Corn oil and phthalate peaks must exhibit >85% resolution.

13.4.1.1.3 Phthalate and methoxychlor peaks must exhibit >85% resolution.

13.4.1.1.4 Methoxychlor and perylene peaks must exhibit >85% resolution.

13.4.1.1.5 Perylene and sulfur peaks must not be saturated and must exhibit >90% baseline resolution

13.4.1.1.6 Nitroaromatic compounds are particularly prone to adsorption. For example 4-nitrophenol recoveries may be low due to a portion of the analyte being discarded after the end of collection time. Columns should be tested with the semivolatiles matrix spiking solution. GPC elution should continue until after perylene has elute or long enough to recover at least 85% of the analytes, whichever time is longer.

13.4.1.2 Calibration for methods 8270, 8041 and 8330

13.4.1.2.1 Using the information from the UV trace, establish appropriate collect and dump time periods to ensure collection of all target analytes. Initiate column eluate collection just before elution of bis (2-ethylhexyl) phthalate and after the elution of the corn oil. Stop eluate collection shortly after the elution of perylene. Collection should be stopped before sulfur elutes.

13.4.1.2.1.1 Elution of corn oil starts at approximately 11.0 minutes

13.4.1.2.1.2 Elution of bis (2-ethylhexyl) phthalate starts at approximately 13.0 minutes

13.4.1.2.1.3 Elution of methoxychlor starts at approximately 14.5 minutes

13.4.1.2.1.4 Elution of perylene starts at approximately 20.0 minutes

13.4.1.2.1.5 Elution of sulfer starts at approximately 23.5 minutes

13.4.1.2.1.6 Collection time for 8270 and 8041 is 11 minutes to 23 minutes

13.4.1.2.1.7 Collection time for 8330 is 12 minutes to 22 minutes

13.4.1.3 Calibration for Organochlorine Pesticides/PCBs – Determining the elution times for the phthalate, methoxychlor, perylene and sulfur. Choose a dump time which removes >85% of the phthalate, but collects >95% of the methoxychlor. Stop collection after the elution of perylene, but before sulfur elutes.

13.4.1.3.1 Collection times for 8081 and 8082 are from 13.5 minutes to 22 minutes

13.4.1.4 Calibration for Polynuclear Aromatic Hydrocarbons – Determine the elution times for corn oil, phthalate and perylene. Start elution collections just before the elution of bis (2-ethylhexyl) phthalate and end collection at the peak of the elution of perylene.

13.4.1.4.1 Collection time for 8310 is from 12 minutes to 22 minutes

14.0 Procedure

14.1 It is very important to have consistent laboratory temperatures during and entire GPC run, which could be 24 hours or more. If temperatures are not consistent, retention times will shift and the dump and collect times determined by the calibration standard will no longer be appropriate. The ideal laboratory temperature to prevent outgassing of the methylene chloride is 72°F.

14.2 GPC Setup

14.2.1 Column Preparation

14.2.1.1 Using manual control options in Trilution set the system to equilibrate for at least 30 minutes prior to starting a run or priming.

14.2.1.2 If system has not been used on a regular basis, prime all lines and pumps either manually or using the automated system following guidelines listed in the Trilution help manual.

14.2.1.3 Verify the flow rate by collecting column eluate for 10 minutes in a graduated cylinder and measure the volume which should be 45-55ml (4.5-5.5 ml/min). If flow rate is outside of this range, corrective action must be taken. Once flow rate is within the ranges of 4.5-5.5 ml/min, record the column pressure (should be 6-10 psi) and room temperature in GPC run log (see table 2). Changes in pressure, solvent flow rate, and temperature conditions can affect analyte retention times and must be monitored. If flow rate and/or column pressure do not fall within the above ranges the column should be replaced. A UV trace that does not meet the criteria in section 13.5.1.1 would also indicate that a new column should put in place.

14.2.1.4 Re-inject the calibration solution after appropriate collect and dump cycles have been set and the solvent flow and column pressure have been established.

14.2.1.4.1 Measure and record the volume of collected GPC eluate in a graduated cylinder. The volume of GPC eluate collected for each sample extract processed may be used to indicate problems with the system during sample processing.

14.2.1.4.2 The retention times for bis (2-ethylhexyl) phthalate and perylene must not vary more than ± 5% between calibrations. If the retention time shift is >5%, take corrective action. Excessive retention time shifts are caused by:

14.2.1.4.2.1 Poor laboratory temperature control or system leaks.

14.2.1.4.2.2 An unstabilized column that requires pumping methylene chloride through it for several more hours.

14.2.1.4.2.3 Excessive laboratory temperatures, causing outgassing of the methylene chloride.

14.2.2.7.3 Analyze a GPC blank by loading 5 ml of methylene chloride into the GPC. Concentrate the methylene chloride that passes through the system during the collect cycle using a Kuderna-Danish (KD) evaporator. Analyze the concentrate by whatever detectors will be used for the analysis of future samples. Exchange the solvent if necessary. If the blank exceeds the estimated quantitation limit of the analytes, pump additional methylene chloride through the system for 1 to 2 hours. Analyze another GPC blank to ensure the system is sufficiently clean. Repeat the methylene chloride pumping if necessary.

14.3 Extract Preparation

14.3.1 Adjust the extract volume to 5 ml. The solvent extract must be primarily methylene chloride. All other solvents, e.g. 1:1 methylene chloride/acetone, must be concentrated to 1 ml (or as low as possible if a precipitate forms) and diluted to 5 ml with methylene chloride. Thoroughly mix the extract before proceeding.

14.3.2 Filter the extract through a 1 micron filter disc by attaching a syringe filter assembly containing the filter disc to a 10 ml syringe. Draw the sample extract through the filter assembly and into the 10 ml syringe. Disconnect the filter assembly before transferring the sample extract into a small glass container, e.g. a 15 ml culture tube. Alternatively, draw the extract into a syringe without the filter assembly, attach the filter assembly and force

the extract through the filter and into the glass container. The latter is the preferred technique for viscous extracts or extracts with a lot of solids. Particulate larger than 5 microns may scratch the valve, which may result in a system leak and cross-contamination of sample extracts in the sample loops.

NOTE: Viscosity of a sample extract should not exceed the viscosity of 1:1 water/glycerol. Dilute samples that exceed the viscosity.

14.4 Screening the Extract

14.4.1 Screen the extract to determine the weight of dissolved residue by evaporating a 100 µL aliquot to dryness and weighing the residue. The weight of dissolved residue loaded on the GPC column cannot exceed 0.500 g. Residues exceeding 0.500 g will very likely result in incomplete extract cleanup and contamination of the GPC switching valve (which results in cross-contamination of sample extracts).

14.4.1.1 Transfer 100µL of the filtered extract from section 14.3.2 to a tared aluminum weighing dish.

14.4.1.2 A suggested evaporation technique is to use a heat lamp. Set up a 250 watt heat lamp in a hood so that it is 8 ± 0.5cm from a surface covered with a clean sheet of aluminum foil. Surface temperature should be 80-100°C (check temperature by placing a thermometer on the foil and under the lamp). Place the weighing dish under the lamp using tongs. Allow it to stay under the lamp for 1 minute. Transfer the weighing dish to an analytical balance or a micro balance and weigh to the nearest 0.1mg. If the residue weight is less than 10mg/100µL, then further weighings are not necessary. If the residue weight is greater than 10mg/100µL then determine if constant weight has been achieved by placing the weighing dish and residue back under the heat lamp for 2 or more additional 0.5 minute intervals. Reweigh after each interval. Constant weight is achieved when three weights agree within ±10%.

14.4.1.3 Repeat the above residue analysis on a blank and a spike. Add 100µL of the same methylene chloride used for the sample extraction to a weighing dish and determine residue as above. Add 100µL of a corn oil spike (5g/100ml) to another weighing dish and repeat the residue determination.

14.4.2 A residue weight of 10mg/100µL of extract represents 500mg in 5ml of extract. Any sample extracts that exceed the 10mg/100µL residue weight must be diluted so that the 5ml loaded on the GPC column does not exceed 0.500g. Following is a calculation that may be used to determine what dilution is necessary if the residue exceeds 10mg.

$$\text{Y ml taken for dilution} = 5 \text{ ml final volume} \times \frac{\text{10mg maximum}}{\text{X mg of residue}}$$

Example

$$Y \text{ ml taken for dilution} = 5 \text{ ml final volume} \times \frac{10\text{mg maximum}}{15 \text{ mg of residue}}$$

Y ml taken for dilution = 3.3 ml

Therefore, taking 3.3 ml of sample extract from 14.3.2 and diluting it to 5ml with methylene chloride will result in 5 ml of diluted extract loaded on the GPC column that contains 0.500 g of residue.

NOTE: This dilution factor must be included in the final calculation of analyte concentrations.

14.5 GPC CLEANUP

14.5.1 Calibrate the GPC at least once per week following the procedure outlined in section 13.5.1. Ensure that UV trace requirements, flow rate and column pressure criteria are acceptable. Also, retention time shift must be <5% when compared to retention times in the last calibration UV trace.

14.5.1.1 If these criteria are not met, follow appropriate maintenance methods to try to regain resolution.

14.5.2 Load sample vials with 5 ml of filtered extract from section 14.3. The Method Blank (MB) and Laboratory Control Standard (LCS) must be run through the GPC process from each prep batch that the samples originated from.

NOTE: The number of samples from each prep batch that are put through GPC will vary by client, location and project specifications.

14.5.3 Set the GPC up to run cleanup of the samples, verifying that collection and dump times correlate with the calibration times for each analysis specified in section 13.5.1.2 through 13.5.1.4. Multiple methods may be used on each GPC run. Follow software specific guidelines for setting up a GPC run.

NOTE: It may be necessary to run multiple rinse methods between samples to ensure no cross-contamination between particularly dirty samples.

14.5.4 Monitor sample volumes collected. Changes in sample volumes collected may indicate one or more of the following problems:

14.5.4.1 Change in solvent flow rate caused by channeling in column or changes in column pressure.

14.5.4.2 Increase in column operating pressure due to the absorption of particles or gel fines onto either the guard column or the analytical column gel, if a guard column is not used.

14.5.4.3 Leaks in the system or significant variances in room temperature.

14.6 Concentrate the extract by following the methods listed in the sections for Sample Concentration for methods 8041, 8081, 8082, 8270, 8330 and 8310.

15.0 Data Analysis And Calculations

Refer to method specific SOP for information

16.0 Method Performance

Refer to method specific SOP for information

17.0 Pollution Prevention

Pollution prevention encompasses any technique that reduces or eliminates the quantity or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. Whenever feasible, laboratory personnel shall use pollution prevention techniques to address their waste generation.

18.0 Data Assessment And Acceptance Criteria For Qc Measures

Refer to method specific SOP for information.

19.0 Corrective Measures Of Handling Out Of Control Or Unacceptable Data

Refer to method specific SOP for information

20.0 Contingencies For Handling Out Of Control Or Unacceptable Data

Refer to method specific SOP for information

21.0 Waste Management

Samples are routinely held (refrigerated) for up to six weeks from analysis date before they enter the waste stream. Waste disposal of samples and standards follows the procedures documented in the Laboratory Waste Disposal SOP (Quality Assurance Section, SOP NO. FO-8, Rev. 4).

22.0 Equipment/Instrument Maintenance, Computer Hardware and Software and Trouble Shooting

Refer to method specific SOP for information

23.0 References

23.1 Wise, R.H.; Bishop, D.F.; Williams, R.T.; Austern, B.M. "Gel Permeation Chromatography in the GC/MS Analysis of Organics in Sludges"; U.S. EPA Municipal Environmental Research Laboratory: Cincinnati, Ohio 45268.

23.2 Czuczwa, J.; Alford-Stevens, A. "Optimized Gel Permeation ChromatographicCleanup for Soil, Sediment, Waste and Waste Oil Sample Extracts for GC/MS Determination of Semivolatile Organic Pollutants, JAOAC, submitted April 1989.

23.3 Marsden, P.J.; Taylor, V.; Kennedy, M.R. "Evaluation of Method 3640 Gel Permeation Cleanup"; Contract No. 68-03-3375, U.S. Environmental Protection Agency, Cincinnati, Ohio, pp. 100, 1987.

23.4 USEPA, SW-846 Method 3640A, Rev 1. September 1994.

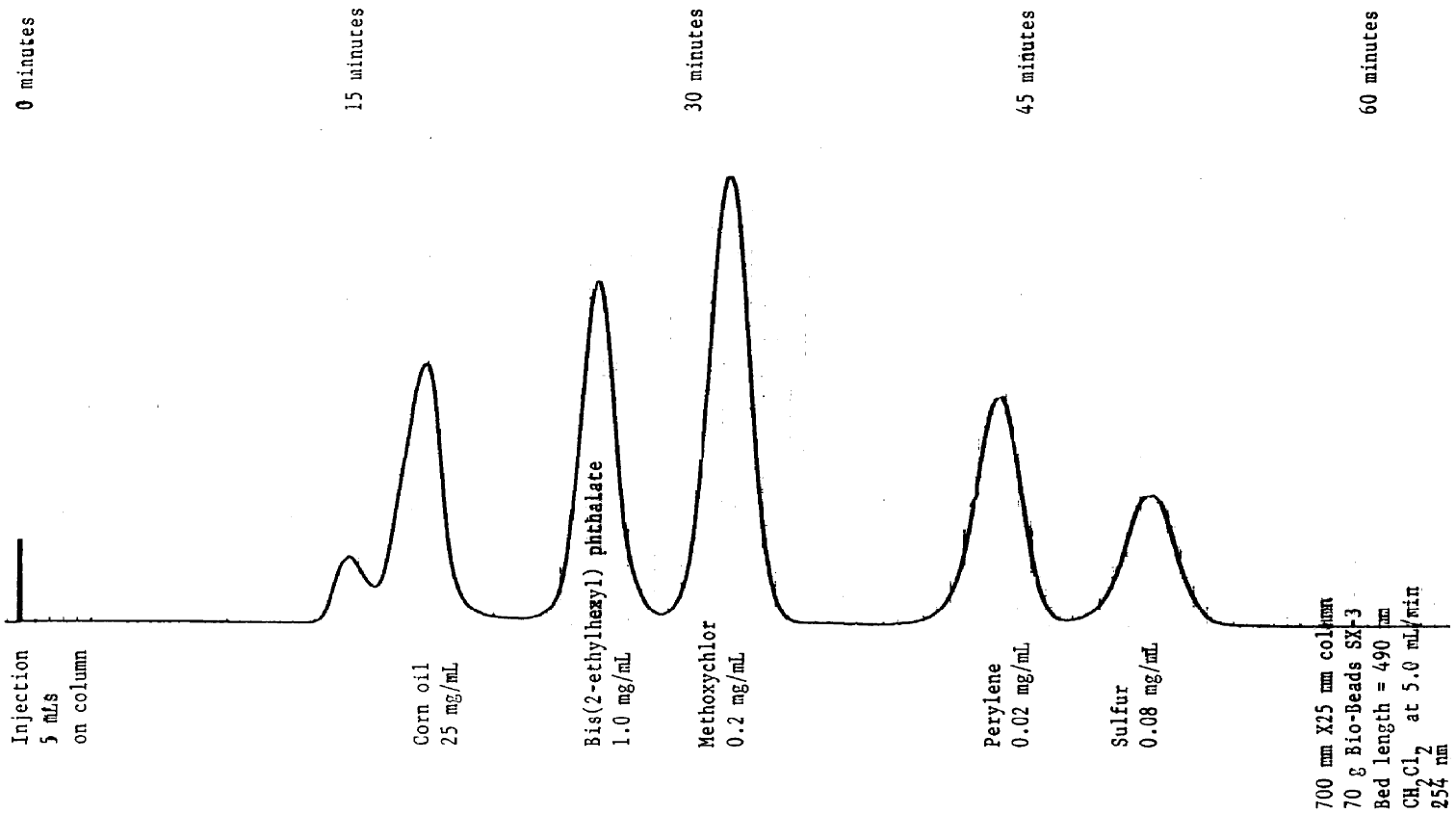
23.5 Gilson, Inc. “Gilson GX-271 Liquid Handlers User’s Guide”, 2006.

24.0 Tables, Diagrams, Flowcharts, and Validation Data

Table 2
GPC Log Book

Run Date	Prep Batch	Time Start	Time Stop	Temp °F	Flow mL/min	Calibration Date	Analyst	Comments
								Page 1

Table 3
UV Chromatogram of GPC Calibration Solution



CT Laboratories
Baraboo Laboratory Divison

Title: **TCLP and SPLP Extraction for Non-Volatile Parameters**

SOP Number: **CL-8B**

Prepared by: _____
Date

Technical Review by: _____
Date

Reviewed by: _____
Quality Assurance ***Date***

_____
Laboratory Director ***Date***

SOP Manual Control Number:_____

1.0 SCOPE AND APPLICATION

1.1 The Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) are designed to determine the mobility of both organic and inorganic analytes present in liquid, solid, and multiphasic wastes.

1.2 The following procedure will be used for performing the metals and semi-volatile extraction.

2.0 METHOD SUMMARY

2.1 TCLP

2.1.1 For liquid wastes (i.e., those containing less than 0.5% dry solid material), the waste, after filtration through a 0.6 to 0.8 µm glass fiber filter, is defined as the TCLP extract.

2.1.2 For wastes containing greater than or equal to 0.5% solids, the liquid, if any, is separated from the solid phase and stored for later analysis; the particle size of the solid phase is reduced, if necessary. The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid employed is a function of the alkalinity of the solid phase of the waste. Following extraction, the liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8 µm glass fiber filter.

2.1.3 If compatible (i.e., multiple phases will not form on combination), the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

2.2 SPLP

2.2.1 For liquid samples (i.e., those containing less than 0.5 % dry solid material), the sample, after filtration through a 0.6 to 0.8 µm glass fiber filter, is defined as the SPLP extract.

2.2.2 For samples containing greater than 0.5 % solids, the liquid phase, if any, is separated from the solid phase and stored for later analysis; the particle size of the solid phase is reduced, if necessary. The solid phase is extracted with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid employed is a function of the region of the country where the sample site is located if the sample is a soil. If the sample is a waste or wastewater, the extraction fluid employed is a pH 4.2 solution. Following extraction, the liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8 µm glass fiber filter.

2.2.3 If compatible (i.e., multiple phases will not form on combination), the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together. If incompatible, the liquids are

analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

3.0 DEFINITIONS

3.1 Batch - A batch consists of a maximum of 20 samples of similar matrix which are prepared and analyzed in the same manner. Each batch is given a unique prep batch number for tracking purposes.

3.2 PB or MB (Prep Blank/ Method Blank) - A Reagent Blank which is carried through the entire preparation and analytical method. The method blank is used to detect possible contamination that may occur prior to or during the sample preparation. A minimum of one MB is prepared per batch, and is analyzed at the beginning of an analytical batch.

3.3 MS (Matrix Spike): - A separate sample aliquot to which a known concentration of analyte has been added which is carried through the entire preparation and analytical procedure. The purpose of a matrix spike is to reveal any matrix effect from the sample on the recovery of the analyte by the method being used. One MS is prepared for each waste type in a given batch of samples. Failure to meet criteria may be due to poor recovery during the preparation method or due to matrix interference within the sample.

4.0 HEALTH AND SAFETY

4.1 Gloves and protective clothing should be worn to protect against unnecessary exposure to hazardous chemicals and contaminants in samples. All activities performed while following this procedure should utilize appropriate laboratory safety systems.

5.0 CAUTIONS

There are no cautions

6.0 INTERFERENCES

Refer to the sample analytical methods for interferences.

7.0 PERSONNEL QUALIFICATIONS

7.1 All personnel performing this analysis should be instructed in the use of personal protective equipment prior to beginning analysis.

7.2 Personnel should know how to read a meniscus and how to use a balance correctly.

8.0 APPARATUS AND MATERIALS

8.1 Rotator apparatus capable of turning at 30 +/- 2 rpm.

8.2 2 liter glass extraction jars.

8.3 2 liter polyethylene extraction containers.

8.4 Millipore pressure filtration apparatus. Note: The interior surface of the pressure filtration apparatus should be free smooth and free of scratches. Clean using only a very soft bristled brush if necessary. Also, the screen

on which the filter is placed should be clean of debris. If any of the holes are clogged they can be cleaned by sonicating for 15 minutes.

8.5 Glass fiber filters 0.7 micron: Environmental Express TCLP filters or equivalent.

8.6 Ceramic filtration funnel, 15 cm.

8.7 2 liter filtration flask.

8.8 pH meter.

8.9 Top-loading balance, 0.01 g capacity.

8.10 Hotplate.

8.11 Magnetic stirrer.

8.12 100 mL graduated cylinder.

8.13 5 mL oxford pipette.

8.14 Thermometer, 100^0C.

8.15 Reagents:

8.15.1 De-ionized water: Milli-Q type II

8.15.2 Hydrochloric acid 1N: Prepare in hood. Into a 1 liter volumetric flask, add 900 mL of D.I. H2O. Carefully add 83 mL ACS reagent grade conc. HCl. Dilute to volume with D.I. H2O and mix well.

8.15.3 Glacial acetic acid, conc. ACS reagent grade.

8.15.4 Sodium Hydroxide 10N: Into a 1 liter volumetric flask, add 500 mL of D.I. H2O. Dissolve 400g. ACS reagent grade NaOH pellets (caution: mixture will become very hot). When cool, dilute to volume with D.I. H2O and mix well.

8.15.5 SPLP extraction fluid acid mixture: To a 100 mL volumetric flask, add 50 mL D.I. H2O. Carefully add 6 g. Conc. H2SO4 and 4 g. Conc. HNO3. Mix by swirling and dilute to volume with D.I. H2O.

8.16 EXTRACTION FLIUDS

8.16.1 TCLP extraction fluid #1: (To prepare a 20 liter quantity): Fill a 20 L carboy with 19 L Of D.I. H_2O. Add 114 mL glacial acetic acid and 128.6 mL 10N NaOH. Dilute to 20 L With D.I. H_2O and mix by stirring. When correctly prepared, the pH of this fluid will be 4.93 +/- 0.05.

8.16.2 TCLP extraction fluid #2: (To prepare a 20 liter quantity): Fill a 20 L Carboy with 19 L of D.I. H_2O. Add 114 mL glacial acetic acid. Dilute to 20 L and mix by stirring. When correctly prepared, the pH of this fluid will be 2.88 +/- .05.

8.16.3 SPLP extraction fluid #1: To be used for sites that are east of the Mississippi River. Prepare a sufficient quantity of extraction fluid by adding the SPLP acid mixture (see step 8.15.5 of this SOP) to D.I. H_2O to obtain a pH of 4.20 +/- 0.05. Note: solutions are unbuffered and the exact pH may not be obtained.

8.16.4 SPLP extraction fluid #2: To be used for sites that are west of the Mississippi River. Prepare a sufficient quantity of extraction fluid by adding the SPLP acid mixture (see step 8.15.5 of this SOP) to

D.I. H_2O to obtain a pH of 5.00 +/- 0.05. Note: solutions are unbuffered and the exact pH may not be obtained.

9.0 INSTRUMENT OR METHOD CALIBRATION

No calibration is necessary.

10.0 SAMPLE COLLECTION, HANDLING AND PRESERVATION

10.1 Preservatives shall not be added to samples before extraction. Extracts to be analyzed for metals shall be preserved following filtration with conc. HNO_3. Extracts to be analyzed for Semivolatile organic compounds (SVOCs) shall not be preserved following filtration. Extracts to be analyzed for Phenolics shall be preserved following filtration with conc. sulfuric acid.

10.2 Sample hold times are as follows (days):

	SVOCs	Mercury	Metals	Phenolics
From sample date to TCLP extraction:	14	28	180	28
From TCLP extraction to preparative extraction:	7	n/a	n/a	n/a
From preparative extraction to analysis:	40	28	180	28

See TCLP method 1311 sec. 6.0 and SPLP method 1312 sec. 6.0 for a detailed description of sample handling.

11.0 SAMPLE PREPARATION AND ANALYSIS

11.1 See appropriate SOP for sample analysis following extraction with this mehod.

11.2 DETERMINE SAMPLE % SOLIDS

11.2.1 For solid samples which contain no free liquids, proceed to sec. 11.3.2.

11.2.2 For samples which are liquid, contain free liquids, or are multi-phasic, filtration or liquid/solid separation is required as follows:

11.2.2.1 Preweigh a GFF filter and record the weight.

11.2.2.2 Preweigh a receiving beaker and record the weight.

11.2.2.3 Preweigh a transfer beaker and record the weight.

11.2.2.4 Assemble the pressure filtration device with the GFF filter, and place the receiving beaker beneath the outlet.

11.2.2.5 Weigh out a subsample of the waste (100g. minimum) and record the weight. An additional minimum 100g. will be needed for the extraction.

11.2.2.6 Transfer the waste to the filtration device and secure the top.

11.2.2.7 Re-weigh the empty transfer beaker and record the weight.

11.2.2.8 Slowly apply air pressure to the filtration device in 10 psi increments up to 50 psi. or until air passes through

the filter. Hold at each increment for 2 minutes before proceeding to the next higher increment.
*Note: Some wastes, such as oily wastes and some paint wastes will contain material that appears to be a liquid. Even after applying pressure to 50 psi, this material may not filter. In this case, the material in the filter holder is defined as the solid phase and is carried through the extraction as a solid. Proceed to sec. 11.4.

11.2.2.9 Weigh the receiving beaker and record the weight.

11.2.2.10 The material in the filter holder is defined as the solid phase of the waste, and the material in the receiving beaker is defined as the liquid phase.
*Note: This subsample is not to be used for the extraction procedure.

11.2.2.11 Determine and record the weight of the liquid phase.

11.2.2.12 Determine the weight of the solid phase by subtracting the weight of the liquid phase from the total weight of the waste.

11.2.2.13 Calculate the % solids as follows:

$$\% \text{ solids} = \frac{\text{weight of solid phase}}{\text{total weight of waste}} \times 100$$

11.3 EVALUATION OF % SOLIDS

11.3.1 If the % solids is <0.5%, the filtrate is defined as the TCLP extract. Proceed to section 11.5 to prepare the extract for analysis.

11.3.2 If the % solids is significantly >0.5%, the solid portion must have a particle size which is smaller than 1cm. or have a surface area >3.1 cm^2 /g. (paper, cloth, etc.).If the above is not met, the material must be reduced to particles of the appropriate size by cutting, crushing, or grinding.

11.3.3 If the % solids is $\geq$0.5% or is very close, and it is noticed that the solid material is entrained in the filter, dry the filter at 80-120C until two successive weighings agree within +/- 1%. Determine the % dry solids. If the % dry solids is <0.5%, the filtrate is defined as the TCLP extract. Proceed to section 11.5 . If the % dry solids is >0.5%, see note below.
*Note: there must be a significant level of % solids such that a minimum of 25-50g of solids can be generated for the extraction. This minimum amount of solids will yield 500-1000 mL of extract.

11.4 DETERMINE THE APPROPRIATE EXTRACTION FLUID

11.4.1 TCLP

11.4.1.1 Transfer 5.0 g. of a representative subsample of the waste to a clean 250 mL beaker.

11.4.1.2 Add 96.5 mL D.I. H2O and cover with a

watchglass.

11.4.1.3 Stir vigorously for 5 min.

11.4.1.4 Measure and record the pH.

*Note: Accurate pH measurement is critical; calibrate the pH meter daily with fresh buffer solutions.

11.4.1.5 If the pH is <5.0, use extraction fluid #1.

11.4.1.6 If the pH is >5.0, add 3.5 mL of 1N HCl, cover with a watchglass, and heat on a hotplate to 50^0 C. Hold at 50^0 C for 10 min. Cool to room temperature, measure and record the pH. If the pH is < 5.0, use extraction fluid #1. If the pH is > 5.0, use extraction fluid #2.

11.4.2 SPLP

11.4.2.1 For samples collected from sites east of the Mississippi River, use extraction fluid #1.

11.4.2.2 For samples collected from sites west of the Mississippi River, use extraction fluid #2.

11.5 EXTRACTION PREPARATION

11.5.1 For samples that are 100% total solids

11.5.1.1 Perform particle size reduction if necessary.

11.5.1.2 Weigh **at least** 100 g of sample directly into the extraction vessel and record the weight. (For SVOC and phenolics analysis, a glass container must be used. For metals analysis, a glass or plastic container may be used.)

11.5.1.3 Record the number of the vessel being used and also check it off on the vessel usage sheet in front of the TCLP extraction log. A blank must be run on each container at a minimum of every 20^{th} use.

11.5.1.4 Determine the amount of extraction fluid to add to the extraction container as follows:
Volume of extraction Fluid (mL) = 20 x mass of sample (g)

11.5.1.5 Measure and record the pH of the extraction fluid immediately prior to use.

11.5.1.6 Add the appropriate amount of extraction fluid.

11.5.1.7 Measure and record the initial pH.

11.5.1.8 Tightly cap the extraction container. The sample is now ready for extraction. Proceed to sec. 11.6.

11.5.2 For samples which are liquid, contain free liquids, or are multi-phasic, filtration or liquid/solid separation is required on a new portion of the waste:

11.5.2.1 Preweigh a GFF filter and record the weight. Filters should be prewashed with 1N HNO_3 followed by D.I. H_2O if metals are to be analyzed.

11.5.2.2 Preweigh a receiving beaker and record the weight.

11.5.2.3 Preweigh a transfer beaker and record the weight.

11.5.2.4 Assemble the pressure filtration device with the GFF filter, and place the receiving beaker underneath.

11.5.2.5 Weigh out at least 100 g of waste and record the weight. Ideally, enough sample should be filtered to allow for 100 g of solids to remain.

11.5.2.6 Transfer the waste to the filtration device and secure the top.

11.5.2.7 Re-weigh the empty transfer beaker and record the weight.

11.5.2.8 Slowly apply air pressure to the filtration device in 10 psi increments up to 50 psi. or until air passes through the filter. Hold at each increment for 2 minutes before proceeding to the next higher increment.

11.5.2.9 Weigh the receiving beaker and record the weight.

11.5.2.10 The material in the filter holder is defined as the solid phase of the waste, and the material in the receiving beaker is defined as the liquid phase.

11.5.2.11 Measure and record the weight and volume of the liquid phase.

11.5.2.12 Using a transfer pipette and a small beaker, add a few drops of the liquid phase to a small quantity of D.I. H_2O.

11.5.2.13 If the two phases are miscible, save the liquid phase for addition back to the filtered TCLP or SPLP extract. Store at 4^0 C in an appropriate container until the extraction is complete. If the two phases do not mix, the liquid phase will need to be analyzed separately and the results mathematically combined with the results from the extract.

Calculation:

Final analyte concentration = $$\frac{(V1)(C1) + (V2)(C2)}{V1 + V2}$$

V1 = volume of the first phase liquid
C1 = concentration of the first phase in mg/L
V2 = volume of the second phase liquid
C2 = concentration of the second phase in mg/L

11.5.2.14 Disassemble the filtration apparatus and carefully remove the filter and waste. Perform particle size reduction if necessary. Quantitatively transfer the filter and waste into the appropriate extraction container.

11.5.2.15 Determine the amount of extraction fluid to add to the extraction container as follows:

Volume of extraction Fluid (mL) = 20 x mass of sample (g)

11.5.2.16 Add the appropriate amount of extraction fluid.

11.5.2.17 Measure and record the initial pH.

11.5.2.18 Tightly cap the extraction container. The sample is now ready for extraction.

11.6 EXTRACTION

11.6.1 Secure the samples in the rotation apparatus which is located in the BOD incubator

11.6.2 Rotate for 18 +/- 2 hours. A room temperature of 23 +/- 2^0C must be maintained during the extraction period. This can be checked in the electronic temperature data logger.

11.6.3 Begin rotating. Record the time.

11.7 FILTRATION FOLLOWING EXTRACTION

11.7.1 Record the time and temperature at the end of the extraction period, as well as the minimum and maximum temperatures.

11.7.2 Following the rotation period, measure and record the pH of each bottle

11.7.3 Assemble the 2 L vacuum flask and ceramic filtration funnel.

11.7.4 Obtain the necessary sample containers and pH paper.

11.7.5 Place a 0.7 micron glass fiber filter (Environmental Express TCLP filters) in the filtration funnel. Record the lot # of filter that is used.

11.7.6 Filter the extract.

11.7.7 Transfer a suitable quantity of the filtrate to the appropriate sample containers:

Metals: 250 mL in polyethylene with HNO_3 preservative.
Semi-volatiles and phenolics: 1 L in amber glass jar.

11.7.8 For metals analysis, preserve the sample to pH <2 with conc. HNO_3.

11.7.9 For semi-volatile analysis, preservative is not added. Store at 4 ^{o}C.

11.7.10 For phenolics analysis, preserve the sample to pH<2 with conc. H_2SO_4.

12.0 TROUBLESHOOTING AND MAINTENANCE

12.1 There is no troubleshooting or maintenance for this method.

13.0 DATA ACQUISITION, CALCULATION AND REDUCTION

13.1 See section 11.0 for any applicable calcuations.

14.0 COMPUTER HARDWARE AND SOFTWARE

14.1 Computer with StarLIMS

15.0 DATA MANAGEMENT AND RECORD MANAGEMENT

15.1 Data is recorded in the TCLP/SPLP extraction log.

15.2 Prep data is entered into LIMS, and then the batch sheet is given to the metals prep analyst or the semi-volatile prep analyst.

16.0 QUALITY CONTROL/QUALITY ASSURANCE

16.1 A minimum of one blank, using the same extraction fluid as used for the samples, is required for every extraction batch. Also, a blank must be performed every 20th time an extractions is performed in a particular container to check for contamination.

16.2 A matrix spike is required for each waste type, with a minimum of one matrix spike per extraction batch. Matrix spikes are prepared at the time of digestion/analysis.

17.0 REFERENCES

17.1 *Test Methods for Evaluating Solid Waste*,. EPA-SW-846. September, 1994. Method 1311.

17.2 *Test Methods for Evaluating Solid Waste*,. EPA-SW-846. September, 1994. Method 1312.

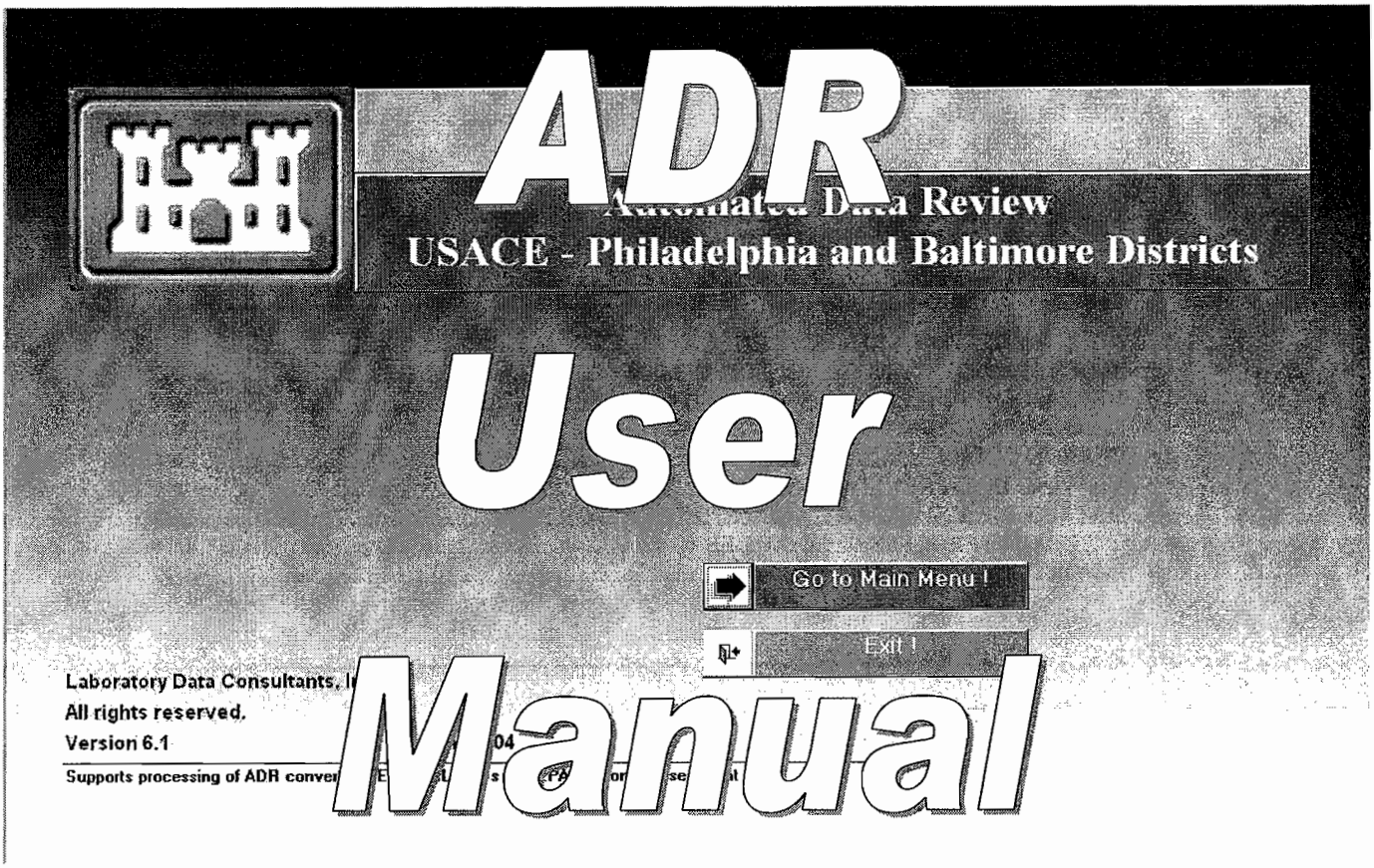

ADR
Automated Data Review
USACE - Philadelphia and Baltimore Districts
User
Manual
Go to Main Menu !
Exit !
Laboratory Data Consultants, I
All rights reserved.
Version 6.1
Supports processing of ADR conver

Table of Contents

1.0
Introduction

Automated Data Review

Automated Data Review evaluates the EDD and applies data review qualifiers to sample results based on laboratory quality control results reported in the EDD and project specific data review criteria specified in a project library. Sample result records in the EDD are updated with applicable data review qualifiers and reason codes, which provide a coded explanation for any data review qualification. Appendix D summarizes the software data review logic. The software provides a variety of post data review qualification and outlier reports summarizing the results of the automated data review.

User Responsibilities

The software was developed as a tool to aid data users in evaluating the quality of analytical chemistry results. The application was designed to perform routine data quality accuracy and precision checks traditionally performed through a manual data review. As inherent with all automated processes, the accuracy and integrity of information imported into the application is of vital importance. In working with analytical laboratories, the data user should design an overall Quality Assurance program to routinely verify the accuracy of electronically reported data versus traditional hardcopy data. The frequency of this check will depend on the capability and performance of the laboratory. This program does not include the evaluation of raw data and therefore full data validation (i.e., EPA Level 4) review must be performed manually.

The User Manual

The User Manual contains several sections and appendices. The remaining pages in this section briefly introduce the different functional parts of the software. Section 2 explains how to create and modify project libraries. Section 3 explains how to upload EDDs and run the EDD error check. Section 4 covers the automated review process. Section 5 includes several database utilities and access to the manual. The appendices provide information on EDD file specifications, standard value and required field restrictions for EDDs.

1.1 INTRODUCTION

This user's manual is provided as a tool for implementing LDC's data review software. The data review software is a Microsoft Access developed computer application that processes an electronic data deliverables (EDD). The software performs error checks for correctness, and completeness on the laboratory analytical data. The software also performs a data review on the EDD that measures integrity of sample results against associated laboratory quality control, holding times, and method detection limits.

Electronic Data Deliverables

Appendix A lists the file specifications for the EDD. The EDD contains sample result information that also includes quality control batch links and accuracy and precision results for surrogates, laboratory control samples, and matrix spike parameters. The EDD files are constructed as a comma-delimited text files or Microsoft Excel .csv files and imported into the application for processing.

The Project Library

The software uses a project specific library as the reference for EDD error checking and data review. The project library is a electronic representation of the Quality Assurance Project Plan (QAPP). The project library contains all analytes and their data review criteria such as reporting limits, blank contamination rules, holding times, and accuracy and precision criteria for each method and sample matrix within the scope of a particular project. A project library is created for each different project. In this way, the software has the flexibility to assess EDDs according to a particular project's requirements. The software includes a Master Library containing a comprehensive list of the most common methods and target analytes. The Master library serves as a template for creating project libraries. The software includes a utility for creating project libraries to minimize typing.

EDD Error Check

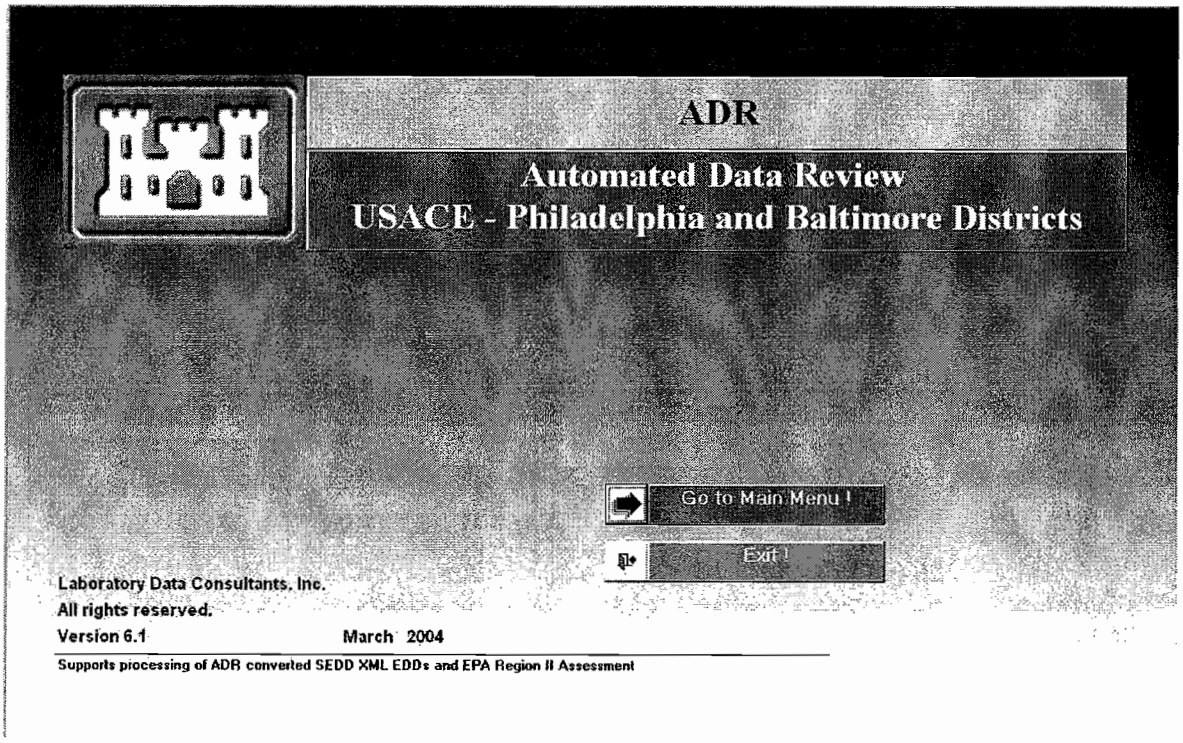
The EDD error check module examines the EDD for correct standard values, missing information in required fields, date/time format, logical date/time values, and duplicate records. The EDD is also checked for target analyte completeness and correct reporting limits. The error checker also examines this EDD to make sure various laboratory QC samples are included depending on the analytical method reported. After checking the EDD for errors the software creates an error log that can be viewed on screen or as a report. Each error is described in detail and if applicable the record number where the error occurs is identified.

EDD error checking is to be performed by the laboratory generating the data. The software can and should be used by the laboratory to check the EDDs and correct them as necessary before delivery to the client.

1.3 MAIN MENUS

The following is a snapshot of the opening screen of the application.

Figure 1-2
Opening Screen



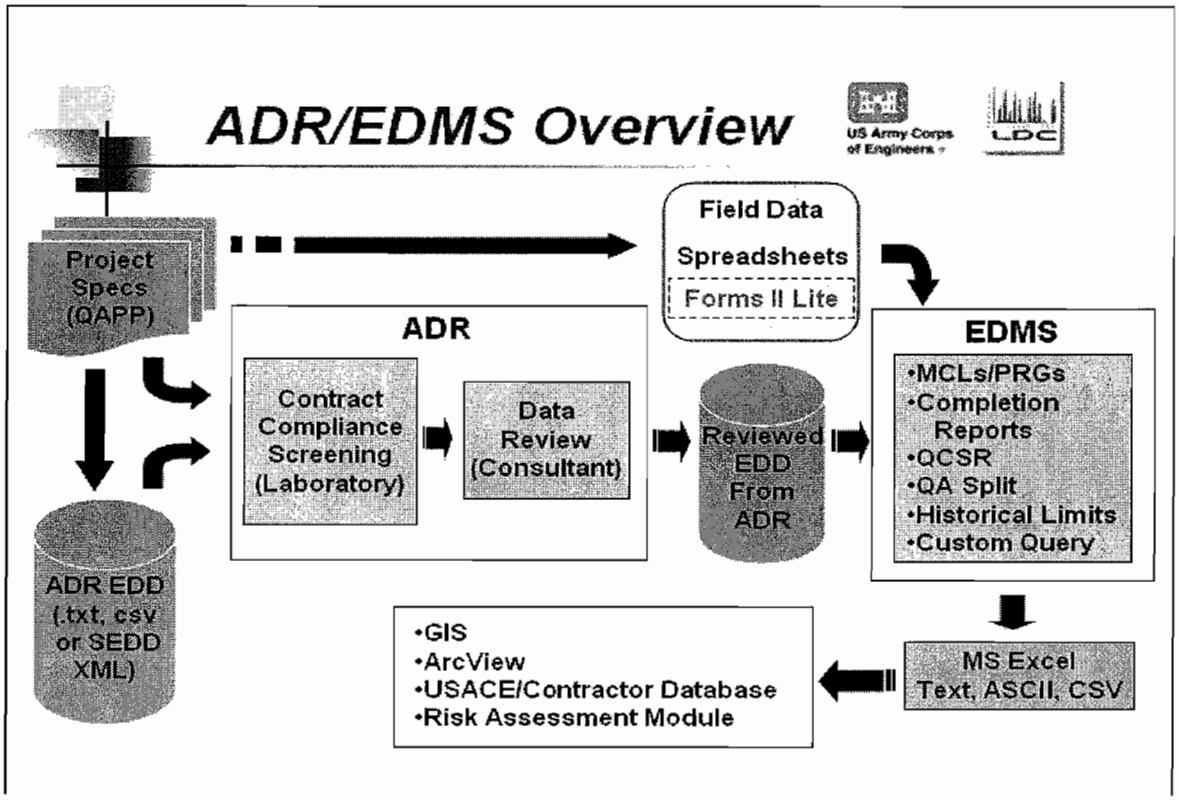
Click on the **Go to Main Menu** button to enter the Main Menu screens. The Main Menu screens provide access to four functional modules. The following pages in this section briefly introduce you to each module. Subsequent sections in this manual provide detailed discussion. The four modules include the following:

- **Project Libraries Menu**
- **EDD Compliance Screening Menu**
- **EDD Automated Data Review Menu**
- **Utilities Menu**

1.2 Process Flow Chart

Figure 1-1 is a flow chart illustrating how the Data Review software and EDMS fit into the data review process.

Figure 1-1
Flow Chart

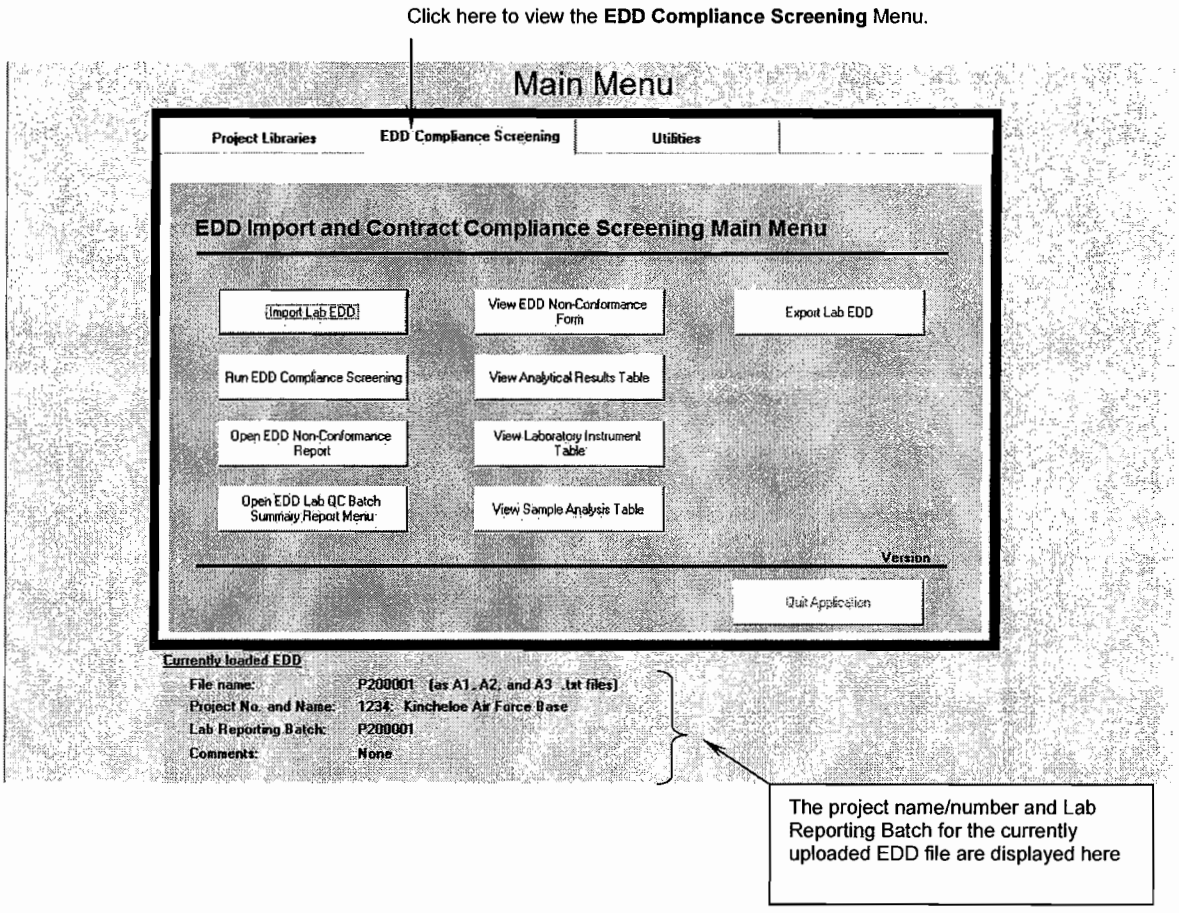


1.3.2 EDD Compliance Screening Main Menu

The EDD Compliance Screening menu gives you access to the following functions:

- **Import EDD files**
- **Run EDD Error Check**
- **View and print the EDD Error Log**
- **View and correct errors in the EDD tables**
- **Save error corrections and export "clean" EDD files**

Figure 1-4
EDD Compliance Screening Main Menu

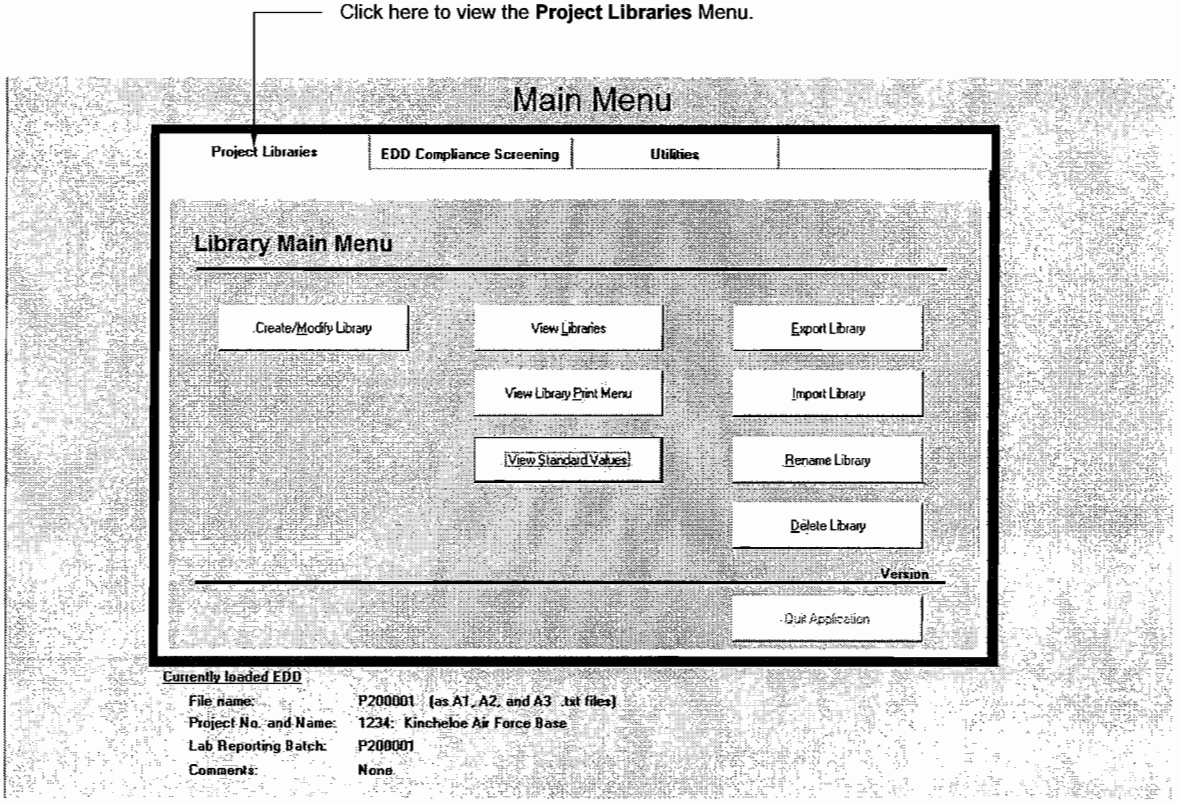


1.3.1 Project Libraries Main Menu

The Project Libraries main menu gives you access to the following functions:

- **Create new project specific libraries**
- **View and modify the information in project libraries**
- **Import/Export libraries**
- **Delete libraries**
- **Rename libraries**
- **Print project library criteria such as QC limits, target compound lists, reporting limits, etc.**
- **View Standard Values in the database**
- **View and modify reason codes**

Figure 1-3
Projects Libraries Main Menu

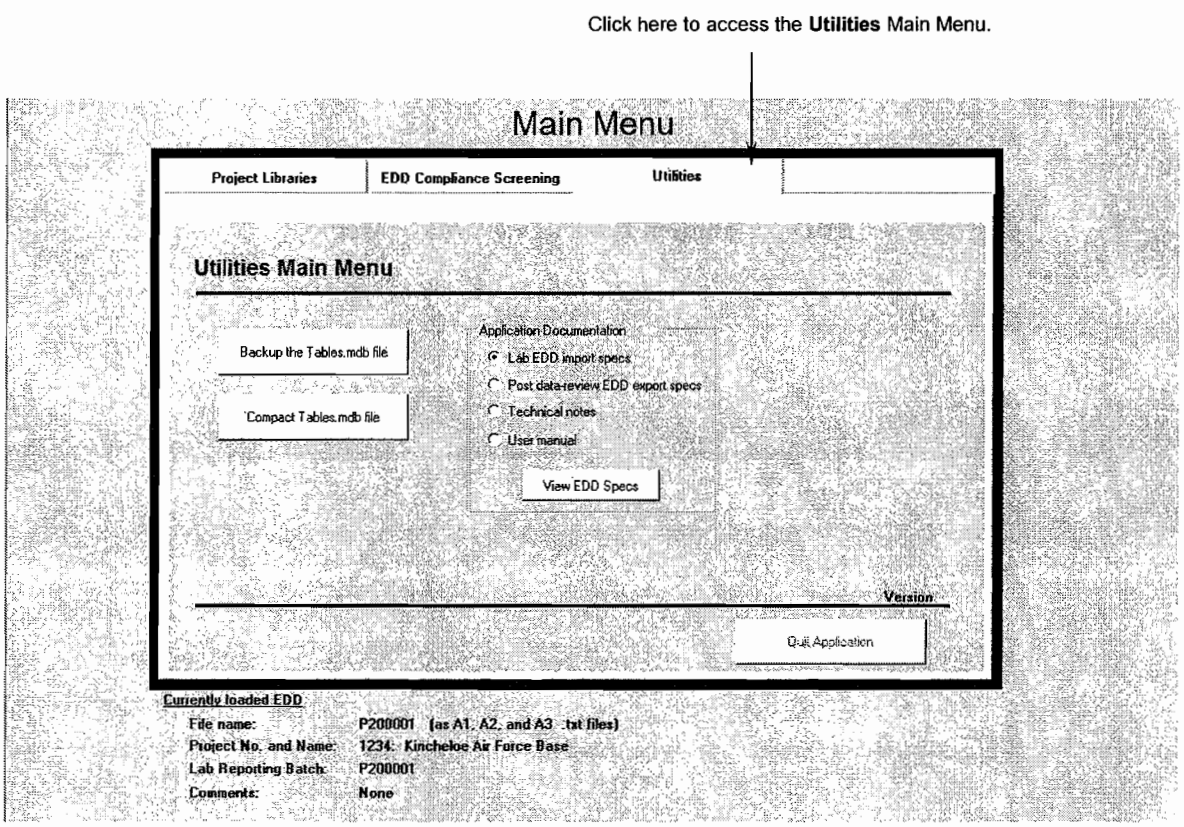


1.3.4 Utilities Main Menu

The utilities menu gives you access to the following functions:

- **View and Print the User Manual**
- **Backup the Tables.mdb file**
- **Compact the Tables.mdb file**

Figure 1-7
Utilities Main Menu

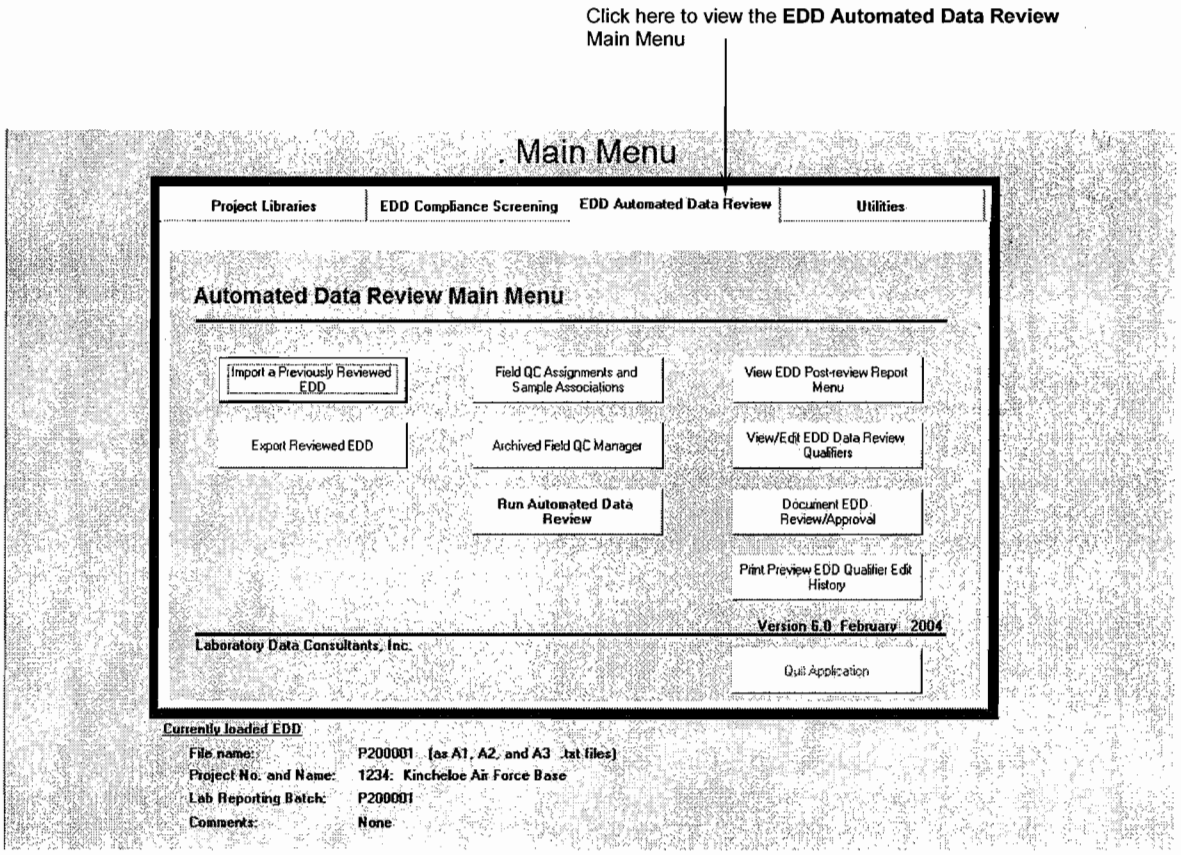


1.3.3 Automated Data Review Process Main Menu

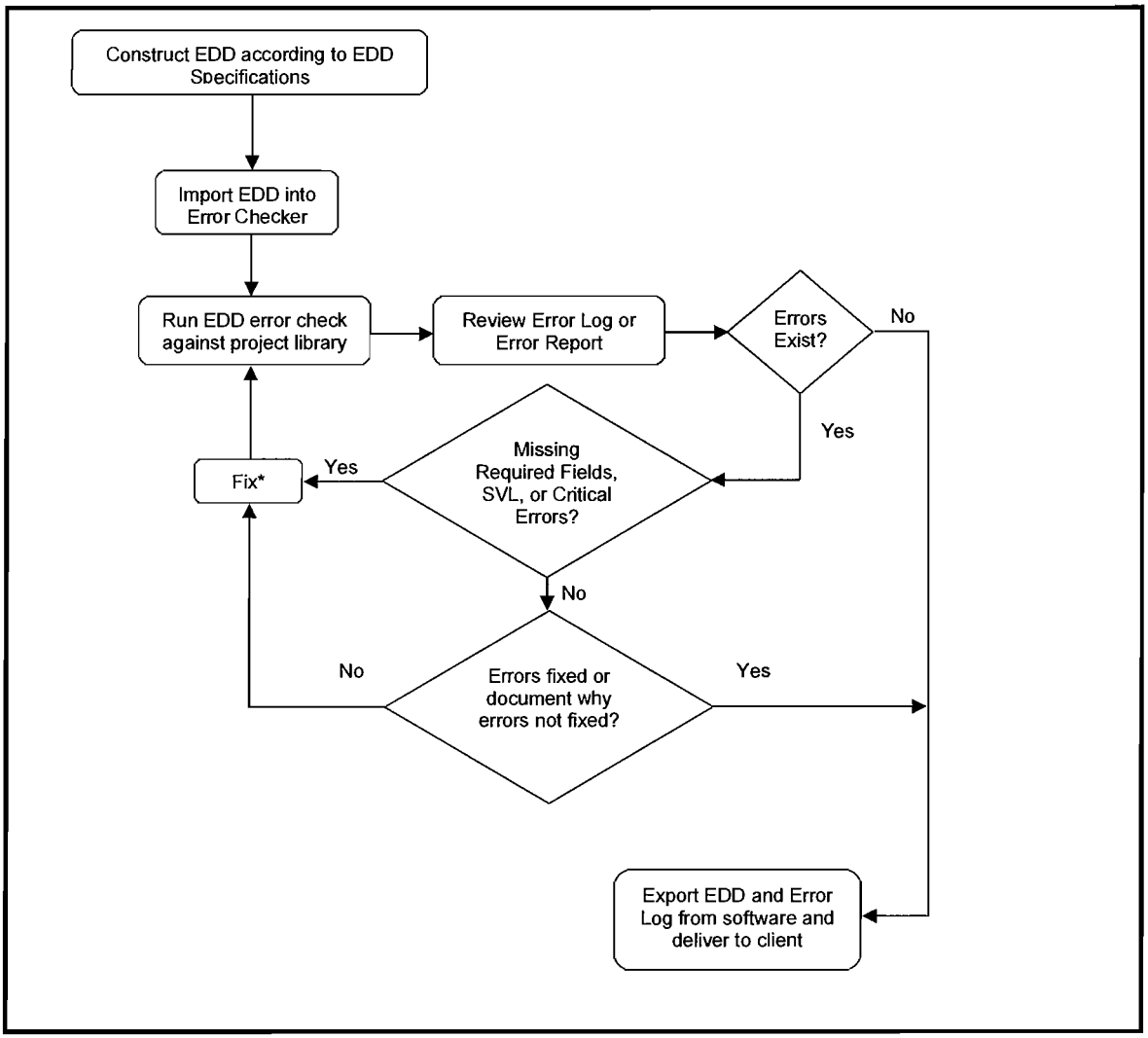
The Data Review menu gives you access to the following functions:

- **Select and assign Field QC/Sample associations**
- **Run the data review process**
- **View data review results**
- **Document EDD review and changes to data review qualifiers**
- **View EDD edit history**
- **Import/Export reviewed EDDs**

Figure 1-6
EDD Automated Data Review Main Menu



1.4.1 Laboratory Process for the Electronic Data Deliverable



* it is highly recommended that any fixes or changes to the EDD occur in the laboratory LIMS rather than within the Error Checking software to ensure laboratory hardcopy reports match the EDD.

1.4 Outline of Process

Consultant

1. Create the project library (e-qapp) using the Master Library or another project library as the source (Section 2.3).
2. Export the project library and send it to the laboratory for review, approval, and project use (Section 2.7).

Laboratory

3. Analyze samples and generate EDD (Appendix A).
4. Import EDD into Error Check software (Section 3.3).
5. Run EDD error check(Section 3.4) and correct and/or explain errors.
6. Export EDD and error report (Section 3.10) then send EDD to consultant.

Consultant

7. Import EDD into Data Review software (Section 3.3).
8. Print/review EDD error log/report (Sections 3.5 and 3.6).
9. Rerun EDD error check against project library to confirm laboratory EDD error check (Section 3.4).
10. Assign field QC in the EDD if applicable (Section 4.2).
11. Run automated data review (Section 4.4).
12. Review post data-review result on screen and/or reports (Sections 4.6 and 4.7). Make any necessary changes to data-review qualifiers (Section 4.6.1).
13. Export data-reviewed EDD (Section 4.8) and import into EDMS.

2.0 Library Module

1.4.2 Consultant Process for the Electronic Data Deliverable

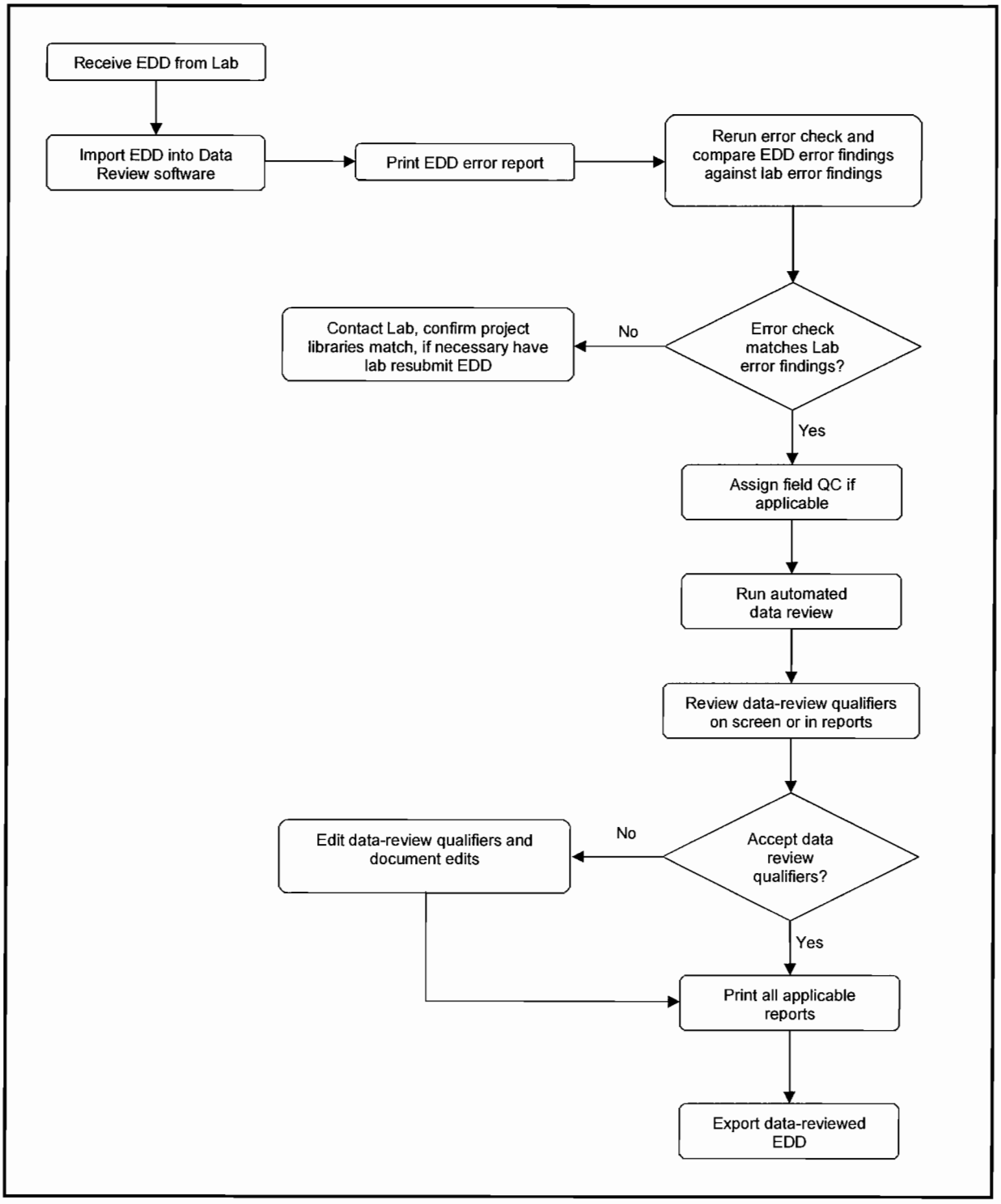
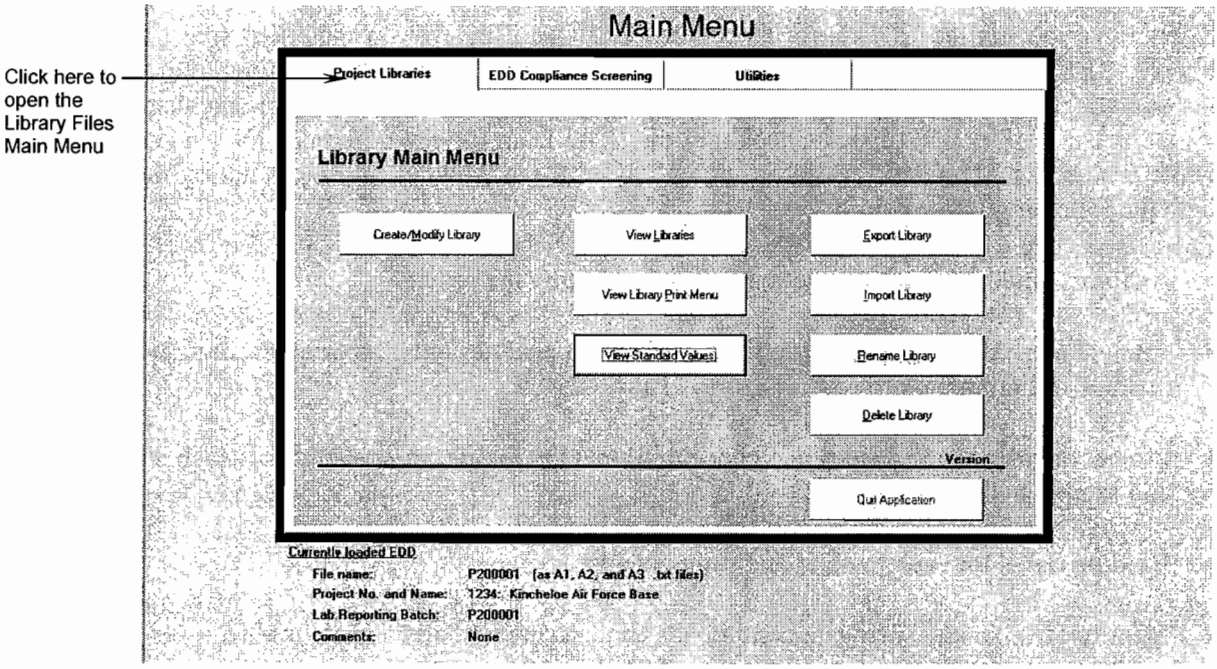


Figure 2-1
Libraries Main Menu



The Master Library

The software includes a Master Library that contains comprehensive method/matrix/analyte list for SW-846 methods. Each record is populated with Client analyte IDs, Analyte Name and units. Use the Master Library as the source for creating your first project libraries. As you build project libraries, you will likely use these as your sources for subsequent project libraries because they will more closely match your project requirements compared with the Master Library.

2.1 LIBRARY FILES MENU

The Project Library

Every time you run the EDD Error Check or EDD Data Review you must first select a project library. The project library is a reference database the user populates with information about all the analytical methods, target analytes, quality control, and data review requirements specified by the project. The EDD Error Check and the EDD Data Review reference the project library while processing EDD data. Before running any of these modules, a project library must exist with the following information:

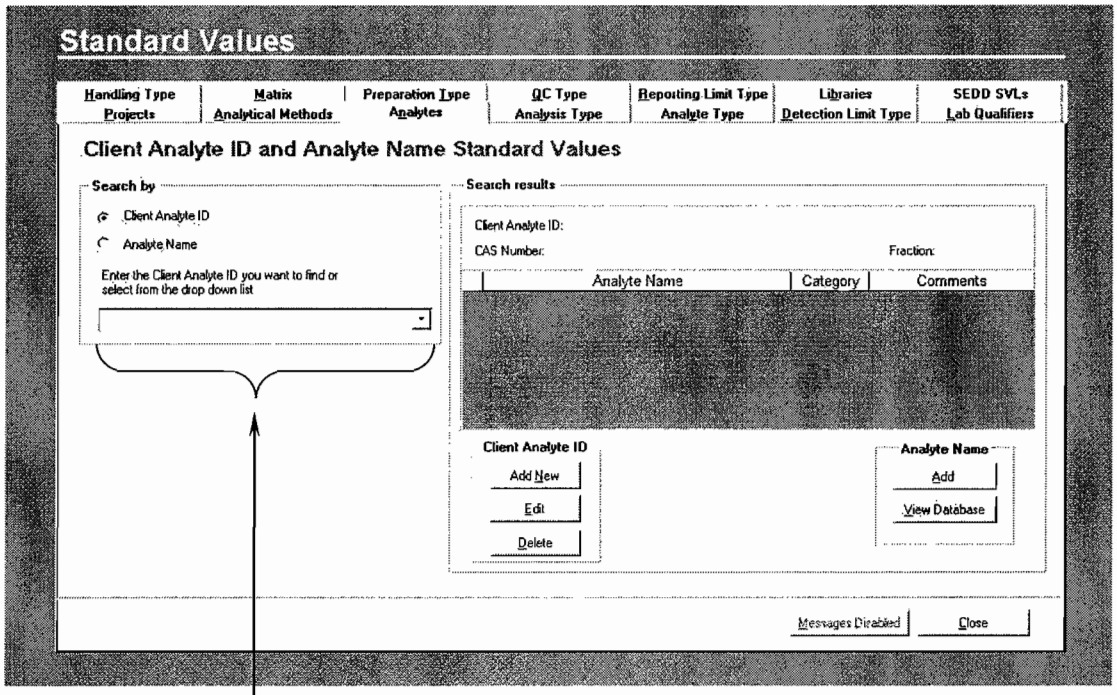
- Analytical methods and sample matrices specified by the project
- Analyte names and client analyte IDs for all target analytes to be reported for each analytical method and sample matrix
- Project reporting limit values and concentration units for all target analytes in each method and sample matrix
- Holding times for each method and sample matrix
- Identity of spike and surrogate compounds for each method and sample matrix
- Accuracy and precision limits for surrogates, matrix spikes, laboratory control samples, laboratory and field duplicates for each method and sample matrix
- Blank contamination rules

The Create/Modify Library function provides an easy means for building new project libraries and modifying existing project libraries. A new project library is built or modified by selecting information from an existing (source) library, then appending that information into your project library (destination library). You may use more than one library as a source if you find that different libraries provide better matches for different methods and sample matrices in your project. Since the source library contains most of the information you need, minimal typing is required when building project libraries. Information such as holding times, method numbers, analyte names, Client analyte IDs, reporting limits, and data review criteria can be automatically transferred from a source library into your project library depending on the scope of information you select. The only typing usually required is for editing quality control values, such as reporting limits, and accuracy and precision control limits to match the values specified by the project.

2.2.1 Analytes Standard Values

When the **Standard Values** button is clicked, the opening default screen is the **Analytes** standard values. From this screen you may search the database to find if an analyte exists and retrieve information about it. You can add, edit, or delete a Client Analyte ID or associate a new Analyte name to an existing Client Analyte ID.

Figure 2-2

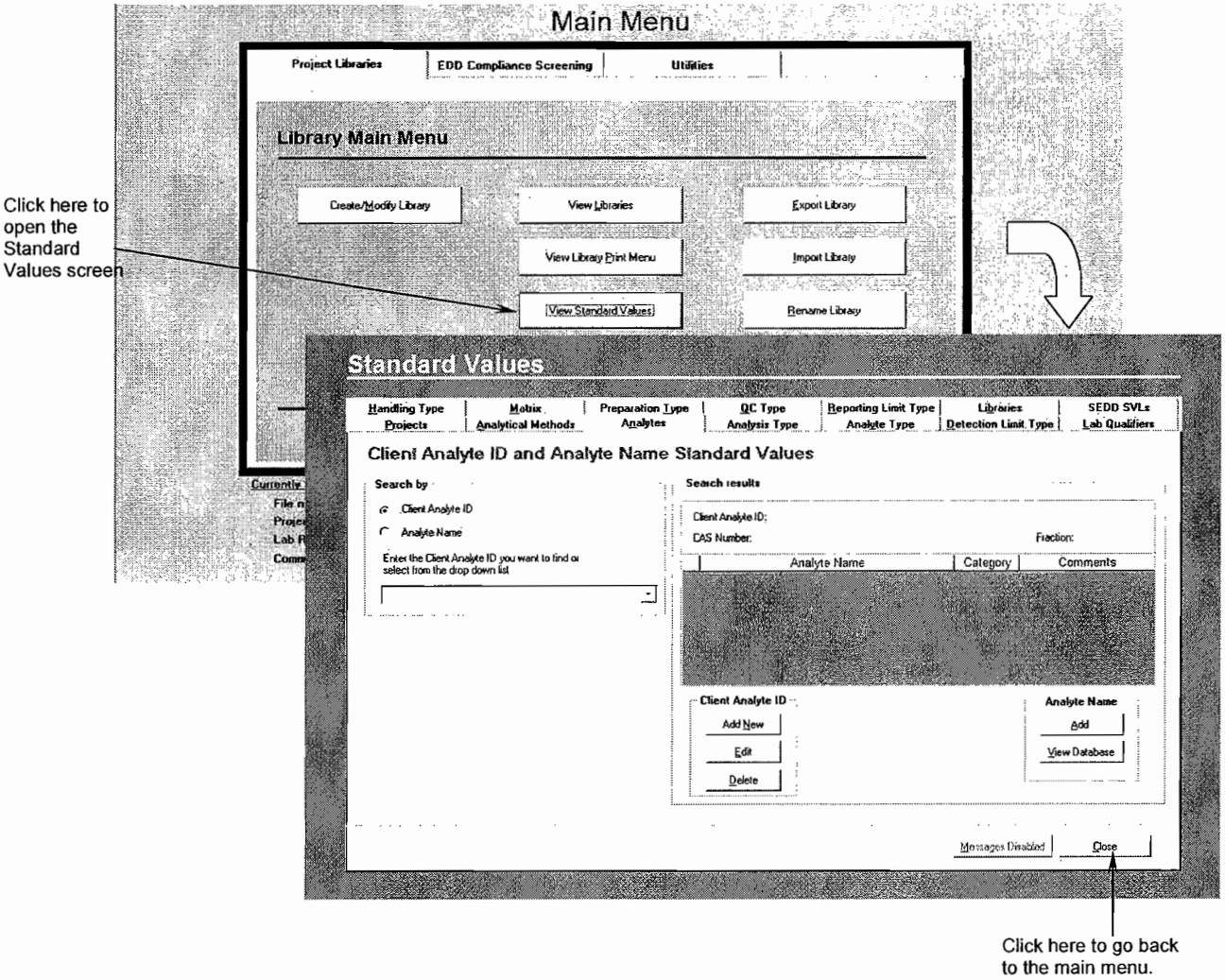


Make a selection here to search the database for a specific Client Analyte ID or Analyte name and retrieve information about it.

2.2 STANDARD VALUES

The standard value tables control the methods, client analyte IDs, and analyte names that can be entered into project libraries. These values are controlled by the project manager and will be entered into the standard value tables. From the **Main Menu**, click on the **Libraries** tab, then click on the **Standard Values** button to open the **Standard Values** screen. This screen allows you to select the standard value to add, edit, or delete. (Note: There are three standard values that cannot be added to or modified. These are **Analyte Type, Matrix** and **QC Type**. All other standard values can be added to or modified).

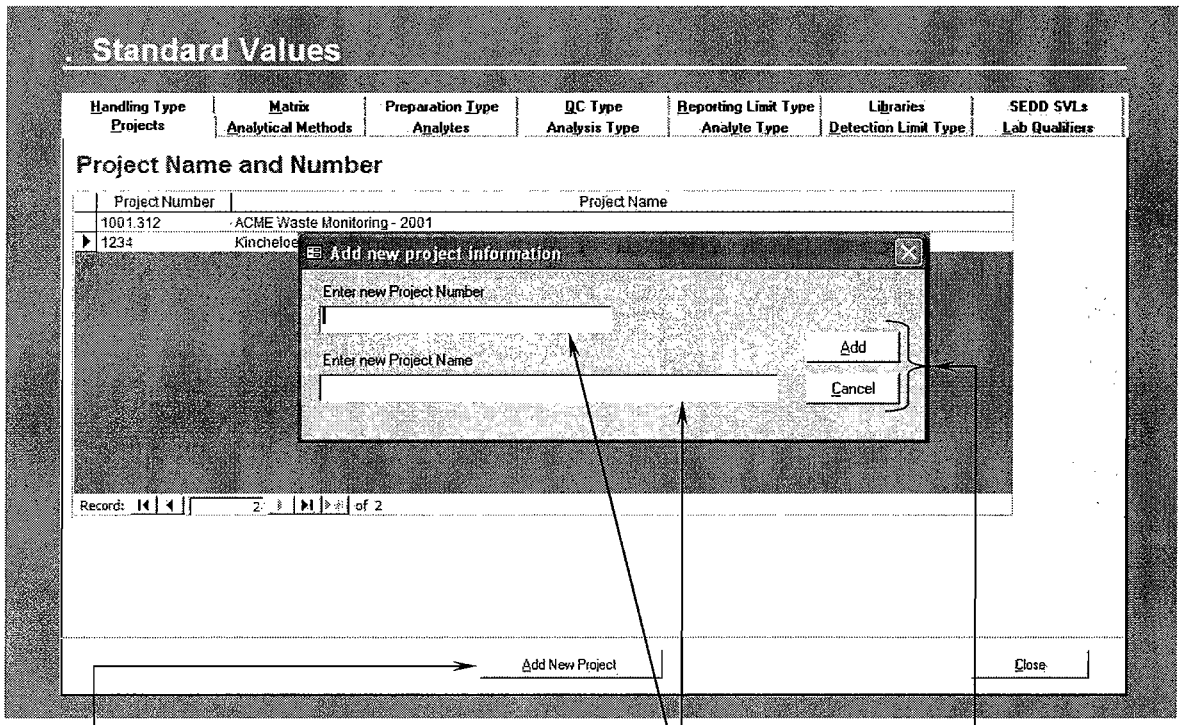
Figure 2-2



2.2.2 Standard Value Additions

Standard Values which can be modified by the user (**Projects, Handling Type, Analytical Methods, Analytes, Preparation Type, Analysis Type, Reporting Limit Type, Detection Limit Type, Libraries** and **Lab Qualifier**) are all modified in a similar manner. The Projects standard value tab is used as an example. The information asked for on the **Add new standard value** pop-up screen will vary depending on which Standard Value tab you are in.

Figure 2-3



1. Click here to open the **Add new Standard Value** window.

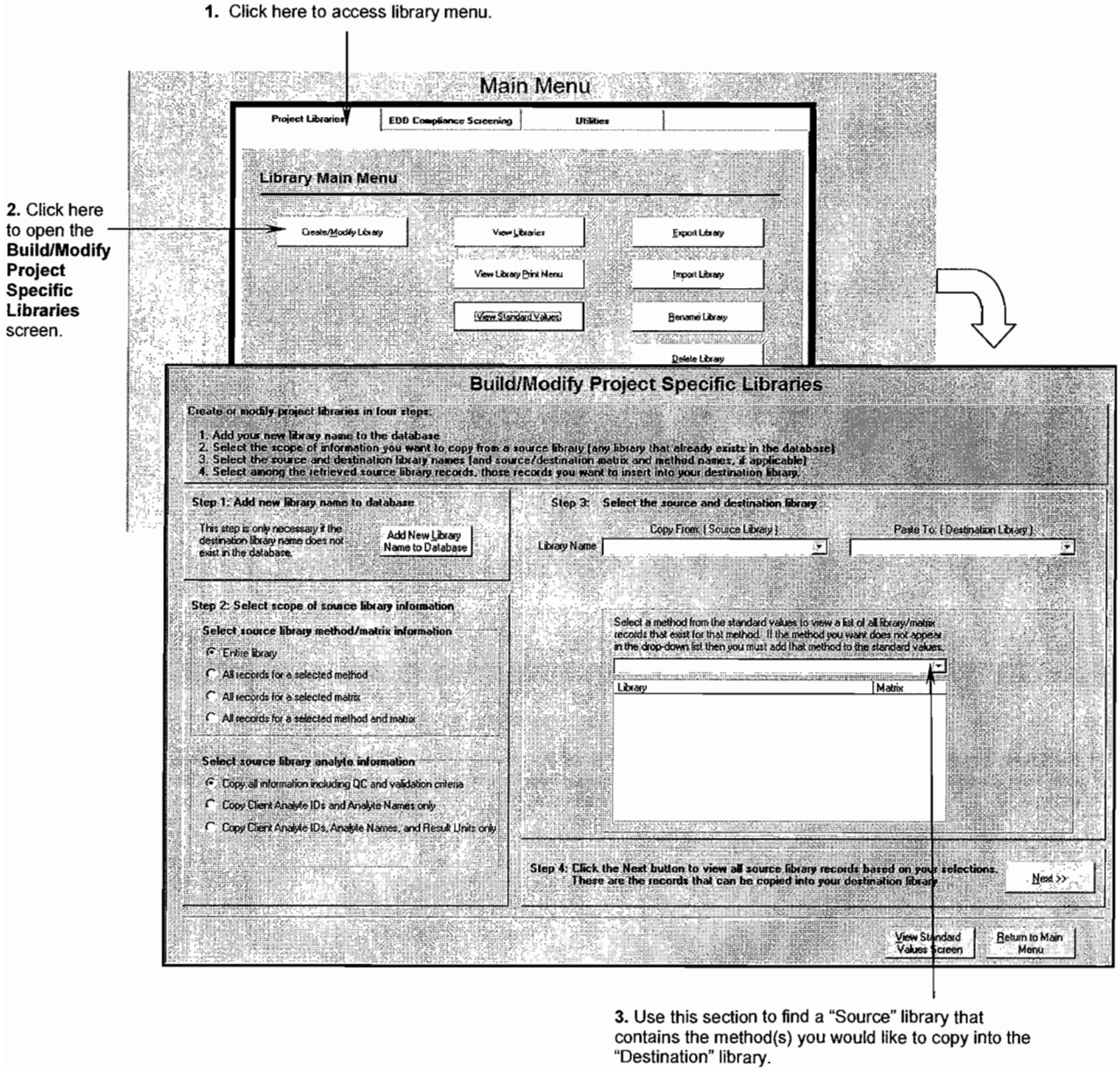
2. Enter the required information in the pop-up window.

3. Click the **Add** button to add the record to the database. Click **Cancel** to close the window without adding the new standard value to the database.

2.3 CREATING AND APPENDING A PROJECT LIBRARY

From the Main Menu, click on the **Library Files** tab to access the Library Files options, then click on **Create/Append Library** button to open the **Build/Modify Project Libraries** screen. This screen allows the user to create a new library name, select both the source and destination libraries, and to select specific information from the source library to make available for copying into a destination library.

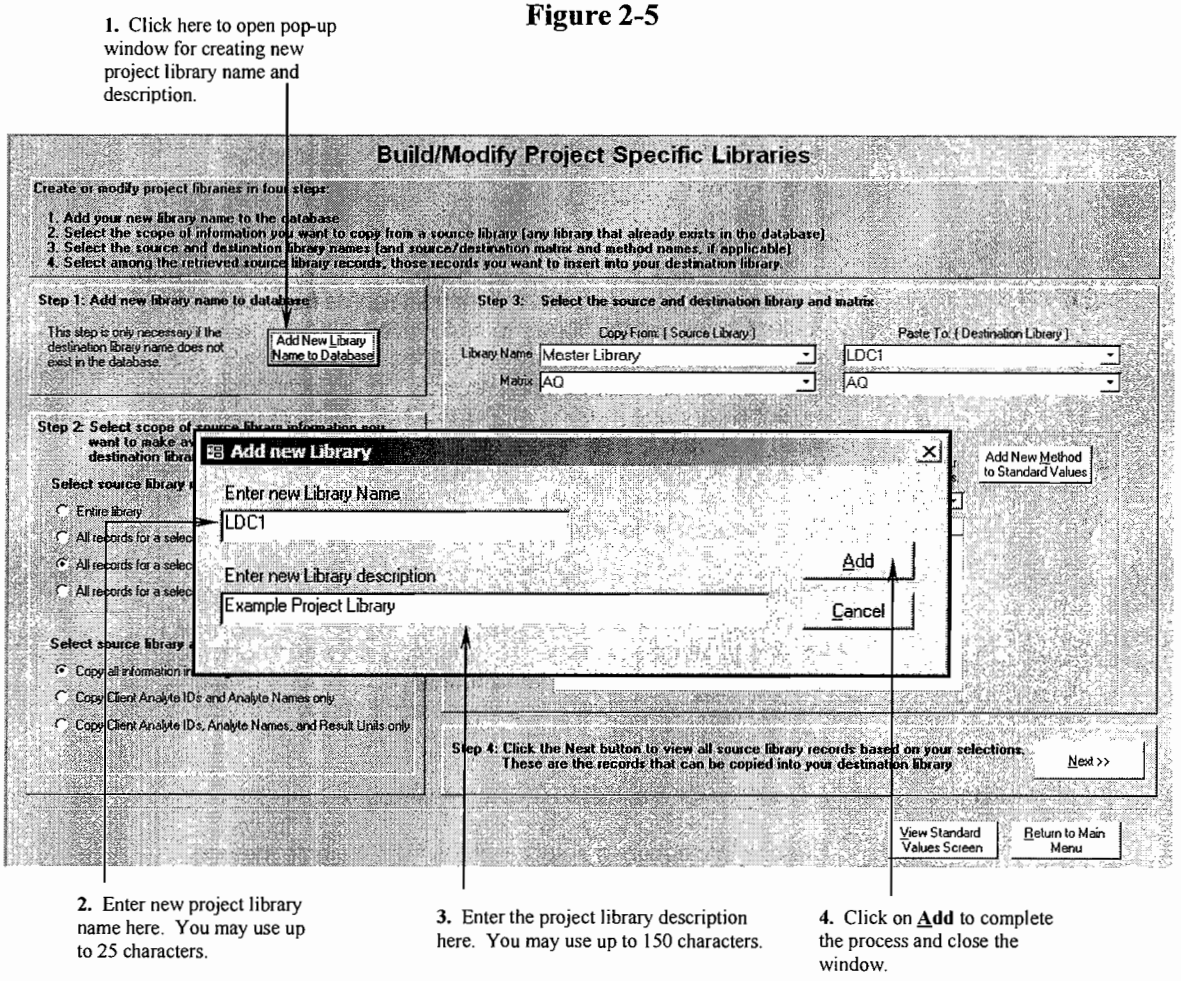
Figure 2-4



Step 1: Create the New Library Name

If you want to add records to a new library, you must first create the new library name. Click on the **Add New Library Name to Database** button to open a pop-up window. Enter the new library name, using up to 25 characters, in the blank field under the heading Enter new Library Name. Enter a library description, using up to 150 characters, in the blank field under the heading Enter new Library Description. After entering the new project library name and description, click on the **Add** button again to close the pop-up window. Skip Step 1 if you want to append records into an existing project library.

Figure 2-5



Step 2a: Select the Scope of Information from the Source Library

Select an option that specifies the scope of information from an existing (source) library that you want to make available for copying into the destination library. The option group at the top of the Step 2 box offers four choices for selecting the scope of information from a source library (see Step 2a in Figure 2-6). The four options and how to use them are described below.

Options for Selecting the Scope of Information from a Source Library

Option:	Entire Library
	Choose this option to select all records from all methods and sample matrices in the source project library to make available for copying into the destination library. The source library name is entered in Step 3. Use this choice when all or most of the methods and analytes in the source library records closely match those required in the destination project library.
Option:	All records for a selected method
	Choose this option to select all matrix records from a single method in the source library to make available for copying into the destination library. The method is entered in Step 3. Use this choice for appending records into a destination project library one method at a time. This option is useful when you want to add records to the destination library from methods in different source libraries.
Option:	All records for a selected matrix
	Choose this option to select all method records for a single matrix from the source library to make available for copying into the destination library. The matrix is entered in Step 3. Use this option when you want to add records for a single matrix to a project library and your source library methods and analyte lists closely match those of your project.
Option:	All records for a selected method and matrix
	Choose this option to select records from a single method and single matrix in the source library to make available for copying into the destination library. The method and matrix are selected in Step 3. Use this option for adding records to a project library when you only want information from one method and one matrix. This choice is useful when you want to add records to your project library using methods from different source libraries, or when you want to add records for only one method and matrix to your project library.

Step 2b: Select the Fields to Copy to the New Library

Select an option that specifies the fields from the source library records you want to make available for copying into the new project library or destination library. The option group at the lower left of the screen offers three options (see Step 2b in Figure 2-6). The three options and when to use them are described below.

Options for Selecting the Fields to Copy to the New Library files

Option:	Copy all Information including QC and validation criteria
	Choose this option to select the Client Analyte IDs, analyte names, detection and reporting limits, and quality control limits from the source library records selected in Step 2 and entered in Step 3. Use this option when the all or most records in the source library closely match those required in the destination library.
Option:	Copy Client Analyte IDs and Analyte Names only
	Choose this option to select the Client Analyte IDs (CAS numbers) and analyte names from the source library records selected in Step 2 and entered in Step 3. This option is useful when the source library has target analytes similar to the source library but other parameters such as reporting limits, units, and QC limits are different in your destination library. Choose a source library with methods and associated target analytes that closely match those of the new project or destination library.
Option:	Copy Client Analyte IDs, Analyte Names, and Result Units only
	Choose this option to select the Client Analyte IDs (CAS numbers), analyte names, and results units from the source library records selected in Step 2 and entered in Step 3. This option is used in the same manner as the previous option, but in this case the units also match.

Step 3a: Enter Source Library Information

Enter the source library name, analytical method, and matrix, as applicable, in the fields displayed under the heading **Copy From: (Source Library)**. The fields available depend on the option selected in Step 2. Make selections from the pull down menus for each field, or type in the values (see Step 3a in Figure 2-6). Only Standard Values are accepted.

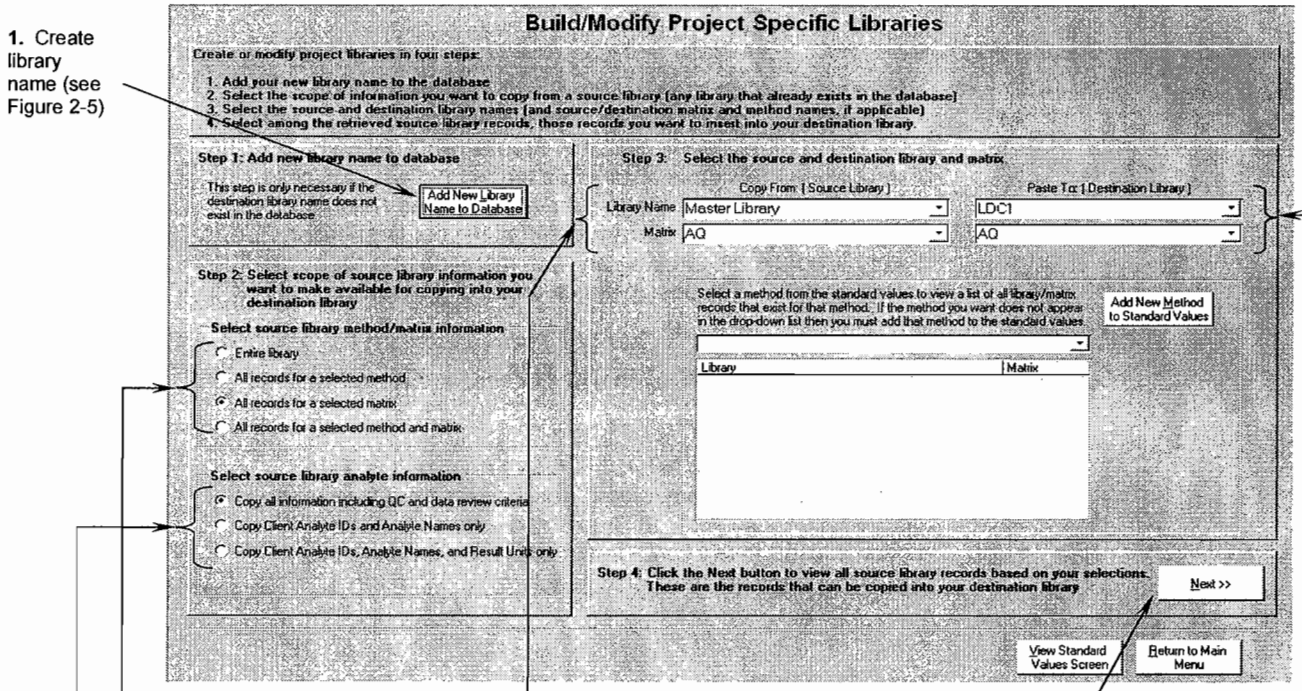
Step 3b: Enter Destination Library Information

Enter the destination library, analytical method, and sample matrix, as applicable, in the fields displayed under the heading **Paste To: (Destination Library)**. The fields available depend on the option selected in Step 2. Make selections from the pull down menus for each field, or type the values (see Step 3b in Figure 2-6). Only Standard Values are accepted. Note: The Destination Library name must be created before you can select it (refer to Step 1).

Step 4: Open the Selected Library Records Screen

Once the source and destination library information are entered, click on the **Next** button (see Step 4 in Figure 2-6) to open the **Final Selection of Source Library Records to Add to Destination Library** Screen.

Figure 2-6
Summary of Steps 1 through 4 in the Create/Append Library Process



1. Create library name (see Figure 2-5)

2a. Click an option to select the scope of information from the source library that you want to make available for appending into the destination library.

2b. Click an option to select what fields you want to make available for appending into the destination library.

3a. Enter the source library ID, method, and matrix for the records you want to make available for appending into the destination library. Use drop-down menus or type in the values. Note: the fields available here depend on the option selected in Step 2a. In this example, all records for a selected matrix were selected so a drop-down menu appeared to select the matrix (AQ).

3b. Select the destination library ID, method and matrix. Again, the fields selected here depend upon the options selected in 2a.

4. Click the **Next** button to open the **Final Selection of Source Library Records to Add to Destination Library** screen.

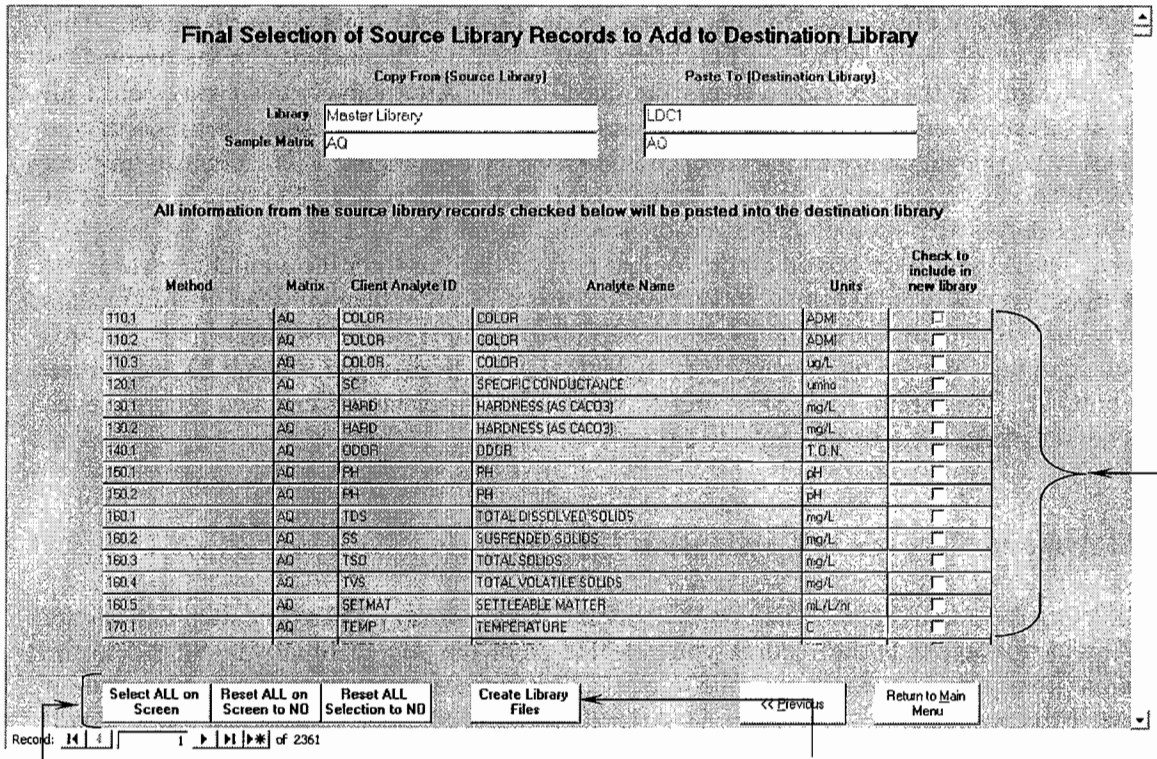
Step 5: Select Records to Copy

The **Final Selection of Source Library Records to Add to Destination Library** Screen displays all the records, based on your selections and entries in Steps 2 through 4 that are available for copying into the destination library (see Step 5 in Figure 2-7). In this step, you must indicate the selected the records from your choices that you want included in the destination library by clicking in the check box located at the far right of each record. This action places a check mark in the box indicating that record is to be included in the destination library. Clicking on the box again clears the check mark. Alternatively, you may select all records on screen by clicking the **Select ALL on Screen** button, then unselect the records you don't want to copy by clicking on the checked box (see Step 5 in Figure 2-7). You can unselect all checked records on screen by clicking on the **Reset ALL on Screen to NO** button. Note that both buttons only affect records displayed on screen, including those accessible by using the scroll bar. The Access filter button on the toolbar may be used to filter the available records. If the filter function was used to display the current records on screen, then only the filtered records on screen (including those accessible using the scroll bar) can be selected or unselected. Records not included in the filter are unaffected by the **Select ALL on Screen** and **Reset ALL on Screen to NO** buttons. The **Reset ALL Selection to NO** button unselects all checked records, even records not on screen (i.e., records outside a filter).

Step 6: Append Records to Destination Library

After selecting records in Step 7, click on the button **Create Library Files** (See Step 6 in Figure 2-7). This action appends the records you selected from the source library in Step 5 to the destination library. This completes the process. Additional records can be appended, if necessary, by repeating Steps 2 through 6. After this step is completed, a pop-up window will appear stating that you have successfully appended the selected records in to the destination library. The pop-up window will give you the choice of viewing the newly created library now by clicking on the Yes button. The library can also be viewed later by returning to the Main Library Menu and clicking on the **View Libraries** button to view and edit the information in your project-specific library.

Figure 2-7
Summary of Steps 5 and 6 in the Create/Append Library Process

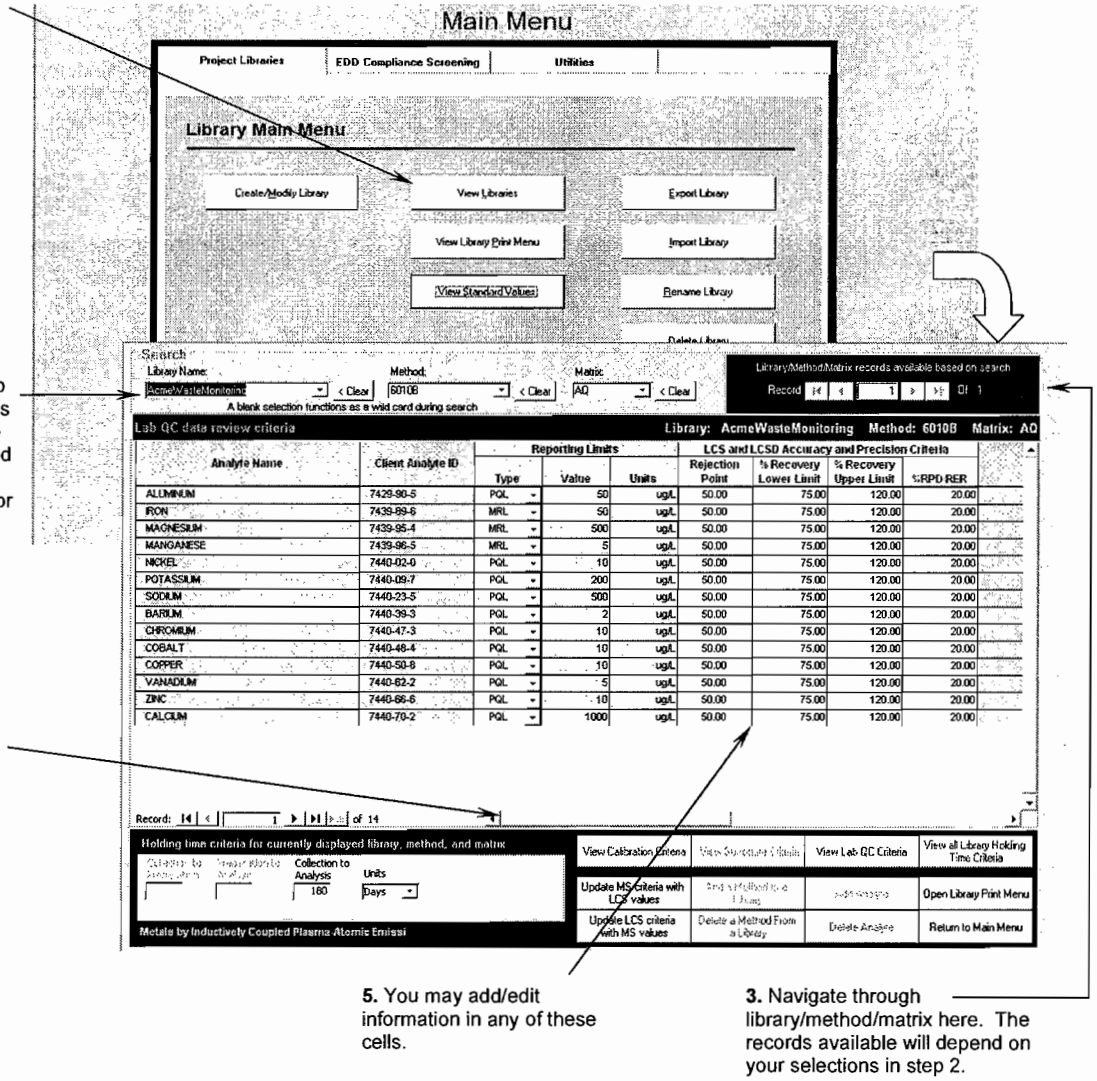


***Note:** Both the **Select ALL on Screen** and **Reset ALL on Screen to NO** buttons only affect records that can be viewed on screen, including those records accessible for viewing using the scroll bar. If a filter was employed, only the filtered records are affected. Records not included in the filter remain unaffected by these buttons.

2.4 VIEWING/MODIFYING PROJECT LIBRARY

From the Main Menu, click the **Project Libraries** tab, then click on the **View Libraries** button. This will take you to the library main viewing screen. This screen allows you to edit reporting limits, precision and accuracy, and method blank acceptance criteria. Other related QC screens can be viewed by clicking the buttons at the bottom of the screen. Use the drop down filter menus on the fields in the "Select one or more search parameters" at the top of the screen to view the analyte records you want. You can filter on any combination of library ID, sample matrix, and method. Use these screens to view and edit project library table records. Each screen is detailed in the following pages.

Figure 2-8

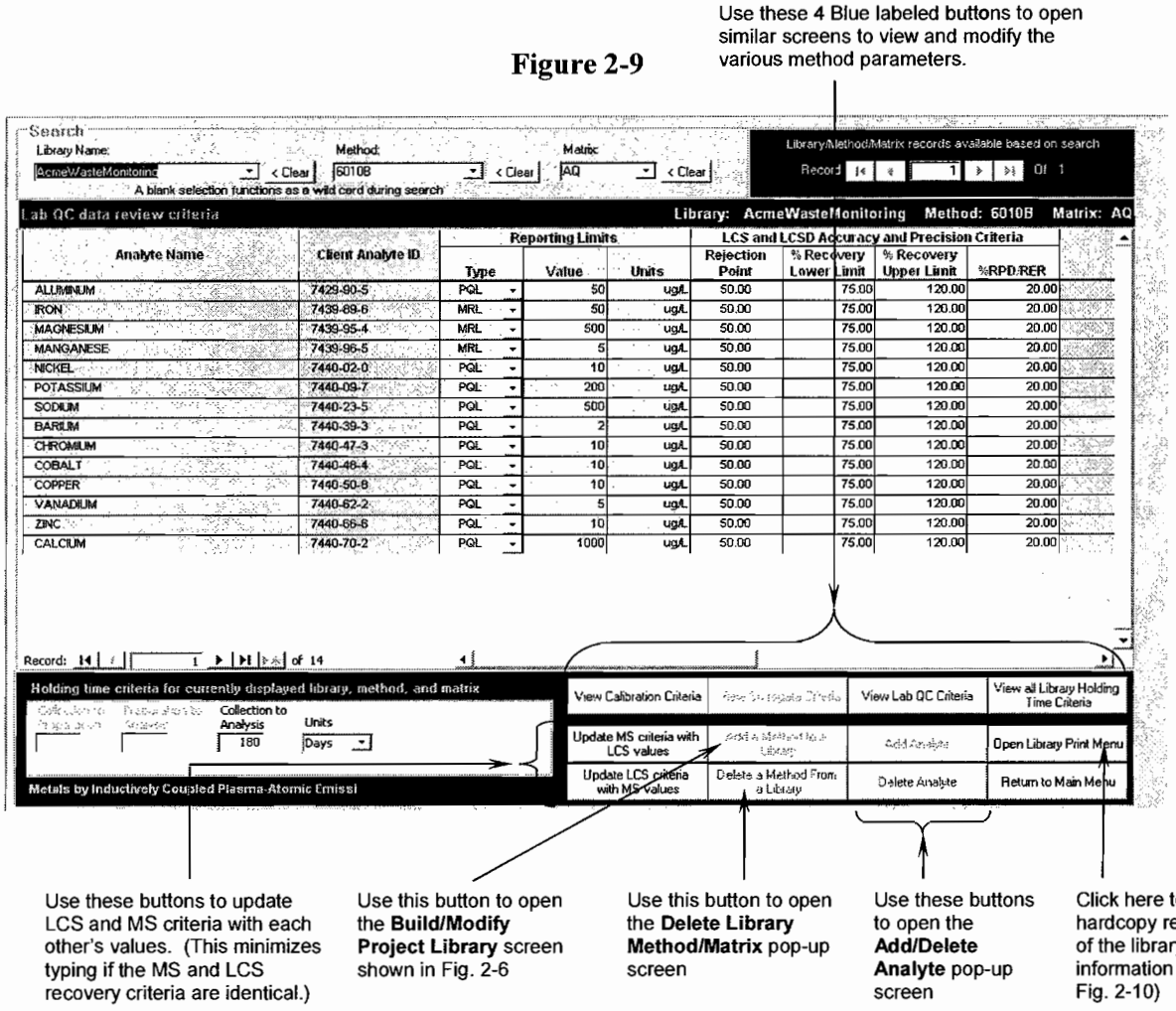


2.4.1 Other Functions of the Project Library Screen

From the main library viewing screen you will be able to access other screens and functions of the library. The library viewing screen first opens in the Lab QC Criteria view. To view and modify other method criteria (Surrogate, Holding Time, Calibration) click on the corresponding green labeled button. This screen also has the function of populating the MS/MSD recovery values with the LCS recovery values, or vice versa, by clicking the corresponding buttons.

You can also access other features of the program by clicking the colored buttons. Clicking the Add Method to a Library button will open up the Build/Modify Project Library screen that is discussed above in Fig. 2-6. Clicking the Delete Method from a Library button will open the Delete Library Method/Matrix pop-up screen. This screen is very similar to the Standard Values addition window, but the function is to delete the information from the database.

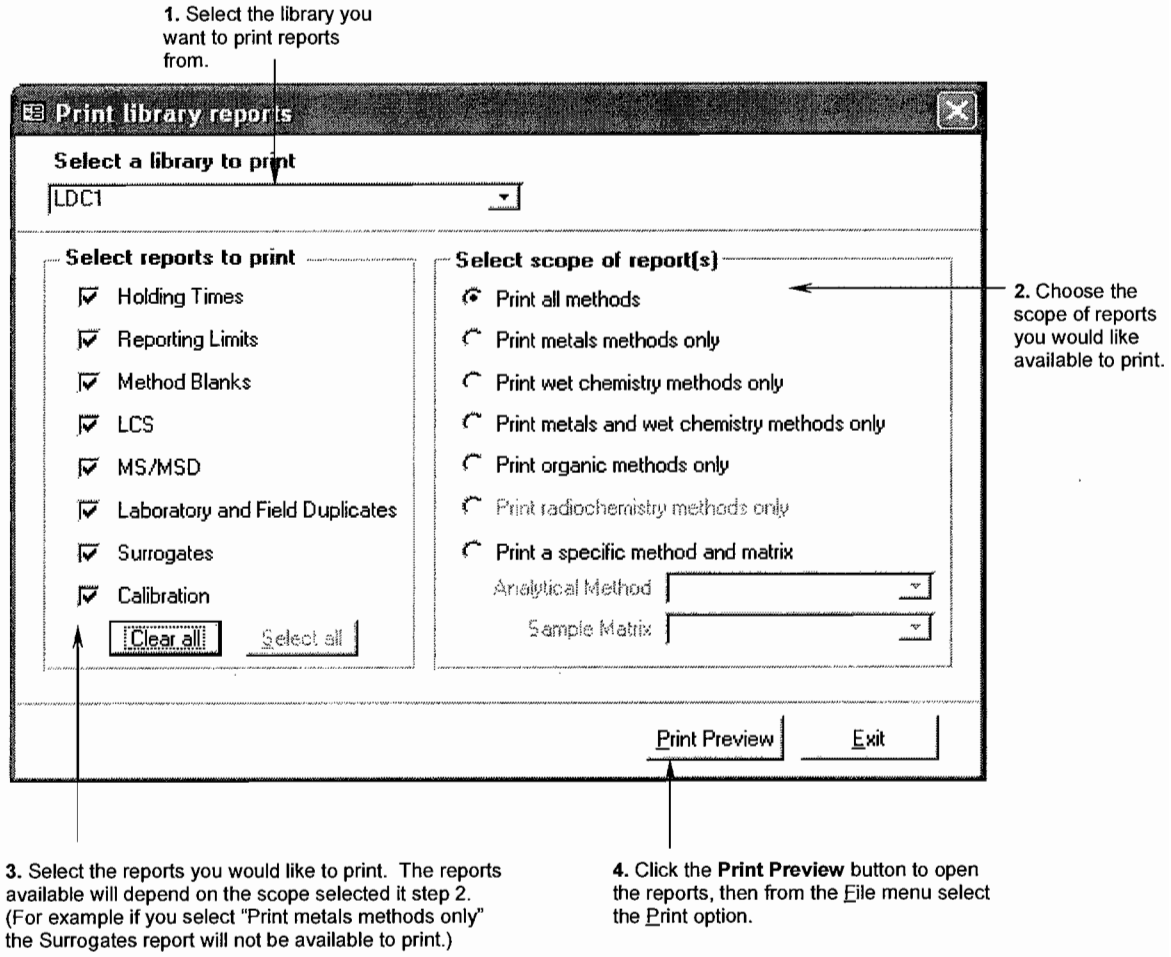
Figure 2-9



2.5 PRINT LIBRARY REPORTS

From the Main Menu, click the **Project Libraries** tab, then click on the **Library Print Menu** button. This will take you to the **Print library reports** pop-up screen. From this screen you may select to print all of the information from a library or a subset of the information.

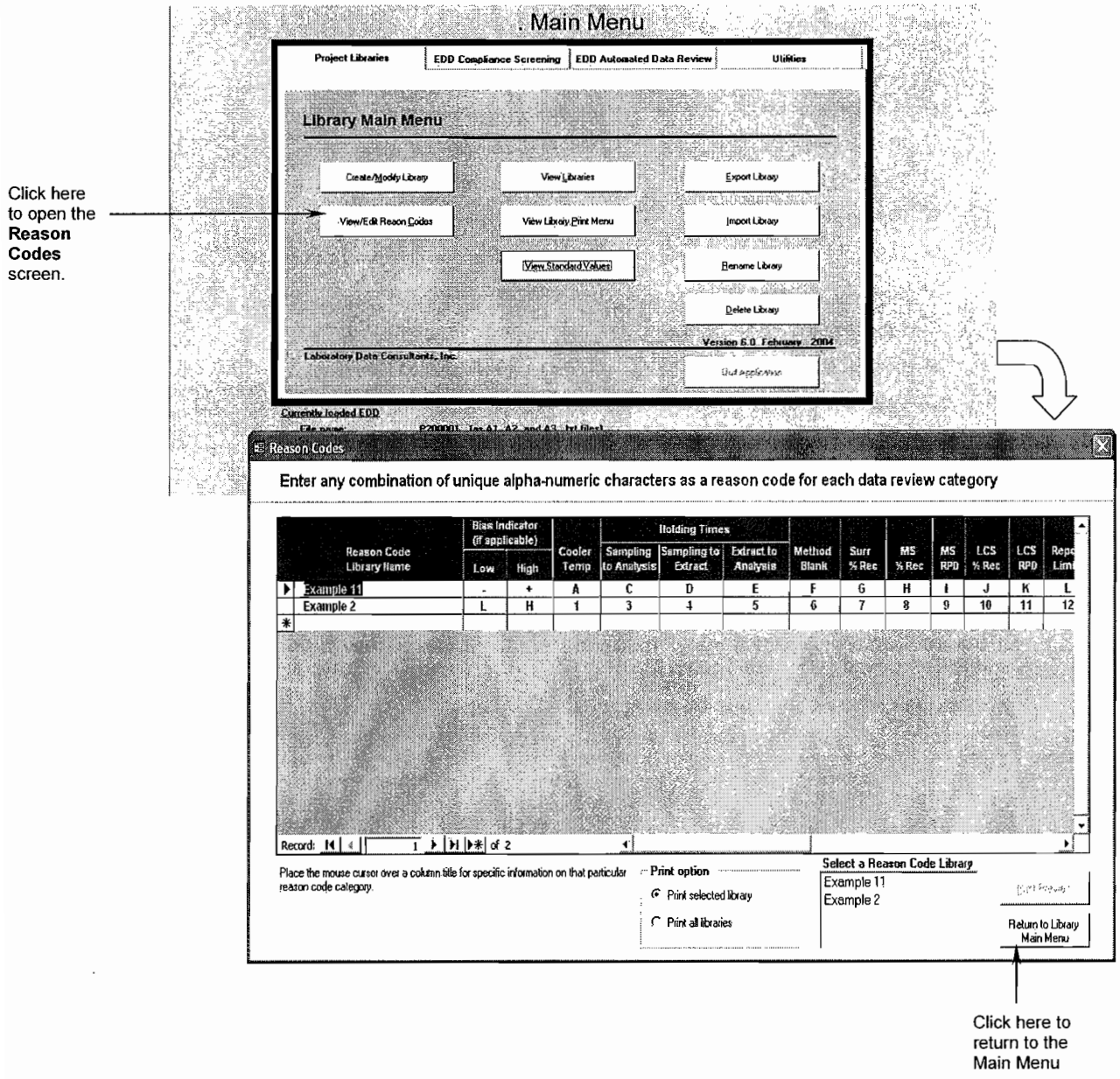
Figure 2-10



2.6 REASON CODES

The Reason Code library allows you to apply Reason Codes and Bias Indicators to the qualified data during the validation process. From the Main Menu click the **View Reason Codes** button. This will open the **Reason Codes** screen. From this screen you may modify values and/or create a new Reason Code library. Typically for a given client and/or project this will only be necessary once at the start up phase.

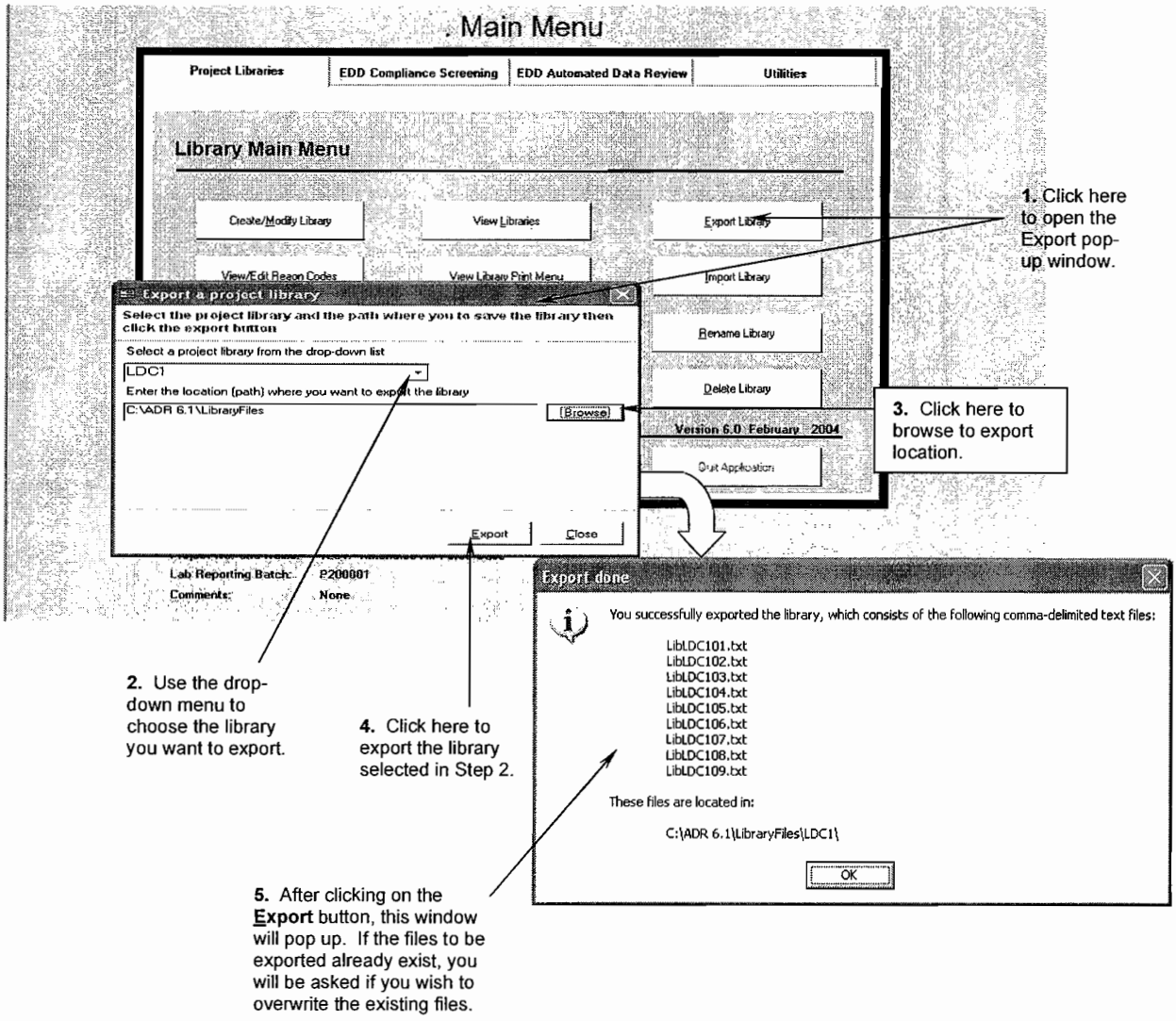
Figure 2-11



2.7 EXPORTING LIBRARY FILES

The **Export Library** function exports a project library as a text file so that it can be archived or uploaded into another user's application. When a project library is downloaded, nine related text files are created. The downloaded files are saved in a folder with the library name in the subdirectory called **LibraryFiles**, which is located in the 'parent' directory where the application resides. The naming convention for the files is to prefix the library name with "Lib" and give each file a consecutive suffix from 01-09 (ie: LibUser Manual Example Lib01.txt).

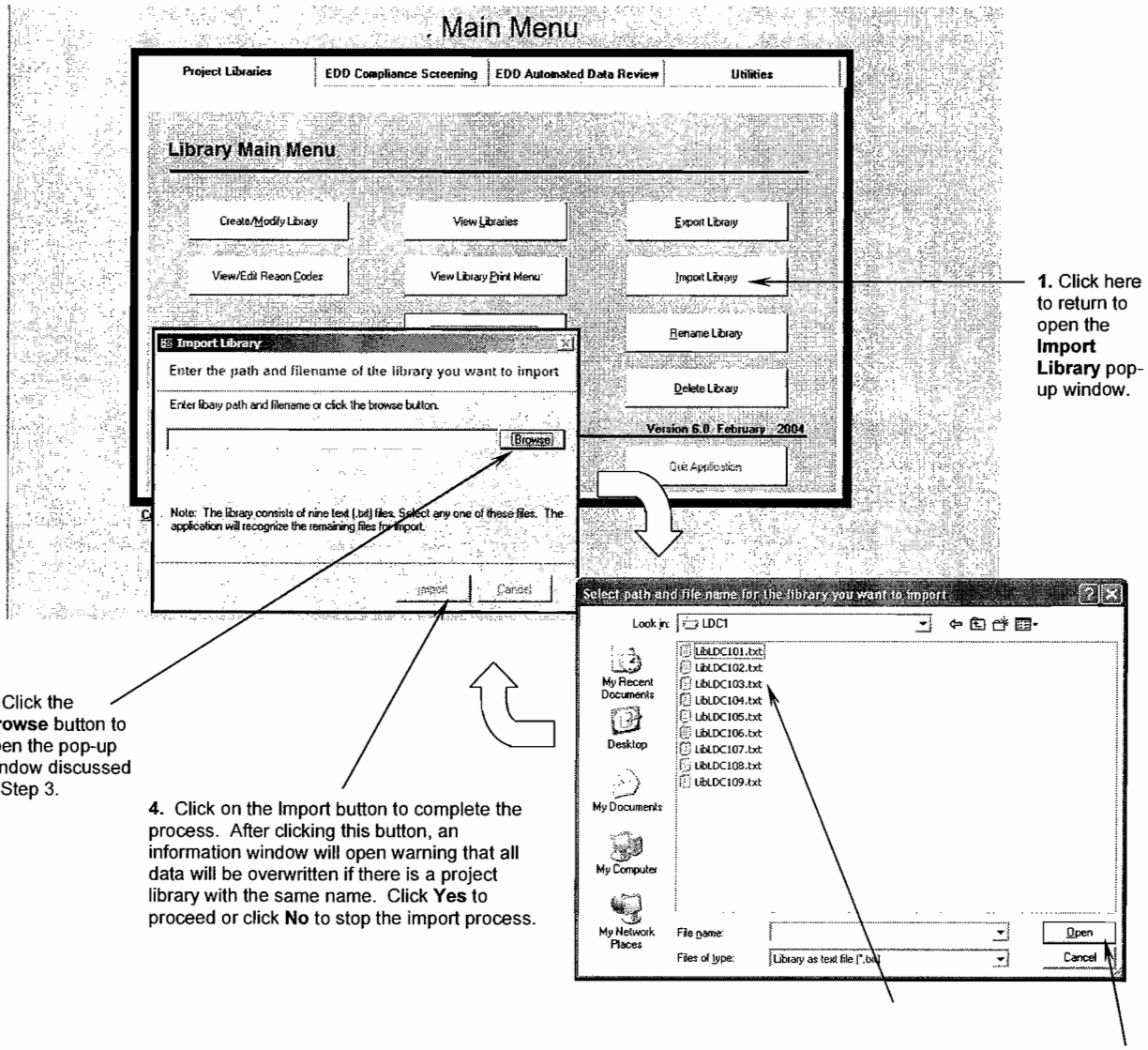
Figure 2-12



2.8 IMPORTING LIBRARY FILES

The **Import Library** function imports an previously exported project library. Project libraries are imported through the use of the **Import Library** function explained in Figure 2-13.

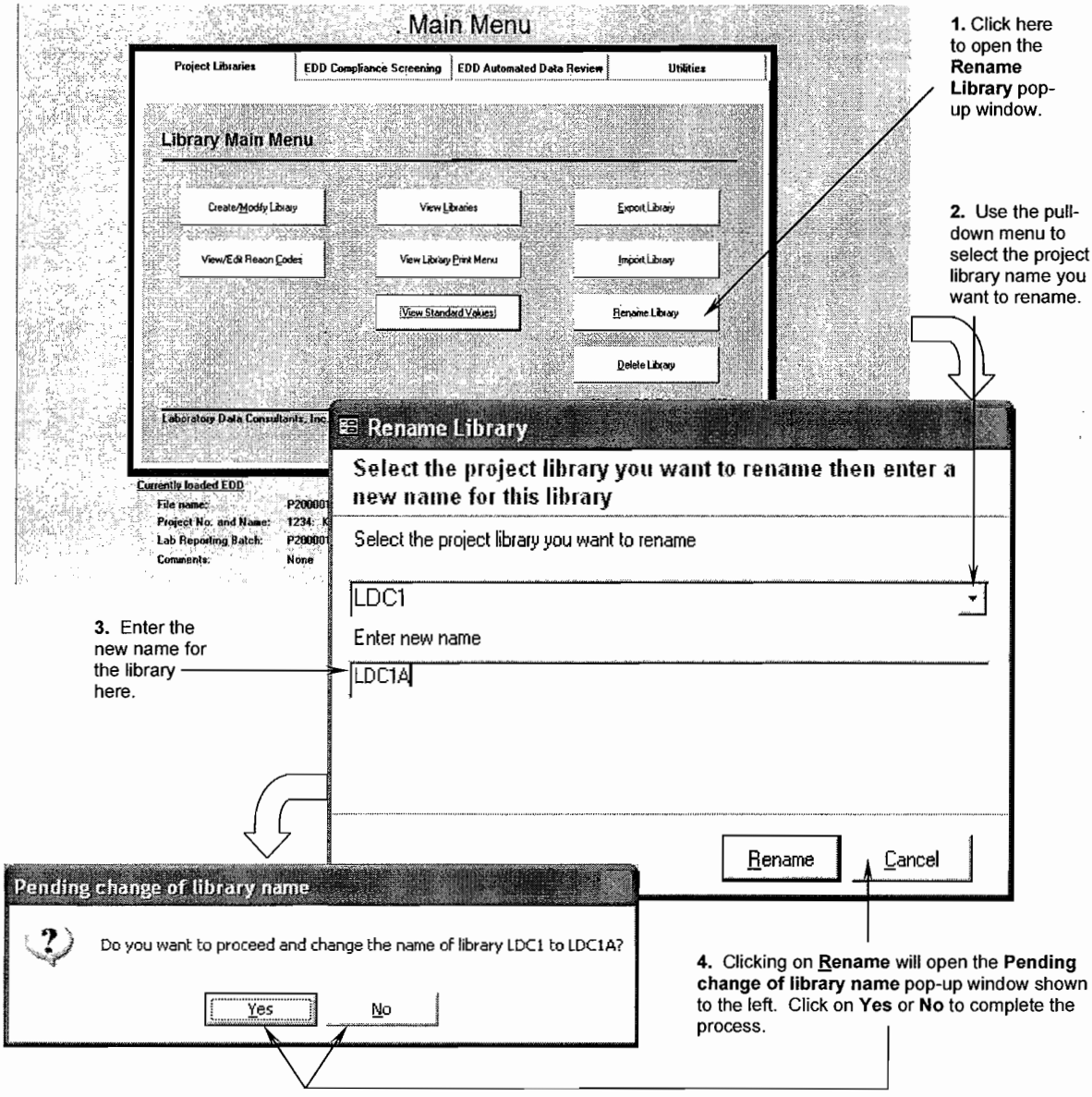
Figure 2-13



2.9 RENAMING PROJECT LIBRARIES

The **Rename Library** function changes the name of a project library. This is useful if you want to keep the original state of a current library, but also edit it for a new project. First export a copy (see Fig. 2-12) of the library you want to use, then continue with this procedure. **(CAUTION: to re-examine a previously processed EDD you must have a copy of the library used to process that EDD).**

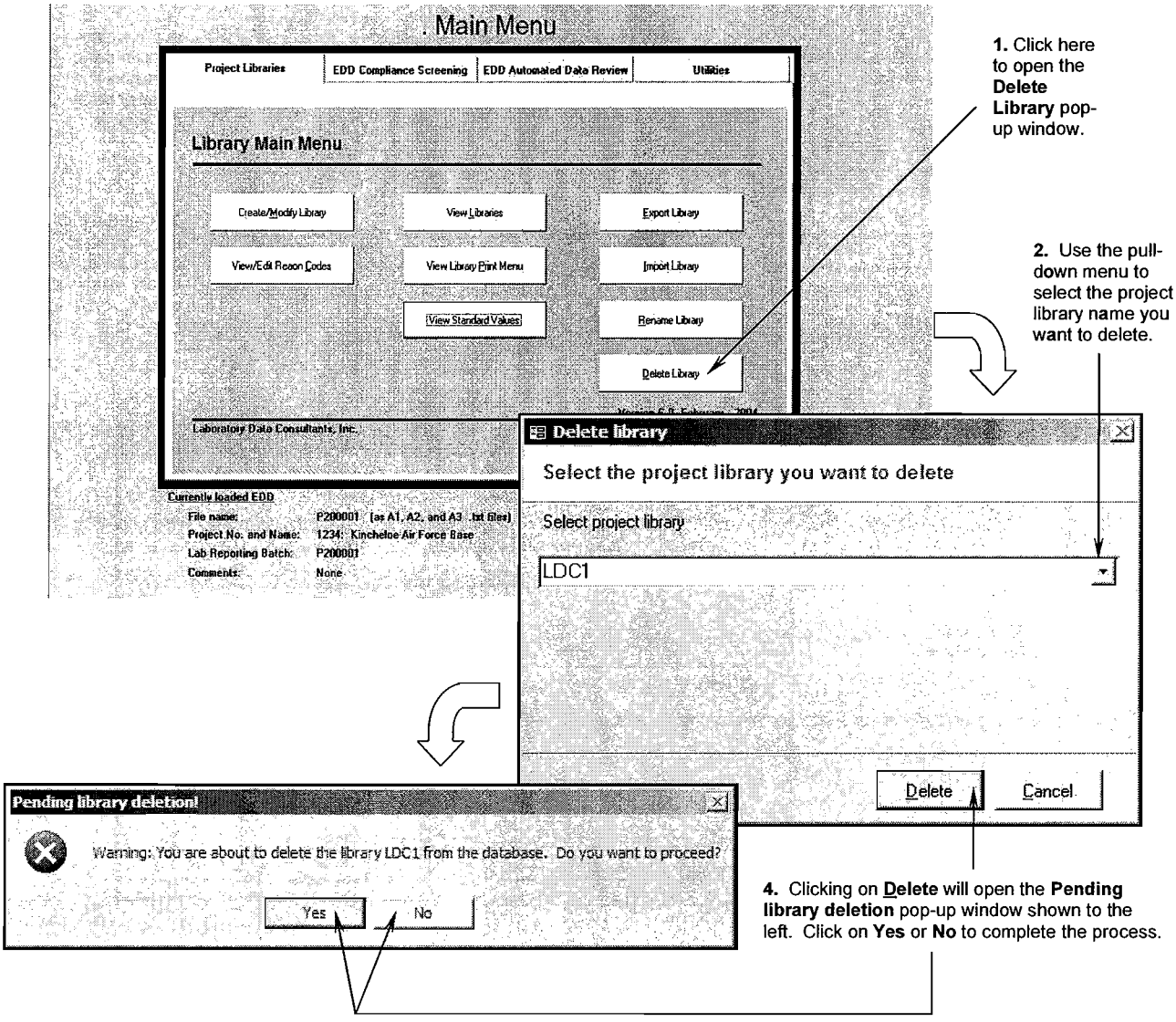
Figure 2-14



2.10 DELETING PROJECT LIBRARIES

The **Delete Library** function deletes a specific project library from the database tables. Previously exported libraries are not affected by this action. **(CAUTION: it is recommended that you first export (see Fig. 2-12) and archive a copy of the library before deleting it from the database.)**

Figure 2-15



3.0
CCS Module

3.1 EDD ERROR CHECK MENU

EDD Error Check

EDD Error Check performs a comprehensive error check of the EDD using the project library as the reference. An EDD is first uploaded into the application from a source such as a diskette, hard drive or e-mail file. The EDD Error Check is then initiated by choosing a reference project library and then executing the Run EDD Error Check command. The following checks are performed on the EDD file:

- Required fields, standard values, field length, and date/time format
- Client Analyte ID, analyte names, units, and reporting limits for each method and matrix reported in the EDD match the same information set up for each method and matrix in the project library
- Completeness (missing or extra compounds)
- Spike and surrogate (if applicable) compounds reported in QC sample records match those specified for each method and matrix set up in the project library
- Method blank and LCS records exist for each Preparation Batch
- Matrix spike/spike duplicate or Sample Duplicate records (if applicable) exist for each Method Batch
- Problems with Preparation Batch and Method Batch ID and sample association
- Sample results qualified by the laboratory as non-detect match the reporting limit, and reporting limits match the project library reporting limits (corrected for dilution and percent moisture, if applicable)
- Duplicate records
- Consistent lab qualifiers

EDD Error Log/Report

EDD Error Check creates an error log that summarizes all errors found in the EDD. The error log can be viewed on screen or printed as a report. When viewed on screen, the user may perform searches or apply filters to facilitate assessment and correction. When viewed as a report there will be a summary page of errors. Additionally the report groups errors into categories (i.e. missing required fields and non-valid values). The error log and error report provide the following information:

- Assigns each error a type code (a code that gives a general description of the error). Additionally, the report also summarizes the number of each type of error and the total number of errors.

- Describes each error individually and, where applicable, indicates the incorrect or missing entry.

- Lists the field name and record number where each error occurs, if applicable.

EDD Error Correction

The error log allows easy view of EDD errors when a record number is listed for a particular error. Click on the record number and a window opens below showing a view of the EDD with the focus on the record number where the error occurred. While EDD errors can be corrected within the application, it is highly recommended instead that errors be corrected within the Laboratory LIMS, a new EDD created and imported into the Error check software, and the error check run again. EDDs must match hardcopy reports. If an EDD is corrected with the software, the EDD may not match the hardcopy report.

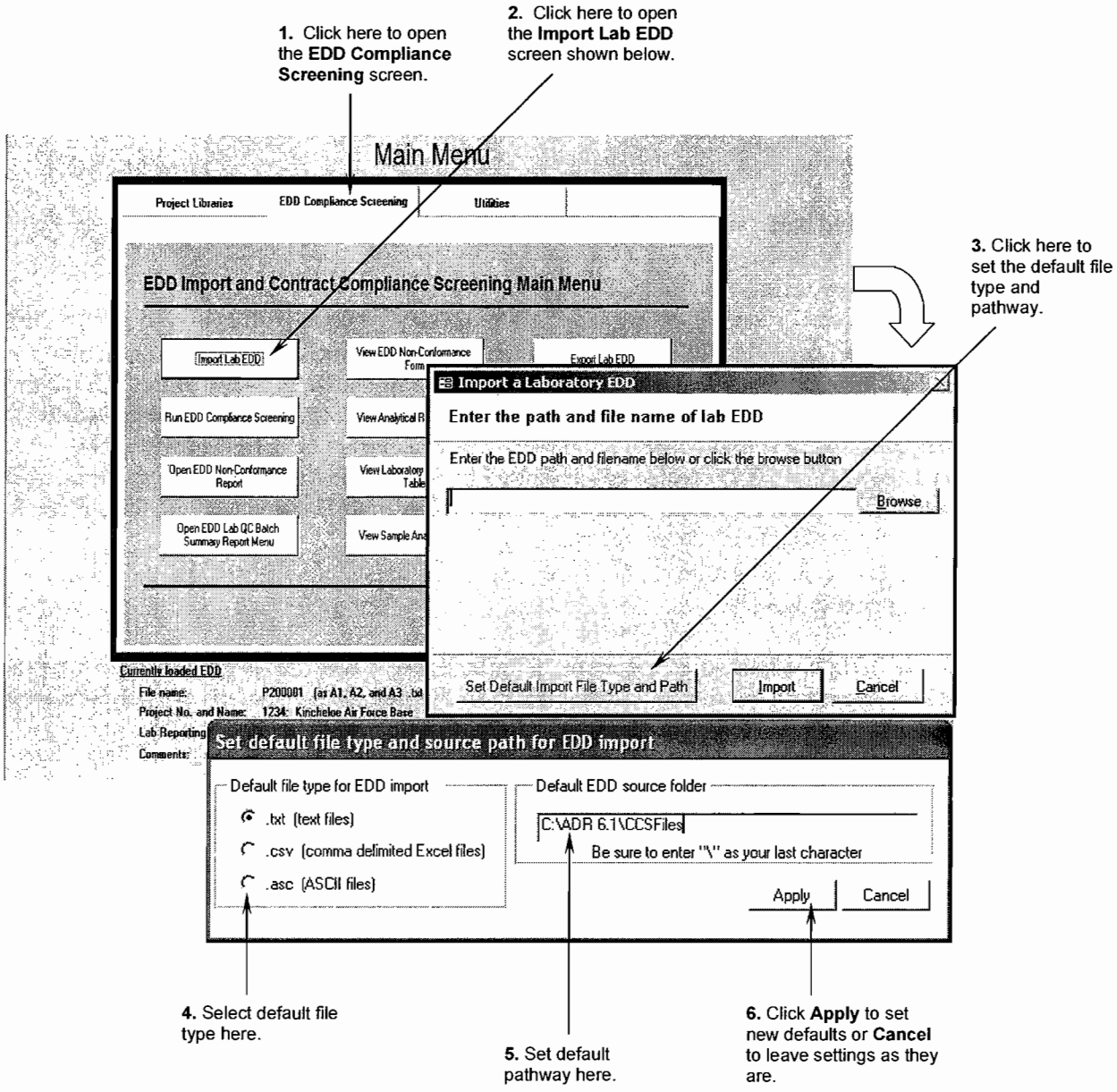
Saving Corrected EDDs

The corrected EDD is exported as a comma delimited ASCII test file in a sub-directory of the user's choice. The user is prompted to name the file. The default file name is the Lab Reporting Batch ID. This EDD set is the one to be sent by the Laboratory to the client.

3.2 SETTING THE DEFAULT IMPORT FILE TYPE AND PATH

From the Main Menu click on the **EDD Error Check** tab, then click on the **Import Lab EDD** button to open the **Import Lab EDD** screen. Click on the Set **Default Import file Type and Path** button. This will open the **Default type and source path** pop-up window. This screen will allow you to set the default file type for the software (text files, Excel comma delimited files, or ASCII files). It also allows you to specify what directory you would like to initiate EDD searches from.

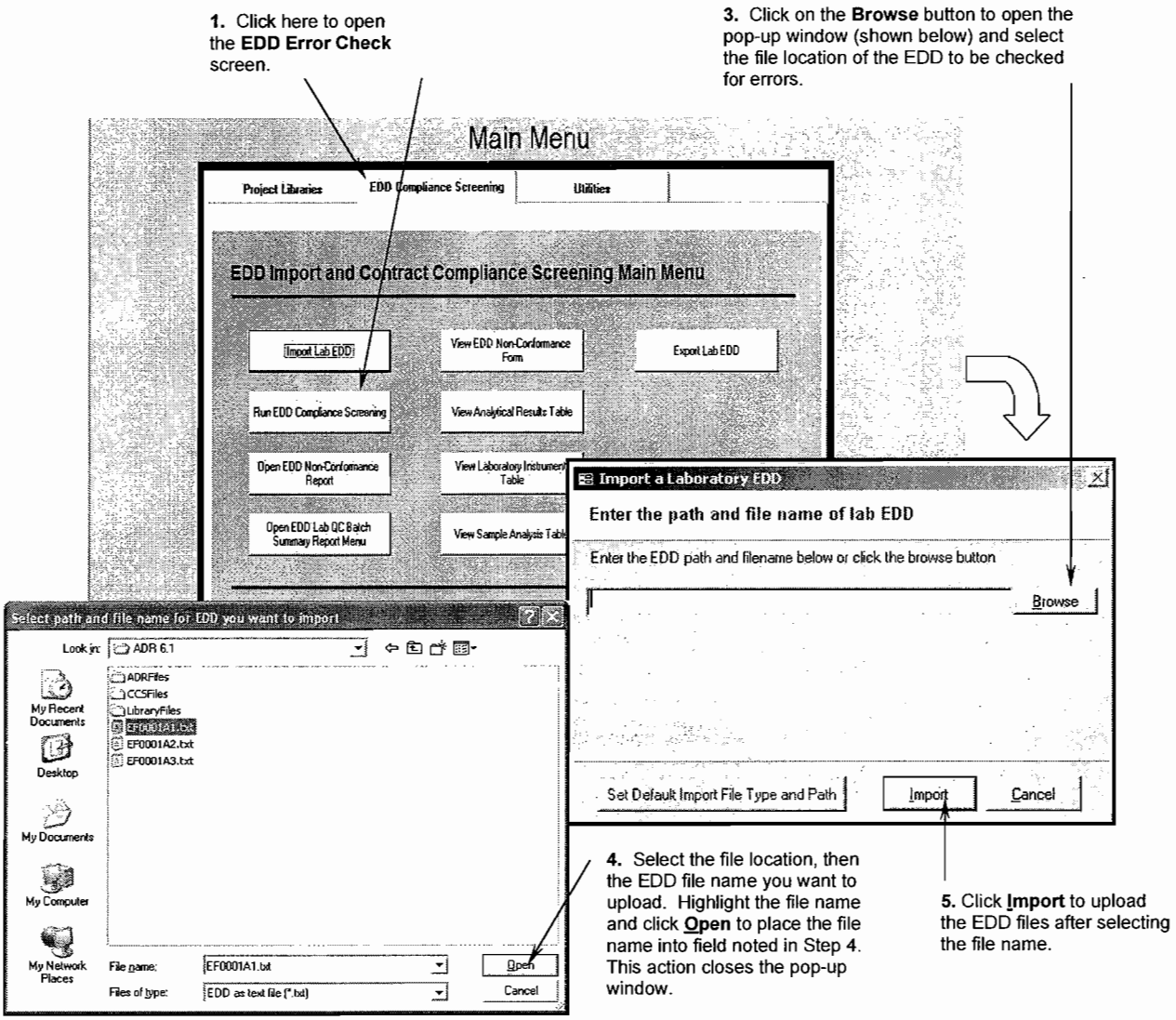
Figure 3-1



3.3 IMPORT EDD

From the Main Menu click on the **EDD Error Check** tab then click on the **Import Lab EDD** button to open the **Import Lab EDD** screen. Click on the Browse box (this will open a windows explorer pop-up window) and navigate to the where the EDD to be checked is stored. Highlight the EDD and click the **Open** button. Click on the **Import** button to complete the import process. **(NOTE: The EDD will consist of three files, the A1, A2, and A3. You only need to select one and the software will recognize and import the rest.)**

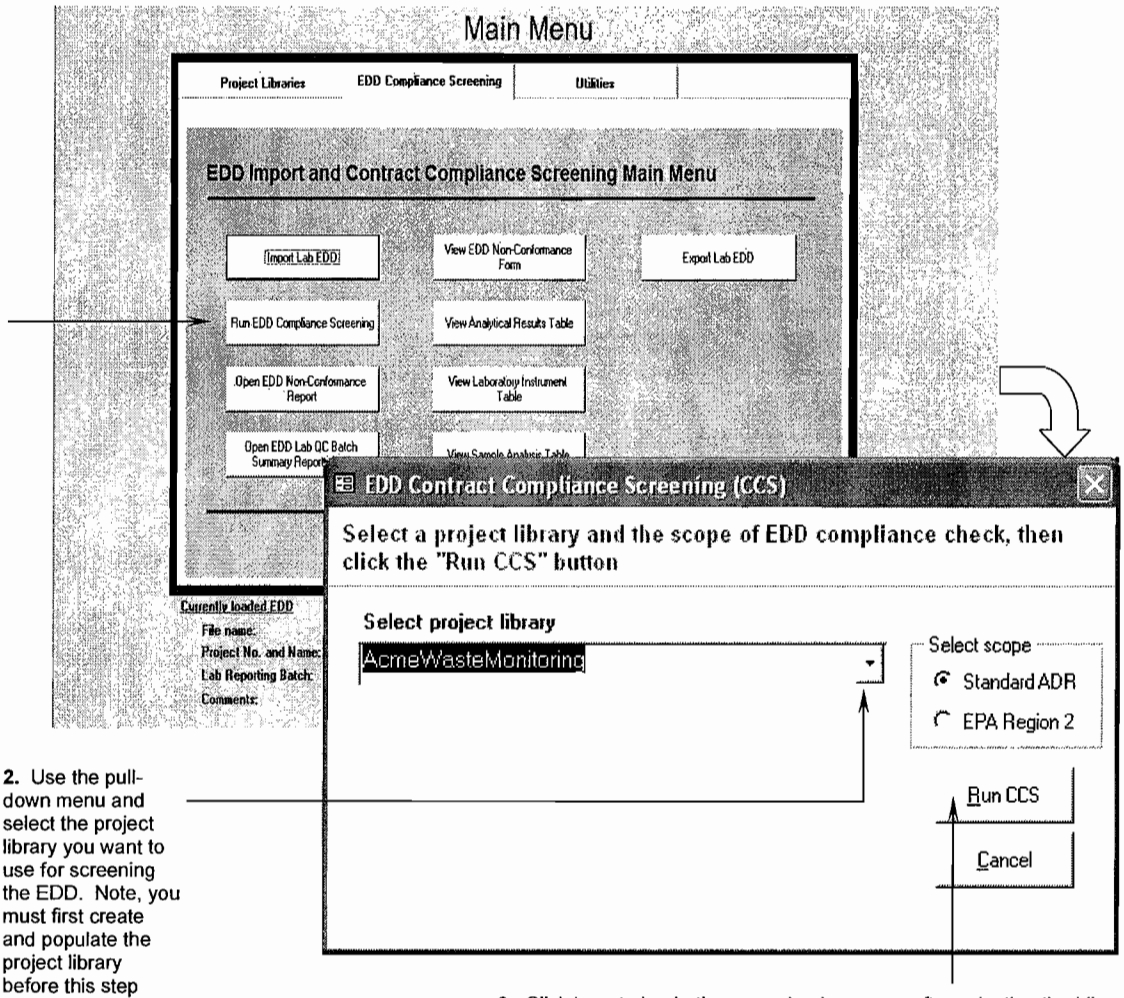
Figure 3-2



3.4 RUN ERROR CHECK MODULE

After importing the EDD begin the **EDD Error Check** by clicking on the **Run EDD Error Check** button. A screen will open instructing you to select the project specific library (the project library must be created and populated before running error check, see Section 2 of this manual). Use the pull-down menu to select the project library, be sure to select the correct library otherwise a large number of errors may be generated. After entering the project library ID, click the **Run** button to start the error check process. The error check takes about 30 seconds to two minutes depending on the size of the EDD files, computer memory, and the processor speed. When the error check has finished, an information window pops open with a message stating "Processing Lab EDD is now complete". Click OK in this window to return to the EDD Error Check Main Menu and review the error report.

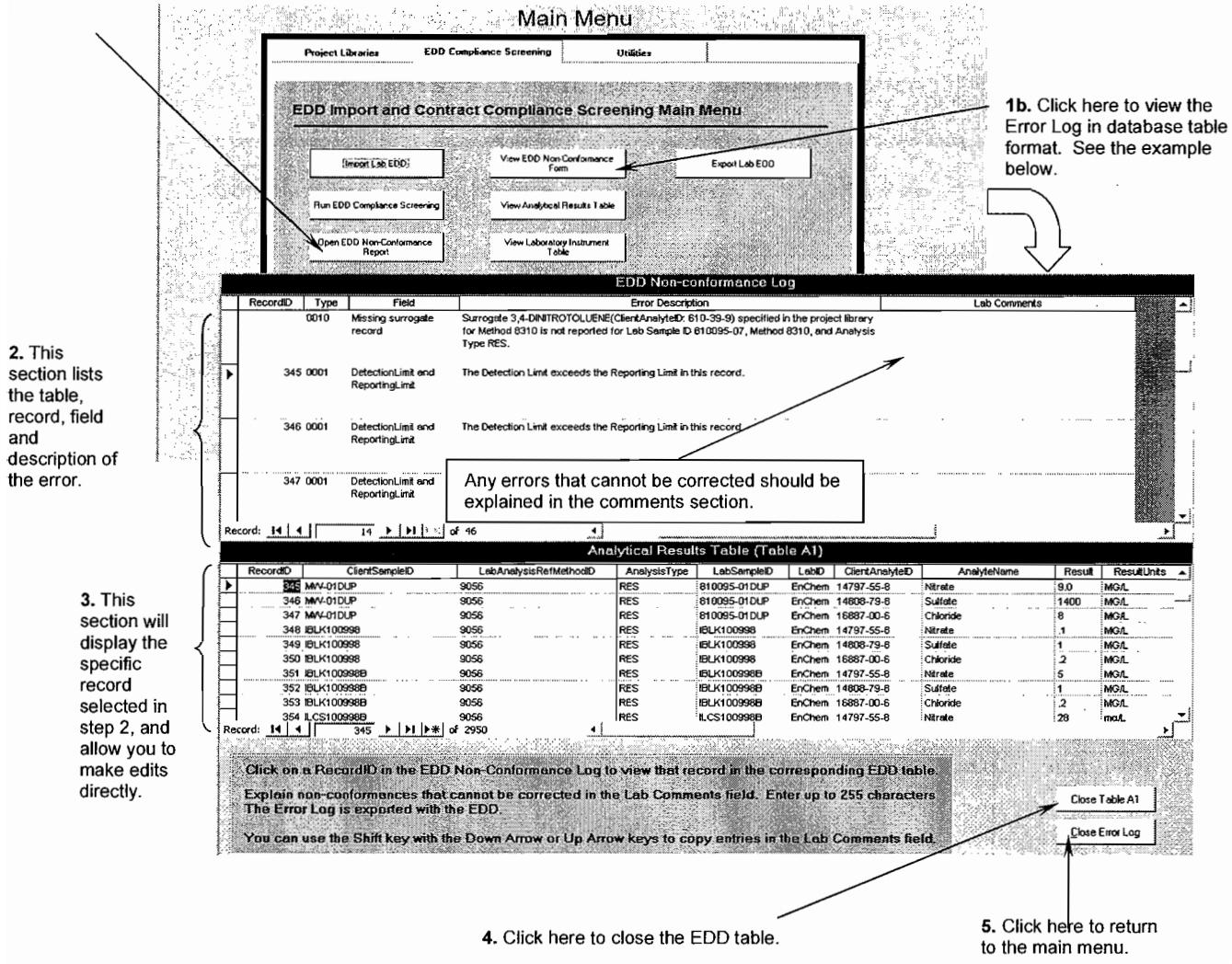
Figure 3-3



3.5 EDD ERROR LOG

After the error check has finished, the EDD Error Log can be viewed in two different formats using either the **View EDD Error Log** or **Print Preview EDD Error Report** buttons. The **View EDD Error Log** button displays the EDD Error Log in table format. Figure 3-4 shows an example of the EDD Error Log in table format. You may perform filter, find, and sort operations in the EDD Error Log to facilitate error evaluation and correction. The **Print Preview EDD Error Report** button displays the EDD Error Log in report format. Both views display the same information but the report format includes a summary page that lists the count for each type of error, a description of the error type and the total number of errors. Figure 3-5 shows an example of the EDD Error Log in report format. Below is an example of the log in table format.

Figure 3-4

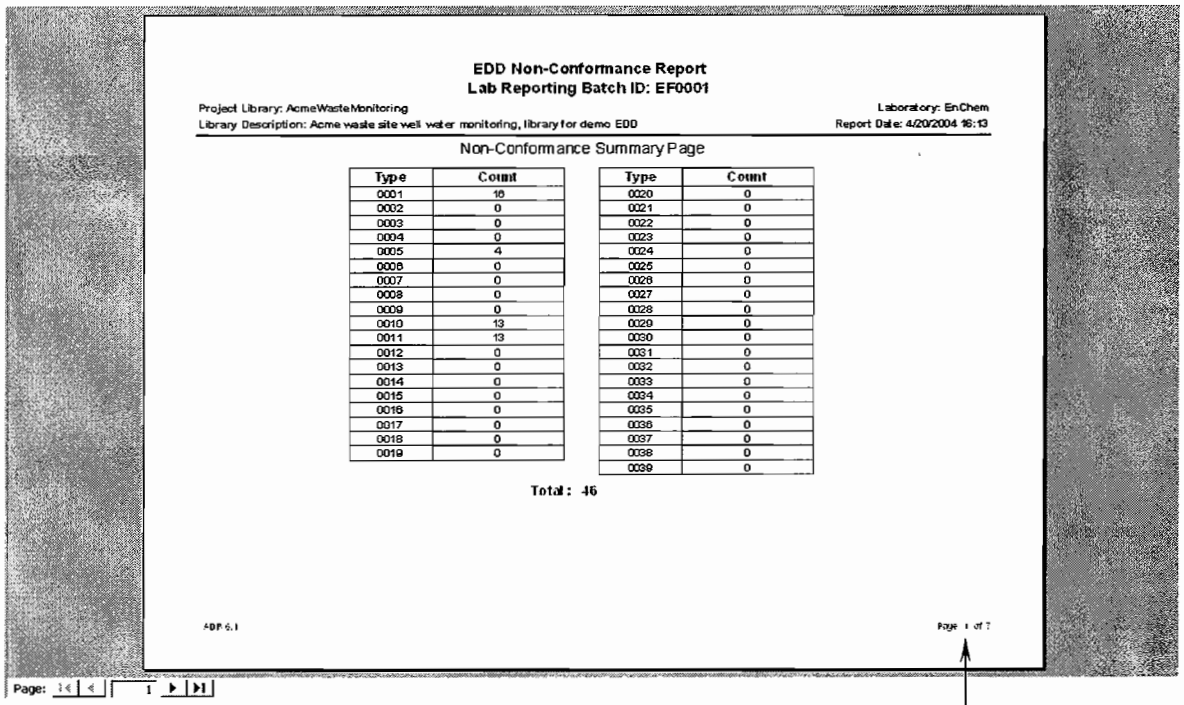


3.6 EDD ERROR REPORT

3.6.1 Summary Page

The EDD Error Report presents the same information as viewed in the EDD Error Log table format. View the EDD Error Report by clicking the **Print Preview EDD Error Report** button as described in Figure 3-9. On screen the EDD Error Report is displayed in report format. You cannot perform filter, find, or sort operations in the report view. Page one of the EDD Error Report summarizes the number of each type of error found and the total number of errors as illustrated in Figure 3-10. Errors are listed by both Error Type and Description. Use the counter on the lower left of the screen to advance through the pages of the error report. Use the printer icon on the Tool Bar to print the entire report. To print a specific page or range of pages use the File Pull-down on the Menu Bar to access the print options (Note that the Tool Bar is not shown in Figure 3-10). When looking at the report it is helpful to look at the total at the bottom middle. If there are many errors it may be easier to view the Error Log, filter on the individual error codes, and look for systematic errors.

Figure 3-5
An example of the first page of the EDD Error Report



EDD Non-Conformance Report
Lab Reporting Batch ID: EF0001

Project Library: AcmeWasteMonitoring
Library Description: Acme waste site well water monitoring, library for demo EDD

Laboratory: EnChem
Report Date: 4/20/2004 16:13

Non-Conformance Summary Page

Type	Count
0001	16
0002	0
0003	0
0004	0
0005	4
0006	0
0007	0
0008	0
0009	0
0010	13
0011	13
0012	0
0013	0
0014	0
0015	0
0016	0
0017	0
0018	0
0019	0

Type	Count
0020	0
0021	0
0022	0
0023	0
0024	0
0025	0
0026	0
0027	0
0028	0
0029	0
0030	0
0031	0
0032	0
0033	0
0034	0
0035	0
0036	0
0037	0
0038	0
0039	0

Total: 46

Page: 1

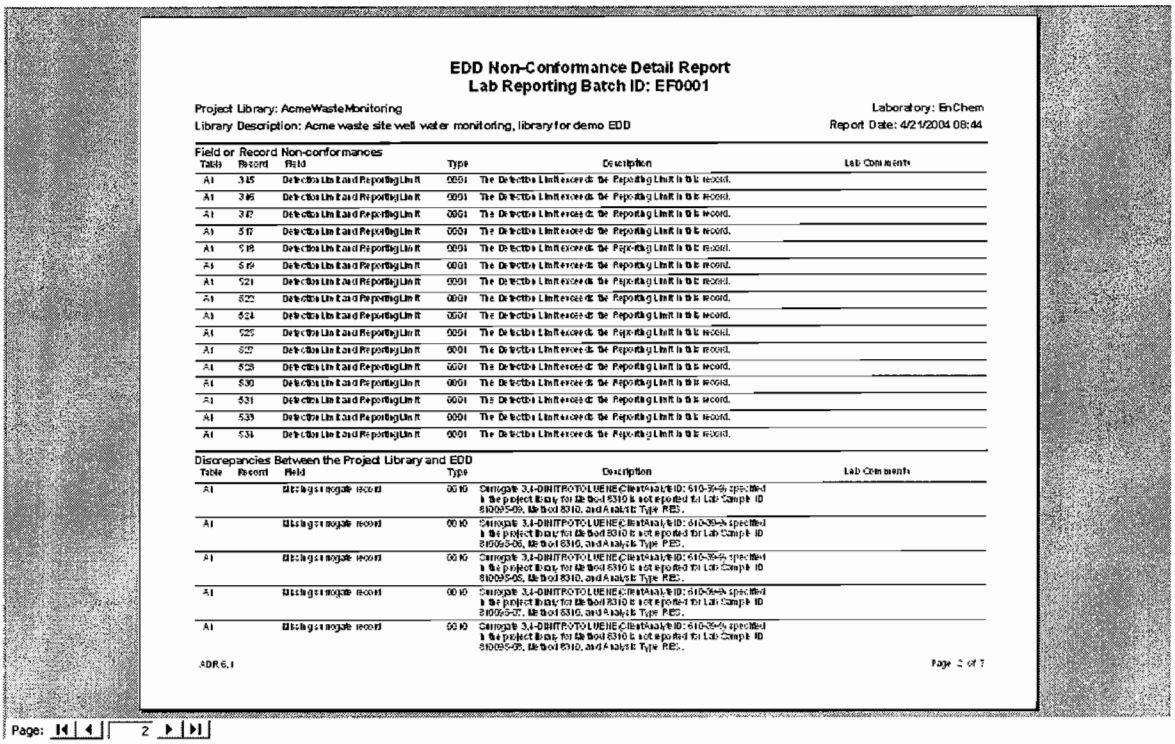
Advance through the pages of the Error log report here

The number of pages in the EDD Error log is indicated here. Always check the number of pages before printing. If error checking generates a lengthy Error report, you probably want to review on screen rather than print.

3.6.2 EDD ERROR Report -- Detail Page(s)

Subsequent pages in the EDD Error Report contain the same information displayed in the database view of the error log. Figure 3-10 shows an example of a page from the EDD Error Report. The header on each page indicates the Lab Reporting Batch, the report date, the reference project library used during the Error Check, and the laboratory identification. The detail section of the report lists a record number and field name where each error occurs (if applicable), the type number for that error (see Figure 3-11), and a description of the error.

Figure 3-6
An example of the Detail in the EDD Error Report



EDD Non-Conformance Detail Report
Lab Reporting Batch ID: EF0001

Project Library: AcmeWasteMonitoring — Laboratory: EnChem
Library Description: Acme waste site well water monitoring, library for demo EDD — Report Date: 4/21/2004 08:44

Field or Record Non-conformances

Table	Record	Field	Type	Description	Lab Comments
A1	345	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	346	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	347	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	517	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	518	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	519	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	521	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	522	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	524	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	525	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	527	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	528	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	530	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	531	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	533	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	
A1	534	Detection Limit and Reporting Limit	0001	The Detection Limit exceeds the Reporting Limit in this record.	

Discrepancies Between the Project Library and EDD

Table	Record	Field	Type	Description	Lab Comments
A1		Missing surrogate record	0010	Surrogate 2,4-DINITROTOLUENE/ClientAnalyteID: 610-39-9, specified in the project library for Method 8310 is not reported for Lab Sample ID 810095-09, Method 8310, and Analysis Type PES.	
A1		Missing surrogate record	0010	Surrogate 2,4-DINITROTOLUENE/ClientAnalyteID: 610-39-9, specified in the project library for Method 8310 is not reported for Lab Sample ID 810095-06, Method 8310, and Analysis Type PES.	
A1		Missing surrogate record	0010	Surrogate 2,4-DINITROTOLUENE/ClientAnalyteID: 610-39-9, specified in the project library for Method 8310 is not reported for Lab Sample ID 810095-05, Method 8310, and Analysis Type PES.	
A1		Missing surrogate record	0010	Surrogate 2,4-DINITROTOLUENE/ClientAnalyteID: 610-39-9, specified in the project library for Method 8310 is not reported for Lab Sample ID 810095-07, Method 8310, and Analysis Type PES.	
A1		Missing surrogate record	0010	Surrogate 2,4-DINITROTOLUENE/ClientAnalyteID: 610-39-9, specified in the project library for Method 8310 is not reported for Lab Sample ID 810095-08, Method 8310, and Analysis Type PES.	

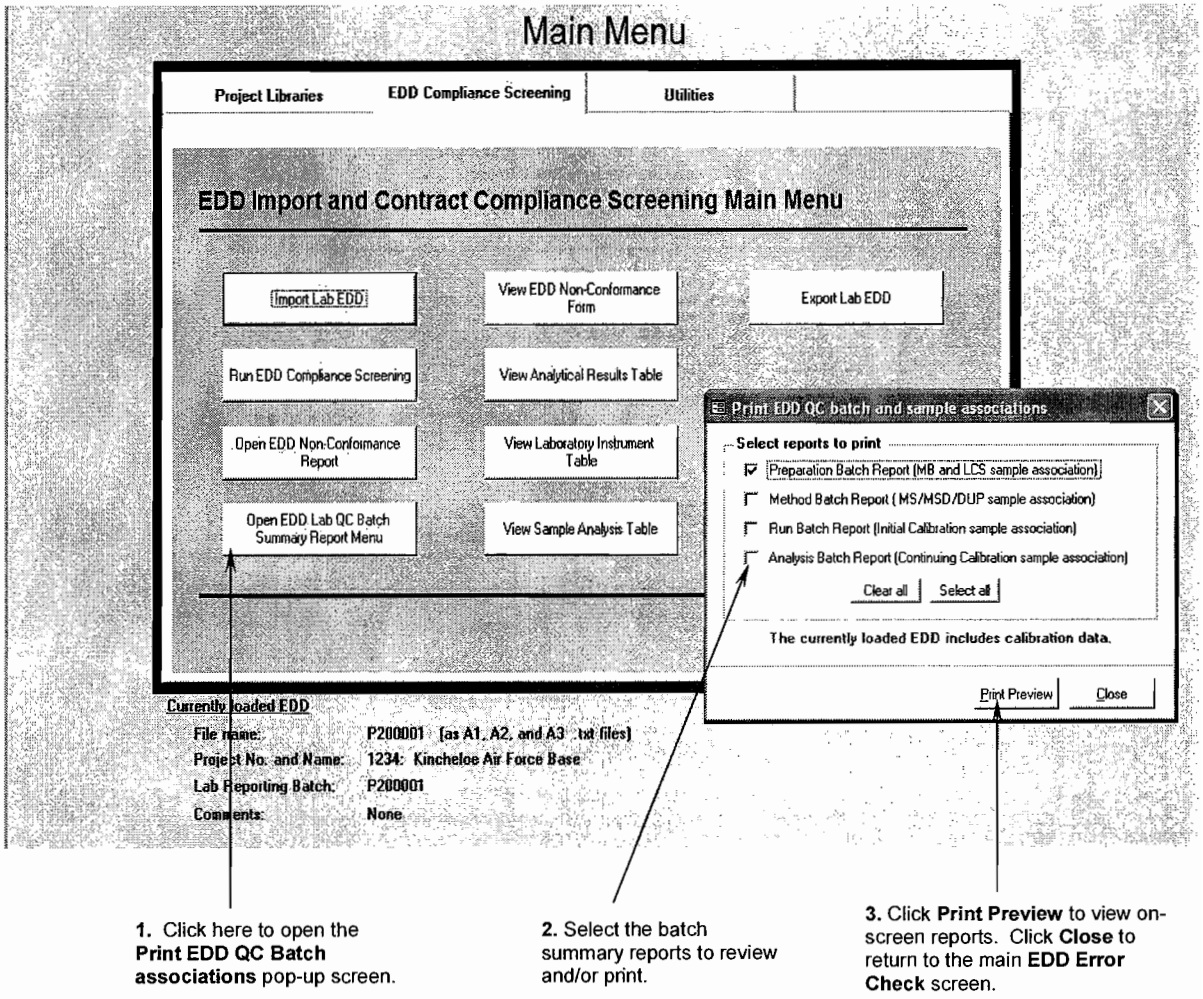
ADR 6.1 — Page 2 of 7

Page: 2

3.7 Printing QC Batch Summary Reports

This feature of the software allows you to print various summary reports of the different QC batches and their associated samples. Use this feature of the software to check for correct associations of QC and calibration samples to the client samples in the EDD. The example in Figure 3-11 is a Preparation Batch summary for EPA method 300.0 and shows the Method Blank and Laboratory Control Sample associated with a batch of samples.

Figure 3-10



1. Click here to open the **Print EDD QC Batch associations** pop-up screen.

2. Select the batch summary reports to review and/or print.

3. Click **Print Preview** to view on-screen reports. Click **Close** to return to the main **EDD Error Check** screen.

3.7.1 QC Batch Summary Report Example

Figure 3-11

EDD Preparation Batch Summary and Associated Samples

EDD Reporting Batch ID: EF0001

Method: 6010B

Matrix ID: AQ **Preparation Batch: METPB100898**

Client Sample ID	Lab Sample ID	Analysis Type	Sample Type	Analysis Date and Time
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Method: 8081A

Matrix ID: AQ **Preparation Batch: PPB101198W**

Client Sample ID	Lab Sample ID	Analysis Type	Sample Type	Analysis Date and Time
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Matrix ID: AQ **Preparation Batch: PPB102098W**

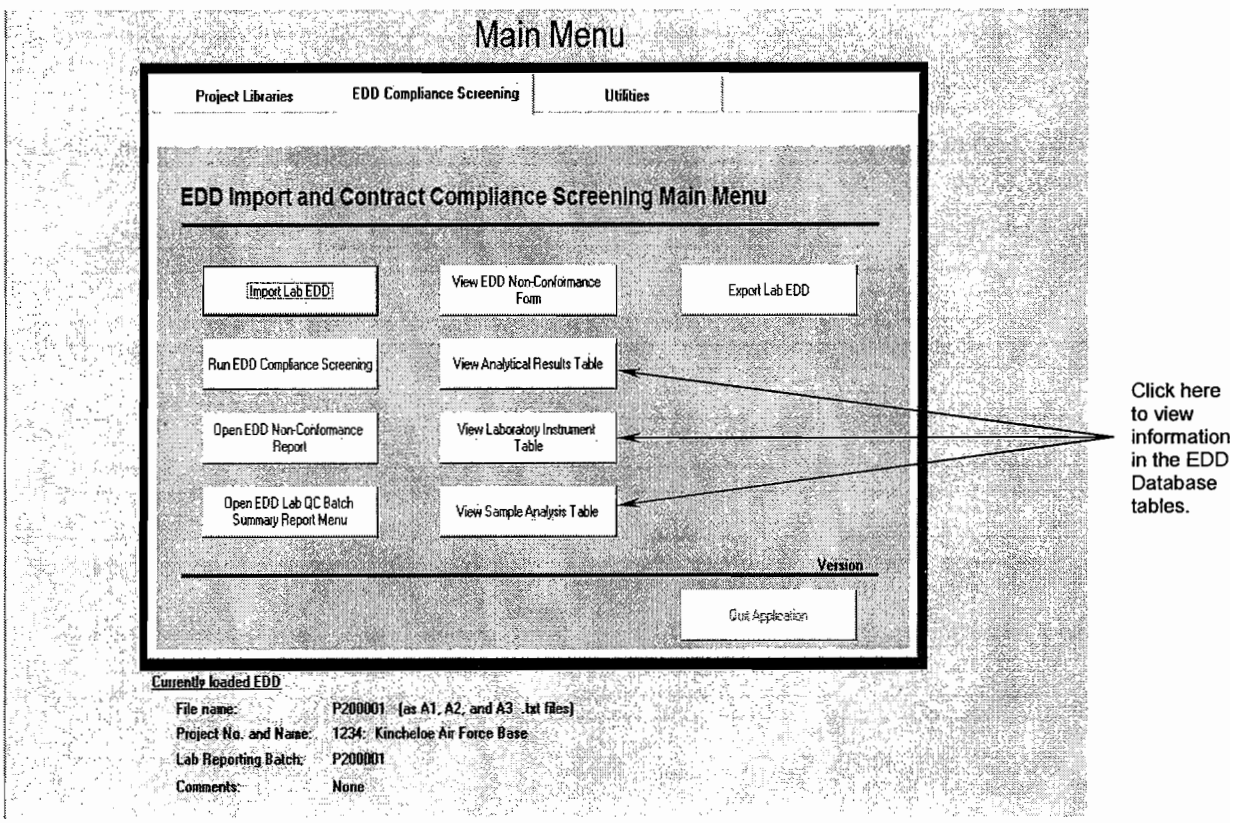
Client Sample ID	Lab Sample ID	Analysis Type	Sample Type	Analysis Date and Time
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

3.8 VIEWING/MODIFYING EDD FILES

Appendix A provides detailed information on the field types, field length, standard values, and required fields, for each EDD table. After running the error check and reviewing the EDD error log, open the EDD by clicking on the **View EDD** button and make corrections. The Error Log and Error Report provide information to quickly locate and correct EDD errors. Each error is catalogued by a code number and table name, and where applicable, record number and field name. Most errors include a detailed description. Use the error report along with the filter, find, and sort tools within Access to facilitate locating and correcting errors within the tables. After making corrections, run the error check again and review the new error report. If necessary, make additional corrections and run the error check again. Repeat this process until the error report is acceptable. Since the EDD Error Check uses the project library as its reference, it is recommended to have printouts of the various QC parameters in your project library when correcting EDD errors.

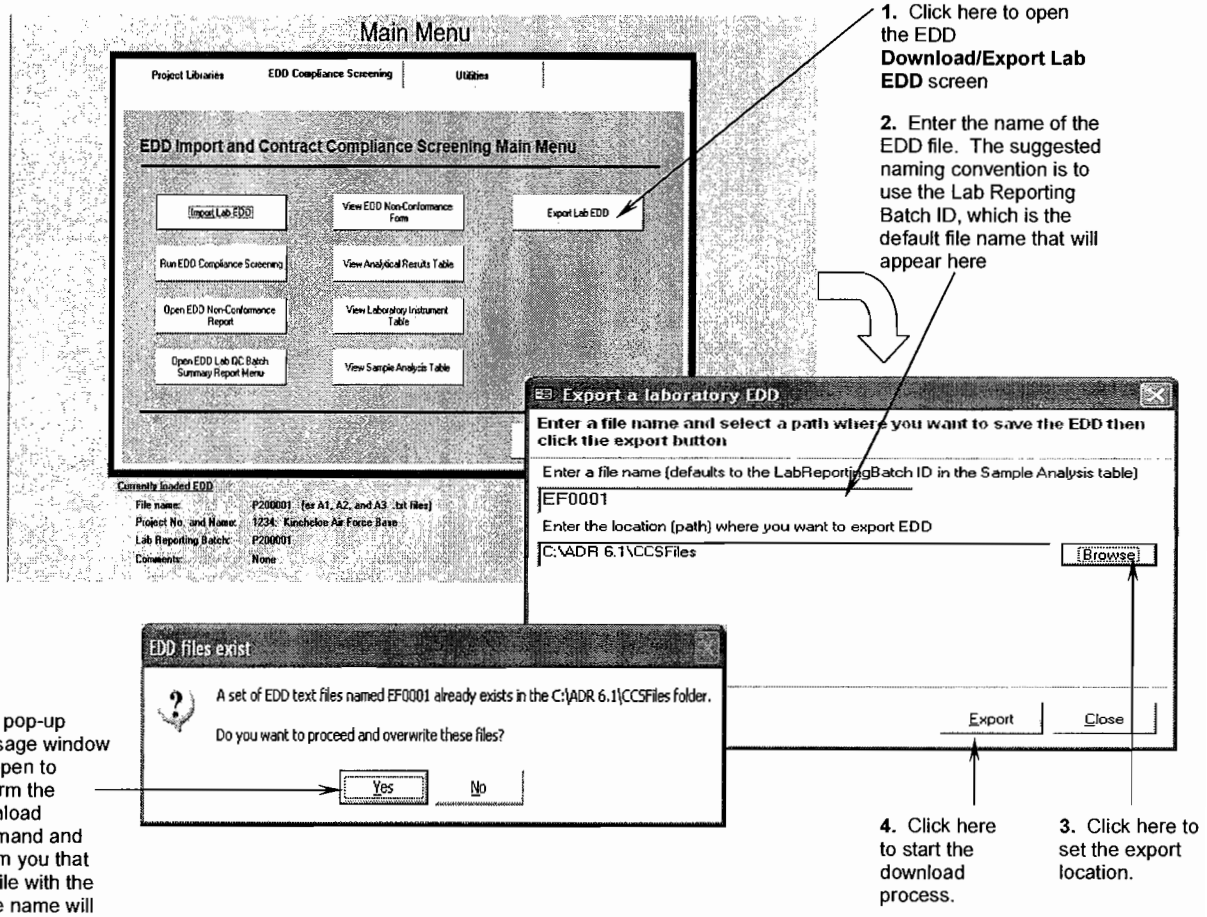
Figure 3-12



3.9 EXPORTING EDD FILES

After correcting EDD errors or making any modification to the EDD, download the EDD to save your changes (the uploading of another EDD will overwrite the current EDD and any changes that have been made). The EDD will be exported to the folder selected by the user.

Figure 3-13



Some tips regarding exporting EDD files:

- When you export the EDD, four comma delimited ASCII text files are created: The EDD and the EDD error log.
- The EDD is downloaded into the **CCSFiles** subdirectory, or a subdirectory of the user's choice.
- Before uploading a new EDD file make sure you have downloaded the current uploaded file if changes were made.

4.0 Validation Module

4.1 AUTOMATED DATA REVIEW PROCESS

The software automatically reviews sample results against method holding time, MDL, blank contamination, and laboratory quality control parameters. The software then updates sample result records with data review qualifiers if review parameters exceed project criteria specified in the project library. An EDD is ready for automated data review if error checking reveals no EDD errors. The automated data review process involves the following steps:

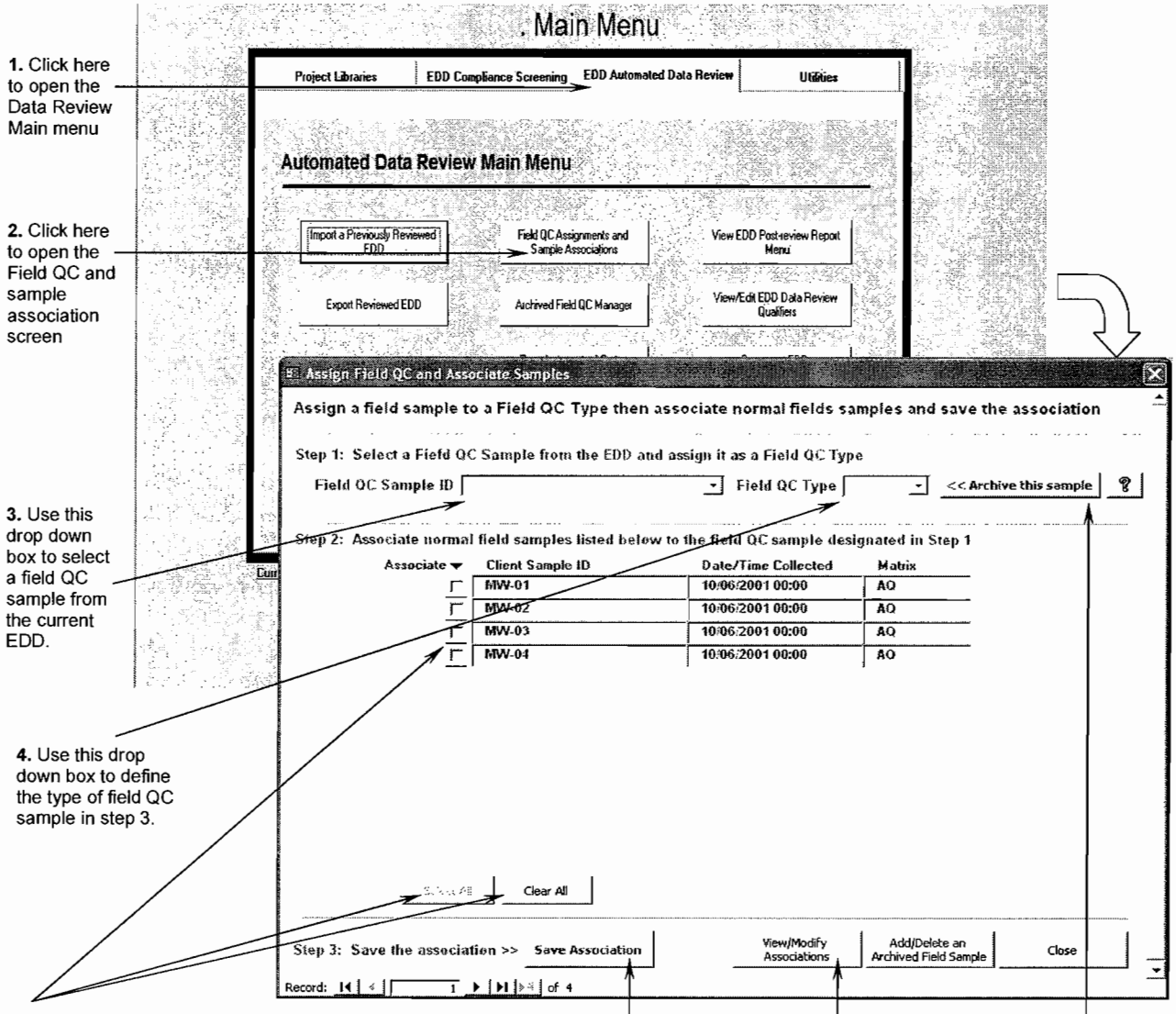
- Import the lab EDD with the EDD Error Check menu (Covered in Section 3.3)
- Run the EDD error check to confirm an error free EDD (Covered in Section 3.4)
- Make field QC assignments and sample association, if necessary (Covered in Section 4.2)
- Open data review menu, select a project library, select data review parameters, and run automated data review (Covered in Section 4.4)
- View results and print reports (Covered in Sections 4.6 and 4.7)

When the automated data review process has finished you may view post-review sample results and associated laboratory quality control results on screen. You may change data-review qualifiers, if necessary. Changes to data review qualifiers must be documented with the date of edit, the person performing the edit, and a reason for the edit before they are written to the EDD. The software keeps a history of any changes made to data review qualifiers after running automated data review. It also provides a variety of post-data review reports. These reports include data qualifier reports and quality control outlier reports. After final approval the reviewed EDD is exported. Previously reviewed EDDs can be re-imported if necessary.

4.2 SELECT FIELD QC AND ASSOCIATED SAMPLES

Identify which samples reported in the EDD are field QC samples such as field blanks, equipment blanks, etc., and associate samples to each Field QC type.

Figure 4-1



1. Click here to open the Data Review Main menu

2. Click here to open the Field QC and sample association screen

3. Use this drop down box to select a field QC sample from the current EDD.

4. Use this drop down box to define the type of field QC sample in step 3.

5. Associate samples to this Field QC sample by using any combination of checking the box next to an individual sample, clicking the **Select All** button, or clicking the **Clear All** button.

6. Save the current associations on screen by clicking the **Save/Append Selection** button.

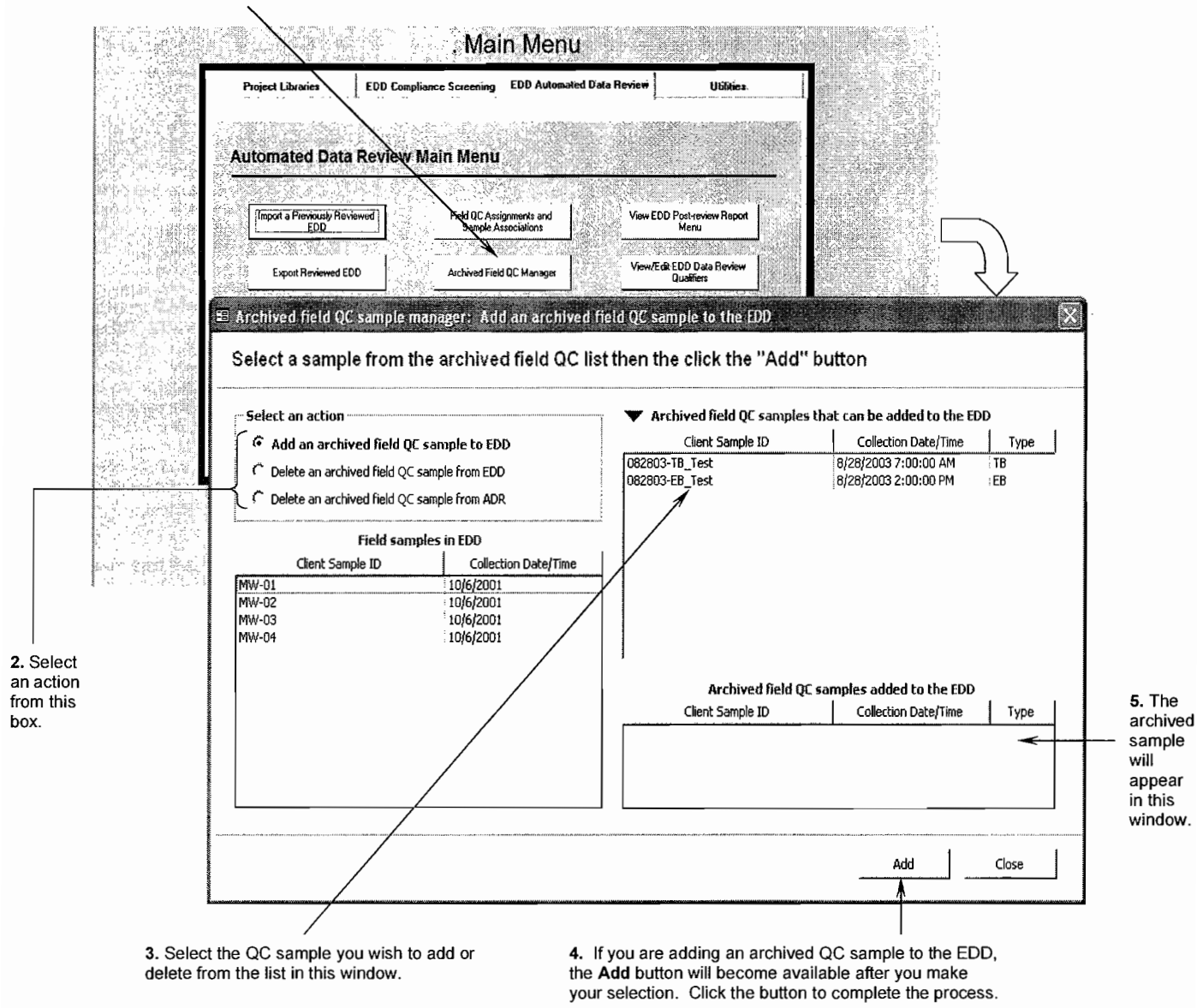
7. Click the **View/Modify Associations** button from this screen to open the **View/Modify: Field QC and Associated Samples** screen. This is discussed further in the next section.

8. Clicking the Archive button stores all records for the field QC sample assigned in Step 3. This field QC sample can then be selected at a later time for data review of sample results in EDDs that do not report this field QC sample.

4.2.1 Archived Field QC Management

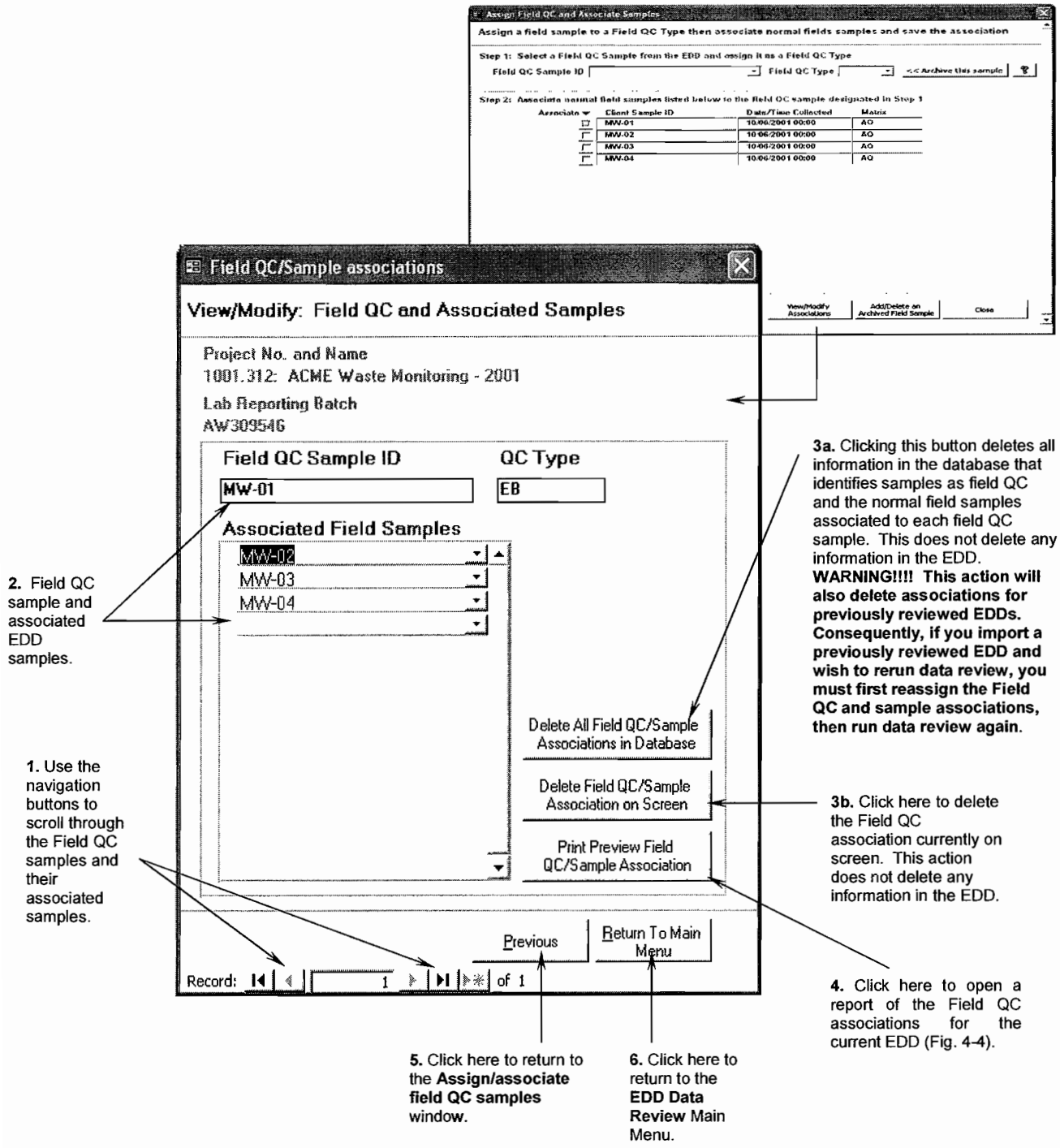
Any field QC selected for archiving in Step 8 of Figure 4-1 can be accessed through this screen. For example, an equipment rinsate sample may be selected to cover several different EDDs. In this case, the rinsate would first be selected to archive in the original EDD. After another EDD has been imported, you would open the screen below, select **Add an archived field QC sample to EDD** from the top left box, select the appropriate QC sample from the **Archived field QC samples that can be added to the EDD** window in the upper right hand corner, then click the Add button in the bottom right corner of the window. The user would then repeat the process outlined in section 4.2 above to select the EDD samples to assign to the archived QC sample(s).

Figure 4-2



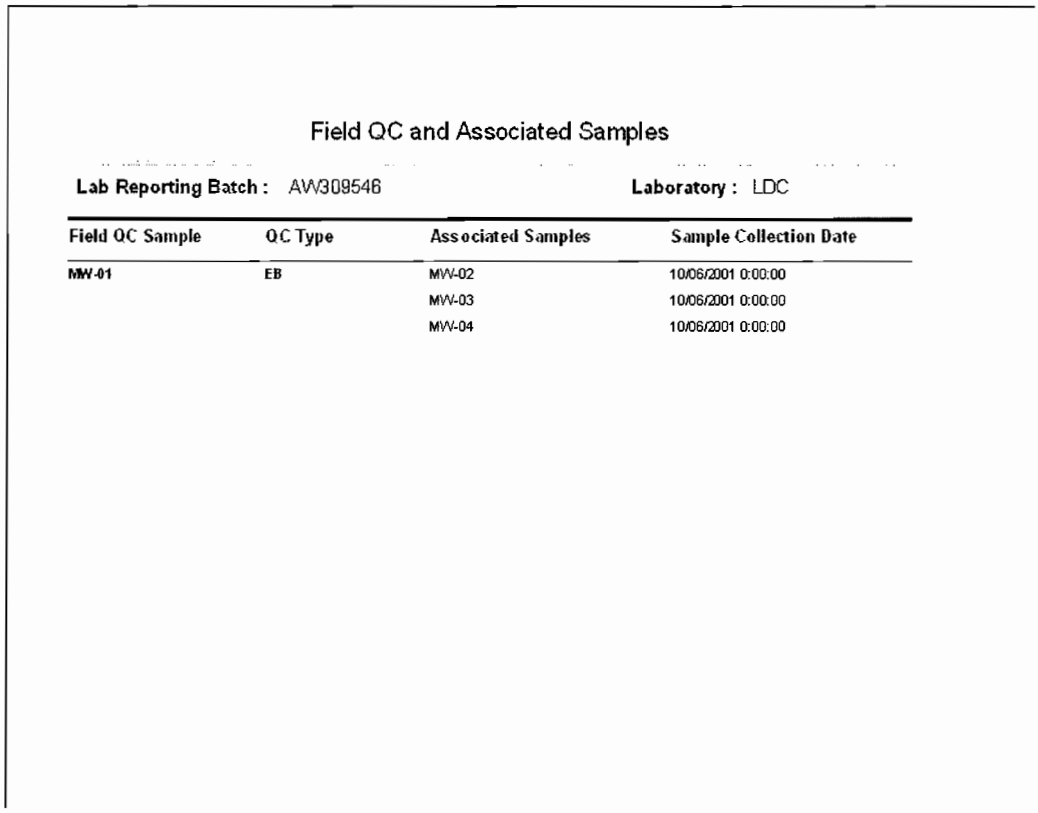
4.3 VIEW/MODIFY FIELD QC ASSOCIATIONS

Figure 4-3



4.3.1 Field QC and Associated Samples Report

Figure 4-4



Field QC and Associated Samples

Lab Reporting Batch : AW308546 **Laboratory :** LDC

Field QC Sample	QC Type	Associated Samples	Sample Collection Date
MW-01	EB	MW-02	10/06/2001 0:00:00
		MW-03	10/06/2001 0:00:00
		MW-04	10/06/2001 0:00:00

4.4 RUNNING AUTOMATED DATA REVIEW

An EDD is ready for automated data review after correcting errors that were found in the EDD Error Check module, and making field QC assignments and sample associations as described in **Figure 4-1**.

The first step (See Fig. 4-4) to running automated data review is to select the project library. This was created in section 2 of this manual and is populated with all the methods, analytes, and corresponding precision and accuracy control limits, as well as holding times. After selecting the project library you must make several choices as to the scope of validation required.

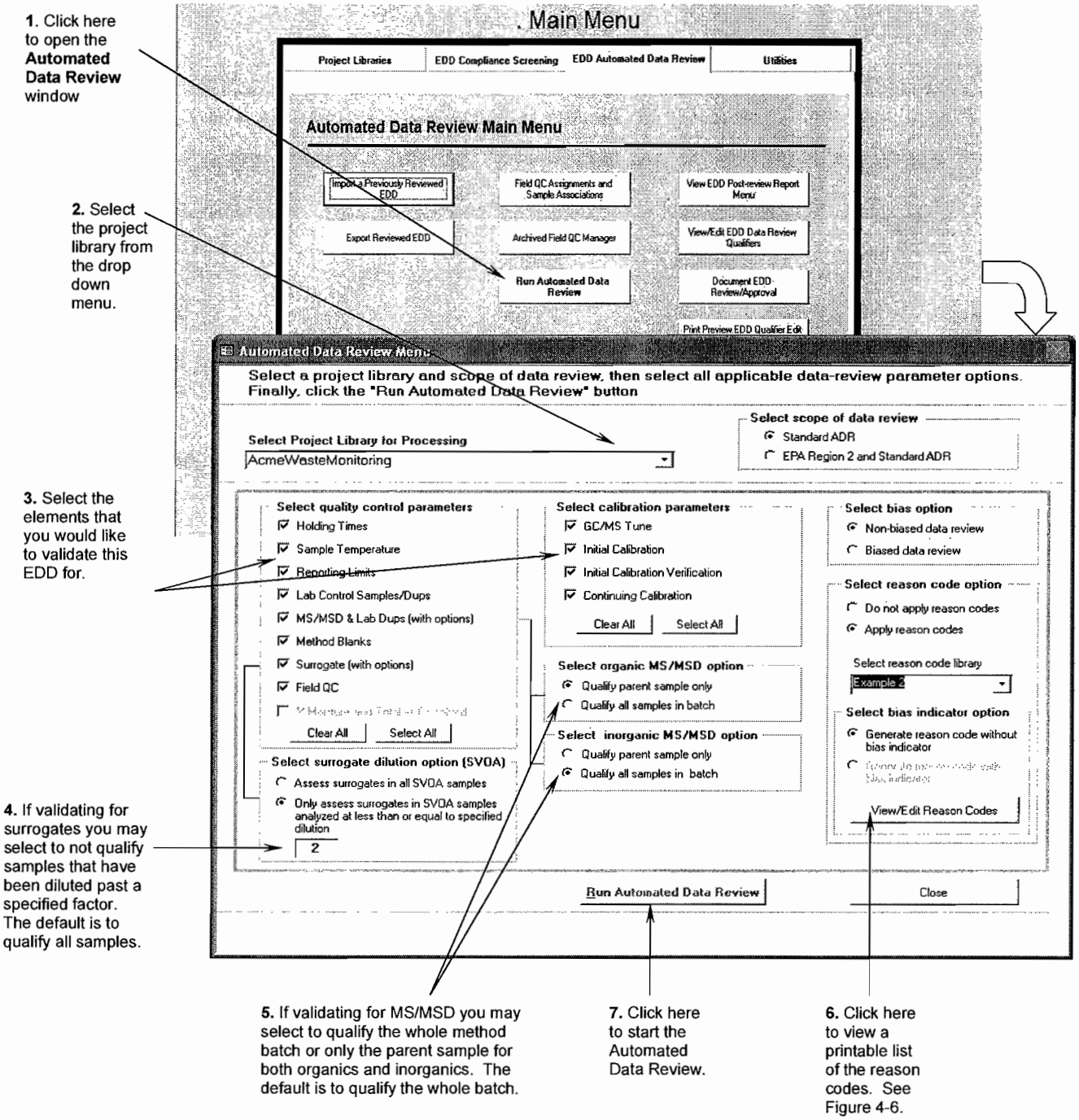
In the top left of the review screen you must select one or more review elements. You may choose all or any combination of these. Based on your selections you may have other choices to make. For instance if you select the Matrix Spikes/Dups option you will be able to select whether the Matrix Spike will qualify only the parent sample or the entire method batch for both organics and inorganics. Also, if you select the option to have the surrogates evaluated you will be able to specify a dilution cut-off for Semi-Volatile methods. For example if you select this option and set the dilution factor to 20 and there is a semi-volatile sample in the EDD at a dilution of 50, the surrogates in the sample will not be evaluated.

Reason codes may be assigned to qualified data. A reason code is a code that will give definition to a qualified result. Reason codes may be modified and are maintained similar to the library. A list of the example reason codes is available by clicking on the View Reason Codes at the bottom middle of the screen (see Figure 4-6).

When you have made all your selections click the **Run Automated Data Review** button to start the process. A window will appear letting you know that data review is done (Note: if there are any critical errors in the library or EDD at this point a report will open up listing these errors and instruct you to fix them before the data review process can continue). When you click OK you will be returned to the Data Review Main screen.

4.4.1 Snapshot of starting the Data Review process

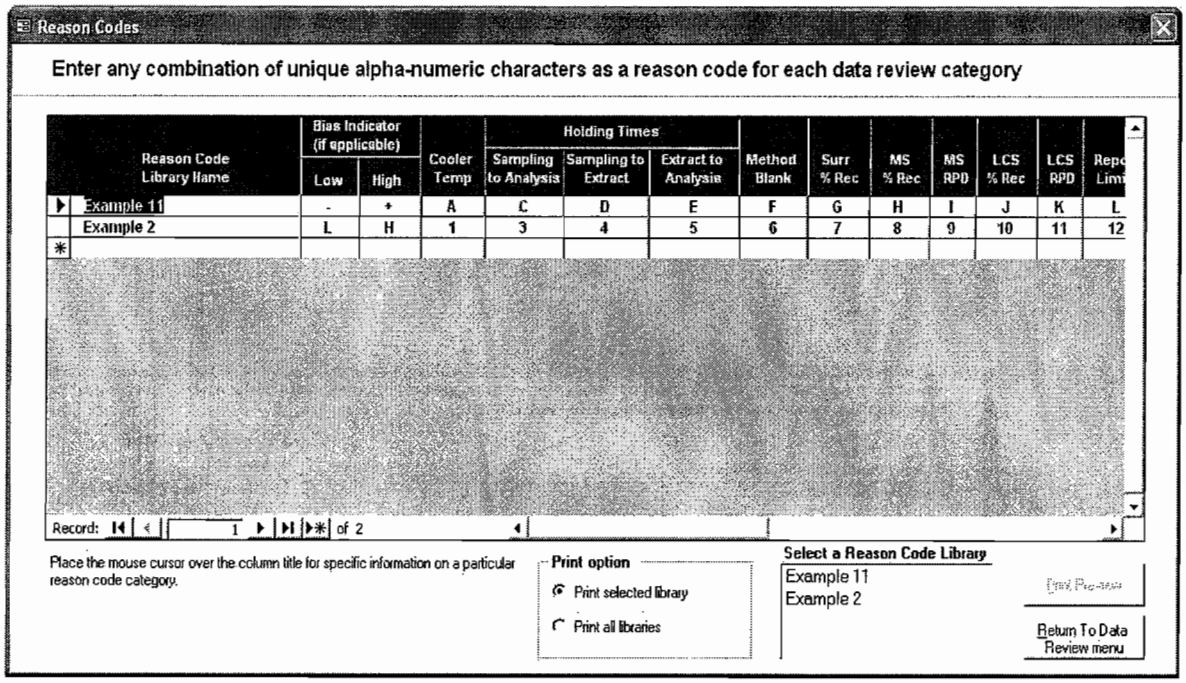
Figure 4-5



4.5 DATA REVIEW REASON CODES

The reason codes are defined and reside in a separate library. The Reason Codes may be modified by the user. Reason code libraries may be added as necessary also. Figure 4-6 shows a list of the example reason codes in the library.

Figure 4-6



4.6 VIEWING DATA REVIEW RESULTS

After the data review process is finished, you may view the resulting qualifiers for a specific sample and method. From the EDD Data Review Main Menu, click on the **View/Edit EDD Data Review Qualifiers**. This will open the **Data Review Summary** screen. At the top left of this screen, there is a pull-down menu of all the samples in the EDD listed by Field Sample ID. From this menu, select the Field Sample ID you want to review. After the sample is selected by the user, two tables will appear below. The first table is a list of the various methods that were run on that particular sample and the corresponding Lab ID(s) for the Field Sample ID selected. Results for the sample can then be viewed along with any data review qualifiers by either selecting the Lab Sample ID from the first column and then clicking on the **Sample Results** button at the bottom left of the screen or by clicking on the method for that Lab Sample ID in the green-shaded column. Either of these actions will display the results for the method selected along with any applicable qualifiers in the table directly below. The overall review qualifier is listed in the green-shaded column to the right of the result and by scrolling to the right the user will see the area(s) where the qualifier was applied. For example, if the sample is qualified as estimated due to problems with the percent recovery of a matrix spike, a J will appear in the MS overall and The MS Recovery columns. If the user wishes to see the results of the MS which caused the qualification, then click on the **MS/MSD** button in the **View associated QC** box at the bottom of the window. This will cause the Sample results window to be replaced with a window displaying the MS/MSD results associated with the selected sample. The same procedure can be applied to the method blanks, LCS, lab dups and surrogate results by clicking on the corresponding button. To close this window and return to the sample results window, click on the **Sample Results** button again.

Qualifiers can be edited for any sample result simply by double-clicking on the analyte name. This will open the **Change automated data review qualifiers** window. See section 4.6.1 for further discussion.

Figure 4-7

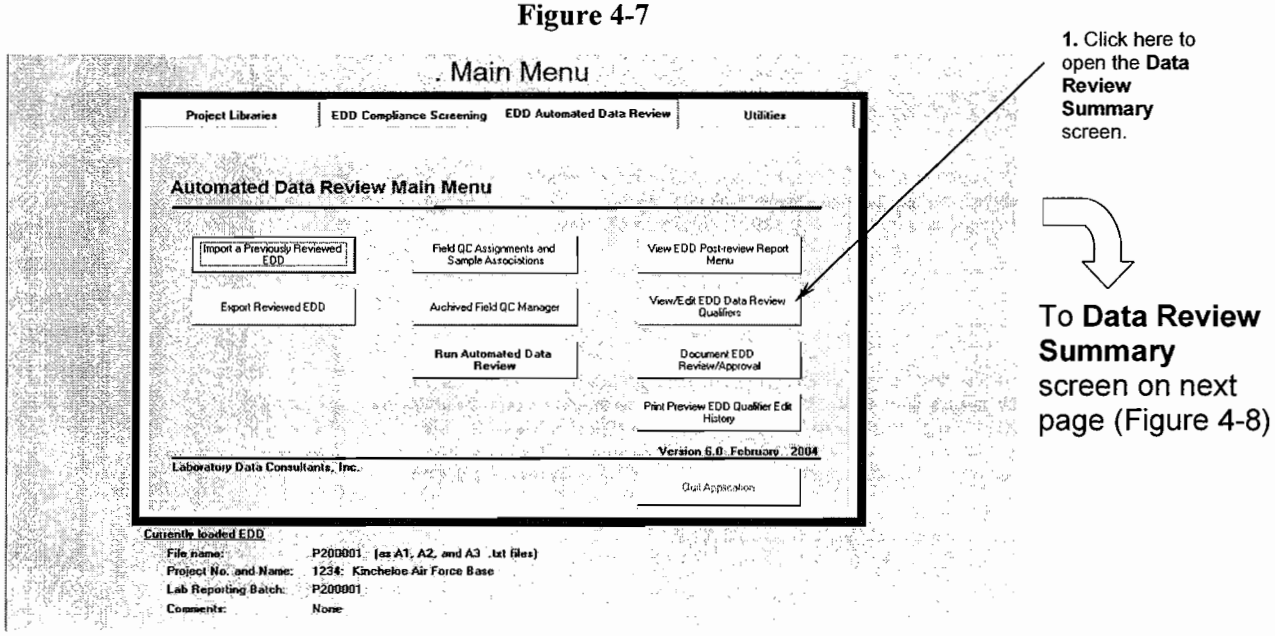
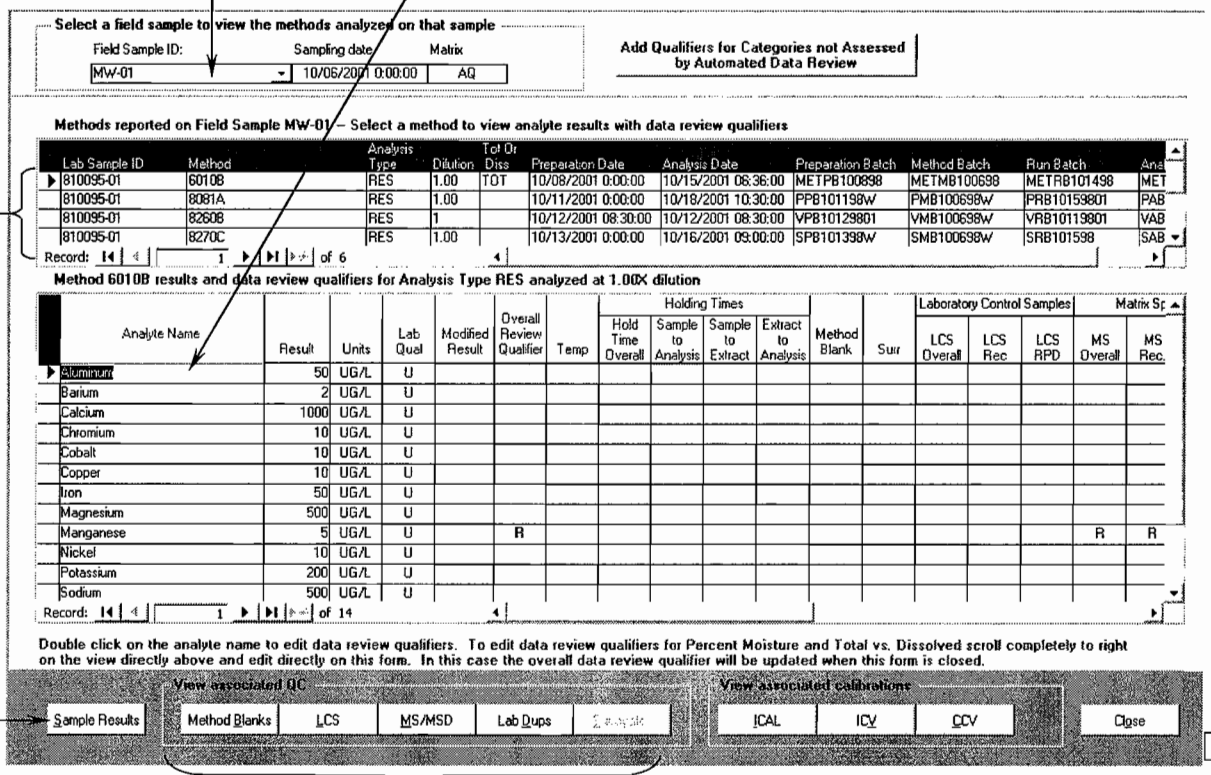


Figure 4-8

Results for all the target analytes, and a summary of all result qualifiers are listed here. You may perform sort and find operation on these records. The qualification summary includes the qualification contributed by each quality control and calibration element, and an overall qualifier.

1. Click here to open the pull-down menu and select the sample view by its Field Sample ID.

Double-clicking on an analyte name will open the **Change automated data review qualifiers** window which will allow the user to edit qualifiers for that analyte (see section 4.6.1 and figure 4-9).



The results of any QC sample associated with the sample selected in Step 1 may be viewed by clicking the corresponding button in the **View associated QC** box.

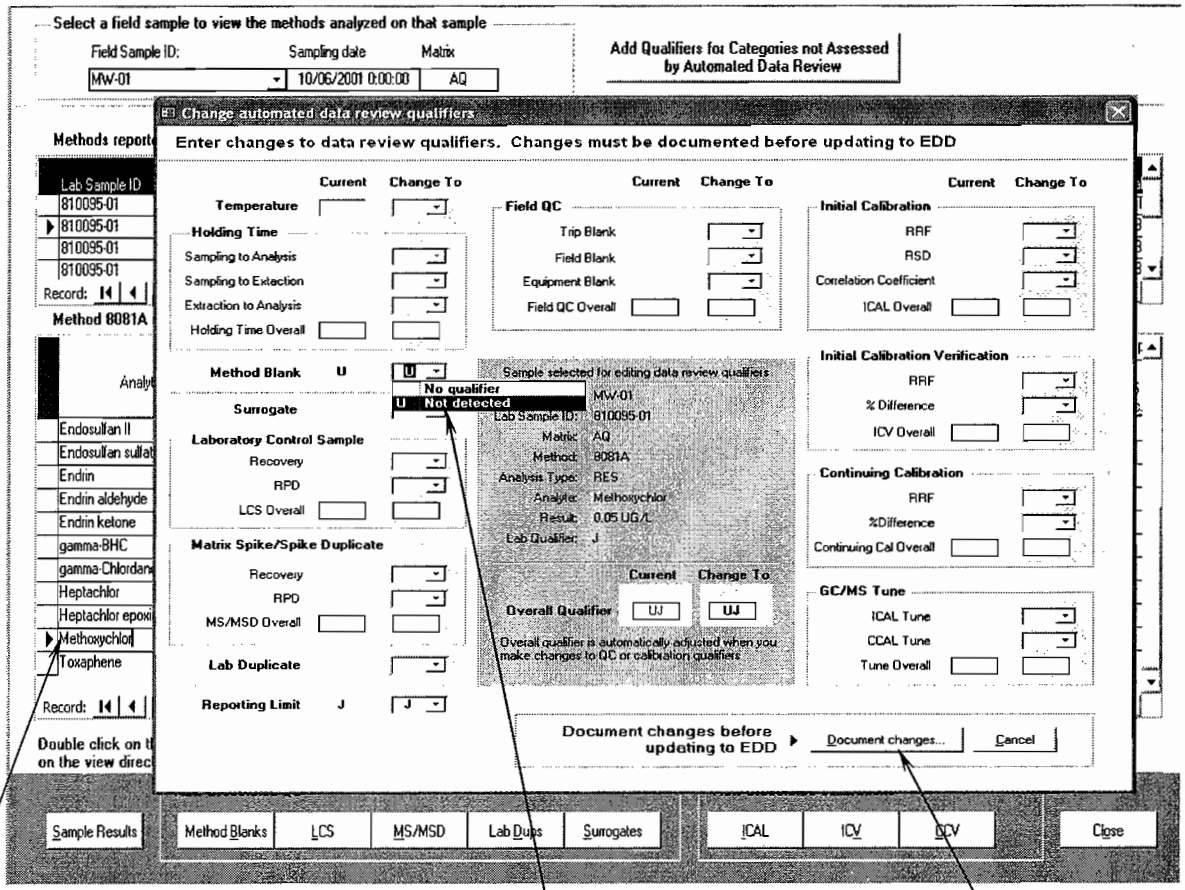
To **Change Automated Data Review Qualifiers** screen on next page (Figure 4-9)

2. All the methods performed on the sample selected in Step 1 are shown here. Note that the sample is identified here by its Lab Sample ID. It is possible that there may be multiple Lab Sample IDs for a given Field Sample ID, e.g., total vs dissolved may be given different IDs by the lab. Click on a method to view the results and qualification summary on that method for the Lab Sample ID selected. Alternatively, click on the Lab Sample ID and then click the **Sample Results** button.

4.6.1 Change Automated Data Review Qualifiers Screen

This screen allows you to make manual edits to the qualifiers. The user must click on the **Document changes** button at the bottom of the window, enter a reason for the change and enter their username in order for the change to be effective.

Figure 4-9



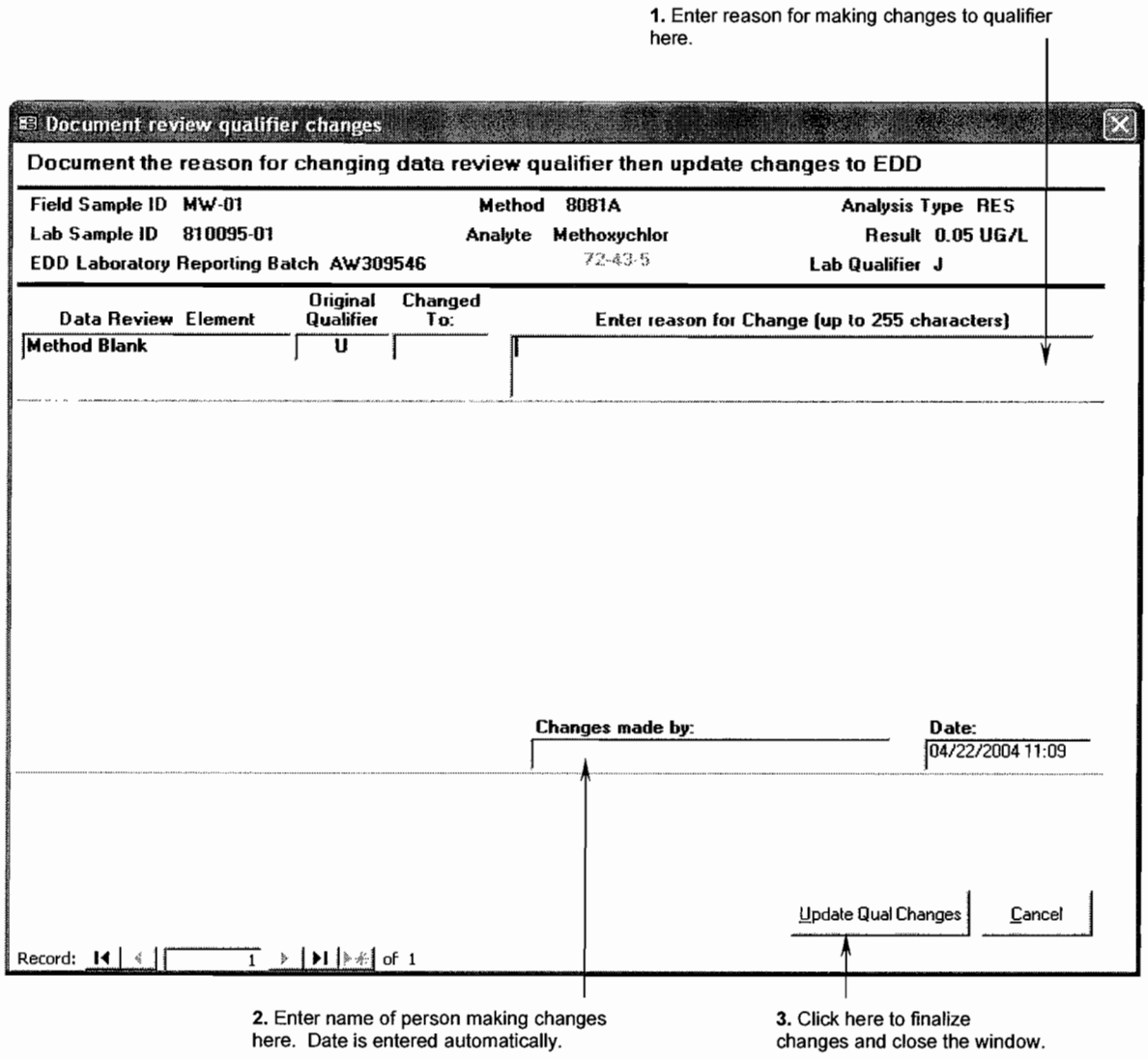
Double-clicking on the Methoxychlor field will open the Change automated data review qualifiers window for Methoxychlor. This process can be repeated for any of the sample results in the Analyte Name column.

You may manually add or remove validation findings from this screen. Place the cursor in any cell and choose from the drop-down menu to update the qualification code.

When your edits are completed, click here to finalize changes. This will open the Document review qualifier Changes window (figure 4-10).

Figure 4-10

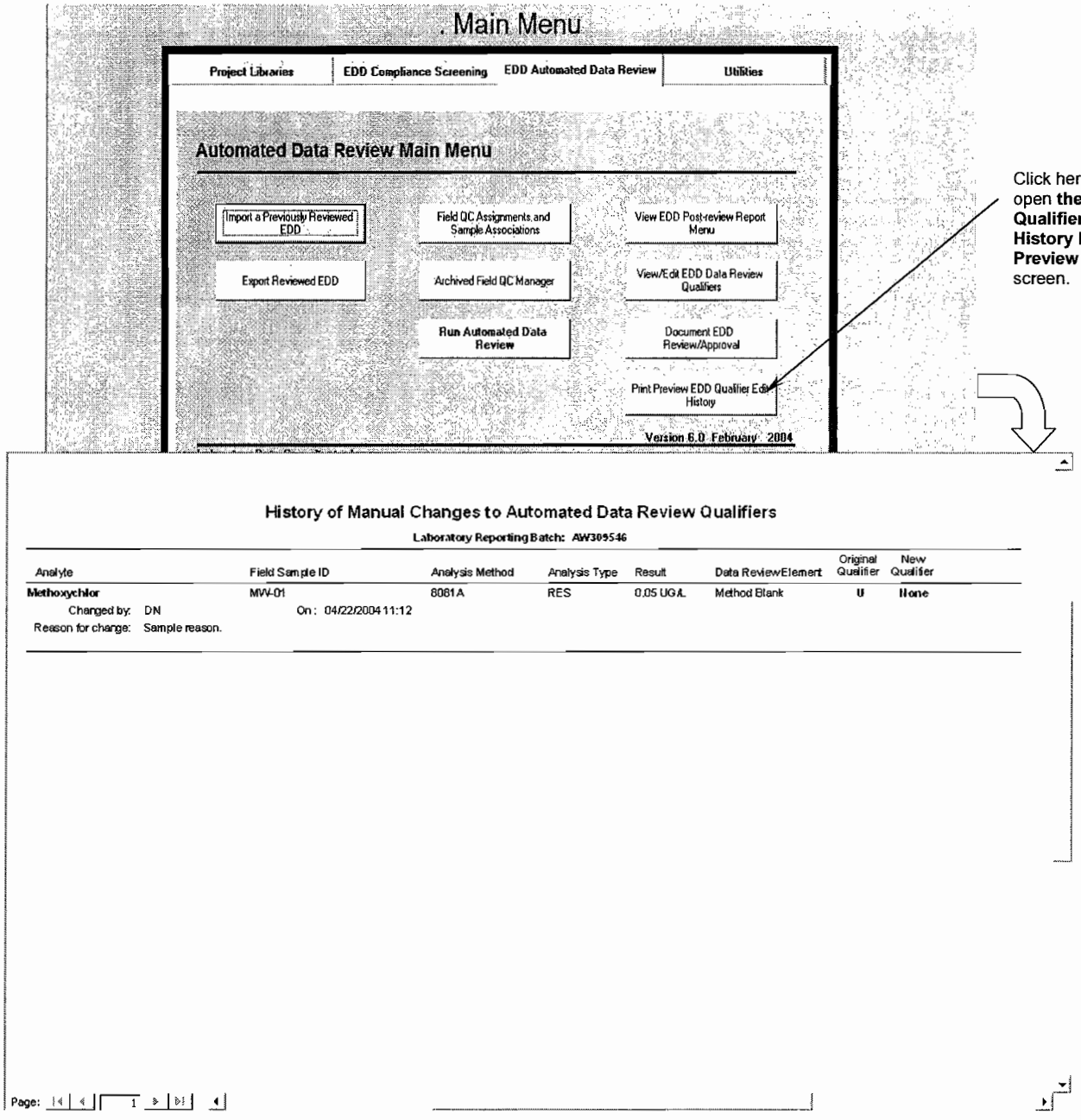
Document Review Qualifier Changes Window



4.6.2 Preview EDD Qualifier Edit History Screen

Any edits made in the process described in section 4.6.1 will be documented and can be viewed by clicking this button, located at the bottom right of the EDD Data Review Tab Main Menu. Clicking this button will generate a pop-up print preview screen which shows any manual edits that have been made to the EDD.

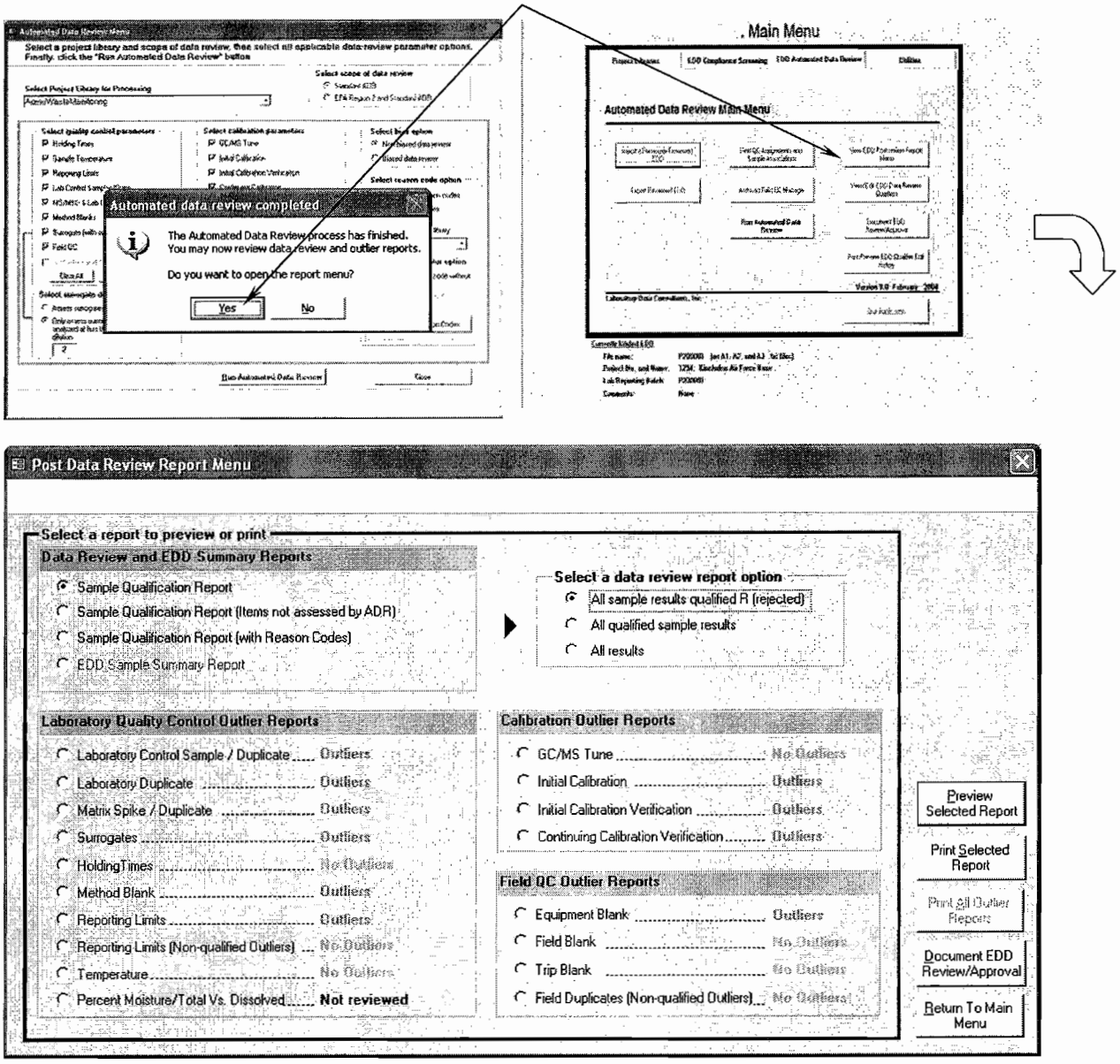
Figure 4-11



4.7 DATA REVIEW SUMMARY AND OUTLIER REPORTS

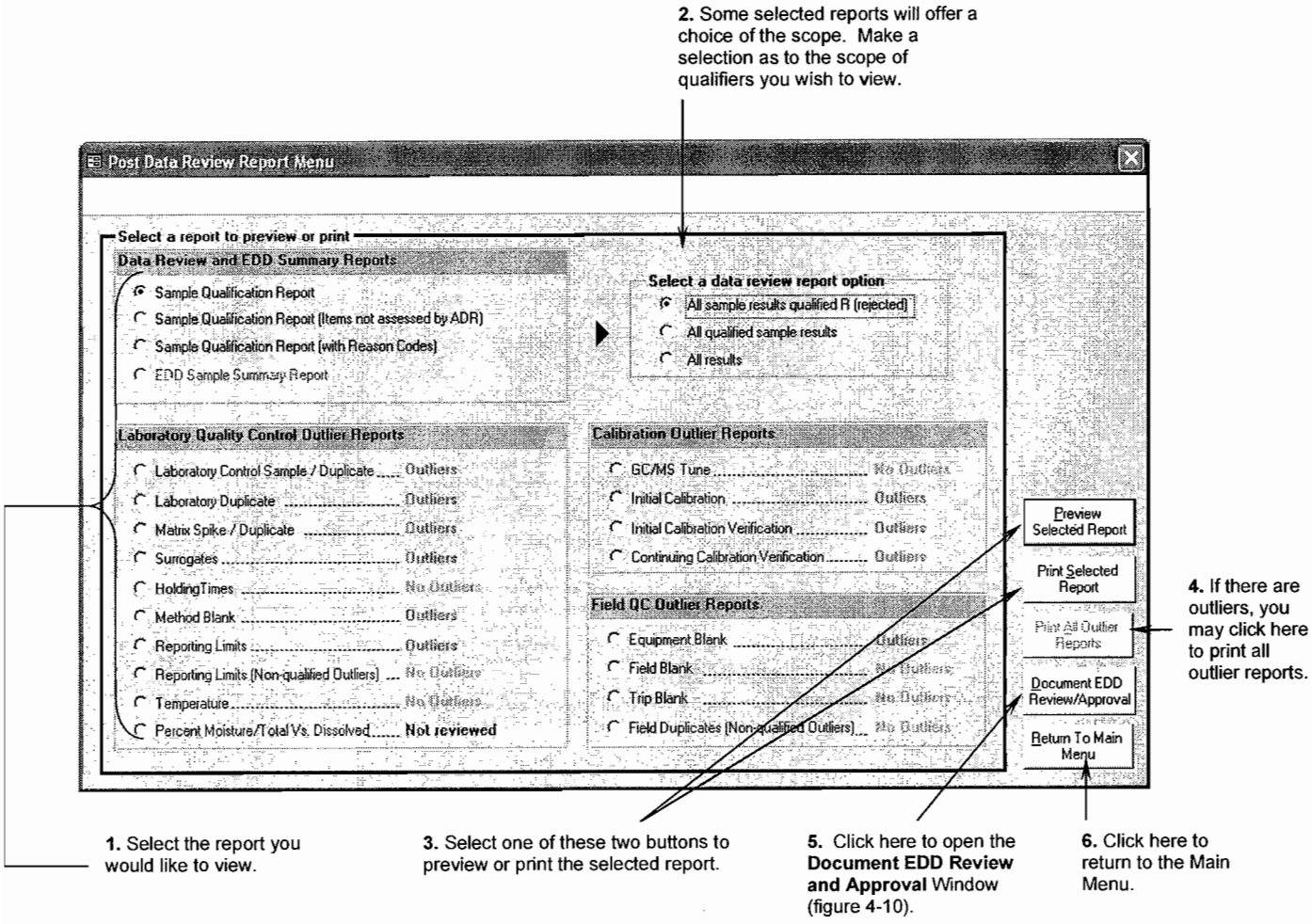
Once the automated data review process is finished, a pop-up window will appear. Click the Yes button on the pop-up window or alternatively, click the **View EDD Post Report Review Menu** button on the EDD Data Review Tab.

Figure 4-12



4.7.1 Report Menu Screen

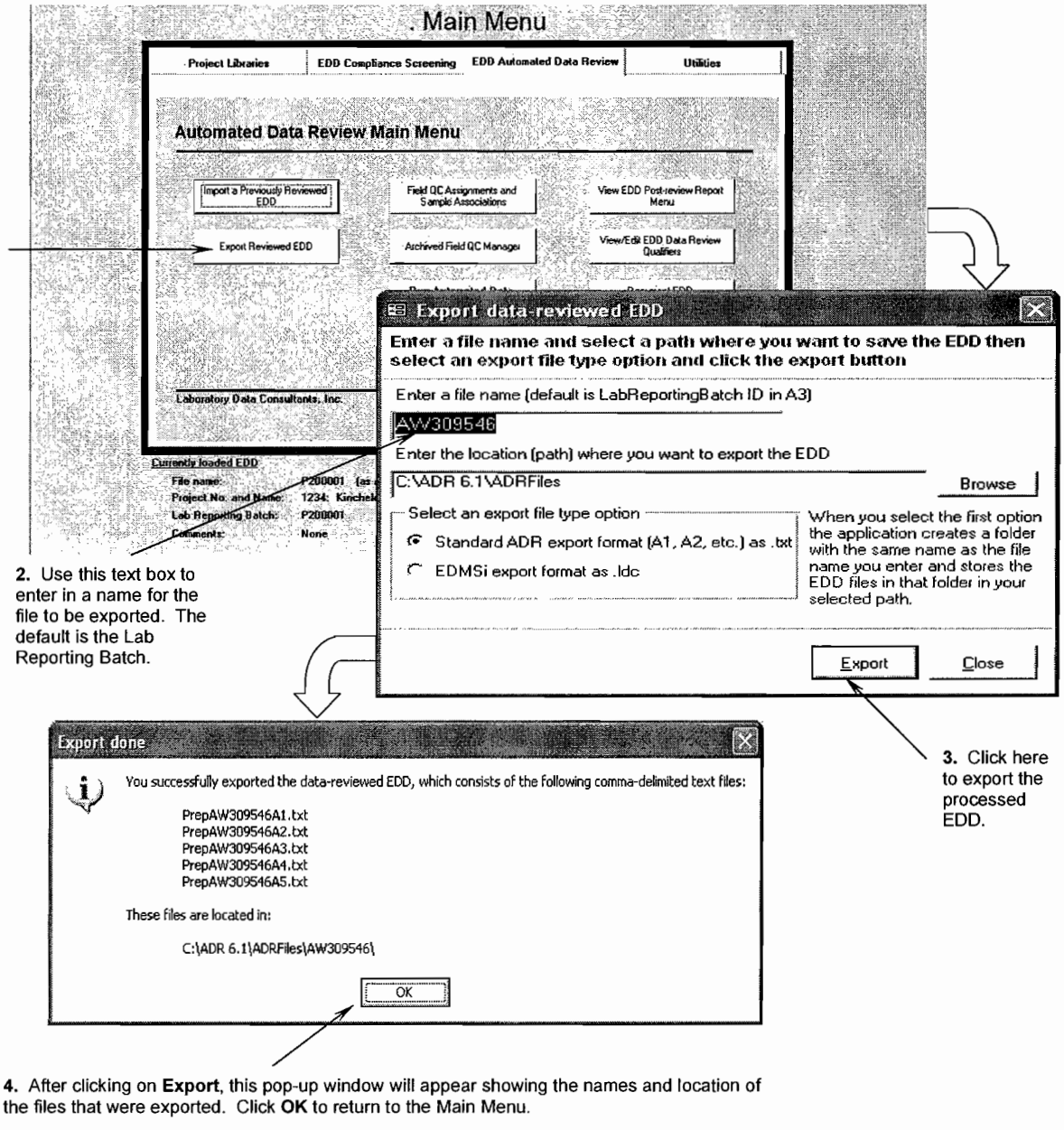
Figure 4-13



4.8 EXPORTING PROCESSED EDD DATA FILES

The Export Reviewed EDD function exports the processed EDD as an text file so that it can be archived, imported into another user's application, or imported into a database. When the processed EDD is exported, three text files are created. The exported files are saved in the subdirectory called "ADRFiles", which is located in the 'parent' directory where the application resides. The naming convention for the files is to prefix the Lab Reporting Batch with "Prep" and give each file an alphanumeric suffix from 01-04 (ie: PrepSDGA1.txt).

Figure 4-14



2. Use this text box to enter in a name for the file to be exported. The default is the Lab Reporting Batch.

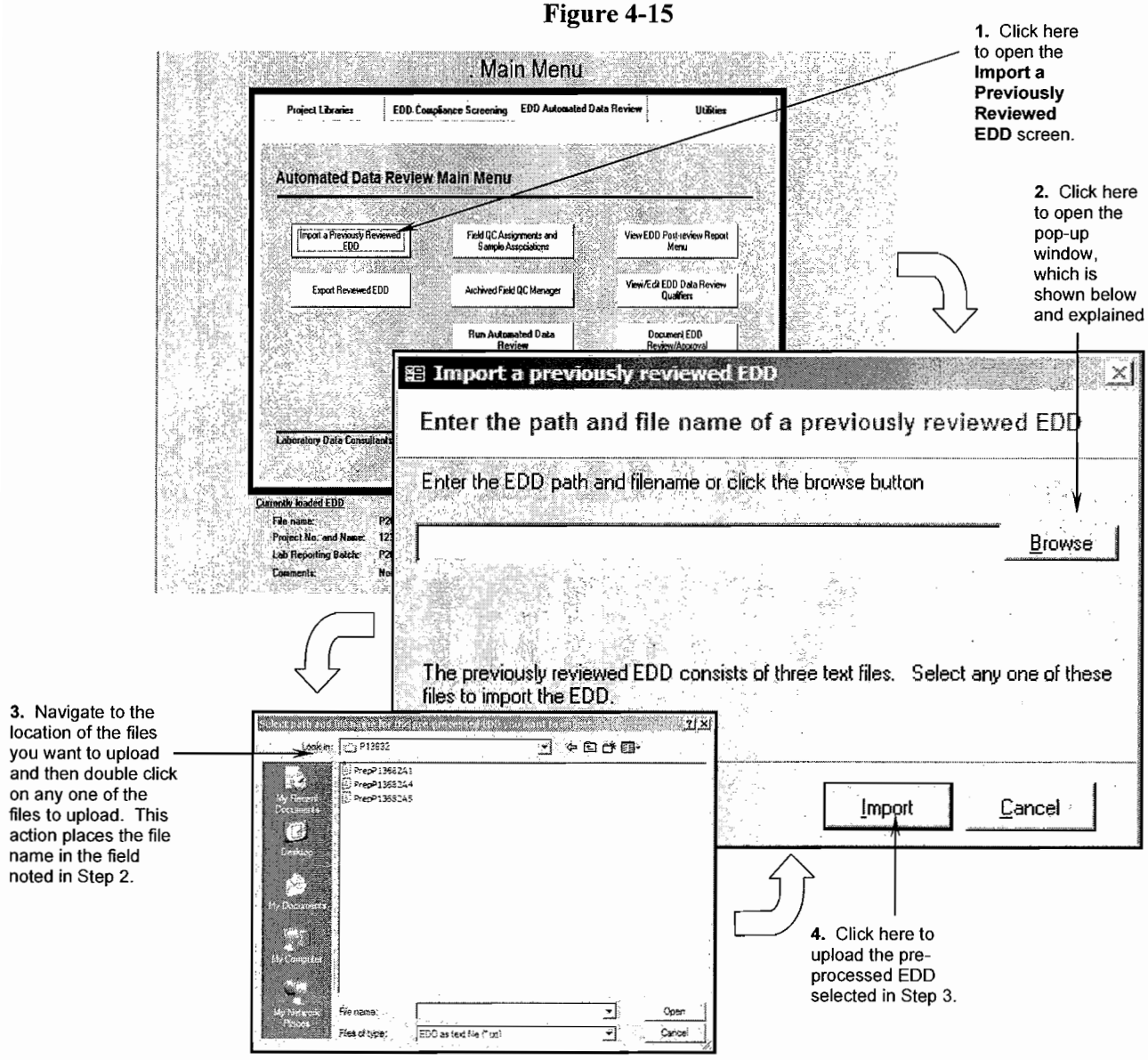
3. Click here to export the processed EDD.

4. After clicking on **Export**, this pop-up window will appear showing the names and location of the files that were exported. Click **OK** to return to the Main Menu.

4.9 IMPORTING PROCESSED EDD DATA FILES

The Import Previously Reviewed EDD function imports a previously processed EDD. ADaPT processed EDD's are created through the use of the Download utility explained in Figure 4-14. **(CAUTION: The incoming EDD will overwrite any changes or processing done to the EDD currently in the application. It is recommended that you first download a copy of the current EDD to preserve any changes or processing done.)**

Figure 4-15

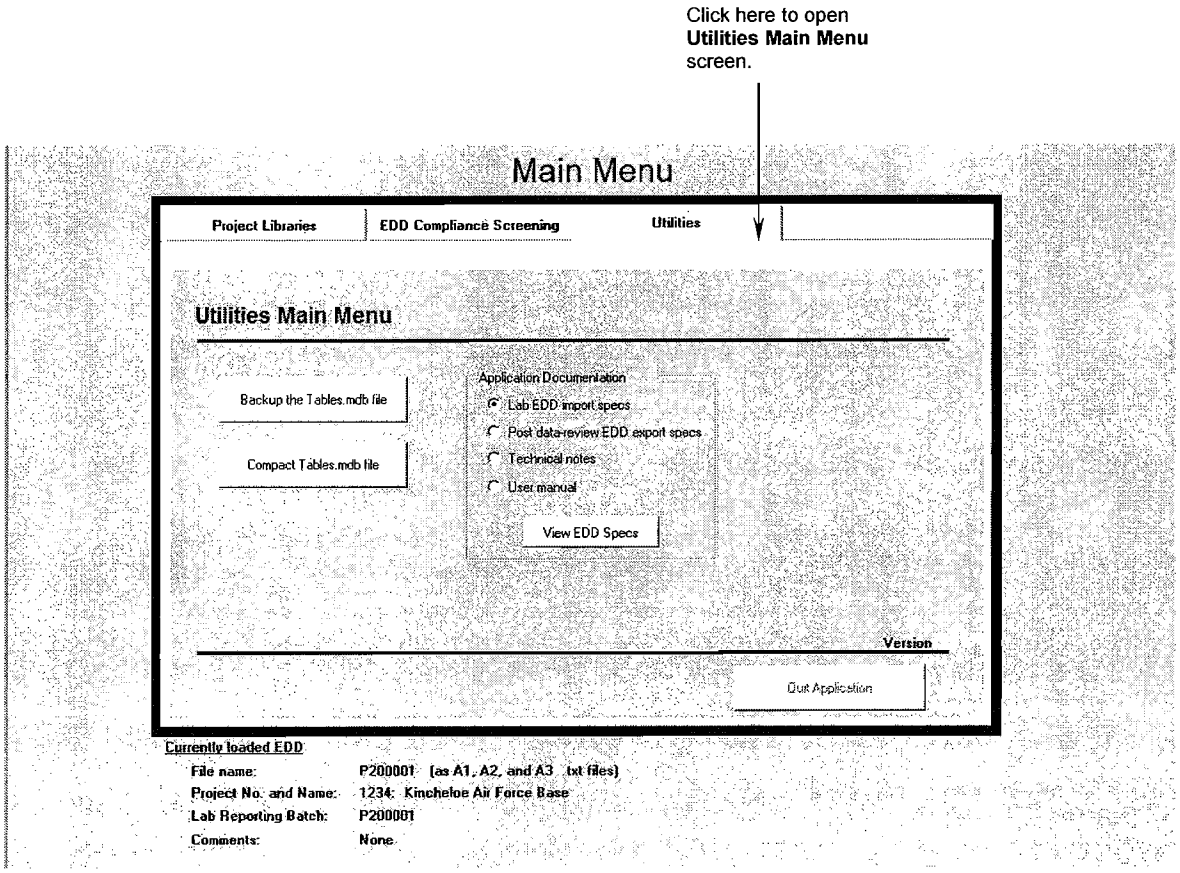


5.0
Utilities
Module

5.1 UTILITIES

Use the Utilities module to view the user manual and for maintaining the database.

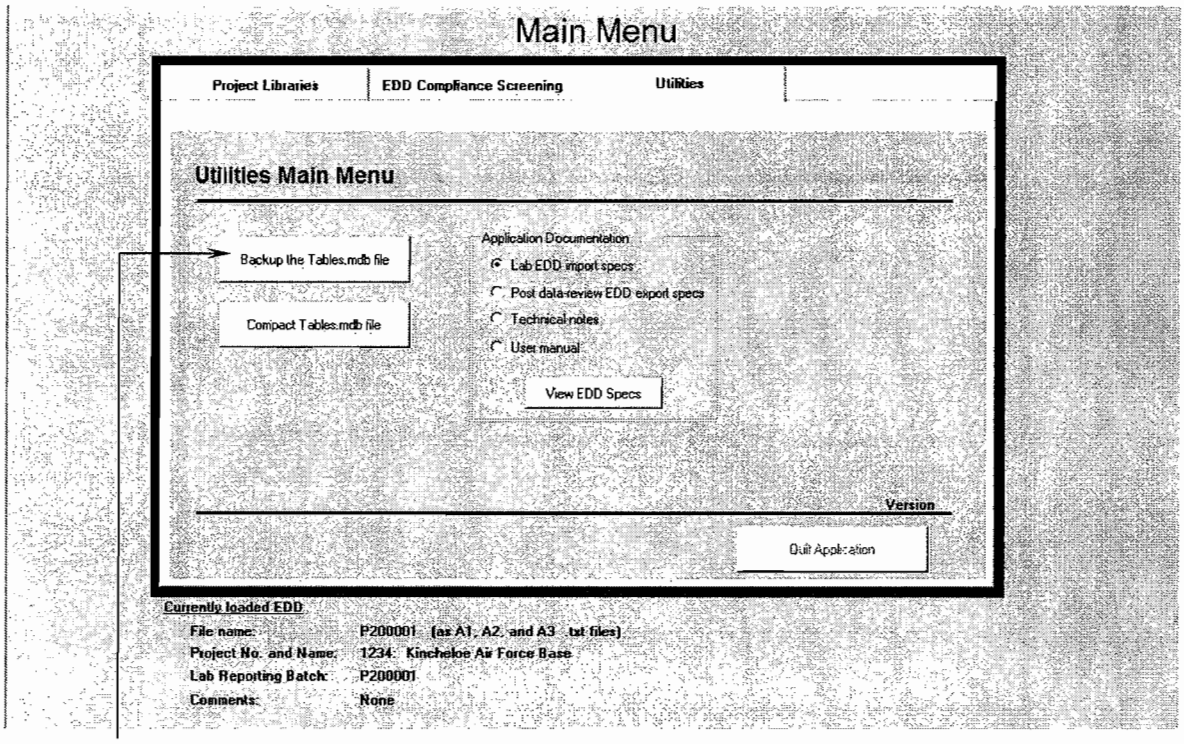
Figure 5-1
Utilities Main Menu Screen



5.2 BACKING UP THE DATABASE

The Backup Database utility creates a copy of the current Tables.mdb file and places it in the "LibraryFiles" subfolder with the date of backup appended to the file name. Backups should be done routinely to guard against possible corruption of the database.

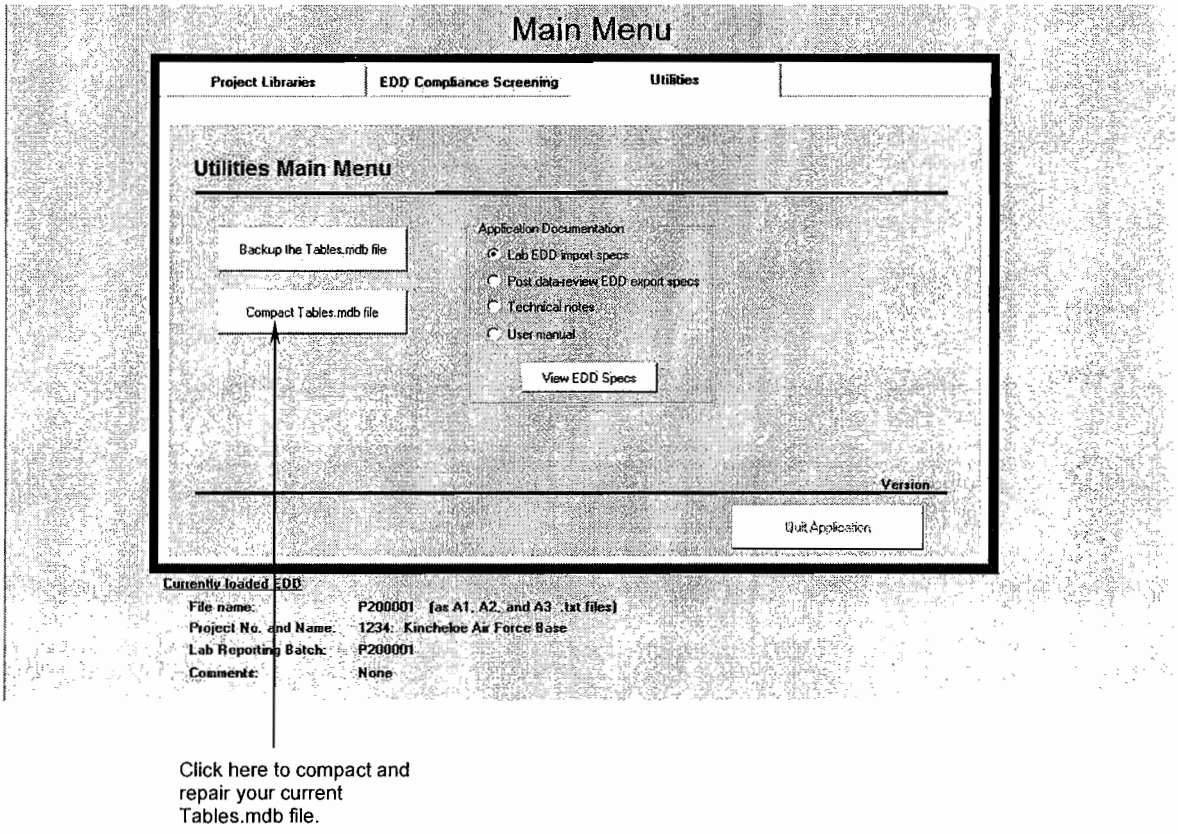
Figure 5-2



5.3 COMPACTING THE DATABASE

The Compact Database utility actually does two things. It first creates a copy of the current Tables.mdb file and places it in the "LibraryFiles" subfolder with the date of compact included in the file name. It then compacts the Tables.mdb file by freeing up unused disk space that may have been set aside for the database. If the compacted database is not corrupted, it will then replace the working database with the compacted one. If the compacted database is corrupted, a pop-up screen will appear warning the user.

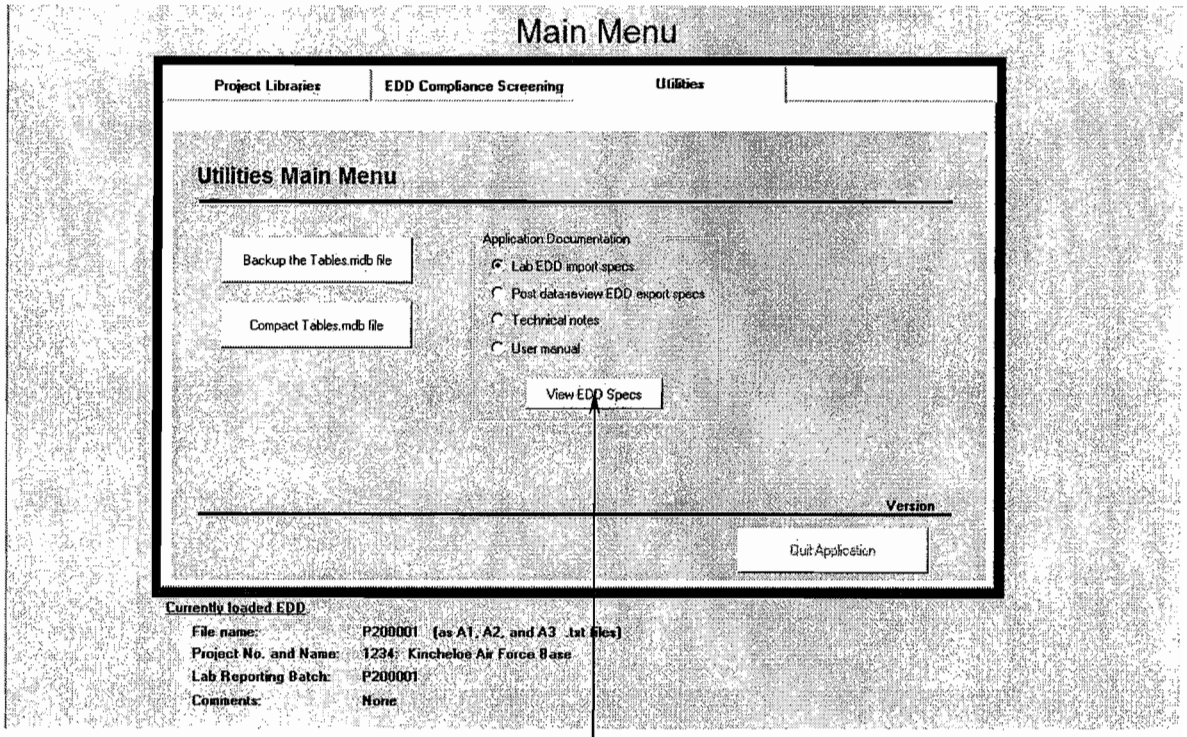
Figure 5-3



5.4 APPLICATION DOCUMENTATION

The User's Manual can be viewed by clicking on the **View User Manual** button in the Utilities Main Menu.

Figure 5-4



Appendix A

APPENDIX A

Electronic Data Deliverable Specifications

The EDD consists of three separate, comma-delimited ASCII text files (two, if instrument calibration information is not required by the project). Each file follows the naming convention of using the Laboratory Reporting Batch ID followed by the table identifier (A1, A2, or A3), and then a ".txt" extension. For example, if a laboratory reporting batch is identified as SDG001 and instrument calibration is included in the EDD, the file names for this EDD would be:

SDG001A1.txt
SDG001A2.txt (included only if instrument calibration is required by the project)
SDG001A3.txt

Each file corresponds to a database table. Uploading the EDD places the contents of each file into its corresponding database table. The tables are identified as the Analytical Results Table (A1), Laboratory Instrument Table (A2), and Sample Analysis Table (A3). After uploading the EDD, you can view the contents of each file (table) in the CCS/EDD Upload Main Menu.

Analytical Results Table (A1 File in the EDD)

The Analytical Results table contains analytical test result records for client samples and quality control samples (excluding calibrations and tunes). For every sample analyzed by a particular method a result record must exist for each analyte and surrogate (if applicable) required by that method (specified in the project library). For laboratory control samples and matrix spikes, a result record must exist for every spiked analyte and surrogate (if applicable) specified in the project library.

Laboratory Instrument Table (A2 File in the EDD)

The Laboratory Instrument table contains records related to instrument tuning (GC/MS only) and initial and continuing calibration (all methods). For each calibration sample a record must exist for each target analyte reported in a method (specified in the project library). Initial calibrations and initial calibration verifications are linked to associated samples using a unique Run Batch ID. Continuing calibrations are linked to associated samples using a unique Analysis Batch ID. GC/MS tunes are linked to initial and continuing calibrations (and hence samples) using the Run Batch and Analysis Batch IDs respectively. Depending on the level of validation required by the client, the Laboratory Instrument table may not be requested in the EDD. If the Laboratory Instrument table is not included in the EDD, the application will still create an A2 file when you download the EDD; however, this file will contain no information and will not be used in the CCS process.

Sample Analysis Table (A3 File in the EDD)

The Sample Analysis table contains information related to sample and QC analyses (excluding calibrations and tunes). A record exists for each sample/method/matrix/analysis type combination. The Sample Analysis table also contains information for date and time; QC batch association, dilution and moisture content (if applicable).

EDD Field Elements

The name, description, data type, length, and standard values (if required) assigned to the fields in each table are listed in Appendix A. Some fields can only contain a restricted set of information called standard values. Appendix B lists the field names and standard values these fields can hold. Certain fields in each table require information for a given combination of sample, matrix, method, analyte type, and calibration or QC type records. These are referred to as required fields. Appendix C indicates the required fields for each table according to the instrument category (method), matrix, analyte type, sample, and QC or calibration type record. CCS checks that required fields are populated.

Appendix A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding calibrations) on an analyte level.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ClientSampleID	Client's identifier for a sample, this should be taken directly from the Chain of Custody If a sample is analyzed as a duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the ClientSampleID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in both EDDs. For the Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID. Do not append suffixes for dilutions, reanalysis, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01DL and MW01RE are not allowed.	Text	25	No
LabAnalysisRefMethodID	Laboratory reference method (i.e., 8260B, 8270C, 6010B, 6010B-Cr, etc.) The LabAnalysisRefMethodID is specified in the project library which should be developed by/or in conjuction with the client.	Text	25	Yes
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field is critical for distinguishing results for the same compound when multiple analyses are submitted for the same sample and method (i.e. dilutions, re-extracts, etc). This field is analogous with run number.	Text	10	Yes
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. Suffixes may be applied to the LabSampleID to designate dilutions, reanalysis, etc. The LabSampleID must be unique for each Method Blank, LCS, and LCSD.	Text	25	
LabID	Identification of the laboratory performing the analyses	Text	7	
ClientAnalyteID	CAS # or unique client identification. If a CAS # is not available, use a unique identifier provided by the client. For TICs from GC/MS analyses, enter retention time in decimal minutes as the ClientAnalyteID. The ClientAnalyteID for a particular target analyte is specified in the project library. Each sample must have the full target list reported. This may be done through multiple runs (i.e. The original run reports all compounds except 1 due to high concentration. The diluted run only reports the 1 analyte not reported from the initial analysis). *NOTE*- Each sample analysis must report all surrogates. For spiked QC (i.e. MS, LCS) only report the spike compounds (and surrogates if applicable).	Text	12	Yes
AnalyteName	Chemical name for the analyte (i.e., Benzene, Lead) The AnalyteName is specified in the project library.	Text	60	Yes
Result	Result value for the analyte. Entries must be numeric. For non-detects of target analytes and spikes, do not enter "ND" or leave this field blank. If an analyte or	Number	10	

Appendix A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding calibrations) on an analyte level.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
	spike was not detected, enter the value fro the ReportingLimit field (see below).			
ResultUnits	Units for Result (i.e., mg/Kg, ug/L, etc.) The result units to be reported for each target analyte and matrix in a given method are specified in the project library.	Text	10	Yes
LabQualifiers	A string of single letter result qualifiers assigned by the lab based on client-defined rules and values. The "U" Lab Qualifier must be entered for all non-detects. Other pertinent lab qualifiers may be entered with the "U" qualifier.	Text	7	Yes
DetectionLimit	The detection limit value for the analyte being measured	Number	10	
DetectionLimitType	Specifies the type of detection limit (i.e., MDL, IDL, etc.)	Text	10	Yes
RetentionTime	The time expressed in decimal minutes between injection and detection, neccessary for GC/MS TICs only.	Number	4	
AnalyteType	Defines the type of result such as surrogate, spike, internal standard, and target compound. For spiked QC (i.e. MS, LCS) only compounds that were actually spiked should have the value SPK, if the full target list is reported, but not all spiked, the non-spiked compounds should have a value of TRG.	Text	7	Yes
PercentRecovery	The percent recovery value of a spike or surrogate compound. Enter the recovery value as a numeric character. The % Recovery must match the hard copy report. If the spike or surrogate was not recovered because of dilution, enter "DIL". If a spike or surrogate was not recovered because of matrix interference, enter "INT". If a spike or surrogate was not recovered because it was not added to the sample, enter "NS".	Number	4	
RelativePercentDifference	The relative percent difference (RPD) of two QC results such as MS/MSD, LCS/LCSD, and sample duplicates. Report RPD in the Sample Duplicate, LCSD, and MSD records only.	Number	4	
ReportingLimit	Reporting limit (RL) value for the measured analyte. Factor in the dilution factor (including any preparation dilutions) and percent moisture correction, if applicable. The Reporting Limit for each analyte and matrix in a given method is specified in the project library. The laboratory RL reported in the EDD must be less than or equal to the value in the library.	Number	10	
ReportingLimitType	Specifies the type of reporting limit (i.e., CRQL, PQL, SQL, RDL, etc). The Reporting Limit Type for each method and matrix is specified in the project library.	Text	10	Yes

Appendix A1
Field Descriptions for the Analytical Results Table (Table A1)

Contains laboratory test results and related information for field and QC samples (excluding calibrations) on an analyte level.

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ReportableResult	This field indicates whether or not the laboratory chooses an individual analyte result as reportable. Enter "YES" if the result is reportable. Enter "NO" if the result is not reportable (the best result). If only one analysis is submitted for a particular sample and method, enter "YES" for all target compounds (Analyte Type = TRG) and all TICs (Analyte Type = TIC, for GC/MS only). If two or more analyses are submitted for a particular sample and method (i.e. initial analysis, reanalysis and/or dilutions), enter "YES" from only <u>one</u> of the analyses for each target compound. For example: a sample was run a second time at dilution because benzene exceeded the calibration range in the initial, undiluted analysis. All target analytes are reported in each analysis. For the initial analysis, enter "NO" for benzene and enter "YES" for all other compounds. For the diluted analysis enter "YES" for benzene and enter "NO" for all other compounds. For TICs (Analyte Type = TIC), if more than one analysis is submitted for a particular sample and method, choose only one of the analyses where Reportable Result = YES for <u>all</u> TICs. For example, a sample was run a second time because one or more target compounds exceeded the calibration range in the undiluted analysis. Choose a particular analysis and enter "YES" for all TICS. In the other analysis enter "NO" for all TICs.	Text	3	Yes

Appendix A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains information related to tuning and calibration of laboratory instruments on an analyte basis

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
InstrumentID	Laboratory instrument identification	Text	15	
QCType	Type of instrument QC (i.e., Instrument_Performance_Check or type of calibration standard)	Text	10	Yes
Analyzed	Analysis date/time for BFB, DFTPP, initial calibration verification standards, calibration verification standards, and continuing calibration standards. For the initial calibration, enter date and time of the last standard analyzed. Also, see comments about initial calibrations in the AlternateLabAnalysisID field name description.	Date/ Time	16*	
AlternateLabAnalysisID	Common laboratory identification used for standards (i.e., VOA STD50, CCAL100, BFB50, etc). For initial calibration, enter ICAL. Information from the initial calibration is entered as one record for each analyte that summarizes the results of the initial calibration (i.e. %RSD, correlation coefficient, and avg RF). Records are not entered for each individual standard within the initial calibration.	Text	12	
LabAnalysisID	Unique identification of the raw data electronic file associated with the calibration standard or tunes (i.e., 9812101MS.DV). Leave this field blank for the initial calibration. See comments about initial calibrations in the Alternate_Lab_Analysis_ID field description. This field is only applicable where an electronic instrument file is created as part of the analysis.	Text	15	
LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 8270C, 6010B, 6010B-Cr, etc.). The Lab Analysis Ref Method ID is specified in the project.	Text	25	Yes
ClientAnalyteID	CAS # or unique client identification. If CAS # is not available, use a unique identifier provided by the client. Records for each calibration must report the full target analyte list including surrogates as applicable. The target analyte list is specified for each method in the project library.	Text	12	Yes
AnalyteName	Chemical name for the analyte (i.e., Benzene, Lead). The Analyte Name for each method is specified in the project library.	Text	60	Yes
RunBatch ICAL	Unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The RunBatchID links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the RunBatch ID also links a BFB or DFTPP tune. A new and unique RunBatchID must used with every new initial calibration.	Text	12	

LR
BD
BS
LB
SD
MS

ICB
ICV
CCB
CCV
FL
PB

Appendix A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains information related to tuning and calibration of laboratory instruments on an analyte basis

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalysisBatch	Unique laboratory identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The AnalysisBatchID links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the Analysis Batch ID also links the BFB or DFTPP tune. A new and unique Analysis Batch ID must be used with every new continuing calibration or continuing calibration verification. For GC methods, only report opening standards, do not include closing standards (unless the closing standard functions as the opening standard for a subsequent set of analyses, in which case a new and unique AnalysisBatchID is assigned). When dual or confirmation columns/detectors are used, enter results from the primary column/detector only (this is similar to CLP Pesticide reporting).	Text	12	
LabReportingBatch	Unique laboratory identifier for a batch of samples including associated calibrations and method QC, reported as a group by the lab (i.e. lab work order #, log-in #, or SDG). Links all instrument calibrations, samples, and method QC reported as a group or SDG.	Text	12	
PercentRelativeStandard Deviation	The standard deviation as a percentage of the mean used to evaluate initial calibration linearity. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the %RSD. Leave this field blank if the Correlation Coefficient is used.	Number	5	
CorrelationCoefficient	The correlation coefficient resulting from linear regression of the initial calibration. For metals by ICAP, enter '1.0' if a two-point initial calibration was analyzed. Organic methods may use either %RSD or Correlation Coefficient. If applicable, enter the Correlation Coefficient. Leave this field blank if the %RSD is used	Number	5	
RelativeResponseFactor	This field applies to GC/MS only. For continuing calibration enter the relative response factor. For initial calibration enter the average relative response factor. Refer to comments about initial calibration records in the field description for AlternateLabAnalysisID.	Number	5	
PercentDifference (or Percent Recovery)	For organic methods, this field is the difference between 2 measured values expressed as a percentage. If %RSD is reported, enter the % difference between the average response factor of the initial calibration (IC) and the response factor of the initial calibration verification (ICV) or continuing calibration (CCV). If correlation coefficient is used, enter the % difference between the true value and the measured value. The PercentDifference is expressed as a negative or positive value. Do not express PercentDifference as an absolute value. **Use a**	Number	5	

Appendix A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains information related to tuning and calibration of laboratory instruments on an analyte basis

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
	negative value if the CCV or ICV response factor is less than the IC average response factor or, in the case of correlation coefficient, the CCV or ICV measured value is less than the true value. Use a positive value if the CCV or ICV response factor is greater than the IC average response factor, or in the case of correlation coefficient, the CCV or ICV measured value is greater than the true value. For inorganic methods, this field is the recovery of an analyte expressed as a percentage of the true amount (i.e., %R for a metal in the continuing calibration or initial calibration verification by Method 6010B).			
Peak_ID_01	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 50; For DFTPP, m/z = 51	Number	10	
Percent_Ratio_01	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_01	Number	10	
Peak_ID_02	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 75; For DFTPP, m/z = 68	Number	10	
Percent_Ratio_02	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_02.	Number	10	
Peak_ID_03	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 95; For DFTPP, m/z = 69	Number	10	
Percent_Ratio_03	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_03.	Number	10	
Peak_ID_04	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 96 For DFTPP, m/z = 70	Number	10	
Percent_Ratio_04	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_04.	Number	10	
Peak_ID_05	Identifies individual ions for GC/MS tuning compounds (I.e., BFB, DFTPP). For BFB, m/z = 173; For DFTPP, m/z = 127	Number	10	
Percent_Ratio_05	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_05.	Number	10	
Peak_ID_06	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 174; For DFTPP, m/z = 197	Number	10	
Percent_Ratio_06	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_06.	Number	10	
Peak_ID_07	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 175; For DFTPP, m/z = 198	Number	10	
Percent_Ratio_07	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_07.	Number	10	
Peak_ID_08	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 176; For DFTPP, m/z = 199	Number	10	
Percent_Ratio_08	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_08.	Number	10	

Appendix A2
Field Descriptions for the Laboratory Instrument Table (Table A2)

Contains information related to tuning and calibration of laboratory instruments on an analyte basis

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
Peak_ID_09	Identifies individual ions for GC/MS tuning compounds (i.e., BFB, DFTPP). For BFB, m/z = 177; For DFTPP, m/z = 275	Number	10	
Percent_Ratio_09	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_09.	Number	10	
Peak_ID_10	Identifies individual ions for GC/MS tuning compounds (i.e., DFTPP). For DFTPP, m/z = 365	Number	10	
Percent_Ratio_10	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_10.	Number	10	
Peak_ID_11	Identifies individual ions for GC/MS tuning compounds (i.e., DFTPP). For DFTPP, m/z = 441	Number	10	
Percent_Ratio_11	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_11.	Number	10	
Peak_ID_12	Identifies individual ions for GC/MS tuning compounds (i.e., DFTPP). For DFTPP, m/z = 442	Number	10	
Percent_Ratio_12	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_12.	Number	10	
Peak_ID_13	Identifies individual ions for GC/MS tuning compounds (i.e., DFTPP). For DFTPP, m/z = 443	Number	10	
Percent_Ratio_13	Ion abundance ratios of the GC/MS tuning compounds reported as a percentage. Linked to an individual Peak_ID_13.	Number	10	

* Date/time format is: MM/DD/YYYY hh:mm where MM = month, DD = day, YYYY = year, hh = hour in 24 hour format, and mm = minutes.

Appendix A3
Field Description for the Sample Analysis Table (A3)

Contains information related to laboratory sample and QC analyses (excluding calibrations and tunes), analytical methods, batching information, and sample preparation

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
ProjectNumber	Project number assigned by the client	Text	30	Yes
ProjectName	Project name assigned by the client	Text	90	Yes
ClientSampleID	Client's identifier for a sample, this should be taken directly from the Chain of Custody If a sample is analyzed as a duplicate, matrix spike, or matrix spike duplicate, append suffixes DUP, MS and MSD respectively to the ClientSampleID with no intervening spaces or hyphens (i.e. MW01DUP, MW01MS, and MW01MSD). Parent sample records must exist for each MS and MSD. If an MS/MSD is shared between two EDDs, records for the MS/MSD and its parent sample must exist in both EDDs. For the Method Blanks, LCS, and LCSD enter the unique LaboratorySampleID. Do not append suffixes for dilutions, reanalysis, or re-extracts (the AnalysisType field is used for this distinction). For example, MW01DL and MW01RE are not allowed.	Text	25	
Collected	Date/Time of sample collection Leave this field blank for Method Blank, LCS, and LCSD.	Date/ Time	16*	
MatrixID	Sample matrix (i.e., AQ, SO, etc.)	Text	10	Yes
LabSampleID	Laboratory tracking number for field samples and lab generated QC samples such as method blank, LCS, and LCSD. Suffixes may be applied to the Lab_Sample_ID to designate dilutions, reanalysis, etc. The Lab_Sample_ID must be unique for each Method Blank, LCS, and LCSD.	Text	25	
QCType	This record identifies the type of quality control sample QC (i.e., Duplicate, LCS, Method Blank, MS, or MSD). For regular samples, leave this field blank. Each Method Batch must contain records for a matrix spike for inorganic methods, and a matrix spike and matrix spike duplicate for organic methods.	Text	7	Yes
ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport client or field samples. Links all samples to a cooler or shipping container. Leave blank for method blanks, LCS, and LCSD.	Text	25	
Temperature	Temperature (in centigrade degrees) of the cooler as received.	Number	4	
LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 8270C, 6010B, 6010B-Cr, etc.). The Lab Analysis Ref Method ID is specified in the project library.	Text	25	Yes
PreparationType	Preparation Method Number (i.e. 3010A, 3510C, 3550C, 5030B, etc.) For methods that do not have a specific preparation method number, use "Gen Prep".	Text	25	Yes

Appendix A3
Field Description for the Sample Analysis Table (A3)

Contains information related to laboratory sample and QC analyses (excluding calibrations and tunes), analytical methods, batching information, and sample preparation

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
AnalysisType	Defines the analysis type (i.e., Dilution, Reanalysis, etc.). This field is critical for distinguishing results for the same compound when multiple analyses are submitted for the same sample and method (i.e. dilutions, re-extracts, etc). This field is analogous with run number.	Text	10	Yes
Prepared	Preparation date/time	Date/ Time	16*	
Analyzed	Date and time of analysis	Date/ Time	16*	
LabID	Identification of the laboratory performing the analysis	Text	7	
QCLevel	Level of analytical laboratory QC associated with the analysis (i.e., Certificate of Analysis)	Text	10	Yes
ResultBasis	Wet or dry weight	Text	3	Yes
TotalOrDissolved	This field indicates if the results related to this sample and method are expressed as total or dissolved. This field is applicable to samples analyzed for metals.	Text	3	Yes
Dilution	Overall dilution of the sample aliquot. A value of one corresponds to nominal method conditions. Insert value of one for blanks, LCS, and LCSD.	Number	4	
HandlingType	Type of leaching procedure (i.e., SPLP,TCLP, WET).	Text	10	Yes
HandlingBatch	Unique laboratory identifier for a batch of samples prepared together for a leaching procedure (i.e., SPLP, TCLP, or WET preparation). Links samples with leaching blanks.	Text	12	
LeachateDate	Leachate date (i.e., date for SPLP, TCLP, or WET preparation)	Date /Time	16*	
PercentMoisture	Percent of sample composed of water. Enter for soil and sediment samples only.	Number	4	
MethodBatch	Unique laboratory identifier for a batch of samples of similar matrices analyzed by one method and treated as a group for field QC purposes. Links the matrix spike and/or matrix spike duplicate or laboratory duplicates to associated samples. *Note* the MethodBatch association does not have to coincide with the PreparationBatch association. The MethodBatch is specifically used to link the MS/MSD and/or DUP to associated samples.	Text	25	
PreparationBatch	Unique laboratory identifier for a batch of sample aliquots prepared together for analysis by one method. Links samples with method blanks and laboratory control samples. *Note* the PreparationBatch association does not have to coincide with the MethodBatch association. The PreparationBatch is specifically used to link the Method Blank and LCS to associated samples.	Text	25	

Appendix A3
Field Description for the Sample Analysis Table (A3)

Contains information related to laboratory sample and QC analyses (excluding calibrations and tunes), analytical methods, batching information, and sample preparation

Field Name	Field Name Description	Field Type	Field Length	Standard Value List
RunBatch	Unique identifier for a batch of analyses performed on one instrument under the control of one initial calibration and initial calibration verification. The Run Batch ID links both the initial calibration and initial calibration verification to subsequently analyzed and associated continuing calibrations, field samples, and QC analyses. For GC/MS methods, the Run_Batch ID also links a BFB or DFTPP tune. A new and unique Run Batch ID must used with every new initial calibration. The identifier entered in this field links a particular sample/method/analysis type record to a set of associated initial calibration and initial calibration verification records from Table A2.	Text	25	
AnalysisBatch	Unique laboratory identifier for a batch of analyses performed on one instrument and under the control of a continuing calibration or continuing calibration verification. The Analysis Batch ID links the continuing calibration or calibration verification to subsequently analyzed and associated field sample and QC analyses. For GC/MS methods, the Analysis Batch ID also links the BFB or DFTPP tune. A new and unique Analysis Batch ID must be used with every new continuing calibration or continuing calibration verification. The identifier entered in this field links a particular sample/method/analysis type record to a set of associated continuing calibration records from Table A2.	Text	25	
LabReportingBatch	Unique laboratory identifier for a batch of samples including associated calibrations and method QC, reported as a group by the lab (i.e. lab work order #, log-in #, or SDG). Links all instrument calibrations, samples, and method QC reported as a group or SDG.	Text	12	
LabReceipt	Date the sample was received in the lab	Date/ Time	16*	
LabReported	Date the hardcopy data were reported by the lab	Date/ Time	16*	

* Date/time format is: MM/DD/YYYY hh:mm where MM = month, DD = day, YYYY = four digits of the year, hh = hour in 24 hour format, and mm = minutes.

Appendix B

Appendix B Standard Value List (SVL)

Field Name	Standard Value	Standard Value Description
Analysis_Type*	DL	Dilution of the original sample
	DL2	Second dilution of the original sample
	DL3	Third dilution of the original sample
	DL4	Fourth dilution of the original sample
	RE	Reanalysis/reextraction of sample
	RE2	Second reanalysis/reextraction of sample
	RE3	Third reanalysis/reextraction of sample
	RE4	Fourth reanalysis/reextraction of the original sample
	RES	The initial or original sample.
Analyte_Name*	Refer to Project Library	Refer to Project Library
Analyte_Type⊗	IS	Internal standard as defined per CLP usage
	SPK	Spiked analyte
	SURR	Surrogate as defined as per CLP usage
	TIC	Tentatively identified compound for GC/MS analysis
	TRG	Target compound
Client_Analyte_ID*	Refer to Project Library	Refer to Project Library
Detection_Limit_Type*	CRDL	Contract required detection limit
	IDL	Instrument detection limit
	MDA	Minimum detectable activity
	MDL	Method detection limit
Handling_Type*	WET	Wet leaching procedure
	SPLP	Synthetic Precipitation Leaching Procedure
	TCLP	Toxicity Characteristic Leaching Procedure
Lab_Analysis_Ref_Method_ID*	Refer to Project Library	Refer to Project Library
Lab_Qualifiers*	*	INORG: Duplicate analysis was not within control limits
	*	ORG: Surrogate values outside of contract required QC limits
	+	INORG: Correlation coefficient for the method of standard additions (MSA) was less than 0.995
	A	ORG: Tentatively identified compound (TIC) was a suspected aldol-condensation product
	B	INORG:Value less than contract required detection limit but greater than or equal to instrument detection limit
	B	ORG: Compound is found in the associated blank as well as in the sample
	C	ORG: Analyte presence confirmed by GC/MS
	D	Result from an analysis at a secondary dilution factor
	E	INORG: Reported value was estimated because of the presence of interference
	E	ORG: Concentrations exceed the calibration range of the instrument
	H	Analysis performed outside method or client-specified holding time requirement
	J	Estimated value
	M	INORG: Duplicate injection precision was not met
	N	INORG: Spiked sample recovery was not within control limits
	N	ORG: Presumptive evidence of a compound
	P	ORG: Difference between results from two GC columns unacceptable (>25% Difference)
	S	Reported value was determined by the method of standard additions (MSA)
	U	Compound was analyzed for but not detected. Analyte result was below the Reporting_Limit_Type.
	W	INORG: Post digestion spike was out of control limits
	X	Reserved for a lab-defined data qualifier
	Y	Reserved for a lab-defined data qualifier
	Z	Reserved for a lab-defined data qualifier
Matrix_ID⊗	AIR	Air
	AQ	Water

Appendix B Standard Value List (SVL)

Field Name	Standard Value	Standard Value Description
	ASH	Ash
	BIOTA	Biological matter
	FILTER	Filter
	LIQUID	Non-aqueous liquid
	OIL	Oil
	SED	Sediment
	SLUDGE	Sludge
	SO	Soil
	SOLID	Non-soil/sediment solid
	TISSUE	Tissue
	WASTE	Waste
	WIPE	Wipe
Preparation_Type*	3005A	Acid Digestion of Waters for Total Recoverable or Dissolved Metals by FLAA or ICP
	3010A	Acid of Aqueous Samples and Extracts for Total Metals by FLAA or ICP
	3015	Microwave Assisted Acid Digestion of Aqueous Samples and Extracts
	3020A	Acid Digestion of Aqueous Samples and Extracts for Total Metals by GFAA
	3031	Acid Digestion of Oils for Metals Analysis by AA or ICP
	3050B	Acid Digestion of Sediments, Sludges, and Soils
	3051	Microwave Assisted Acid Digestion of Sediments, Sludges, Soils and Oils
	3052	Microwave Assisted Acid Digestion of Siliceous and Organically Based Matrices
	3060A	Alkaline Digestion for Hexavalent Chromium
	3510C	Separatory Funnel Liquid-Liquid Extraction
	3520C	Continuous Liquid-Liquid Extraction
	3535	Solid Phase Extraction
	3540C	Soxhlet Extraction
	3541	Automated Soxhlet Extraction
	3545	Pressurized Fluid Extraction
	3550B	Ultrasonic Extraction
	3560	Supercritical Fluid Extraction of Total Recoverable Petroleum Hydrocarbons
	5030B	Purge and Trap for Aqueous Samples
	5035	Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples
	7470A	Acid digestion of waters for Mercury analysis
	7471A	Acid digestion of soils and solids for Mercury analysis
	8015B	Shake out
	8330	Extraction and cleanup for Method 8330
	9045	Preparation of soils for pH measurement
	9056	Preparation of soils and waters for Method 9056
	Gen Prep	Generic preparation type when a preparation method ID does not exist (used mostly for general chemistry methods)
Project_Name*	Refer to SOW	Refer to SOW
Project_Number*	Refer to SOW	Refer to SOW
QC_Level*	COA	Certificate of Analysis
	COACAL	Certificate of Analysis plus calibration data
QC_Type⊗	CV	(Calibration Verification) Analytical standard run at a specified frequency to verify the calibration of the analytical system
	CCV	(Continuing Calibration Verification) Analytical standard run every 12 hours to verify the calibration of the GC/MS system
	DUP	A second aliquot of a sample that is treated the same as the original aliquot to determine the precision of the method
	EB	Field equipment rinseate
	FB	(Field blank) Analyte-free water or solvent brought to the field in sealed containers and transported to lab with sample containers
	FD	Duplicate sample taken from a field sample
	IC	(Initial Calibration) Analysis of analytical standards for a series of different specified concentrations
	ICV	(Initial Calibration Verification) Analytical standard run at a specified frequency to verify the accuracy of the initial calibration of the analytical system

Appendix B Standard Value List (SVL)

Field Name	Standard Value	Standard Value Description
	IPC	(Instrument Performance Check) Analysis of DFTPP or BFB to evaluate the performance of the GC/MS system
	LCS	(Laboratory Control Sample) A control sample of known composition
	LCSD	(Laboratory Control Sample Duplicate) A duplicate control sample of known composition
	MB	Analytical control consisting of all reagents and standards that is carried through the entire procedure (Method Blank)
	MS	(Matrix Spike) Aliquot of a matrix spiked with known quantities and subjected to the entire analytical procedure to measure recovery
	MSD	(Matrix Spike Duplicate) A second aliquot of the same matrix as the matrix spike that is spiked in order to determine the precision of the method
	PB	(Preparation Blank) Analytical control containing distilled, deionized water and reagents, and subjected to entire analytical procedure
	SB	(Storage Blank) Aliquot of analyte-free water or solvent stored with the samples as a check on contamination from the storage process
	TB	(Trip Blank) Analyte free water transported with sample bottles prior to and after sample collection
Reportable_Result⊗	Yes	Identifies a result record as reportable
	No	Identifies a result record as non-reportable
Reporting_Limit_Type*	CRDL	Contract required detection limit
	CRQL	Contract required quantitation limit
	MRL	Method reporting limit
	PQL	Practical quantitation limit
	QL	Quantitation limit
	SQL	Sample quantitation limit
	RAL	Regulatory action level
	RDL	Reportable detection limit
Result_Basis⊗	DRY	Result was calculated on a dry weight basis
	WET	Result was calculated on a wet weight basis
Result_Units These valid values are dependent on what is entered in the project library	ug/L	Micrograms per liter
	mg/L	Milligrams per liter
	ug/Kg	Micrograms per kilogram
	mg/Kg	Milligrams per kilogram
	pg/L	Picograms per liter
	ng/Kg	Nanograms per kilogram
Total_Or_Dissolved⊗	DIS	Dissolved
	TOT	Total

⊗ These standard values can not be added to or modified
* These standard values can be added to and/or modified (See section 2 of this manual)

Appendix C

Table C1 (1 of 2)
Required Fields in the Analytical Results Table for GC/MS, GC, and HPLC Methods

	GC/MS Methods			GC and HPLC Methods		
Field	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time	T		T			
Analyte_Type	X	X	X	X	X	X
Percent_Recovery	S	R	R	S	R	R
Relative_Percent_Difference		D	D		D	D
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

Key

- X Required Field
- D Required field for spiked compounds in the LCSD and MSD only
- Q Required field if laboratory has qualifed result
- R Required field if Analyte_Type = "SPK" or "SURR"
- S Required field for surrogate compounds only
- T Required field for tentatively identified compounds by GC/MS only
- * Also includes Equipment Blanks, Field Blanks, Trip Blanks, and Field Duplicates

Table C1 (2 of 2)
Required Fields in the Analytical Results Table for ICAP, AA, and IC Methods

	ICAP and AA Methods			IC and Wet Chemistry Methods		
Field	Regular Sample*	Sample Duplicate, MS/MSD	Method Blank, LCS/LCSD	Regular Sample*	Sample Duplicate MS/MSD	Method Blank, LCS/LCSD
Client_Sample_ID	X	X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X
Result	X	X	X	X	X	X
Result_Units	X	X	X	X	X	X
Lab_Qualifiers	Q	Q	Q	Q	Q	Q
Detection Limit	X	X	X	X	X	X
Detection_Limit_Type	X	X	X	X	X	X
Retention_Time						
Analyte_Type	X	X	X	X	X	X
Percent_Recovery		S	S		S	S
Relative_Percent_Difference		D	D		D	D
Reporting_Limit	X	X	X	X	X	X
Reporting_Limit_Type	X	X	X	X	X	X
Reportable_Result	X	X	X	X	X	X

Key

X Required field
Q Required field if laboratory has qualified result
D Required field for spiked compounds in LCSD or MSD, or target compounds in the Sample Duplicate only
S Required field if Analyte_Type = "SPK"
* Also includes Trip Blanks, Equipment Blanks, and Field Blanks

Table C2
Required Fields in the Laboratory Instrument Table

	GC/MS Tunes		Initial Calibration				Initial Calibration Verification				Calibration Verification, Continuing Calibration
Field	VOA	SVOA	GC/MS	GC HPLC	ICP/AA	IC*	GC/MS	GC HPLC	ICP/AA	IC*	ALL METHODS
Instrument_ID	X	X	X	X	X	X	X	X	X	X	X
QC_Type	X	X	X	X	X	X	X	X	X	X	X
Analyzed	X	X	X	X	X	X	X	X	X	X	X
Alternate_Lab_Analysis_ID	X	X	X	X	X	X	X	X	X	X	X
Lab_Analysis_ID	X	X					X	X	X	X	X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X	X	X	X	X	X
Client_Analyte_ID	X	X	X	X	X	X	X	X	X	X	X
Analyte_Name	X	X	X	X	X	X	X	X	X	X	X
Run_Batch	X	X	X	X	X	X	X	X	X	X	X
Analysis_Batch	C	C									X
Lab_Reporting_Batch	X	X	X	X	X	X	X	X	X	X	X
Percent_Relative_Standard_Deviation			X	X							
Correlation_Coefficient			B	B	X	X					
Relative_Response_Factor			X				X				M
Percent_Difference							X	X	X	X	X
Peak_ID_01	X	X									
Percent_Ratio_01	X	X									
Peak_ID_02	X	X									
Percent_Ratio_02	X	X									
Peak_ID_03	X	X									
Percent_Ratio_03	X	X									
Peak_ID_04	X	X									
Percent_Ratio_04	X	X									
Peak_ID_05	X	X									
Percent_Ratio_05	X	X									
Peak_ID_06	X	X									
Percent_Ratio_06	X	X									
Peak_ID_07	X	X									
Percent_Ratio_07	X	X									
Peak_ID_08	X	X									
Percent_Ratio_08	X	X									
Peak_ID_09	X	X									
Percent_Ratio_09	X	X									
Peak_ID_10		X									
Percent_Ratio_10		X									
Peak_ID_11		X									
Percent_Ratio_11		X									

	GC/MS Tunes		Initial Calibration				Initial Calibration Verification				Calibration Verification, Continuing Calibration
Field	VOA	SVOA	GC/MS	GC HPLC	ICP/AA	IC*	GC/MS	GC HPLC	ICP/AA	IC*	ALL METHODS
Peak_ID_12		X									
Percent_Ratio_12		X									
Peak_ID_13		X									
Percent_Ratio_13		X									

Key

X Required field (some fields are not applicable to some General (Wet) Chemistry tests)

B Required field if reporting best fit

C Required field if BFB or DFTPP associated with a continuing calibration only

M Required field for GC/MS continuing calibration only

*IC Includes Ion Chromatography and Classical or Wet Chemistry methods. Methods such as pH, Conductivity, and others do not use traditional calibration procedures, therefore some fields marked as a required field under the "IC" column do not apply for these methods.

Table C3
Required Fields in the Sample Analysis Table

	GC, GC/MS, HPLC Methods		ICAP and AA Methods		IC and Wet Chemistry Methods	
Field	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD	Method Blanks, LCS/LCSD	Regular Samples*, Sample Duplicate, MS/MSD
Client_Sample_ID	X	X	X	X	X	X
Collected		X		X		X
Matrix_ID	X	X	X	X	X	X
Lab_Sample_ID	X	X	X	X	X	X
QC_Type	X	Q	X	Q	X	X
Shipping_Batch_ID		X		X		X
Temperature		X				X
Lab_Analysis_Ref_Method_ID	X	X	X	X	X	X
Preparation_Type	X	X	X	X	X	X
Analysis_Type	X	X	X	X	X	X
Prepared	A	A	X	X	N	N
Analyzed	X	X	X	X	X	X
Lab_ID	X	X	X	X	X	X
QC_Level	X	X	X	X	X	X
Results_Basis		S		S		S
Total_Or_Dissolved			W	W		
Dilution	X	X	X	X	X	X
Handling_Type	L	L	L	L	L	L
Handling_Batch	L	L	L	L	L	L
Leachate_Date	L	L	L	L	L	L
Percent Moisture		S		S		S
Method_Batch	X	X	X	X	X	X
Preparation_Batch	X	X	X	X	X	X
Run_Batch	C	C	C	C	C	C
Analysis_Batch	C	C	C	C	C	C
Lab_Reporting_Batch	X	X	X	X	X	X
Lab_Receipt		X		X		X
Lab_Reported	X	X	X	X	X	X

Key

- X Required field
- A Required field for samples prepared by methanol extraction
- C Required field if Instrument Calibration Table (A2) is included in EDD
- L Required field if analysis performed on SPLP, TCLP, or WET extracts
- N Required field only for samples that require preparation before analysis
- Q Required field for Sample Duplicate, MS, and MSD only
- S Required field if "Matrix_ID" = "SO" or "SED"
- W Required field for aqueous samples only
- * Includes Trip Blanks, Equipment Blanks, and Field Blanks

Appendix D

Qualification Summary for GC/MS Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES (Extraction and Analysis)	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
COOLER TEMPERATURE	1) > 6 and ≤10 degrees Centigrade	J	J-	UJ	All samples shipped in the affected cooler (Shipping Batch)
	2) >10 degrees Centigrade	J	J-	R	
	3) < 2 degrees Centigrade	None	None	None	
INSTRUMENT TUNING	1) Ion abundance criteria not met	JN	JN	R	All samples associated to an initial calibration (Run Batch), if tune is associated to an initial calibration. All samples associated to a continuing calibration (Analysis Batch), if tune is associated to a continuing calibration.
INITIAL CALIBRATION	1) Average RRF < 0.05	J	J	R	All samples associated to the initial calibration (Run Batch)
	2) %RSD > 30%	J	J	UJ	
	3) r < 0.995	J	J	UJ	
INITIAL CALIBRATION VERIFICATION (ICV)	1) Average RRF < 0.05	J	J	R	All samples associated to the ICV (Run Batch)
	2) % Difference > +25%	J	J+	None	
	3) % Difference < -25% and ≥ -50%	J	J-	UJ	
	4) % Difference < -50%	J	J-	R	
CONTINUING CALIBRATION VERIFICATION (CCV)	1) Average RRF < 0.05	J	J	R	All samples associated to the CCV (Analysis Batch)
	2) % Difference > +25%	J	J+	None	
	3) % Difference < -25% and ≥ -50%	J	J-	UJ	
	4) % Difference < -50%	J	J-	R	

Qualification Summary for GC/MS Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
METHOD BLANK CONTAMINATION	1) Common lab contaminant and tentatively identified compound (TIC) results less than or equal to 10 times blank contamination	U	U	None	All samples in the same Preparation Batch as the method blank
	2) Other compound results less than or equal to 5 times blank contamination	U	U	None	
SURROGATE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	Note: For semivolatile analysis, two or more surrogates in a fraction must be out of criteria for qualification unless recovery < 10%.				
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Parent Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	All samples in the same Preparation Batch as the LCS
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
REPORTING LIMITS	1) Result greater than the project-reporting limit and lab qualifier = U	N/A	N/A	None	Sample (noted on outlier report)
	2) Result less than the project-reporting limit where lab qualifier is not U.	J	J	N/A.	
FIELD DUPLICATES	1) RPD > CL	None.	None	None	Noted in outlier report

Qualification Summary for GC/MS Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
FIELD BLANKS EQUIPMENT BLANKS	1) Common lab contaminants and tentatively identified compound (TIC) results less than or equal to 10 times blank contamination	U	U	None	All samples in the same sampling event
	2) Other lab contaminant results less than or equal to 5 times blank contamination	U	U	None	
TRIP BLANKS	1) Common lab contaminants and tentatively identified compound (TIC) results less than or equal to 10 times blank contamination	U	U	None	All samples in the same Shipping Batch as the trip blank
	2) Other lab contaminant results less than or equal to 5 times blank contamination	U	U	None	

Qualification Summary for GC Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES (Extraction and Analysis)	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
COOLER TEMPERATURE	1) > 6 and ≤10 degrees Centigrade	J	J-	UJ	All samples shipped in the affected cooler. (Shipping Batch)
	2) >10 degrees Centigrade	J	J-	R	
	3) < 2 degrees Centigrade	None	None	None	
INITIAL CALIBRATION	1) %RSD > 20%	J	J	UJ	All samples associated with initial calibration (Run Batch)
	2) r < 0.995	J	J	UJ	
INITIAL CALIBRATION VERIFICATION (ICV)	1) % Difference > +25%	J	J+	None	All samples associated with initial calibration verification (Run Batch)
	2) % Difference < -25% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
CONTINUING CALIBRATION (CV)	1) % Difference > +15%	J	J+	None	All samples associated with continuing calibration (Analysis Batch)
	2) % Difference < -15% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
METHOD BLANK CONTAMINATION	1) Common lab contaminant results less than or equal to 10 times the blank contamination	U	U	None	All samples in the same Preparation Batch
	2) Other compound results less than or equal to 5 times the blank contamination	U	U	None	
SURROGATE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	

Qualification Summary for GC Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Parent Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	All samples in the same Preparation Batch
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
REPORTING LIMITS	1) Result greater than the project-reporting limit and lab qualifier = U.	N/A	N/A	None	Sample (noted in outlier report)
	2) Result less than the project-reporting limit where lab qualifier is not U.	J	J	N/A.	Sample
FIELD DUPLICATES	1) RPD > CL	None	None	None	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	1) Common lab contaminant results within 10 times blank contamination	U	U	None	All samples in the same sampling event
	2) Other lab contaminant results within 5 times blank contamination	U	U	None	
TRIP BLANKS	1) Common lab contaminant results within 10 times blank contamination	U	U	None	All samples in the same Shipping Batch
	2) Other lab contaminant results within 5 times blank contamination	U	U	None	

Qualification Summary for HPLC Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES (Extraction and Analysis)	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
COOLER TEMPERATURE	1) > 6 and ≤10 degrees Centigrade	J	J-	UJ	All samples shipped in the affected cooler. (Shipping Batch)
	2) >10 degrees Centigrade	J	J-	R	
	3) < 2 degrees Centigrade	None	None	None	
INITIAL CALIBRATION	1) %RSD > 20%	J	J	UJ	All samples associated with initial calibration (Run Batch)
	2) r < 0.995	J	J	UJ	
INITIAL CALIBRATION VERIFICATION (ICV)	1) % Difference > +15%	J	J+	None	All samples associated with initial calibration verification (Run Batch)
	2) % Difference < -15% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
CONTINUING CALIBRATION (CV)	1) % Difference > +15%	J	J+	None	All samples associated with continuing calibration (Analysis Batch)
	2) % Difference < -15% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
METHOD BLANK CONTAMINATION	1) Sample results less than or equal to 5 times the blank contamination.	U	U	None	All samples in the same Preparation Batch
SURROGATE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	Parent Sample
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	

Qualification Summary for HPLC Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 10%	J	J-	UJ	All samples in the same Preparation Batch
	2) % Recovery <10%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
REPORTING LIMITS	3) Reporting limits not matching the project specified limits.	None	None	None	Sample (noted in outlier report)
	4) Results reported below the project reporting detection limit.	J	J	None	Sample
FIELD DUPLICATES	1) RPD > CL	None	None	None	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	1) Common lab contaminant results within 10 times blank contamination	U	U	None	All samples in the same sampling event
	2) Other lab contaminant results within 5 times blank contamination	U	U	None	
TRIP BLANKS	1) Common lab contaminant results within 10 times blank contamination	U	U	None	All samples in the same Shipping Batch
	2) Other lab contaminant results within 5 times blank contamination	U	U	None	

Qualification Summary for Metals Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
INITIAL CALIBRATION	1) r < 0.995	J	J	UJ	All samples associated with initial calibration (Run Batch)
INITIAL CALIBRATION VERIFICATION (ICV)	1) % Recovery > 110% but ≤ 125% (Hg, % Recovery > 120% but ≤ 135%)	J	J+	None	All samples associated with initial calibration verification (Run Batch)
	2) % Recovery > 125% (Hg, % Recovery > 135%)	R	R	None	
	3) % Recovery < 90% but ≥75% (Hg, % Recovery < 80% but ≥ 65%)	J	J-	UJ	
	4) % Recovery < 75% (Hg, % Recovery < 65%)	R	R	R	
CALIBRATION VERIFICATION	1) % Recovery > 110% but ≤ 125% (Hg, % Recovery > 120% but ≤ 135%)	J	J+	None	All samples associated with continuing calibration (Analysis Batch)
	2) % Recovery > 125% (Hg, % Recovery > 135%)	R	R	None	
	3) % Recovery < 90% but ≥ 75% (Hg, % Recovery < 80% but ≥ 65%)	J	J-	UJ	
	4) % Recovery < 75% (Hg, % Recovery < 65%)	R	R	R	
METHOD BLANK CONTAMINATION	Sample results less than or equal to 5 times the blank contamination	U	U	None	All samples in the same Preparation Batch
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 30%	J	J-	UJ	All samples in the same Method Batch
	2) % Recovery <30%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	

Qualification Summary for Metals Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 50%	J	J-	UJ	All samples in the same Preparation Batch
	2) % Recovery <50%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
REPORTING LIMITS	1) Result greater than the project-reporting limit and lab qualifier = U	N/A	N/A.	None	Sample (noted in outlier report)
	2) Result less than the project reporting limit where lab qualifier is not U.	J	J	N/A.	Sample
FIELD DUPLICATES	RPD > CL	None	None	None	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	Sample results within 5 times blank contamination	U	U	None	All samples in the same sampling event

Qualification Summary for Ion Chromatography and Wet Chemistry Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
HOLDING TIMES	1) Holding time exceeded by 2 times or less	J	J-	UJ	Sample
	2) Holding time exceeded by greater than 2 times	J	J-	R	
COOLER TEMPERATURE	1) > 6 degrees Centrigrade 2) < 2 degrees Centigrade	None	None	No Qual	Noted on outlier report for samples shipped in affected cooler
INITIAL CALIBRATION	1) %RSD > 20%	J	J	UJ	All samples associated with initial calibration (Run Batch)
	2) r < 0.995	J	J	UJ	
INITIAL CALIBRATION VERIFICATION (ICV)	1) % Difference > +10%	J	J+	None	All samples associated with initial calibration verification (Run Batch)
	2) % Difference < -10% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
CALIBRATION VERIFICATION	1) % Difference > +10%	J	J+	No qual	All samples associated with continuing calibration (Analysis Batch)
	2) % Difference < -10% and ≥ -50%	J	J-	UJ	
	3) % Difference < -50%	J	J-	R	
METHOD BLANK CONTAMINATION	Sample results less than or equal to 5 times the blank contamination	U	U	None	All samples in the same Preparation Batch
MATRIX SPIKE RECOVERY	1) % Recovery < CL but ≥ 30%	J	J-	UJ	All samples in the same Method Batch
	2) % Recovery <30%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	
LABORATORY CONTROL SAMPLE RECOVERY	1) % Recovery < CL but ≥ 50%	J	J-	UJ	All samples in the same Preparation Batch
	2) % Recovery <50%	J	J-	R	
	3) % Recovery > CL	J	J+	None	
	4) RPD > CL	J	J	UJ	

Qualification Summary for Ion Chromatography and Wet Chemistry Methods

QUALITY CONTROL ITEM	EVALUATION	DATA QUALIFIER FLAG			SAMPLE(S) QUALIFIED
		Detects			
		Non Biased	Biased	Nondetects	
REPORTING LIMITS	1) Result greater than the project-reporting limit and lab qualifier = U	N/A.	N/A.	None	Sample (noted in outlier report)
	2) Result less than the project-reporting limit where lab qualifier is not U.	J	J	N/A	Sample
FIELD DUPLICATES	1) RPD > CL	None	None	None	Non-compliant results listed in the ADR outlier report
FIELD BLANKS EQUIPMENT BLANKS	Sample results within 5 times blank contamination	U	U	None	All samples in the same sampling event

Appendix E

Post Review EDD Export Specifications - Analytical Results (A1) Comma Delimited Text File

Order	Field Name*	Field Description	Field Type	Field Length
1	RecordID	Record number.	Number	Single
2	ClientSampleID	Client field sample identifier.	Text	25
3	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).	Text	25
4	AnalysisType	Defines type of analysis (i.e. dilution, reanalysis, etc.).	Text	10
5	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.	Text	25
6	LabID	Identifier of laboratory performing the analysis.	Text	7
7	ClientAnalyteID	CAS number or unique analyte identifier.	Text	12
8	AnalyteName	Chemical name for analyte.	Text	60
9	Result	Reportable result for the analyte.	Text	10
10	ResultUnits	Units of measure for the result (i.e. mg/Kg, ug/L, etc.).	Text	10
11	LabQualifiers	A string of letter or symbol qualifiers assigned by the lab based on contractor defined rules and values.	Text	7
12	DetectionLimit	Detection limit for the analyte being measured.	Text	10
13	DetectionLimitType	Specifies the type of detection limit (i.e. MDL, IDL, etc.).	Text	10
14	RetentionTime	The time expressed in decimal minutes between injection and detection for GC/MS TICs only.	Text	5
15	AnalyteType	Defines the type of result such as surrogate, spike, or target analyte.	Text	7
16	PercentRecovery	The percent recovery of a spiked QC compound such as a matrix spike, LCS spike, or surrogate.	Text	5
17	RelativePercentDifference	RPD between to QC results such as MS/MSD.	Number	Single
18	ReportingLimit	Analyte reporting limit.	Text	10
19	ReportingLimitType	Defines the type of reporting limit (PQL, CRQL, etc.).	Text	10
20	ReportableResult	(YES or NO) Indicates which result is the useable result when results from two or more analyses for the same sample and method (ie dilutions, reanalyses, etc) are reported in the EDD.	Text	3
21	**Filename**	File name of the EDD. The same as the LabReportingBatch in the Sample Analysis table (A3).	Text	12
22	**DVModifiedConcentration**	ADR modified analyte result due to blank contamination.	Text	10
23	**DVQualTemperature**	Data review qualifier for temperature outlier.	Text	5
24	**DVQualPreservation**	Data review qualifier for preservation anomaly.	Text	5
25	**DVQualHTSamplingToAnalysis**	Data review qualifier for holding time violation from sampling time to analysis time.	Text	5
26	**DVQualHTSamplingToExtraction**	Data review qualifier for holding time violation from sampling time to extraction.	Text	5
27	**DVQualHTExtractionToAnalysis**	Data review qualifier for holding time violation from extraction time to analysis time.	Text	5
28	**DVQualHoldingTime**	Overall data review qualifier for holding time violation.	Text	5
29	**DVQualMethodBlanks**	Data review qualifier for contamination in an associated method blank.	Text	5
30	**DVQualSurrogateRecovery**	Data review qualifier for surrogate recovery outlier.	Text	5
31	**DVQualMS**	Overall data review qualifier for associated MS and MSD recovery and/or RPD outlier.	Text	5
32	**DVQualMSRecovery**	Data review qualifier for MS and/or MSD	Text	5

Post Review EDD Export Specifications - Analytical Results (A1) Comma Delimited Text File				
Order	**Field Name***	**Field Description**	**Field Type**	**Field Length**
		recovery outlier.		
33	**DVQualMSRPD**	Data review qualifier for MS/MSD RPD .outlier.	Text	5
34	**DVQualLCS**	Overall data review qualifier for LCS and LCS recovery and/or RPD outlier.	Text	5
35	**DVQualLCSRecovery**	Data review qualifier for associated LCS and/or LCSD recovery outlier.	Text	5
36	**DVQualLCSRPD**	Data review qualifier for LCS/LCSD RPD outlier.	Text	5
37	**DVQualRepLimits**	Data review qualifier for result reported below the reporting limit.	Text	5
38	**DVQualReportingLimits**	Data review comment ("OutX") when reporting limit exceeds the project reporting limit.	Text	5
39	**DVQualFieldQC**	Overall data review qualifier for Field QC.	Text	5
40	**DVQualFieldBlank**	Data review qualifier for contamination in an associated Field Blank.	Text	5
41	**DVQualEquipmentBlank**	Data review qualifier for contamination in an associated Equipment Rinsate or Equipment Blank.	Text	5
42	**DVQualTripBlank**	Data review qualifier for contamination in an associated Trip Blank.	Text	5
43	**DVQualFieldDuplicate**	Data review qualifier for an associated Field Duplicate RPD outlier.	Text	5
44	**DVQualIC**	Overall data review qualifier for associated initial calibration outliers.	Text	5
45	**DVQualInitialCalibrationRRF**	Data review qualifier for an associated initial calibration relative response factor outlier.	Text	5
46	**DVQualInitialCalibrationRSD**	Data review qualifier for an associated initial calibration relative percent difference outlier.	Text	5
47	**DVQualInitialCalibrationCC**	Data review qualifier for an associated initial calibration corrrelation coefficient outlier.	Text	5
48	**DVQualICV**	Overall data review qualifier for an associated initial calibration verification.	Text	5
49	**DVQualInitialCalibration VerificationRRF**	Data review qualifier for an associated initial calibration verification relative response factor outlier.	Text	5
50	**DVQualInitialCalibration VerificationPD**	Data review qualifier for an associated initial calibration verification percent difference outlier.	Text	5
51	**DVQualCCV**	Overall data review qualifier for associated continuing calibration outliers.	Text	5
52	**DVQualContinuingCalibration VerificationRRF**	Data review qualifier for an associated continuing calibration relative response factor outlier.	Text	5
53	**DVQualContinuingCalibration VerificationPD**	Data review qualifier for an associated continuing calibration percent difference outlier.	Text	5
54	**DVQualOverall**	Overall data review qualifier for all QC and calibration qualifiers.	Text	7
55	**TagLabSampleID (see comment)**	Temporary placeholder.	Text	5
56	**TagDetQual01 (see comment)**	Temporary placeholder.	Text	5
57	**TagNonDetQual01 (see comment)**	Temporary placeholder.	Text	5
58	**TagDetQual02 (see comment)**	Temporary placeholder.	Text	5
59	**TagNonDetQual02 (see comment)**	Temporary placeholder.	Text	5
60	**surDVQualDet (see comment)**	Temporary placeholder.	Text	5
61	**surDVQualNonDet (see comment)**	Temporary placeholder	Text	5
62	**DVQualInstrumentPerformance CheckRunBatch**	Data review qualifier for GC/MS Tune outlier related to initial calibration.	Text	5
63	**DVQualInstrumentPerformance CheckAnaBatch**	Data review qualifier for GC/MS Tune outlier related to continuing calibration.	Text	5
64	**DVQualIPC**	Overall data review qualifier for GC/MS tune	Text	5

Post Review EDD Export Specifications - Analytical Results (A1) Comma Delimited Text File				
Order	**Field Name***	**Field Description**	**Field Type**	**Field Length**
		outliers.		
65	**DVQualLabDup**	Data review qualifier for RPD outlier in laboratory duplicate.	Text	5
66	**DVQualCode**	User-defined Reason Code	Text	15
67	**FieldDupRPD**	RPD calculated from Field duplicate and parent sample	Text	50
68	**DVQualMergedQualifier**	Merged lab and data review qualifiers	Text	7
69	**DVQualMergedResult**	Final result (modified concentration if applicable)	Text	10
70	**DVQualPercMoi**[1]	Data review qualifier for percent moisture	Text	5
71	**DVQualLabDupNR**[1]	Data review qualifier for laboratory duplicate not reported	Text	5
72	**DVQualLcsNR**[1]	Data review qualifier for laboratory control sample(s) not reported	Text	5
73	**DVQualDissTotDiff**[1]	Data review qualifier for dissolved and total fraction differing by more than 10%	Text	5
74	**Error**	Radiochemistry error	Text	10
75	**DVQualSampleDupCount**[1]	Data review qualifier for sample count being >20 in a duplicate batch	Text	5
76	**DVQualMsSampleCoun**[1]**t**	Data review qualifier for sample count being >20 in a matrix spike batch	Text	5
77	**DVQualLcsCount**[1]	Data review qualifier for sample count being >20 in a laboratory control sample batch	Text	5
78	**DVQualMbMissing**[1]	Data review for missing method blank	Text	5
79	**DVQualPercMoiDissTotDiff**[1]	Combined data review qualifier for percent moisture and total vs dissolved difference outliers	Text	5
80	**DVQualInternalStandard**[2]	Data review qualifier for internal standard outlier	Text	5
81	**DVQualCalibrationBlank**[2]	Data review qualifier for calibration blank contamination	Text	5
82	**DVQualRcm**[2]	Data review qualifier for resolution check mixture problem	Text	5
83	**DVQualPem**[2]	Data review qualifier for performance evaluation mixture problem	Text	5
84	**DVQualProfessionalJudgement**[2]	Data review qualifier for any reason deemed necessary by data-review chemist	Text	5
85	**DVQualTempManual**	Temporary placeholder.	Text	5

Comment: Fields that contain temporary placeholders hold information contributed during the review process that is used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the review module.

* Field Names in bold font are added to the EDD during review and included in the exported validated EDD file

1 Data review qualifiers in these cases are added as applicable by automated data review if the option for EPA Region II assessment is selected..

2 Data review qualifiers in these cases are added manually by the user and not assessed by automated data review.

Post Review EDD Export Specifications – Sample Analysis (A3)
Comma Delimited Text File

Order	Field Name*	Field Description	Field Type	Field Length
1	RecordID	Record number.	Number	Single
2	ProjectNumber	ProjectNumber assigned by client.	Text	30
3	ProjectName	ProjectName assigned by client.	Text	90
4	ClientSampleID	Client field sample identifier.	Text	25
5	Collected	Date and time sample was collected.	Date/Time	***
6	MatrixID	Sample matrix.	Text	10
7	LabSampleID	Internal laboratory sample tracking number for samples and lab generated QC.	Text	25
8	QCType	Identifies the type of quality control sample, regular field samples are null.	Text	7
9	ShippingBatchID	Unique identifier assigned to a cooler or shipping container used to transport field samples.	Text	25
10	Temperature	Temperature in degrees C of the samples as received in the lab.	Number	Single
11	LabAnalysisRefMethodID	Laboratory reference method (i.e. 8260B, 6010B, etc.).	Text	25
12	**PreparationType**	Preparation method number (i.e. 3010A, 3510C, etc.).	Text	25
13	**AnalysisType**	Defines type of analysis (i.e. dilution, reanalysis, etc.).	Text	10
14	**Prepared**	Date and time of sample preparation/extraction.	Date/Time	***
15	**Analyzed**	Date and time of sample analysis.	Date/Time	***
16	**LabID**	Identifier of laboratory performing analysis.	Text	7
17	**QCLevel**	Level of analytical QC associated with analysis (i.e. Level III, etc.).	Text	10
18	**ResultBasis**	Indicates if a result is expressed as wet or dry.	Text	3
19	**TotalorDissolved**	Indicates if a result is expressed as total or dissolved (for metals only).	Text	3
20	**Dilution**	Sample dilution during analysis.	Number	Single
21	**HandlingType**	Type of leaching procedure, if applicable (i.e. SPLP, TCLP, etc.).	Text	10
22	**HandlingBatch**	Unique laboratory identifier for a batch of samples prepared together for a leaching procedure.	Text	12
23	**LeachateDate**	Date and time of leaching procedure.	Date/Time	***
24	**PercentMoisture**	Percent moisture of sample.	Number	Single
25	**MethodBatch**	Unique laboratory identifier for a batch of samples with similar matrix and analyzed together by one method. Links samples to matrix spikes and duplicates.	Text	12
26	**PreparationBatch**	Unique laboratory identifier for a batch of samples prepared together for analysis by one method. Links samples with method blanks and laboratory control samples.	Text	12
27	**RunBatch**	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of on an initial calibration. Links the initial calibration to associated samples.	Text	12
28	**AnalysisBatch**	Unique laboratory identifier for a batch of analyses performed on one instrument under the control of a continuing calibration. Links continuing calibrations to associated samples.	Text	12
29	**LabReportingBatch**	Unique laboratory identifier for a batch of samples, QC, and calibration standards reported as a group by the lab (i.e. order number, SDG #, etc.).	Text	12
30	**LabReceipt**	Date samples received in laboratory.	Date/Time	***
31	**LabReported**	Date laboratory hardcopy submitted.	Date/Time	***
32	DataReviewCompany**	Company running the automated review software.	Text	25
33	DataReviewDate	Date and time EDD was validated.	Date/Time	***
34	ValidatedBy**	Person running the automated review.	Text	25
35	ValidationDate**	Date and time when automated data review qualifiers were reviewed	Date/Time	***

Post Review EDD Export Specifications – Sample Analysis (A3) Comma Delimited Text File				
Order	**Field Name***	**Field Description**	**Field Type**	**Field Length**
36	ApprovedBy**	Person performing secondary review of data review flags.	Text	25
37	ApprovalDate**	Date and time of secondary review by "ApprovedBy".	Date/Time	***
38	FileName	File name of EDD (same as LabReportingBatch).	Text	12
39	TagLabSampleID (see comment)	Temporary place holder.	Text	5
40	TagDetQual (see comment)	Temporary place holder.	Text	5
41	TagNonDetQual (see comment)	Temporary place holder.	Text	5
42	TempFlag (see comment)	Temporary place holder.	Text	1
43	LabMethodCategory	Method category used on import into EDMS	Text	10

Comment: Fields that contain temporary placeholders hold values created during the validation process. These values are used in generating reports. This information is kept with the output file so that if the file is ever imported back into the application, reports can be generated without having to rerun the validation module.

* Field Names in bold font are added to the EDD during automated data review and included in the exported data-reviewed EDD file

**Automated data review does not update these fields with any information but these fields are still part of the exported data-reviewed file. These fields may be populated manually by the user from various forms in the application prior to exporting.

*** Date/Time format: MM/DD/YYYY hh:mm

Appendix F

Technical Notes

Identifying Variations of a Method

The "LabAnalysisRefMethodID" field may be used to identify variations of a method in both the EDD and project library. To do this, place a "/" between the method and the identifier for the method (eg. 8260B/NoDCP, 8260B/ListA, 8260B/ShortList, etc.). The method designation must be consistent between the Analytical Results (A1) Table, the Laboratory Instrument (A2) Table, and the Sample Analysis (A3) Table as well as in the Project library. The maximum width for the "LabAnalysisRefMethodID" field, including the "/" separator, is 25 characters. Note: Prior to building a project library, the Analytical Methods standard value list must be appended with the Method/Descriptor combinations used in the EDD.

Identifying "Total" and "Dissolved" Results (Aqueous Metals Analyses Only)

The "Total_Or_Dissolved" field in the A3 table is used to identify at the sample and method level whether a set of results is being reported as "total" metals or "dissolved" metals. Similarly, the "Analysis_Type" field (in both the A1 and A3 tables) will be used to designate at the parameter level whether an individual result is a "total" result or "dissolved" result. To designate a result as a "total" or "dissolved" result, place a "/TOT" or "/DIS" immediately after the analysis type designation (eg. RES/TOT, RES/DIS, DL/TOT, DL/DIS, etc). The designation must be consistent between the A1 and A3 tables. The maximum width for the "Analysis_Type" field, including the "/" separator, is 10 characters. Note: Prior to performing an EDD error check, the Analysis Type valid value list must be appended with Analysis Type designations (See Table 1).

Reporting Results Derived from a Leachate Procedure

When a leachate procedure (eg TCLP, WET, SPLP, etc) is performed, the "Analysis_Type" field (in both the A1 and A3 tables) will be used to designate the results as being associated with a leachate procedure. To designate a result as a leachate result, place a "/" along with the initials of the leaching procedure immediately after the analysis type designation (eg. RES/TCLP, RES/WET, DL/SPLP, etc). The designation must be consistent between the A1 and A3 tables as well as in the project library. The maximum width for the "Analysis_Type" field, including the "/" separator, is 10 characters. Note: Prior to performing an EDD error check, the Analysis Type valid value list must be appended with Analysis Type designations (See Table 1).

Table 1: Standard Values to Add to "Analysis Type" SVL Library

SVLs for Total and Dissolved Metals Analyses	SVLs for TCLP Analyses	SVLs for WET Analyses	SVLs for SPLP Analyses
RES/TOT	RES/TCLP	RES/WET	RES/SPLP
RES/DIS	DL/TCLP	DL/WET	DL/SPLP
RE/TOT	DL2/TCLP	DL2/WET	DL2/SPLP
RE/DIS	RE/TCLP	RE/WET	RE/SPLP
	RE2/TCLP	RE2/WET	RE2/SPLP

Preparing Project Libraries

When preparing a project library, a copy-up and copy-down feature is available that allows entries within a field to be copied from one record to the next. (To use the copy feature, hold the shift key while using either a up or down arrow to copy from a record containing a value to an adjacent record to be populated).

Naming Convention for Lab Duplicate, MS/MSD Samples

Lab duplicate, matrix spike and matrix spike duplicate samples are now associated with their parent sample via the Client Sample ID (versus the Lab Sample ID in earlier versions of the software). In order for the correct association to be made, it is crucial the Client Sample ID adhere to the EDD specifications. Append suffixes DUP, MS and MSD, without an intervening hyphen or space, to the Client Sample ID of the parent sample in order to create the Client Sample ID for the laboratory duplicate, matrix spike, and matrix spike duplicate, respectively. For example, if the parent Client Sample ID is 98100001, the laboratory duplicate would appear with a Client Sample ID of 9810001DUP, the matrix spike sample would appear with a Client Sample ID of 9810001MS, and the matrix spike duplicate would appear with a Client Sample ID of 9810001MSD. Parent sample records must exist for each DUP, MS and MSD record. If a DUP or MS/MSD is shared between two EDDs, records for the DUP or MS/MSD and its parent sample must exist in the A1 and A3 tables for both EDDs. Note: If an end data user specifies that all samples in the method batch will be associated with these QC samples, the Client Sample ID naming convention is not crucial since all samples will be linked to the DUP, MS or MSD via the Method Batch number.

Methods with Parameter-Specific Holding Times

Although infrequent, there are methods where the holding time criteria is not consistent between analytes (ie Method 300). The "LabAnalysisRefMethodID" field may be used in both the EDD and project library to identify those methods with parameter-specific holding times. To do this, place a "/" between the method and the specific parameter(s) (eg. 300.0/NO3, 300.0/AllExceptNO3, etc.). The method designation must be consistent between all tables (A1, A2 and A3) as well as in the Project library. The maximum width for the "LabAnalysisRefMethodID" field, including the"/" separator, is 25 characters. Note: Prior to building a project library, the Analytical Methods standard value list must be appended with the Method/Descriptor combinations used in the EDD.

Applying Preparation Date for Solids (TS, TSS, TDS)

When a solids analysis (total solids, total suspended solids or total dissolved solids) is performed, the preparation date field should be populated with the date the sample aliquot was measured. The preparation method should be indicated as METHOD.

How to Handle Multiple Analysis Dates for a Single Method (ie 6010B Analytes)

If the results for a sample/method are composited from more than one analysis date and/or time and the Analysis Type is the same (ie RES), the records in both the A1 and A3 files must be distinguished using unique Analysis Type entries (RES1, RES2, RES3, etc). For example, if some parameters from a 6010B analysis were performed on one day and others were performed on a different day, those parameters associated with the first analysis date should be assigned an Analysis Type RES1 and those from the second analysis date should be assigned an Analysis Type of RES2. The Analysis Type valid value list must be appended with the new valid values to avoid errors appearing on the EDD Non-conformance Report.

Reanalysis of Method Blanks and Laboratory Control Samples

If a method blank and/or laboratory control sample are re-analyzed, the re-analysis results must have a Preparation Batch identifier different from that assigned to the initial results, regardless of how the Analysis Type field has been populated.

Reanalysis of Matrix Spike, MS Duplicate and Laboratory Duplicate Samples

If a matrix spike (MS), matrix spike duplicate (MSD) and/or laboratory duplicate (DUP) are re-analyzed, the re-analysis results must have a Method Batch identifier different from that assigned to the initial results, regardless of how the Analysis Type field has been populated.

Assignment of Reason Codes for Field Duplicate Outliers

Although validation qualifiers are not assigned when the RPD of a set of field duplicates exceeds the project library limits, a reason code will be assigned if the user has selected "Assign Reason Codes" at the time of validation and the field duplicate field has been populated in the Reason Code Library. A reason code alerts the user that the field duplicate RPD criteria has been exceeded so they may determine whether a qualifier is warranted. Users who do not wish to assign a reason code should not enter a reason code format in the Field Duplicate field of the Reason Code Library.

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ATTACHMENT E
SUBCONTRACTOR LABORATORY ACCREDITATIONS

Provided on CD

State of Utah
JON HUNTSMAN Jr.
Governor
GARY HERBERT
Lieutenant Governor

Utah Department of Health
David N. Sundwall, MD
Executive Director

Epidemiology and Laboratory Services
Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories

Bureau of Laboratory Improvement
David B Mendenhall, MPA, MT (ASCP)
Bureau Director

NELAP
Recognized

STATE OF UTAH
DEPARTMENT OF HEALTH

ENVIRONMENTAL LABORATORY CERTIFICATION PROGRAM

CERTIFICATION

is hereby granted to

ALS Laboratory Group, Environmental Division (Salt Lake City, UT)

960 West Levoy Drive
Salt Lake City UT 84123

Scope of accreditiation is limited to the
State of Utah Accredited Fields of Accreditiation
Which accompanies this Certificate

Continued accredited status depends on successful
Ongoing particitpation in the program

EPA Number: UT00009
Expiration Date: 11/30/2009

Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories
Deputy Director of Epidemiology and Laboratory Services

Utah Department of Health
David N. Sundwall, MD
Executive Director

Epidemiology and Laboratory Services
Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories

Bureau of Laboratory Improvement
David B Mendenhall, MPA, MT (ASCP)
Bureau Director

State of Utah
JON HUNTSMAN Jr.
Governor
GARY HERBERT
Lieutenant Governor

NELAP Recognized

11/25/2008

ALS Laboratory Group, Environmental Division (Salt Lake City, UT)
Brent E Stephens
960 West Levoy Drive
Salt Lake City UT 84123

ID # DATA1
EPA ID: UT00009

Director,

On the basis of your most recent assessment, Proficiency Testing results and continuing compliance with the ELCP requirements, the laboratory listed is certified for environmental monitoring under the Clean Water Act and authorized to perform the following methods, for the analytes and matrix listed:

Non-Potable Water

Inorganics and Metals

120.1 [1982]	Conductance (Specific Conductance, umhos at 25-C)
150.1 [1982]	pH (Electometric)
160.1 [1971]	Residue, Filterable (Gravimetric, Dried at 180-C)
160.2 [1971]	Residue, Non-Filterable (Gravimetric, Dried at 103-105-C)
1664 A [1999]	Oil & Grease and Total Petroleum Hydrocarbons
200.7 [1998]	Aluminum
200.7 [1998]	Antimony
200.7 [1998]	Arsenic
200.7 [1998]	Barium
200.7 [1998]	Beryllium
200.7 [1998]	Boron
200.7 [1998]	Cadmium
200.7 [1998]	Calcium
200.7 [1998]	Chromium, Total
200.7 [1998]	Cobalt
200.7 [1998]	Copper
200.7 [1998]	Iron
200.7 [1998]	Lead
200.7 [1998]	Magnesium
200.7 [1998]	Manganese
200.7 [1998]	Molybdenum
200.7 [1998]	Nickel
200.7 [1998]	Potassium
200.7 [1998]	Selenium
200.7 [1998]	Silver
200.7 [1998]	Sodium
200.7 [1998]	Strontium
200.7 [1998]	Thallium
200.7 [1998]	Tin
200.7 [1998]	Titanium

The expiration for the laboratory's certification is 11/30/2009. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data users to verify the most current certification letter for the authorized method. For further assistance please call 801-538-9370.

Inorganics and Metals

200.7 [1998]	Vanadium
200.7 [1998]	Zinc
200.8 [1998]	Aluminum
200.8 [1998]	Antimony
200.8 [1998]	Arsenic
200.8 [1998]	Barium
200.8 [1998]	Beryllium
200.8 [1998]	Cadmium
200.8 [1998]	Chromium
200.8 [1998]	Cobalt
200.8 [1998]	Copper
200.8 [1998]	Iron
200.8 [1998]	Lead
200.8 [1998]	Manganese
200.8 [1998]	Molybdenum
200.8 [1998]	Nickel
200.8 [1998]	Selenium
200.8 [1998]	Silver
200.8 [1998]	Strontium
200.8 [1998]	Thallium
200.8 [1998]	Tin
200.8 [1998]	Vanadium
200.8 [1998]	Zinc
2320 B [20th ED]	Alkalinity (Titration) [SM 20th ED]
2340 B [20th ED]	Hardness (Calculation) [SM 20th ED]
245.1 [1994]	Mercury
2540 C [20th ED]	Total Dissolved Solids Dried at 180-C [SM 20th ED]
2540 D [20th ED]	Total Suspended Solids Dried at 103-105-C [SM 20th ED]
300.0	Bromide
300.0	Chloride
300.0	Fluoride
300.0	Nitrate
300.0	Nitrite
300.0	ortho-Phosphate
300.0	Sulfate
310.1 [1978]	Alkalinity
310.2 [1974]	Alkalinity
335.4 [1993]	Cyanide, Total
340.2 [1974]	Fluoride
350.1 [1993]	Nitrogen, Ammonia
351.2 [1978]	Nitrogen, Total Kjeldahl
353.2 [1993]	Nitrogen, Nitrate-Nitrite
365.1 [1993]	Ortho-Phosphate
365.4 [1974]	Phosphorous, Total
415.1 [1974]	Organic Carbon, Total
420.4 [1993]	Phenolics, Total
4500 (F-) C [20th	Fluoride (Ion-Selective Electrode) [SM 20th ED]
4500 (H+) B [20t	pH (Electrometric) [SM 20th ED]
HACH 8000	Chemical Oxygen Demand (COD)

Solid & Chemical Materials

Inorganics and Metals

Sludge	Inorganic Pollutants

The effective date of this certificate letter is: 12/1/2008.

The analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. It is the certified laboratory's responsibility to review this letter for discrepancies. The certified laboratory must document any discrepancies in this letter and send notice to this bureau within 15 days of receipt. This certificate letter will be recalled in the event your laboratory's certification is revoked.

Respectfully,

Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories
Deputy Director of Epidemiology and Laboratory

Utah Department of Health
David N. Sundwall, MD
Executive Director

Epidemiology and Laboratory Services
Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories

Bureau of Laboratory Improvement
David B Mendenhall, MPA, MT (ASCP)
Bureau Director

State of Utah
JON HUNTSMAN Jr.
Governor
GARY HERBERT
Lieutenant Governor

NELAP Recognized

2/5/2009

ALS Laboratory Group, Environmental Division (Salt Lake City,
Brent E Stephens
960 West Levoy Drive
Salt Lake City UT 84123

ID # DATA1
EPA ID: UT00009

Director,

On the basis of your most recent assessment, Proficiency Testing results and continuing compliance with the ELCP requirements, the laboratory listed is certified for environmental monitoring under the Resource Conservation and Recovery Act and authorized to perform the following methods, for the analytes and matrix listed:

Characteristics

	Solid	Non-Potable Water	
1010	☑	☑	Ignitability
1110	☑	☑	Corrosivity Toward Steel
1311	☑	☑	Toxicity Characteristic Leaching Procedure Metals
1311	☑	☑	Toxicity Characteristic Leaching Procedure Semi-Volatiles
1311	☑	☑	Toxicity Characteristic Leaching Procedure Volatiles
1312	☑	☑	Synthetic Precipitation Leaching Procedure (TCLP Approval)
Sec 7.3.3	☑	☐	Reactive Cyanide
Sec 7.3.4	☑	☐	Reactive Sulfide
Sec 8.3	☑	☑	Reactivity

Inorganics

	Solid	Non-Potable Water	
1664 A	☐	☑	Oil & Grease
1664A	☐	☑	Total Petroleum Hydrocarbons
6850	☑	☑	Perchlorate
9012 A	☑	☑	Total and Amenable Cyanide
9034	☑	☑	Acid-Soluble and Acid-Insoluble Sulfides
9040 B	☐	☑	pH
9045 C	☑	☐	Soil and Waste pH
9050	☐	☑	Specific Conductance
9060	☐	☑	Total Organic Carbon
9066	☐	☑	Phenolics
9081	☑	☐	Cation-Exchange Capacity of Soil (Sodium Acetate)
9095	☑	☐	Paint Filter Liquids Test

The expiration for the laboratory's certification is 11/30/2009. The Utah Environmental Laboratory Certification Program (ELCP) encourages clients and data users to verify the most current certification letter for the authorized method. For further assistance please call 801-538-9370.

Metal Digestion

	Solid	Non-Potable Water	
3005 A	☐	☑	Acid Digestion Total Recoverable or Dissolved Metals
3010 A	☐	☑	Acid Digestion for Total Metals
3015 A	☐	☑	Microwave Acid Digestion of Aqueous Samples and Extracts
3050 A	☑	☐	Acid Digestion of Sediments, Sludges and Soils
3051 A	☑	☐	Microwave Acid Digestion of Sediment, Sludges, Soils & Oils
3060 A	☑	☐	Alkaline Digestion for Hexavalent Chromium

Metals

	Solid	Non-Potable Water	
6010 B	☑	☑	Aluminum
6010 B	☑	☑	Antimony
6010 B	☑	☑	Arsenic
6010 B	☑	☑	Barium
6010 B	☑	☑	Beryllium
6010 B	☑	☑	Cadmium
6010 B	☑	☑	Calcium
6010 B	☑	☑	Chromium
6010 B	☑	☑	Cobalt
6010 B	☑	☑	Copper
6010 B	☑	☑	Iron
6010 B	☑	☑	Lead
6010 B	☑	☑	Magnesium
6010 B	☑	☑	Manganese
6010 B	☑	☑	Molybdenum
6010 B	☑	☑	Nickel
6010 B	☑	☑	Potassium
6010 B	☑	☑	Selenium
6010 B	☑	☑	Silver
6010 B	☑	☑	Sodium
6010 B	☑	☑	Strontium
6010 B	☑	☑	Thallium
6010 B	☑	☑	Tin
6010 B	☑	☑	Titanium
6010 B	☑	☑	Vanadium
6010 B	☑	☑	Zinc
6020 A	☑	☑	Aluminum
6020 A	☑	☑	Antimony
6020 A	☑	☑	Arsenic
6020 A	☑	☑	Barium
6020 A	☑	☑	Beryllium
6020 A	☑	☑	Cadmium
6020 A	☑	☑	Chromium
6020 A	☑	☑	Cobalt
6020 A	☑	☑	Copper
6020 A	☑	☑	Lead
6020 A	☑	☑	Manganese
6020 A	☑	☑	Molybdenum
6020 A	☑	☑	Nickel
6020 A	☑	☑	Selenium
6020 A	☑	☑	Silver

Metals

	Solid	Non-Potable Water	
6020 A	☑	☑	Thallium
6020 A	☑	☑	Tin
6020 A	☑	☑	Vanadium
6020 A	☑	☑	Zinc
7196 A	☑	☑	Chromium, Hexavalent (Chromium, VI)
7470 A	☐	☑	Mercury
7471 A	☑	☐	Mercury

Miscellaneous

	Solid	Non-Potable Water	
7580	☑	☑	White Phosphorus (P4)

Organic Cleanup

	Solid	Non-Potable Water	
3640	☑	☑	Gel Permeation Cleanup

Organic Extraction

	Solid	Non-Potable Water	
3510 C	☐	☑	Separatory Funnel Liquid-Liquid Extractions
3520 C	☐	☑	Continuous Liquid-Liquid Extraction
3540	☑	☐	Soxhlet Extraction
3550 A	☑	☐	Ultrasonic Extraction
3580	☑	☐	Waste Dilution
3810	☑	☑	Headspace

Organic Instrumentation

	Solid	Non-Potable Water	
8015 B	☑	☑	Diesel Range Organics (DROs)
8015 B	☑	☑	Nonhalogenated Organics Using GC/FID
8081 A	☑	☑	4,4'-DDD
8081 A	☑	☑	4,4'-DDE
8081 A	☑	☑	4,4'-DDT
8081 A	☑	☑	Aldrin
8081 A	☑	☑	alpha-BHC(alpha-hexachlorocyclohexane)
8081 A	☑	☑	alpha-Chlordane
8081 A	☑	☑	beta-BHC(beta-hexachlorocyclohexane)
8081 A	☑	☑	Chlordane - not otherwise specified
8081 A	☑	☑	Chlordane, total
8081 A	☑	☑	delta-BHC(delta-hexachlorocyclohexane)
8081 A	☑	☑	Dieldrin
8081 A	☑	☑	Endosulfan I
8081 A	☑	☑	Endosulfan II
8081 A	☑	☑	Endosulfan sulfate
8081 A	☑	☑	Endrin
8081 A	☑	☑	Endrin Aldehyde
8081 A	☑	☑	Endrin Ketone
8081 A	☑	☑	gamma-BHC (Lindane, gamma-hexachlorocyclohexane)
8081 A	☑	☑	gamma-Chlordane

Organic Instrumentation

	Solid	Non-Potable Water	
8081 A	☑	☑	Heptachlor
8081 A	☑	☑	Heptachlor Epoxide
8081 A	☑	☑	Methoxychlor
8081 A	☑	☑	Organochlorine Pesticides
8081 A	☑	☑	Toxaphene [Chlorinated camphene]
8082	☑	☑	Aroclor-1016 [PCB-1016]
8082	☑	☑	Aroclor-1221 PCB-1221]
8082	☑	☑	Aroclor-1232 [PCB-1232]
8082	☑	☑	Aroclor-1242 [PCB-1242]
8082	☑	☑	Aroclor-1248 [PCB-1248]
8082	☑	☑	Aroclor-1254 [PCB-1254]
8082	☑	☑	Aroclor-1260 [PCB-1260]
8082	☑	☑	PCBs
8151 A	☐	☐	2,4,5-T
8151 A	☑	☐	2,4,5-TP (Silvex)
8151 A	☑	☐	2,4-D
8151 A	☑	☐	2,4-DB
8151 A	☑	☐	Chlorinated Herbicides
8151 A	☑	☐	Dalapon
8151 A	☑	☐	Dichlorprop(Dichloroprop)
8151 A	☑	☐	Dinoseb (DNBP, 2-sec-butyl-4,6-dinitrophenol)
8151 A	☑	☐	MCPA
8151 A	☑	☐	MCPP
8151 A	☐	☐	Pentachlorophenol
8260 B	☑	☑	Gasoline Range Organics (GROs)
8260 C	☑	☑	1,1,1,2-Tetrachloroethane
8260 C	☑	☑	1,1,1-Trichloroethane
8260 C	☑	☑	1,1,2,2-Tetrachloroethane
8260 C	☑	☑	1,1,2-Trichloroethane
8260 C	☑	☑	1,1-Dichloroethane
8260 C	☑	☑	1,1-Dichloroethylene (-ethene)
8260 C	☑	☑	1,2,3-Trichloropropane
8260 C	☑	☑	1,2,4-Trichlorobenzene
8260 C	☑	☑	1,2-Dibromo-3-chloropropane (DBCP, Dibromochloropropane)
8260 C	☑	☑	1,2-Dibromoethane (EDB, Ethylene dibromide)
8260 C	☑	☑	1,2-Dichlorobenzene
8260 C	☑	☑	1,2-Dichloroethane
8260 C	☑	☑	1,2-Dichloropropane
8260 C	☑	☑	1,3-Dichlorobenzene
8260 C	☑	☑	1,4-Dichlorobenzene
8260 C	☑	☑	2-Hexanone
8260 C	☑	☑	4-Methyl-2-pentanone (MIBK, Isopropylacetone, Hexone)
8260 C	☑	☑	Acetone
8260 C	☑	☑	Benzene
8260 C	☑	☑	Bromochloromethane
8260 C	☑	☑	Bromodichloromethane
8260 C	☑	☑	Bromoform
8260 C	☑	☑	Carbon Disulfide
8260 C	☑	☑	Carbon Tetrachloride
8260 C	☑	☑	Chlorobenzene
8260 C	☑	☑	Chloroethane

Organic Instrumentation

	Solid	Non-Potable Water	
8260 C	☑	☑	Chloroform
8260 C	☑	☑	cis-1,3-dichloropropene
8260 C	☑	☑	Dibromomethane
8260 C	☑	☑	Dichlorodifluoromethane
8260 C	☑	☑	Dichloromethane (DCM, Methylene chloride)
8260 C	☑	☑	Diethyl Ether
8260 C	☑	☑	Ethyl Acetate
8260 C	☑	☑	Ethyl Methacrylate
8260 C	☑	☑	Ethylbenzene
8260 C	☑	☑	Hexachlorobutadiene
8260 C	☑	☑	Isopropylbenzene
8260 C	☑	☑	meta-Xylene
8260 C	☑	☑	Methyl bromide [Bromomethane]
8260 C	☑	☑	Methyl chloride [Chloromethane]
8260 C	☑	☑	Methyl Ethyl Ketone (MEK, 2-Butanone)
8260 C	☑	☑	Methyl-t-Butyl Ether (MTBE)
8260 C	☑	☑	Naphthalene
8260 C	☑	☑	ortho-Xylene
8260 C	☑	☑	para-Xylene
8260 C	☑	☑	Styrene
8260 C	☑	☑	Tetrachloroethylene (Perchloroethylene -ethene)
8260 C	☑	☑	Toluene
8260 C	☑	☑	trans-1,2-Dichloroethylene (-ethene)
8260 C	☑	☑	trans-1,3-Dichloropropylene (-propene)
8260 C	☑	☑	Trichloroethene (Trichloroethylene)
8260 C	☑	☑	Trichlorofluoromethane
8260 C	☑	☑	Vinyl Chloride
8260 C	☑	☑	Volatile Organic Compounds
8270 D	☑	☑	1,2,4-Trichlorobenzene
8270 D	☑	☑	1,2-Dichlorobenzene
8270 D	☑	☑	1,3-Dichlorobenzene
8270 D	☑	☑	1,4-Dichlorobenzene
8270 D	☑	☑	2,4,5-Trimethylaniline
8270 D	☑	☑	2,4,6-Trichlorophenol
8270 D	☑	☑	2,4-Dichlorophenol
8270 D	☑	☑	2,4-Dimethylphenol
8270 D	☑	☑	2,4-Dinitrophenol
8270 D	☑	☑	2,4-Dinitrotoluene (2,4-DNT)
8270 D	☑	☑	2,6-Dinitrotoluene (2,6-DNT)
8270 D	☑	☑	2-Chloronaphthalene
8270 D	☑	☑	2-Methyl-4,6-dinitrophenol (4,6-Dinitro-2-methylphenol)
8270 D	☑	☑	2-Methylphenol (o-cresol, 2-Hydroxytoluene)
8270 D	☑	☑	2-Nitroaniline
8270 D	☑	☑	2-Nitrophenol
8270 D	☑	☑	3,3'-Dichlorobenzidine
8270 D	☑	☑	3-Methylphenol (m-cresol, 3-Hydroxytoluene)
8270 D	☑	☑	3-Nitroaniline
8270 D	☑	☑	4-Chloro-3-methylphenol
8270 D	☑	☑	4-Methylphenol (p-cresol, 4-Hydroxytoluene)
8270 D	☑	☑	4-Nitroaniline
8270 D	☑	☑	4-Nitrophenol

Organic Instrumentation

	Solid	Non-Potable Water	
8270 D	☑	☑	Acenaphthene
8270 D	☑	☑	Acenaphthylene
8270 D	☑	☑	Anthracene
8270 D	☑	☑	Benzo(a)anthracene
8270 D	☑	☑	Benzo(a)pyrene
8270 D	☑	☑	Benzo(b)fluoranthene
8270 D	☑	☑	Benzo(g,h,i)perylene
8270 D	☑	☑	Benzo(k)fluoranthene
8270 D	☑	☑	Benzoic Acid
8270 D	☑	☑	bis(2-chloroethoxy)methane
8270 D	☑	☑	bis(2-Chloroethyl)ether
8270 D	☑	☑	bis(2-chloroisopropyl)ether
8270 D	☑	☑	bis(2-Ethylhexyl) phthalate (DEHP)
8270 D	☑	☑	Butyl Benzyl Phthalate
8270 D	☑	☑	Chrysene
8270 D	☑	☑	Diethyl Phthalate
8270 D	☑	☑	Dimethyl Phthalate
8270 D	☑	☑	Di-n-butyl phthalate
8270 D	☑	☑	Di-n-octyl Phthalate
8270 D	☑	☑	Fluoranthene
8270 D	☑	☑	Fluorene
8270 D	☑	☑	Hexachlorobenzene
8270 D	☑	☑	Hexachlorobutadiene
8270 D	☑	☑	Hexachlorocyclopentadiene
8270 D	☑	☑	Hexachloroethane
8270 D	☑	☑	Indeno(1,2,3-cd)pyrene
8270 D	☑	☑	Isophorone
8270 D	☑	☑	Naphthalene
8270 D	☑	☑	Nitrobenzene
8270 D	☑	☐	n-Nitrosodimethylamine
8270 D	☑	☑	n-Nitroso-di-n-Propylamine
8270 D	☑	☑	n-Nitrosodiphenylamine
8270 D	☑	☑	Pentachlorophenol
8270 D	☑	☑	Phenanthrene
8270 D	☑	☑	Phenol
8270 D	☑	☑	Pyrene
8270 D	☑	☑	Semivolatile Organic Compounds
8330	☑	☑	1,3,5-Trinitrobenzene (1,3,5-TNB)
8330	☑	☑	1,3-Dinitrobenzene (1,3-DNB)
8330	☑	☑	2,4,6-Trinitrotoluene (2,4,6-TNT)
8330	☑	☑	2,4-Dinitrotoluene (2,4-DNT)
8330	☑	☑	2,6-Dinitrotoluene (2,6-DNT)
8330	☑	☑	2-Amino-4,6-Dinitrotoluene (2-Am-DNT)
8330	☑	☑	2-Nitrotoluene (2-NT)
8330	☑	☑	3-Nitrotoluene (3-NT)
8330	☑	☑	4-Amino-2,6-Dinitrotoluene (4-Am-DNT)
8330	☑	☑	4-Nitrotoluene (4-NT)
8330	☑	☑	Hexahydro-1, 3, 5-tritro-1, 3, 5-triazine (RDX)
8330	☑	☑	Methyl-2,4,6-Trinitrophenylnitramine (TETRYL)
8330	☑	☑	Nitroaromatics and Nitramines
8330	☑	☑	Nitrobenzene

Organic Instrumentation

	Solid	Non-Potable Water	
8330	☑	☑	Nitroglycerin
8330	☑	☑	Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX)
8330	☑	☑	Pentaerythrite tetranitrate (PETN)
8332	☑	☑	Nitroglycerine
8332	☑	☑	Nitroglycerine By HPLC

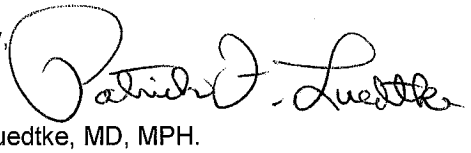
Volatile Organic Preparation

	Solid	Non-Potable Water	
5030	☑	☑	Purge-and-Trap for Aqueous Samples
5035	☑	☐	Purge-and-Trap and Extraction for Volatile Organics

The effective date of this certificate letter is: 2/12/2009.

The analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. It is the certified laboratory's responsibility to review this letter for discrepancies. The certified laboratory must document any discrepancies in this letter and send notice to this bureau within 15 days of receipt. This certificate letter will be recalled in the event your laboratory's certification is revoked.

Respectfully,



Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories
Deputy Director of Epidemiology and Laboratory

State of Utah
JON HUNTSMAN Jr.
Governor
GARY HERBERT
Lieutenant Governor

Utah Department of Health
David N. Sundwall, MD
Executive Director

Epidemiology and Laboratory Services
Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories

Bureau of Laboratory Improvement
David B Mendenhall, MPA, MT (ASCP)
Bureau Director

NELAP Recognized

2/5/2009

ALS Laboratory Group, Environmental Division (Salt Lake City,
Brent E Stephens
960 West Levoy Drive
Salt Lake City UT 84123

ID # DATA1
EPA ID: UT00009

Director,

On the basis of your most recent assessment, Proficiency Testing results and continuing compliance with the ELCP requirements, the laboratory listed is certified for environmental monitoring under the Safe Drinking Water Act and authorized to perform the following methods, for the analytes and matrix listed:

Drinking Water

Inorganics and Metals

120.1 [1982]	Conductivity
150.1 [1982]	pH
160.1 [1971]	Residue, Filterable
200.7 [1998]	Aluminum
200.7 [1998]	Antimony
200.7 [1998]	Arsenic
200.7 [1998]	Barium
200.7 [1998]	Beryllium
200.7 [1998]	Boron
200.7 [1998]	Cadmium
200.7 [1998]	Calcium
200.7 [1998]	Chromium
200.7 [1998]	Cobalt
200.7 [1998]	Iron
200.7 [1998]	Magnesium
200.7 [1998]	Manganese
200.7 [1998]	Molybdenum
200.7 [1998]	Nickel
200.7 [1998]	Potassium
200.7 [1998]	Selenium
200.7 [1998]	Silver
200.7 [1998]	Sodium
200.7 [1998]	Strontium
200.7 [1998]	Thallium
200.7 [1998]	Tin
200.7 [1998]	Titanium
200.7 [1998]	Vanadium
200.7 [1998]	Zinc
200.8 [1994]	Aluminum

Inorganics and Metals

200.8 [1994]	Antimony
200.8 [1994]	Arsenic
200.8 [1994]	Barium
200.8 [1994]	Beryllium
200.8 [1994]	Cadmium
200.8 [1994]	Chromium
200.8 [1994]	Manganese
200.8 [1994]	Nickel
200.8 [1994]	Selenium
200.8 [1994]	Silver
200.8 [1994]	Strontium
200.8 [1994]	Thallium
200.8 [1994]	Tin
200.8 [1994]	Vanadium
200.8 [1994]	Zinc
200.8 [1994]	Molybdenum
2320 B [20th ED]	Alkalinity - Titration Method [20th ED]
2340 B [20th ED]	Hardness by Calculation (CaCO3) [20th ED]
245.1 [1994]	Mercury
2540 C [20th ED]	Total Dissolved Solids [20th ED]
2540 D [20th ED]	Total Suspended Solids [20th ED]
300.0	Chloride
300.0	Fluoride
300.0	Ortho-Phosphate
310.1 [1978]	Alkalinity
335.4 [1993]	Cyanide
340.2 [1974]	Fluoride
350.1 [1993]	Ammonia as Nitrogen
365.1 [1993]	ortho-Phosphate as P
4500 (F-) C [20th	Fluoride by Ion-Selective Method [20th ED]
4500 (H+) B [20t	pH [20th ED]

Nitrate

300.0	Nitrate
353.3 [1974]	Nitrate/Nitrite

Nitrite

300.0	Nitrite

Organics

524.2 [1995]	Purgeable Organic Compounds In Water
524.2 [1995]	Benzene
524.2 [1995]	Bromobenzene
524.2 [1995]	Bromochloromethane
524.2 [1995]	Bromodichloromethane [Dichlorobromomethane]
524.2 [1995]	Bromoform
524.2 [1995]	Bromomethane [Methyl bromide]
524.2 [1995]	n-Butylbenzene
524.2 [1995]	sec-Butylbenzene
524.2 [1995]	Carbon Tetrachloride
524.2 [1995]	Chlorobenzene
524.2 [1995]	Chloroethane
524.2 [1995]	Chloroform
524.2 [1995]	Chloromethane [Methyl chloride]
524.2 [1995]	2-Chlorotoluene
524.2 [1995]	4-Chlorotoluene
524.2 [1995]	Chlorodibromomethane

Organics

524.2 [1995]	Dibromomethane
524.2 [1995]	1,3-Dichlorobenzene
524.2 [1995]	1,2-Dichlorobenzene
524.2 [1995]	1,4-Dichlorobenzene
524.2 [1995]	Dichlorodifluoromethane
524.2 [1995]	1,1-Dichloroethane
524.2 [1995]	1,2-Dichloroethane
524.2 [1995]	1,1-Dichloroethene
524.2 [1995]	cis-1,2-Dichloroethene
524.2 [1995]	trans-1,2-Dichloroethene
524.2 [1995]	1,2-Dichloropropane
524.2 [1995]	1,3-Dichloropropane
524.2 [1995]	2,2-Dichloropropane
524.2 [1995]	1,1-Dichloropropene
524.2 [1995]	cis-1,3-Dichloropropene
524.2 [1995]	trans-1,3-Dichloropropene [-pylene]
524.2 [1995]	Ethylbenzene
524.2 [1995]	Isopropylbenzene
524.2 [1995]	Naphthalene
524.2 [1995]	n-Propylbenzene
524.2 [1995]	Styrene
524.2 [1995]	1,1,1,2-Tetrachloroethane
524.2 [1995]	1,1,2,2-Tetrachloroethane
524.2 [1995]	Tetrachloroethene [-ethylene, Perchloroethylene]
524.2 [1995]	Toluene
524.2 [1995]	1,2,3-Trichlorobenzene
524.2 [1995]	1,2,4-Trichlorobenzene
524.2 [1995]	1,1,1-Trichloroethane
524.2 [1995]	1,1,2-Trichloroethane
524.2 [1995]	Trichloroethene [-ethylene]
524.2 [1995]	Trichlorofluoromethane
524.2 [1995]	1,2,3-Trichloropropane
524.2 [1995]	1,2,4-Trimethylbenzene
524.2 [1995]	1,3,5-Trimethylbenzene
524.2 [1995]	Vinyl Chloride
524.2 [1995]	Total Triholamethanes
524.2 [1995]	Methyl Tert-Butyl Ether (MTBE)
524.2 [1995]	Methylene Chloride [Dichloromethane, DCM]
524.2 [1995]	meta-Xylene
524.2 [1995]	ortho-Xylene
524.2 [1995]	para-Xylene
524.2 [1995]	trans-1,2-Dichloroethene
524.2 [1995]	2-Butanone [Methyl ethyl ketone, MEK]

Pb/Cu

200.7 [1998]	Copper
200.7 [1998]	Lead
200.8 [1994]	Copper
200.8 [1994]	Lead

Sulfates

300.0	Sulfate

The effective date of this certificate letter is: 2/12/2009.

The analytes by method which a laboratory is authorized to perform at any given time will be those indicated in the most recent certificate letter. The most recent certification letter supersedes all previous certification or authorization letters. It is the certified laboratory's responsibility to review this letter for discrepancies. The certified laboratory must document any discrepancies in this letter and send notice to this bureau within 15 days of receipt. This certificate letter will be recalled in the event your laboratory's certification is revoked.

Respectfully,

Patrick F. Luedtke, MD, MPH.
Director of Public Health Laboratories
Deputy Director of Epidemiology and Laboratory

USACE Candidate Environmental Laboratory
Self-Declaration Form

The following form is provided to the candidate environmental laboratory by the COR, filled-out and returned by the laboratory (with the accompanying required documentation specified below), and evaluated by the COR for policy compliance before the laboratory can provide environmental analytical support to USACE contracts. Before testing services can be performed by the laboratory, the COR will notify the candidate laboratory of the acceptability of the declaration and supporting documentation. The form is to be updated on an annual basis.

Legal name of laboratory:	**ALS Laboratory Group, Environmental Division (Salt Lake City, UT**
Street address:	**960 West LeVoy Drive** **Salt Lake City, UT 84123**
Name of Owner:	**ALS Laboratory Group**
Owner address (if different):	**Suite 210** **10450 Stancliff Road** **Houston, TX 77099**
Phone number:	**(281) 530-5656**
E-Mail address:	**NA**
Web site:	**http://www.alsglobal.com and** **http://www.datachem.com**
Laboratory director:	**Brent E. Stephens**
Phone number:	**(801) 266-7700**
E-Mail address:	**stephens@datachem.com**
Quality Assurance Officer:	**Robert P. Di Rienzo (Bob)**
Phone number:	**(801) 266-7700**
E-Mail address:	**dirienzo@datachem.com**

USACE Candidate Environmental Laboratory
Self-Declaration Form

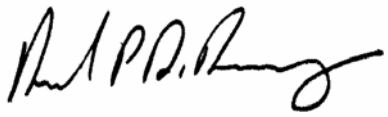
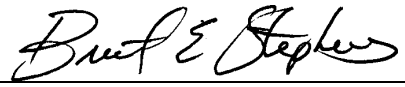
The undersigned persons understand and acknowledge that:

a. Laboratory operations, which will be utilized for testing in support of environmental analytical testing for USACE, are in full compliance with the DOD Quality Systems Manual (Version 3, including NELAC Standard Chapter 5 and Appendix requirements). All written documentation provided to USACE, accompanying this declaration, accurately reflect policy/practices implemented by laboratory staff.

b. The Laboratory will notify USACE immediately of change in status of laboratory operations that may affect on-going compliance as declared per item a.

c. The Laboratory acknowledges that USACE may audit the laboratory, relative to policy compliance at any time deemed appropriate; and will allow a designated COR full access to information and facilities to conduct such audit operations.

d. Signatories are authorized to sign this form on behalf of the owner and that there are no misrepresentations in the information provided in the initial laboratory assessment package.

Signature of Quality Assurance Officer:	
Date:	**January 26, 2009**
Signature of Laboratory Director:	
Date:	**January 26, 2009**

Note - A completed declaration form is to be accompanied by:

ALS Laboratory Group Self Declaration Website

http://208.109.7.250/usace2009/

Which includes the following:

- a copy of the laboratory's current Quality Manual (including QA SOPs and Ethics program policies/procedures),
- sample preparation and determinative method SOPs for all project required parameters, and
- method performance data — PT sample results (2 rounds), MDL studies and LCS control ranges for the preparatory-determinative method combinations — for all project required parameters. Documentation related to NELAP accreditation(s) for parameters can serve as evidence for successful PT samples results.

STATE OF ILLINOIS

ENVIRONMENTAL PROTECTION AGENCY
NELAP - RECOGNIZED
ENVIRONMENTAL LABORATORY ACCREDITATION

is hereby granted to

CT LABORATORIES

1230 LANGE CT.

BARABOO, WI 53913

NELAP ACCREDITED
ACCREDITATION NUMBER #100457

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

The laboratory agrees to perform all analyses listed on this scope of accreditation according to the Part 186 requirements and acknowledges that continued accreditation is dependent on successful ongoing compliance with the applicable requirements of Part 186. Please contact the Illinois EPA Environmental Laboratory Accreditation Program (IL ELAP) to verify the laboratory's scope of accreditation and accreditation status. Accreditation by the State of Illinois is not an endorsement or a guarantee of validity of the data generated by the laboratory.

Ron Turpin
Manager
Environmental Laboratory Accreditation Program

Scott D. Siders
Accreditation Officer
Environmental Laboratory Accreditation Program

Certificate No.: 002413
Expiration Date: 09/30/2010
Issued On: 11/19/2009

State of Illinois
Environmental Protection Agency

Certificate No.: 002413

Awards the Certificate of Approval

CT Laboratories
1230 Lange Ct.
Baraboo, WI 53913

According to the Illinois Administrative Code, Title 35, Subtitle A, Chapter II, Part 186, ACCREDITATION OF LABORATORIES FOR DRINKING WATER, WASTEWATER AND HAZARDOUS WASTES ANALYSIS, the State of Illinois formally recognizes that this laboratory is technically competent to perform the environmental analyses listed on the scope of accreditation detailed below.

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Hazardous and Solid Waste, Inorganic

1010

Ignitability

1311

TCLP (Organic and Inorganic)

1312

Synthetic Precipitation Leaching Procedure

6010C

Aluminum	Antimony	Arsenic
Barium	Beryllium	Boron
Cadmium	Calcium	Chromium
Cobalt	Copper	Iron
Lead	Lithium	Magnesium
Manganese	Molybdenum	Nickel
Potassium	Selenium	Silica
Silver	Sodium	Strontium
Thallium	Tin	Titanium
Vanadium	Zinc	

7010

Antimony	Arsenic	Lead
Selenium	Silver	Thallium

7196A

Chromium VI

7470A

Mercury

7471A

Mercury

9010B

Cyanide

9012A

Cyanide

9040C

Hydrogen Ion (pH)

9045D

Hydrogen Ion (pH)

9050A

State of Illinois
Environmental Protection Agency
Awards the Certificate of Approval

Certificate No.: 002413

CT Laboratories
1230 Lange Ct.
Baraboo, WI 53913

Hazardous and Solid Waste, Inorganic

9050A

Specific Conductance

9056A

Bromide	Chloride	Fluoride
Nitrate	Nitrite	Phosphate
Sulfate		

9065

Phenolics

9095B

Paint Filter

Chapter 7/9012A

Reactive Cyanide

Chapter 7/9034

Reactive Sulfide

Hazardous and Solid Waste, Organic

8015C

Diesel range organics (DRO)	Gasoline range organics (GRO)	

8081B

4,4'-DDD	4,4'-DDE	4,4'-DDT
Aldrin	alpha-BHC	alpha-Chlordane
beta-BHC	Chlordane - not otherwise specified	delta-BHC
Dieldrin	Endosulfan I	Endosulfan II
Endosulfan sulfate	Endrin	Endrin aldehyde
Endrin ketone	gamma-BHC (Lindane)	gamma-Chlordane
Heptachlor	Heptachlor epoxide	Methoxychlor
Toxaphene		

8082A

PCB-1016	PCB-1221	PCB-1232
PCB-1242	PCB-1248	PCB-1254
PCB-1260		

8260B

1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2,2-Tetrachloroethane
1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene
1,1-Dichloropropene	1,2,3-Trichlorobenzene	1,2,3-Trichloropropane
1,2,4-Trichlorobenzene	1,2,4-Trimethylbenzene	1,2-Dibromo-3-chloropropane (DBCP)
1,2-Dibromoethane (EDB)	1,2-Dichlorobenzene	1,2-Dichloroethane
1,2-Dichloropropane	1,3,5-Trimethylbenzene	1,3-Dichlorobenzene
1,3-Dichloropropane	1,4-Dichlorobenzene	2,2-Dichloropropane
2-Butanone (Methyl ethyl ketone, MEK)	2-Chloroethyl vinyl ether	2-Chlorotoluene
2-Hexanone	4-Chlorotoluene	4-Methyl-2-pentanone (Methyl isobutyl ketone
Acetone	Benzene	Bromobenzene
Bromochloromethane	Bromodichloromethane	Bromoform
Bromomethane	Carbon disulfide	Carbon tetrachloride
Chlorobenzene	Chlorodibromomethane (Dibromochloromethan	Chloroethane
Chloroform	Chloromethane	cis-1,2-Dichloroethene
cis-1,3-Dichloropropene	Dibromomethane	Dichlorodifluoromethane

State of Illinois
Environmental Protection Agency

Certificate No.: 002413

Awards the Certificate of Approval

CT Laboratories
1230 Lange Ct.
Baraboo, WI 53913

Hazardous and Solid Waste, Organic	*8260B*	Dichloromethane (Methylene chloride)
Ethylbenzene	Hexachlorobutadiene	Isopropylbenzene
Methyl-t-butyl ether	m-Xylene	Naphthalene
n-Butylbenzene	n-Propylbenzene	o-Xylene
p-Isopropyltoluene	p-Xylene	sec-Butylbenzene
Styrene	tert-Butylbenzene	Tetrachloroethene
Tetrahydrofuran	Toluene	trans-1,2-Dichloroethene
trans-1,3-Dichloropropene	Trichloroethene	Trichlorofluoromethane
Vinyl acetate	Vinyl chloride	Xylenes (total)
8270C		
1,2,4,5-Tetrachlorobenzene	1,2,4-Trichlorobenzene	1,2-Dichlorobenzene
1,2-Diphenylhydrazine	1,3-Dichlorobenzene	1,4-Dichlorobenzene
2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichlorophenol
2,4-Dimethylphenol	2,4-Dinitrophenol	2,4-Dinitrotoluene (2,4-DNT)
2,6-Dichlorophenol	2,6-Dinitrotoluene (2,6-DNT)	2-Chloronaphthalene
2-Chlorophenol	2-Methylnaphthalene	2-Methylphenol (o-Cresol)
2-Naphthylamine	2-Nitroaniline	2-Nitrophenol
3,3'-Dichlorobenzidine	3-Methylphenol (m-Cresol)	3-Nitroaniline
4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol
4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Methylphenol (p-Cresol)
4-Nitroaniline	4-Nitrophenol	Acenaphthene
Acenaphthylene	Acetophenone	Aniline
Anthracene	Benzidine	Benzo(a)anthracene
Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(g,h,i)perlyene
Benzo(k)fluoranthene	Benzoic acid	Benzyl alcohol
Bis(2-chloroethoxy) methane	Bis(2-chloroethyl) ether	Bis(2-chloroisopropyl) ether
Bis(2-ethylhexyl)phthalate	Butyl benzyl phthalate	Carbazole
Chrysene	Dibenz(a,h)anthracene	Dibenzofuran
Diethyl phthalate	Dimethyl phthalate	Di-n-butyl phthalate
Di-n-octyl phthalate	Diphenylamine	Fluoranthene
Fluorene	Hexachlorobenzene	Hexachlorobutadiene
Hexachlorocyclopentadiene	Hexachloroethane	Hexachloropropene
Indeno(1,2,3-cd) pyrene	Isophorone	Naphthalene
Nitrobenzene	N-Nitrosodimethylamine	N-Nitrosodi-n-propylamine
N-Nitrosodiphenylamine	N-Nitrosopyrrolidine	Pentachlorophenol
Phenanthrene	Phenol	Pyrene
Pyridine		
8310		
Acenaphthene	Acenaphthylene	Anthracene
Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene
Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Chrysene
Dibenz(a,h)anthracene	Fluoranthene	Fluorene
Indeno(1,2,3-cd) pyrene	Naphthalene	Phenanthrene
Pyrene		
8330A		
1,3,5-Trinitrobenzene (1,3,5-TNB)	1,3-Dinitrobenzene (1,3-DNB)	2,4,6-Trinitrotoluene

State of Illinois
Environmental Protection Agency

Certificate No.: 002413

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CT Laboratories
1230 Lange Ct.
Baraboo, WI 53913

Hazardous and Solid Waste, Organic	*8330A*	2,4,6-Trinitrotoluene (2,4,6-TNT)
2,4-Dinitrotoluene (2,4-DNT)	2,6-Dinitrotoluene (2,6-DNT)	2-Amino-4,6-dinitrotoluene (2-Am-DNT)
2-Nitrotoluene (2-NT)	3-Nitrotoluene (3-NT)	4-Amino-2,6-dinitrotoluene (4-Am-DNT)
4-Nitrotoluene (4-NT)	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	Methyl-2,4,6-trinitrophenylnitramine (Tetryl)
Nitrobenzene	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine(	
Wastewater, Inorganic		
SM2340B,18Ed		
Hardness		
SM2540B,18Ed		
Residue (Total)		
SM5210B,18Ed		
Biochemical Oxygen Demand (BOD)		
USEPA160.1		
Residue (TDS)		
USEPA160.2		
Residue (TSS)		
USEPA1664RA		
Oil and Grease		
USEPA300.0R2.1		
Bromide	Chloride	Fluoride
Nitrate	Nitrite	Orthophosphate (as P)
Sulfate		
USEPA310.2		
Alkalinity		
USEPA350.1R2.0		
Ammonia		
USEPA351.2R2.0		
Total Kjeldahl Nitrogen		
USEPA365.4		
Phosphorus		
USEPA376.1		
Sulfide		
USEPA410.4R2.0		
Chemical Oxygen Demand (COD)		
USEPA415.1		
Total Organic Carbon (TOC)		

DEPARTMENT OF THE NAVY
NAVAL SEA SYSTEMS COMMAND
1333 ISAAC HULL AVE SE
WASHINGTON NAVY YARD DC 20376-0001

IN REPLY TO

5090
Ser 04XQ (LABS)/066
August 4, 2009

Mr. Dan Elwood
CT Laboratories
1230 Lange Court
Baraboo, Wisconsin 53913

Subj: COMPLETION LETTER REPORT, CT LABORATORIES - BARABOO, WISCONSIN

NAVSEA Laboratory Quality and Accreditation Office (LQAO) has concluded the assessment of CT Laboratories, located in Baraboo, Wisconsin.

The assessment was intended as a general review of analytical capability to support remediation projects and the laboratory's ability to meet quality assurance requirements presented in the DoD Quality Systems Manual for Environmental Laboratories (Version 3, dated Jan 2006). The specific methods reviewed under the assessment are summarized in the attached table. This letter presents the outcome of our assessment documented in the following reports:

LQAO ltr 5090 Ser 04XQ(LABS)/045 of 14 May 09
LQAO ltr 5090 Ser 04XQ(LABS)/051 of 11 Jun 09
LQAO ltr 5090 Ser 04XQ(LABS)/065 of 3 Aug 09

- **Desk Assessment:** A review of laboratory supplied documentation was conducted. Documentation included the laboratory's quality assurance (QA) manual, selected standard operating procedures (SOPs) and SOP master list, list of major analytical instrumentation, and historical PT information. The documentation was reflective of a laboratory that was in a position to meet Navy requirements; however findings that required resolution were identified.

- **Proficiency Testing (PT) Samples:** CT Laboratories participates in a number of external certification and PT programs, and provided results for the past 2 years. Recurring failures were not identified in any specific analyte group. The laboratory has provided documentation that demonstrates that they have successfully completed two PT samples for all analyses within the scope of the assessment.

- **On-site Assessment:** Existing on-site assessment documentation is available and was applied to this assessment. The State of Illinois Environmental Laboratory Accreditation Program (IL ELAP) conducted an on-site assessment of the laboratory on April 16-18, 2008. IL ELAP is a NELAP recognized accrediting body. The State of Illinois accepted the corrective actions and accredited the laboratory expiring September 16, 2009.

5090
Ser 04XQ (LABS)/066
August 4, 2009

- **Corrective Actions:** The laboratory successfully remedied all of the Navy findings associated with the desk assessment.

The laboratory has provided documentation that demonstrates their capability to support environmental restoration projects (for the tests reviewed under this assessment, and summarized in the following table), and conformance the DoD Quality Systems Manual. If you have questions concerning your standing in the Navy ER QA Program, please contact Pati Moreno at (805) 982-1659.

E. B. HARTZOG, JR.
Director, Laboratory Quality
and Accreditation Office

Copy To: NFESC (P. Moreno, Code 413)

CT Laboratories - Methods Reviewed
(including parameters and matrices)

METHOD	PARAMETER	MATRIX
9056/300 Series	Anions: Chloride, Fluoride, Sulfate, Nitrate, Nitrite, and Ortho-phosphate	Water/Solids
9010B/9012/9014	Amenable & Total Cyanide	Water/Solids
6010B/7000A	Aluminum, Antimony, Arsenic, Barium, Beryllium, Boron, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Molybdenum, Nickel, Potassium, Silver, Sodium, Selenium, Thallium, Vanadium, and Zinc	Water/Solids
7196A	Hexavalent Chromium	Water/Solids
7470A/7471A	Mercury	Water/Solids
8015B	DRO / GRO	Water/Solids
8081A	Organochlorine Pesticides	Water/Solids
8082	Polychlorinated Biphenyls (PCBs)	Water/Solids/ Oil
8260B	Volatile Organic Compounds	Water/Solids
8270C	Semivolatile Organic Compounds	Water/Solids
8310	Poly-Aromatic Hydrocarbons (PAHs) by HPLC	Water/Solids
8330	Explosives by HPLC	Water/Solids
8330B	Explosives by HPLC	Water/Solids
8332	Nitroglycerin by HPLC	Water/Solids

CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board/ACLASS
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that

CT Laboratories
1230 Lange Court
Baraboo, WI 53913

has been assessed by ACLASS
and meets the requirements of

DoD-ELAP

while demonstrating technical competence in the field(s) of

TESTING

Refer to the accompanying Scope(s) of Accreditation for information regarding the types of tests to which this accreditation applies.

ADE-1453
Certificate Number

ACLASS Approval

Certificate Valid: 05/05/2010-05/05/2012
Version No. 001

SCOPE OF DoD-ELAP ACCREDITATION

CT Laboratories

1230 Lange Court, Baraboo, WI 53913
Dan Elwood Phone: 608-356-2760

TESTING

Valid to: May 5, 2012 Certificate Number: ADE- 1453

I. Environmental

MATRIX	SPECIFIC TEST OR GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all SW846 unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water / Solid	Volatile Organics	8260B / 8260C	GC/MS
Water / Solid	Semivolatile Organics	8270C /8270D	GC/MS
Water / Solid	PAHs	8270C SIM	GC/MS
Water / Solid	PCBs	8082A	GC
Water	Ethylene dibromide	8011	GC
Water / Solid	Organochlorine Pesticides	8081B	GC
Water / Solid	Gasoline and Diesel Range Organics	8015B	GC
Water / Solid	Glycols	8015B	GC
Water / Solid	PAHs	8310	HPLC
Water / Solid	Explosives	8330A /8330B	HPLC
Water / Solid	Nitroglycerine	8332	HPLC
Water / Solid	Nitrocellulose	ACOE ERDC	IC
Water	Dissolved gases	EPA RSK 175	GC

MATRIX	SPECIFIC TEST OR GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all SW846 unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water / Solid	Volatile fatty acids	Dionex ICE-AS1	IC
Water / Solid	Metals	6010B / 6010C	ICP
Water / Solid	Metals	200.7	ICP
Water / Solid	Metals	7010	GFAA
Water	Arsenic	7060A	GFAA
Water	Selenium	7040A	GFAA
Water / Solid	Metals	200.9	GFAA
Water	Mercury	7470A	Cold vapor AA
Water	Mercury	245.1	Cold vapor AA
Solid	Mercury	7471A	Cold vapor AA
Water / Solid	Anions	9056A	IC
Water / Solid	Anions	300.0	IC
Water	Cyanide	9010 / 9012	Midi Dist / Colorimetric

MATRIX	SPECIFIC TEST OR GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all SW846 unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Solid	Cyanide	9012	Midi Dist / Colorimetric
Water / Solid	Chromium Hexavalent	7196A	Colorimetric
Water	Sulfides	9034	Titrimetric
Water / Solid	pH/Corrosivity	9040C / 9045D / 150.1 / SM4500H	Electrometric
Water / Solid	Phenolics	9065 / 9066	Colorimetric
Water / Solid	Organic Carbon, Total	9060A, Lloyd Kahn	Oxidation Combustion
Water	Organic Carbon, Total	415.1	Oxidation Combustion
Water	Hexane Extractable Material	1664 RA	Gravimetric
Water	Alkalinity	EPA 310.2	Colorimetric
Water	Ammonia	EPA 350.1 R2.0	Colorimetric
Water	Kjeldahl Nitrogen, Total	EPA 351.2 R2.0	Colorimetric
Water	Phosphorus	EPA 365.4 R2.0 / 365.3	Colorimetric
Water	Flashpoint	1010	Pensky-Martens Closed-Cup
Water	Hardness	SM2340B, 18th Ed.	ICP (Calculation)

MATRIX	SPECIFIC TEST OR GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all SW846 unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Water	Total Solids	SM2540B	Gravimetric
Water	Total Dissolved Solids	SM2540C	Gravimetric
Water	Total Suspended Solids	SM4520D	Gravimetric
Water	COD	410.4	Colorimetric
Water	Turbidity	180.1	Nephelometer
Air	VOCs in Air	NIOSH 1500	GC
Water / Solid	Volatiles Prep	5035	Closed System Purge and Trap
Water	Organics Prep	3510C	Liquid/Liquid Extraction
Solid	Soil Extraction	3545 / 3545A	Accelerated Solvent Extraction (ASE)
Solid	Explosives Prep	8330B	Puck Mill grinding
Water / Solid	TCLP	1311	Non-potable water / Solid
Water / Solid	SPLP	1312	Non-potable water / Solid
Solid	GPC	3640	GPC
Water	Metals Prep	3005A	Hot Block

MATRIX	SPECIFIC TEST OR GROUP OF ANALYTES	SPECIFICATION OR STANDARD METHOD (all SW846 unless specified)	* KEY EQUIPMENT OR TECHNOLOGY USED
Solid	Metals Prep	3050B	Hot Block
Water	Metals Prep	3015	Microwave
Solid	Metals Prep	3051	Microwave
Water	Metals Prep	3010A / 3020A	Acid Digestion

Notes:

1. ** = As Applicable*
2. *This scope is part of and must be included with the Certificate of Accreditation No. ADE- 1453*

Vice President

DoD ELAP -- PT Performance Summary Review				Water ONLY	
Lab Name :	**CT Laboratories**				
City/State :	Baraboo, WI				
PT Provider Used :	ERA & Wibby Environmental				
PartName	PartNumber	NELACCode	AnalyteName	EPAmethod#	Analyte Approvals
Trace Metals	586	1000	Aluminum	6010B/C	Approved
Trace Metals	586	1005	Antimony	6010B/C	Approved
Trace Metals	586	1005	Antimony	7010	Approved
Trace Metals	586	1010	Arsenic	6010B/C	Approved
Trace Metals	586	1010	Arsenic	7010	Approved
Trace Metals	586	1015	Barium	6010B/C	Approved
Trace Metals	586	1020	Beryllium	6010B/C	Approved
Trace Metals	586	1025	Boron	6010B/C	Approved
Trace Metals	586	1030	Cadmium	6010B/C	Approved
Trace Metals	586	1040	Chromium	6010B/C	Approved
Trace Metals	586	1050	Cobalt	6010B/C	Approved
Trace Metals	586	1055	Copper	6010B/C	Approved
Trace Metals	586	1070	Iron	6010B/C	Approved
Trace Metals	586	1075	Lead	6010B/C	Approved
Trace Metals	586	1075	Lead	7010	Approved
Trace Metals	586	1090	Manganese	6010B/C	Approved
Trace Metals	586	1100	Molybdenum	6010B/C	Approved
Trace Metals	586	1105	Nickel	6010B/C	Approved
Trace Metals	586	1140	Selenium	6010B/C	Approved
Trace Metals	586	1140	Selenium	7010	Approved
Trace Metals	586	1150	Silver	6010B/C	Approved
Trace Metals	586	1150	Silver	7010	Approved
Trace Metals	586	1160	Strontium	6010B/C	Approved
Trace Metals	586	1185	Vanadium	6010B/C	Approved
Trace Metals	586	1190	Zinc	6010B/C	Approved
Trace Metals	586	1080	Lithium	6010B/C	other-than PT
Trace Metals	586	1080	Lithium	200.7	other-than PT
Trace Metals	586		Tungsten	6010B/C	other-than PT
Trace Metals	586		Tungsten	200.7	other-than PT
Mercury	574	1095	Mercury	7470A	Approved
Tin and Titanium	573	1175	Tin	6010B/C	Approved
Tin and Titanium	573	1175	Tin	200.7	Approved
Tin and Titanium	573	1180	Titanium	6010B/C	Approved
Tin and Titanium	573	1180	Titanium	200.7	Approved
Chromium VI	898	1045	Chromium VI	7196A	Approved
Demand	578	1565	COD	410.4	Approved
Demand	578	2040	TOC	415.1	Approved
Demand	578	2040	TOC	9060A	Approved
Minerals	581	1505	Alkalinity	310.2	Approved
Bromide	887	1540	Bromide	300.0	Approved
Bromide	887	1540	Bromide	9056	Approved
Hardness	580	1035	Calcium	200.7	Approved
Hardness	580	1035	Calcium	6010B	Approved
Minerals	581	1575	Chloride	300.0	Approved
Minerals	581	1575	Chloride	9056	Approved
Minerals	581	1730	Fluoride	300.0	Approved
Minerals	581	1730	Fluoride	9056	Approved
Hardness	580	1755	Total Hardness (as CaCO3)	SM2340B/6010B	Approved
Hardness	580	1085	Magnesium	200.7	Approved
Hardness	580	1085	Magnesium	6010B/C	Approved
Minerals	581	1125	Potassium	200.7	Approved
Minerals	581	1125	Potassium	6010B/C	Approved
Minerals	581	1155	Sodium	200.7	Approved
Minerals	581	1155	Sodium	6010B/C	Approved
Minerals	581	2000	Sulfate	300.0	Approved
Minerals	581	2000	Sulfate	9056	Approved
Nutrients - #1	584	1515	Ammonia as N	350.1	Approved
Nutrients - #1	584	1810	Nitrate as N	300.0	Approved
Nutrients - #1	584	1810	Nitrate as N	9056	Approved
Nutrients - #1	584	1870	Orthophosphate as P	300.0	Approved
Nutrients - #1	584	1870	Orthophosphate as P	9056	Approved
Nutrients - #2	579	1795	Total Kjeldahl Nitrogen (TKN)	351.2	Approved
Nutrients - #2	579	1910	Total Phosphorous	365.4	Approved
Nitrite	888	1840	Nitrite as N	300.0	Approved
Nitrite	888	1840	Nitrite as N	9056	Approved
Oil & Grease - HEM	582	1860	Oil & Grease	1664A	Approved
pH	577	1900	pH	9040C	Approved
Total Cyanide	588	1645	Total Cyanide	9010/9012A	Approved

Phenolics	589	1905	Total Phenolics (4AAP)	9066	Approved
Sulfide	891	2005	Sulfides	376.1	Approved
Silica	890	1990	Silica (as SiO2)	200.7	Approved
Silica	890	1990	Silica (as SiO2)	6010B/C	Approved
Solids	241	1950	Solids, Total	SM2540B	Approved
Solids	241	1955	Solids, Total Dissolved	SM2540C	Approved
Solids	241	1960	Solids, Total Suspended	SM2540D/160.2	Approved
Volatiles	PT-VOA-WP	5105	1,1,1,2-Tetrachloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	5160	1,1,1-Trichloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	5110	1,1,2,2-Tetrachloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	5165	1,1,2-Trichloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4630	1,1-Dichloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4640	1,1-Dichloroethene	8260B/C	Approved
Volatiles	PT-VOA-WP	4670	1,1-Dichloropropene	8260B/C	Approved
Volatiles	PT-VOA-WP	5150	1,2,3-Trichlorobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	5180	1,2,3-Trichloropropane	8260B/C	Approved
Volatiles	PT-VOA-WP	5155	1,2,4-Trichlorobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	5210	1,2,4-Trimethylbenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4570	1,2-Dibromo-3-chloropropane	8260B/C	Approved
Volatiles	PT-VOA-WP	4585	1,2-Dibromoethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4610	1,2-Dichlorobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4635	1,2-Dichloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4655	1,2-Dichloropropane	8260B/C	Approved
Volatiles	PT-VOA-WP	4615	1,3-Dichlorobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4660	1,3-Dichloropropane	8260B/C	Approved
Volatiles			1,4-Dichloro-2-butene	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4620	1,4-Dichlorobenzene	8260B/C	Approved
Volatiles		4740	1,4-Dioxane	8260B/C	other-than PT
Volatiles		5195	112Trichloro122trifluoroethane	8260B/C	other-than PT
Volatiles			12Dichloro112trifluoroethane	8260B/C	other-than PT
Volatiles		4510	1-Chlorohexane	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4665	2,2-Dichloropropane	8260B/C	Approved
Volatiles			2,3-Dichloro-1-propene	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4410	2-Butanone	8260B/C	Approved
Volatiles	PT-VOA-WP	4500	2-Chloroethyl vinyl ether	8260B/C	Approved
Volatiles	PT-VOA-WP	4535	2-Chlorotoluene	8260B/C	Approved
Volatiles	PT-VOA-WP	4860	2-Hexanone	8260B/C	Approved
Volatiles		5065	2-Propanol	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4540	4-Chlorotoluene	8260B/C	Approved
Volatiles	PT-VOA-WP	4995	4-Methyl-2-pentanone	8260B/C	Approved
Volatiles	PT-VOA-WP	4315	Acetone	8260B/C	Approved
Volatiles	PT-VOA-WP	4375	Benzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4385	Bromobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4390	Bromochloromethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4395	Bromodichloromethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4400	Bromoform	8260B/C	Approved
Volatiles	PT-VOA-WP	4950	Bromomethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4450	Carbon disulfide	8260B/C	Approved
Volatiles	PT-VOA-WP	4455	Carbon tetrachloride	8260B/C	Approved
Volatiles	PT-VOA-WP	4475	Chlorobenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	4485	Chloroethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4505	Chloroform	8260B/C	Approved
Volatiles	PT-VOA-WP	4960	Chloromethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4645	cis-1,2-Dichloroethene	8260B/C	Approved
Volatiles	PT-VOA-WP	4680	cis-1,3-Dichloropropene	8260B/C	Approved
Volatiles		4555	Cyclohexane	8260B/C	other-than PT
Volatiles		4560	Cyclohexanone	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4575	Dibromochloromethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4595	Dibromomethane	8260B/C	Approved
Volatiles	PT-VOA-WP	4625	Dichlorodifluoromethane	8260B/C	Approved
Volatiles	PT-VOA-WP		Dichlorofluoromethane	8260B/C	Approved
Volatiles			Diisopropyl ether	8260B/C	other-than PT
Volatiles		4750	Ethanol	8260B/C	other-than PT
Volatiles		4755	Ethyl acetate	8260B/C	other-than PT
Volatiles			Ethyl ether	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4765	Ethylbenzene	8260B/C	Approved
Volatiles		4850	Hexane	8260B/C	other-than PT
Volatiles		4870	Iodomethane	8260B/C	other-than PT
Volatiles	PT-VOA-WP	5240	m & p-Xylene	8260B/C	other-than PT
Volatiles		4940	Methyl acetate	8260B/C	other-than PT
Volatiles			Methyl iodide	8260B/C	other-than PT
Volatiles		4990	Methyl methacrylate	8260B/C	other-than PT
Volatiles	PT-VOA-WP	5000	Methyl tert-butyl ether	8260B/C	Approved
Volatiles		4965	Methylcyclohexane	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4975	Methylene chloride	8260B/C	Approved

Volatiles	PT-VOA-WP	4435	n-Butylbenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	5250	o-Xylene	8260B/C	other-than PT
Volatiles			Propylene oxide	8260B/C	other-than PT
Volatiles	PT-VOA-WP	4440	sec-Butylbenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	5100	Styrene	8260B/C	Approved
Volatiles		4445	tert-Butyl alcohol	8260B/C	other-than PT
Volatiles	PT-VOA-WP		tert-Butylbenzene	8260B/C	Approved
Volatiles	PT-VOA-WP	5115	Tetrachloroethene	8260B/C	Approved
Volatiles		5210	Tetrahydrofuran	8260B/C	other-than PT
Volatiles	PT-VOA-WP	5140	Toluene	8260B/C	Approved
Volatiles	PT-VOA-WP	4700	trans-1,2-Dichloroethene	8260B/C	Approved
Volatiles	PT-VOA-WP	4685	trans-1,3-Dichloropropene	8260B/C	Approved
Volatiles	PT-VOA-WP	5170	Trichloroethene	8260B/C	Approved
Volatiles	PT-VOA-WP	5175	Trichlorofluoromethane	8260B/C	Approved
Volatiles	PT-VOA-WP	5235	Vinyl chloride	8260B/C	Approved
Volatiles	PT-VOA-WP	5260	Xylenes, total	8260B/C	Approved
Volatiles		4585	Ethylene dibromide	8011	other-than PT
Gas			Methane	RSK 175	other-than PT
Gas			Ethene	RSK 175	other-than PT
Gas			Ethane	RSK 175	other-than PT
Gas			Carbon Dioxide	RSK 175	other-than PT
Base Neutrals	PT-BN-WP	6715	1,2,4,5-Tetrachlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	5155	1,2,4-Trichlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	4610	1,2-Dichlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	4615	1,3-Dichlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	4620	1,4-Dichlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	6380	1-Methylnaphthalene	8270C	Approved
Base Neutrals	PT-BN-WP	6185	2,4-Dinitrotoluene	8270C	Approved
Base Neutrals	PT-BN-WP	6190	2,6-Dinitrotoluene	8270C	Approved
Base Neutrals	PT-BN-WP	5795	2-Chloronaphthalene	8270C	Approved
Base Neutrals	PT-BN-WP	6385	2-Methylnaphthalene	8270C	Approved
Base Neutrals	PT-BN-WP	6460	2-Naphthylamine	8270C	Approved
Base Neutrals	PT-BN-WP	6460	2-Nitroaniline	8270C	Approved
Base Neutrals	PT-BN-WP	5945	3,3'-Dichlorobenzidine	8270C	Approved
Base Neutrals	PT-BN-WP	6465	3-Nitroaniline	8270C	Approved
Base Neutrals	PT-BN-WP	5660	4-Bromophenyl-phenyl ether	8270C	Approved
Base Neutrals	PT-BN-WP	5745	4-Chloroaniline	8270C	Approved
Base Neutrals	PT-BN-WP	5825	4-Chlorophenyl-phenyl ether	8270C	Approved
Base Neutrals	PT-BN-WP	6470	4-Nitroaniline	8270C	Approved
Base Neutrals	PT-BN-WP	5500	Acenaphthene	8270C	Approved
Base Neutrals	PT-BN-WP	5505	Acenaphthylene	8270C	Approved
Base Neutrals		5510	Acetophenone	8270C	other-than PT
Base Neutrals	PT-BN-WP	5545	Aniline	8270C	Approved
Base Neutrals	PT-BN-WP	5555	Anthracene	8270C	Approved
Base Neutrals			Azobenzene & 1,2-Diphenylhydra	8270C	other-than PT
Base Neutrals	PT-BN-WP	5595	Benzidine	8270C	Approved
Base Neutrals	PT-BN-WP	5575	Benzo(a)anthracene	8270C	Approved
Base Neutrals	PT-BN-WP	5580	Benzo(a)pyrene	8270C	Approved
Base Neutrals	PT-BN-WP	5585	Benzo(b)fluoranthene	8270C	Approved
Base Neutrals	PT-BN-WP	5590	Benzo(g,h,i)perylene	8270C	Approved
Base Neutrals	PT-BN-WP	5600	Benzo(k)fluoranthene	8270C	Approved
Base Neutrals	PT-BN-WP	5630	Benzyl alcohol	8270C	Approved
Base Neutrals	PT-BN-WP	5760	Bis(2-chloroethoxy)methane	8270C	Approved
Base Neutrals	PT-BN-WP	5765	Bis(2-chloroethyl)ether	8270C	Approved
Base Neutrals	PT-BN-WP	5780	Bis(2-chloroisopropyl)ether	8270C	Approved
Base Neutrals	PT-BN-WP	6255	Bis(2-ethylhexyl)phthalate	8270C	Approved
Base Neutrals	PT-BN-WP	5670	Butylbenzylphthalate	8270C	Approved
Base Neutrals	PT-BN-WP	5680	Carbazole	8270C	Approved
Base Neutrals	PT-BN-WP	5855	Chrysene	8270C	Approved
Base Neutrals	PT-BN-WP	5895	Dibenzo(a,h)anthracene	8270C	Approved
Base Neutrals	PT-BN-WP	5905	Dibenzofuran	8270C	Approved
Base Neutrals	PT-BN-WP	6070	Diethylphthalate	8270C	Approved
Base Neutrals	PT-BN-WP	6135	Dimethylphthalate	8270C	Approved
Base Neutrals	PT-BN-WP	5925	Di-n-butylphthalate	8270C	Approved
Base Neutrals	PT-BN-WP	6200	Di-n-octylphthalate	8270C	Approved
Base Neutrals	PT-BN-WP	6265	Fluoranthene	8270C	Approved
Base Neutrals	PT-BN-WP	6270	Fluorene	8270C	Approved
Base Neutrals	PT-BN-WP	6275	Hexachlorobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	4835	Hexachlorobutadiene	8270C	Approved
Base Neutrals	PT-BN-WP	6285	Hexachlorocyclopentadiene	8270C	Approved
Base Neutrals	PT-BN-WP	4840	Hexachloroethane	8270C	Approved
Base Neutrals		6295	Hexachloropropene	8270C	other-than PT
Base Neutrals	PT-BN-WP	6315	Indeno(1,2,3-cd)pyrene	8270C	Approved
Base Neutrals	PT-BN-WP	6320	Isophorone	8270C	Approved
Base Neutrals	PT-BN-WP	5005	Naphthalene	8270C	Approved

Base Neutrals	PT-BN-WP	5015	Nitrobenzene	8270C	Approved
Base Neutrals	PT-BN-WP	6530	N-Nitrosodiethylamine	8270C	Approved
Base Neutrals	PT-BN-WP	6545	N-Nitrosodimethylamine	8270C	Approved
Base Neutrals	PT-BN-WP	6545	N-Nitroso-di-n-propylamine	8270C	Approved
Base Neutrals	PT-BN-WP	6535	N-Nitrosodiphenylamine & Diphn	8270C	Approved
Base Neutrals		6565	N-Nitrosopyrrolidine	8270C	other-than PT
Base Neutrals	PT-BN-WP	6615	Phenanthrene	8270C	Approved
Base Neutrals	PT-BN-WP	6665	Pyrene	8270C	Approved
Base Neutrals	PT-BN-WP	5095	Pyridine	8270C	Approved
Acids	PT-ACIDS-WP	6835	2,4,5-Trichlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	6840	2,4,6-Trichlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	6000	2,4-Dichlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	6130	2,4-Dimethylphenol	8270C	Approved
Acids	PT-ACIDS-WP	6175	2,4-Dinitrophenol	8270C	Approved
Acids	PT-ACIDS-WP	6005	2,6-Dichlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	5800	2-Chlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	6400	2-Methylphenol	8270C	Approved
Acids	PT-ACIDS-WP	6490	2-Nitrophenol	8270C	Approved
Acids			3 & 4-Chlorophenol	8270C	other-than PT
Acids	PT-ACIDS-WP	6410	3 & 4-Methylphenol	8270C	Approved
Acids	PT-ACIDS-WP	6360	4,6-Dinitro-2-methylphenol	8270C	Approved
Acids	PT-ACIDS-WP	5700	4-Chloro-3-methylphenol	8270C	Approved
Acids	PT-ACIDS-WP	6500	4-Nitrophenol	8270C	Approved
Acids	PT-ACIDS-WP	5610	Benzoic acid	8270C	Approved
Acids	PT-ACIDS-WP	6605	Pentachlorophenol	8270C	Approved
Acids	PT-ACIDS-WP	6625	Phenol	8270C	Approved
Pesticides	PT-PEST-WP	7025	Aldrin	8081B	Approved
Pesticides	PT-PEST-WP	7110	alpha-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7115	beta-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7105	delta-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7120	gamma-BHC (Lindane)	8081B	Approved
Pesticides	PT-PEST-WP	7240	alpha-Chlordane	8081B	Approved
Pesticides	PT-PEST-WP	7245	gamma-Chlordane	8081B	Approved
Pesticides	PT-PEST-WP	7355	DDD (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7360	DDE (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7365	DDT (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7470	Dieldrin	8081B	Approved
Pesticides	PT-PEST-WP	7510	Endosulfan I	8081B	Approved
Pesticides	PT-PEST-WP	7515	Endosulfan II	8081B	Approved
Pesticides	PT-PEST-WP	7520	Endosulfan sulfate	8081B	Approved
Pesticides	PT-PEST-WP	7540	Endrin	8081B	Approved
Pesticides	PT-PEST-WP	7530	Endrin aldehyde	8081B	Approved
Pesticides	PT-PEST-WP	7535	Endrin ketone	8081B	Approved
Pesticides	PT-PEST-WP	7685	Heptachlor	8081B	Approved
Pesticides	PT-PEST-WP	7690	Heptachlor Epoxide (beta)	8081B	Approved
Pesticides	PT-PEST-WP	7810	Methoxychlor	8081B	Approved
Chlordane	PT-CHLR-WP	7250	Chlordane (total)	8081B	Approved
Toxaphene	PT-TXP-WP	8250	Toxaphene (total)	8081B	Approved
PCBs in Water	PT-PCBW-WP	8880	Aroclor 1016	8082A	Approved
PCBs in Water	PT-PCBW-WP	8885	Aroclor 1221	8082A	Approved
PCBs in Water	PT-PCBW-WP	8890	Aroclor 1232	8082A	Approved
PCBs in Water	PT-PCBW-WP	8895	Aroclor 1242	8082A	Approved
PCBs in Water	PT-PCBW-WP	8900	Aroclor 1248	8082A	Approved
PCBs in Water	PT-PCBW-WP	8905	Aroclor 1254	8082A	Approved
PCBs in Water	PT-PCBW-WP	8910	Aroclor 1260	8082A	Approved
PAHs - Low Level	PT-PAH-WP	5500	Acenaphthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5505	Acenaphthylene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5555	Anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5575	Benzo(a)anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5585	Benzo(b)fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5600	Benzo(k)fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5590	Benzo(g,h,i)perylene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5580	Benzo(a)pyrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5855	Chrysene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5895	Dibenz(a,h)anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6265	Fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6270	Fluorene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6315	Indeno(1,2,3-cd)pyrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5005	Naphthalene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6615	Phenanthrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6665	Pyrene	8310	Approved
Explosives	PT-EXP-WP	9303	2-Amino-4,6-dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9306	4-Amino-2,6-dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	6160	1,3-Dinitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	6185	2,4-Dinitrotoluene	8330A/B	Approved

Explosives	PT-EXP-WP	6190	2,6-Dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9522	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	8330A/B	Approved
Explosives	PT-EXP-WP	5015	Nitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	9507	2-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9510	3-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9513	4-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9432	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	8330A/B	Approved
Explosives	PT-EXP-WP	6415	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)	8330A/B	Approved
Explosives	PT-EXP-WP	6885	1,3,5-Trinitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	9651	2,4,6-Trinitrotoluene	8330A/B	Approved
Explosives		6150	3,5-Dinitroaniline	8330A/B	Approved
Explosives			PETN	8330A/B	Approved
Explosives			Nitroguanidine	8330A/B	other-than PT
Explosives		6485	Nitroglycerine	8332	other-than PT
Nitrocellulose			Nitrocellulose	ACOE ERDC	other-than PT
Volatile Fatty Acid			Acetic acid	9056M	other-than PT
Volatile Fatty Acid			Butyric acid	9056M	other-than PT
Volatile Fatty Acid			Formic acid	9056M	other-than PT
Volatile Fatty Acid			Lactic acid	9056M	other-than PT
Volatile Fatty Acid			Propionic acid	9056M	other-than PT
Volatile Fatty Acid			Pyruvic acid	9056M	other-than PT
Glycol			Ethylene glycol	8015B	other-than PT
Glycol			Propylene glycol	8015B	other-than PT
Gasoline in Water	PT-GAS-WP	8015B	Gasoline - EPA 8015B rev 2 (1996)	8015B	Approved
Diesel in Water	PT-DIES-WP	8015B	Diesel - EPA 8015B rev 2 (1996)	8015B	Approved

DoD ELAP -- PT Performance Summary Review					Soil ONLY
Lab Name :	**CT Laboratories**				
City/State :	Baraboo, WI				
PT Provider Used :	ERA & Wibby Environmental				
PartName	PartNumber	NELACCode	AnalyteName	EPAmethod#	Analyte Approvals
Anions in Soil	873	1540	Bromide	9056	Approved
Anions in Soil	873	1575	Chloride	9056	Approved
Anions in Soil	873	1730	Fluoride	9056	Approved
Anions in Soil	873	2000	Sulfate	9056	Approved
Anions in Soil	873	1810	Nitrate as N	9056	Approved
Anions in Soil	873	1870	Orthophosphate as P	9056	Approved
Cyanide in Soil	621	1645	Total Cyanide	9012A	Approved
Flashpoint	874	1780	Flashpoint	1010	Approved
Hex Chromium in Soil	876	1045	Chromium VI	7196A	Approved
Metals in Soil	620	1000	Aluminum	6010B/C	Approved
Metals in Soil	620	1005	Antimony	6010B/C	Approved
Metals in Soil	620	1005	Antimony	7010/7041	Approved
Metals in Soil	620	1010	Arsenic	6010B/C	Approved
Metals in Soil	620	1010	Arsenic	7010/7060A	Approved
Metals in Soil	620	1015	Barium	6010B/C	Approved
Metals in Soil	620	1020	Beryllium	6010B/C	Approved
Metals in Soil	620	1025	Boron	6010B/C	Approved
Metals in Soil	620	1030	Cadmium	6010B/C	Approved
Metals in Soil	620	1035	Calcium	6010B/C	Approved
Metals in Soil	620	1040	Chromium	6010B/C	Approved
Metals in Soil	620	1050	Cobalt	6010B/C	Approved
Metals in Soil	620	1055	Copper	6010B/C	Approved
Metals in Soil	620	1070	Iron	6010B/C	Approved
Metals in Soil	620	1075	Lead	6010B/C	Approved
Metals in Soil	620	1075	Lead	7010/7421	Approved
Metals in Soil	620	1085	Magnesium	6010B/C	Approved
Metals in Soil	620	1090	Manganese	6010B/C	Approved
Metals in Soil	620	1095	Mercury	7471A	Approved
Metals in Soil	620	1100	Molybdenum	6010B/C	Approved
Metals in Soil	620	1105	Nickel	6010B/C	Approved
Metals in Soil	620	1125	Potassium	6010B/C	Approved
Metals in Soil	620	1140	Selenium	6010B/C	Approved
Metals in Soil	620	1140	Selenium	7010/7740	Approved
Metals in Soil	620	1150	Silver	6010B/C	Approved
Metals in Soil	620	1150	Silver	7010/7760	Approved
Metals in Soil	620	1155	Sodium	6010B/C	Approved
Metals in Soil	620	1160	Strontium	6010B/C	Approved
Metals in Soil	620	1165	Thallium	6010B/C	Approved
Metals in Soil	620	1165	Thallium	70107840	Approved
Metals in Soil	620	1175	Tin	6010B/C	Approved
Metals in Soil	620	1180	Titanium	6010B/C	Approved
Metals in Soil	620	1185	Vanadium	6010B/C	Approved
Metals in Soil	620	1190	Zinc	6010B/C	Approved
Metals in Soil	620	1080	Lithium	6010B/C	other-than PT
Metals in Soil	620	1080	Lithium	200.7	other-than PT
Metals in Soil	620		Tungsten	6010B/C	other-than PT
Metals in Soil	620		Tungsten	200.7	other-than PT
Nitrite	888	1840	Nitrite as N	300.0	other-than PT
Nitrite	888	1840	Nitrite as N	9056	other-than PT
Nutrients in Soil	869	2040	TOC	Lloyd Kahn/9060A	Approved
pH in Soil	875	1900	pH	9045D	Approved
Phenolics	589	1905	Total Phenolics (4AAP)	9066	other-than PT
Volatiles - Low Level	PT-VOA-WP	5105	1,1,1,2-Tetrachloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5160	1,1,1-Trichloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5110	1,1,2,2-Tetrachloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5165	1,1,2-Trichloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4630	1,1-Dichloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4640	1,1-Dichloroethene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4670	1,1-Dichloropropene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5150	1,2,3-Trichlorobenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5180	1,2,3-Trichloropropane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5155	1,2,4-Trichlorobenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5210	1,2,4-Trimethylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4570	1,2-Dibromo-3-chloropropane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4585	1,2-Dibromoethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4610	1,2-Dichlorobenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4635	1,2-Dichloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4635	1,2-Dichloroethylene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4655	1,2-Dichloropropane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5215	1,3,5-Trimethylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4615	1,3-Dichlorobenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4660	1,3-Dichloropropane	8260B/C	Approved

Volatiles - Low Level	PT-VOA-WP	4620	1,4-Dichlorobenzene	8260B/C	Approved
Volatiles - Low Level		5195	112Trichloro122trifluoroethane	8260B/C	other-than PT
Volatiles - Low Level			12Dichloro112trifluoroethane	8260B/C	other-than PT
Volatiles - Low Level		4510	1-Chlorohexane	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4665	2,2-Dichloropropane	8260B/C	Approved
Volatiles - Low Level			2,3-Dichloro-1-propene	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4410	2-Butanone	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4535	2-Chlorotoluene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4860	2-Hexanone	8260B/C	Approved
Volatiles - Low Level		5065	2-Propanol	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4540	4-Chlorotoluene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4995	4-Methyl-2-pentanone	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4315	Acetone	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4385	Bromobenzene	8260B/C	Approved
Volatiles - Low Level		4390	Bromochloromethane	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4395	Bromodichloromethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4400	Bromoform	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4950	Bromomethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4450	Carbon disulfide	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4455	Carbon tetrachloride	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4475	Chlorobenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4485	Chloroethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4505	Chloroform	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4960	Chloromethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4645	cis-1,2-Dichloroethene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4680	cis-1,3-Dichloropropene	8260B/C	Approved
Volatiles - Low Level		4555	Cyclohexane	8260B/C	other-than PT
Volatiles - Low Level		4560	Cyclohexanone	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4575	Dibromochloromethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4595	Dibromomethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4625	Dichlorodifluoromethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP		Dichlorofluoromethane	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	9375	Diisopropyl ether	8260B/C	Approved
Volatiles - Low Level		4750	Ethanol	8260B/C	other-than PT
Volatiles - Low Level		4755	Ethyl acetate	8260B/C	other-than PT
Volatiles - Low Level			Ethyl ether	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4765	Ethylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4835	Hexachlorobutadiene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4840	Hexachloroethane	8260B/C	Approved
Volatiles - Low Level		4850	Hexane	8260B/C	other-than PT
Volatiles - Low Level		4870	Iodomethane	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4900	Isopropylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5240	m & p-Xylene	8260B/C	Approved
Volatiles - Low Level		4940	Methyl acetate	8260B/C	other-than PT
Volatiles - Low Level			Methyl iodide	8260B/C	other-than PT
Volatiles - Low Level		4990	Methyl methacrylate	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	5000	Methyl tert-butyl ether	8260B/C	Approved
Volatiles - Low Level		4965	Methylcyclohexane	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4975	Methylene chloride	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5005	Naphthalene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4435	n-Butylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5090	n-Propylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5250	o-Xylene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4910	p-Isopropyltoluene	8260B/C	Approved
Volatiles - Low Level			Propylene oxide	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	4440	sec-Butylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5100	Styrene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4445	tert-Butylbenzene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5115	Tetrachloroethene	8260B/C	Approved
Volatiles - Low Level		5120	Tetrahydrofuran	8260B/C	other-than PT
Volatiles - Low Level	PT-VOA-WP	5140	Toluene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4700	trans-1,2-Dichloroethene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	4685	trans-1,3-Dichloropropene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5170	Trichloroethene	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5175	Trichlorofluoromethane	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5225	Vinyl Acetate	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5235	Vinyl chloride	8260B/C	Approved
Volatiles - Low Level	PT-VOA-WP	5260	Xylenes, total	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5105	1,1,1,2-Tetrachloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5160	1,1,1-Trichloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5110	1,1,2,2-Tetrachloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5165	1,1,2-Trichloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4630	1,1-Dichloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4640	1,1-Dichloroethene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4670	1,1-Dichloropropene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5150	1,2,3-Trichlorobenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5180	1,2,3-Trichloropropane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5155	1,2,4-Trichlorobenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5210	1,2,4-Trimethylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4570	1,2-Dibromo-3-chloropropane	8260B/C	Approved

Volatiles - Medium Level	PT-VOA-WP	4585	1,2-Dibromoethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4610	1,2-Dichlorobenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4635	1,2-Dichloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4635	1,2-Dichloroethylene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4655	1,2-Dichloropropane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5215	1,3,5-Trimethylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4615	1,3-Dichlorobenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4660	1,3-Dichloropropane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4620	1,4-Dichlorobenzene	8260B/C	Approved
Volatiles - Medium Level		5195	112Trichloro122trifluoroethane	8260B/C	other-than PT
Volatiles - Medium Level			12Dichloro112trifluoroethane	8260B/C	other-than PT
Volatiles - Medium Level		4510	1-Chlorohexane	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4665	2,2-Dichloropropane	8260B/C	Approved
Volatiles - Medium Level			2,3-Dichloro-1-propene	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4410	2-Butanone	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4500	2-Chloroethyl vinyl ether	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4535	2-Chlorotoluene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4860	2-Hexanone	8260B/C	Approved
Volatiles - Medium Level		5020	2-Nitropropane	8260B/C	other-than PT
Volatiles - Medium Level		5065	2-Propanol	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4540	4-Chlorotoluene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4995	4-Methyl-2-pentanone	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4315	Acetone	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4375	Benzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4385	Bromobenzene	8260B/C	Approved
Volatiles - Medium Level		4390	Bromochloromethane	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4395	Bromodichloromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4400	Bromoform	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4950	Bromomethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4450	Carbon disulfide	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4455	Carbon tetrachloride	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4475	Chlorobenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4485	Chloroethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4505	Chloroform	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4960	Chloromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4645	cis-1,2-Dichloroethene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4680	cis-1,3-Dichloropropene	8260B/C	Approved
Volatiles - Medium Level		4555	Cyclohexane	8260B/C	other-than PT
Volatiles - Medium Level		4560	Cyclohexanone	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4575	Dibromochloromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4595	Dibromomethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4625	Dichlorodifluoromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP		Dichlorofluoromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	9375	Diisopropyl ether	8260B/C	Approved
Volatiles - Medium Level		4750	Ethanol	8260B/C	other-than PT
Volatiles - Medium Level		4755	Ethyl acetate	8260B/C	other-than PT
Volatiles - Medium Level			Ethyl ether	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4765	Ethylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4835	Hexachlorobutadiene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4840	Hexachloroethane	8260B/C	Approved
Volatiles - Medium Level		4850	Hexane	8260B/C	other-than PT
Volatiles - Medium Level		4870	Iodomethane	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4900	Isopropylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5240	m & p-Xylene	8260B/C	Approved
Volatiles - Medium Level		4940	Methyl acetate	8260B/C	other-than PT
Volatiles - Medium Level			Methyl iodide	8260B/C	other-than PT
Volatiles - Medium Level		4990	Methyl methacrylate	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	5000	Methyl tert-butyl ether	8260B/C	Approved
Volatiles - Medium Level		4965	Methylcyclohexane	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4975	Methylene chloride	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5005	Naphthalene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4435	n-Butylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5090	n-Propylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5250	o-Xylene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4910	p-Isopropyltoluene	8260B/C	Approved
Volatiles - Medium Level			Pentachlorobenzene	8260B/C	other-than PT
Volatiles - Medium Level			Propylene oxide	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4440	sec-Butylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5100	Styrene	8260B/C	Approved
Volatiles - Medium Level		4445	tert-Butyl alcohol	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	4445	tert-Butylbenzene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5115	Tetrachloroethene	8260B/C	Approved
Volatiles - Medium Level		5120	Tetrahydrofuran	8260B/C	other-than PT
Volatiles - Medium Level	PT-VOA-WP	5140	Toluene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4700	trans-1,2-Dichloroethene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	4685	trans-1,3-Dichloropropene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5170	Trichloroethene	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5175	Trichlorofluoromethane	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5225	Vinyl Acetate	8260B/C	Approved
Volatiles - Medium Level	PT-VOA-WP	5235	Vinyl chloride	8260B/C	Approved

Volatiles - Medium Level	PT-VOA-WP	5260	Xylenes, total	8260B/C	Approved
Base Neutral Acids	PT-BNAs-WP	6715	1,2,4,5-Tetrachlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5155	1,2,4-Trichlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	4610	1,2-Dichlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	4615	1,3-Dichlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	4620	1,4-Dichlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6380	1-Methylnaphthalene	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	6735	2,3,4,6-Tetrachlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6835	2,4,5-Trichlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6840	2,4,6-Trichlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6000	2,4-Dichlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6130	2,4-Dimethylphenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6175	2,4-Dinitrophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6185	2,4-Dinitrotoluene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6005	2,6-Dichlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6190	2,6-Dinitrotoluene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5795	2-Chloronaphthalene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5800	2-Chlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6385	2-Methylnaphthalene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6400	2-Methylphenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6460	2-Nitroaniline	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6490	2-Nitrophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP		3 & 4-Chlorophenol	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	6410	3 & 4-Methylphenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5945	3,3'-Dichlorobenzidine	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6465	3-Nitroaniline	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6360	4,6-Dinitro-2-methylphenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5660	4-Bromophenyl-phenyl ether	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5700	4-Chloro-3-methylphenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5745	4-Chloroaniline	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5825	4-Chlorophenyl-phenyl ether	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6470	4-Nitroaniline	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6500	4-Nitrophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5500	Acenaphthene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5505	Acenaphthylene	8270C	Approved
Base Neutral Acids		5510	Acetophenone	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	5545	Aniline	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5555	Anthracene	8270C	Approved
Base Neutral Acids			Azobenzene/1,2-Diphenylhydra	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	5595	Benzidine	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5575	Benzo(a)anthracene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5580	Benzo(a)pyrene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5585	Benzo(b)fluoranthene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5590	Benzo(g,h,i)perylene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5600	Benzo(k)fluoranthene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5610	Benzoic acid	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5630	Benzyl alcohol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5760	Bis(2-chloroethoxy)methane	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5765	Bis(2-chloroethyl)ether	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5780	Bis(2-chloroisopropyl)ether	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6255	Bis(2-ethylhexyl)phthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5670	Butylbenzylphthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5680	Carbazole	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5855	Chrysene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5895	Dibenzo(a,h)anthracene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5905	Dibenzofuran	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6070	Diethylphthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6135	Dimethylphthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5925	Di-n-butylphthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6200	Di-n-octylphthalate	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6265	Fluoranthene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6270	Fluorene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6275	Hexachlorobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	4835	Hexachlorobutadiene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6285	Hexachlorocyclopentadiene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	4840	Hexachloroethane	8270C	Approved
Base Neutral Acids		6295	Hexachloropropene	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	6315	Indeno(1,2,3-cd)pyrene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6320	Isophorone	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5005	Naphthalene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	5015	Nitrobenzene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6530	N-Nitrosodiethylamine	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6545	N-Nitrosodimethylamine	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6545	N-Nitroso-di-n-propylamine	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6535	N-Nitrosodiphenylamine & Diphn	8270C	Approved
Base Neutral Acids		6565	N-Nitrosopyrrolidine	8270C	other-than PT
Base Neutral Acids	PT-BNAs-WP	6605	Pentachlorophenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6615	Phenanthrene	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6625	Phenol	8270C	Approved
Base Neutral Acids	PT-BNAs-WP	6665	Pyrene	8270C	Approved

Base Neutral Acids	PT-BNAs-WP	5095	Pyridine	8270C	Approved
Pesticides	PT-PEST-WP	7025	Aldrin	8081B	Approved
Pesticides	PT-PEST-WP	7110	alpha-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7115	beta-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7105	delta-BHC	8081B	Approved
Pesticides	PT-PEST-WP	7120	gamma-BHC (Lindane)	8081B	Approved
Pesticides	PT-PEST-WP	7240	alpha-Chlordane	8081B	Approved
Pesticides	PT-PEST-WP	7245	gamma-Chlordane	8081B	Approved
Pesticides	PT-PEST-WP	7355	DDD (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7360	DDE (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7365	DDT (4,4)	8081B	Approved
Pesticides	PT-PEST-WP	7470	Dieldrin	8081B	Approved
Pesticides	PT-PEST-WP	7510	Endosulfan I	8081B	Approved
Pesticides	PT-PEST-WP	7515	Endosulfan II	8081B	Approved
Pesticides	PT-PEST-WP	7520	Endosulfan sulfate	8081B	Approved
Pesticides	PT-PEST-WP	7540	Endrin	8081B	Approved
Pesticides	PT-PEST-WP	7530	Endrin aldehyde	8081B	Approved
Pesticides	PT-PEST-WP	7535	Endrin ketone	8081B	Approved
Pesticides	PT-PEST-WP	7685	Heptachlor	8081B	Approved
Pesticides	PT-PEST-WP	7690	Heptachlor Epoxide (beta)	8081B	Approved
Pesticides	PT-PEST-WP	7810	Methoxychlor	8081B	Approved
Chlordane	PT-CHLR-WP	7250	Chlordane (total)	8081B	Approved
Toxaphene	PT-TXP-WP	8250	Toxaphene (total)	8081B	Approved
PCBs in Water	PT-PCBW-WP	8880	Aroclor 1016	8082A	Approved
PCBs in Water	PT-PCBW-WP	8885	Aroclor 1221	8082A	Approved
PCBs in Water	PT-PCBW-WP	8890	Aroclor 1232	8082A	Approved
PCBs in Water	PT-PCBW-WP	8895	Aroclor 1242	8082A	Approved
PCBs in Water	PT-PCBW-WP	8900	Aroclor 1248	8082A	Approved
PCBs in Water	PT-PCBW-WP	8905	Aroclor 1254	8082A	Approved
PCBs in Water	PT-PCBW-WP	8910	Aroclor 1260	8082A	Approved
PAHs - Low Level	PT-PAH-WP	5500	Acenaphthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5505	Acenaphthylene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5555	Anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5575	Benzo(a)anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5585	Benzo(b)fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5600	Benzo(k)fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5590	Benzo(g,h,i)perylene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5580	Benzo(a)pyrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5855	Chrysene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5895	Dibenz(a,h)anthracene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6265	Fluoranthene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6270	Fluorene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6315	Indeno(1,2,3-cd)pyrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	5005	Naphthalene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6615	Phenanthrene	8310	Approved
PAHs - Low Level	PT-PAH-WP	6665	Pyrene	8310	Approved
Explosives	PT-EXP-WP	9303	2-Amino-4,6-dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9306	4-Amino-2,6-dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	6160	1,3-Dinitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	6185	2,4-Dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	6190	2,6-Dinitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9522	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)	8330A/B	Approved
Explosives	PT-EXP-WP	5015	Nitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	9507	2-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9510	3-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9513	4-Nitrotoluene	8330A/B	Approved
Explosives	PT-EXP-WP	9432	RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)	8330A/B	Approved
Explosives	PT-EXP-WP	6415	Tetryl (Methyl-2,4,6-trinitrophenylnitramine)	8330A/B	Approved
Explosives	PT-EXP-WP	6885	1,3,5-Trinitrobenzene	8330A/B	Approved
Explosives	PT-EXP-WP	9651	2,4,6-Trinitrotoluene	8330A/B	Approved
Explosives		6150	3,5-Dinitroaniline	8330A/B	Approved
Explosives			PETN	8330A/B	Approved
Explosives			Nitroguanidine	8330A/B	other-than PT
Explosives		6485	Nitrioglycerine	8332	other-than PT
Nitrocellulose			Nitrocellulose	ACOE ERDC	other-than PT
Volatile Fatty Acid			Acetic acid	9056M	other-than PT
Volatile Fatty Acid			Butyric acid	9056M	other-than PT
Volatile Fatty Acid			Formic acid	9056M	other-than PT
Volatile Fatty Acid			Lactic acid	9056M	other-than PT
Volatile Fatty Acid			Propionic acid	9056M	other-than PT
Volatile Fatty Acid			Pyruvic acid	9056M	other-than PT
Glycol			Ethylene glycol	8015B	other-than PT
Glycol			Propylene glycol	8015B	other-than PT
Gasoline in Soil	PT-GAS-USTW	8260B	Gasoline - EPA 8015B	8015B	Approved
Diesel in Soil	PT-DIES-USTW	8015B	Diesel - EPA 8015B	8015B	Approved

	DoD ELAP -- PT Performance Summary Review				
Lab Name :	**CT Laboratories**				**Air ONLY**
City/State :	Baraboo, WI				
PT Provider Used :	ERA & Wibby Environmental				
PartName	PartNumber	NELACCode	AnalyteName	EPAmethod#	Analyte Approvals
			Benzene	NIOSH 1500	other-than PT
			Ethylbenzene	NIOSH 1500	other-than PT
			Toluene	NIOSH 1500	other-than PT
			Xylenes	NIOSH 1500	other-than PT

ATTACHMENT F
MUNITIONS CONSTITUENTS SAMPLING RATIONALE

MC Sampling Rationale

This attachment presents the proposed list of munitions constituents (MCs) to be analyzed in samples to be collected at the seven Munitions Response Sites (MRSs) included in the *Work Plan Addendum for Military Munitions Response Program Remedial Investigation Environmental Services, Ravenna Army Ammunition Plant*; hereafter referred to as the "work plan addendum."

Sampling of groundwater is not proposed for the Military Munitions Response Program (MMRP) investigation activities at the Ravenna Army Ammunition Plant (RVAAP). The physical properties of MC (i.e., metals, explosives) associated with the munitions and explosives of concern (MEC) items used or manufactured at the RVAAP indicate that associated MC generally have limited mobility because of their tendency to bind to organic matter or biodegrade. In addition, based on historical and survey data, groundwater assessment for impact from past munitions-related activities is not warranted under the MMRP unless investigations indicate significant soil contamination. Therefore, the proposed investigated media for the MRSs is currently surface soil, wet sediment and surface water; however, MC investigation may also include sampling and analysis of subsurface soil and dry sediment depending on the results for the investigation of MEC/MD.

The first step is to identify the likely MEC used or manufactured at the RVAAP MRSs while they were active. Due to the lack of historical documentation at RVAAP, Shaw could not exclude potential MEC items used/produced at RVAAP from the MRSs, with the exception of the 40mm Firing Range and Block D Igloo–TD MRSs. **Table 1** presents the list of potential munitions that were identified based on either historical information or physical evidence of MEC, munitions debris (MD) or discarded military munitions (DMM) presented in the Archives Search Report (ASR) and/or the Site Inspection (SI) Report (e^2M, 2008) that were prepared for the US Army Corps of Engineers, Baltimore District. **Tables 2** and **3** present the potential munitions at the 40mm Firing Range and Block D Igloo–TD MRSs, respectively. Based on the available information, Shaw was able to determine the potential MEC items at these MRSs. **Tables 1** through **3** also present information on the MCs in the fillers and bodies/casings of the munitions used or potentially used (based on historical records review) at RVAAP that may be found during the field investigation.

Background Assessment Geochemical Analysis

In addition to evaluating the MCs associated with the MEC historically used at each MRS, several additional metals are proposed for analysis of soil, sediment, and surface water samples collected during the RI for use in the geochemical evaluation of background metals. Aluminum, calcium, iron, magnesium, and manganese are typically used as reference elements for geochemical evaluation for soil and sediment. Several of these metals (e.g., aluminum,

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Demolition Materials					
Fuse, Blasting, Time	M700	Weight Unknown	Black Powder	TM 43-0001-38	N/A
		Weight Unknown	Jute and Cotton Yarn, Bitumen and Plastic		
Fuse, Blasting, Time	Safety Fuse	Weight Unknown	Black Powder	TM 43-0001-38	N/A
		Weight Unknown	Fiber Cord		
Igniter, Time, Blasting, Fuse, Waterproof	M60	< 1 oz	M2 Percussion Primer	TM 43-0001-38	N/A
		Weight Unknown	Nylon Body, Steel Components		
Igniter, Time, Blasting, Fuse, Waterproof	M2	< 1 oz	M2 Percussion Primer	TM 43-0001-38	N/A
		Weight Unknown	Metal Body and Components		
Primer, Percussion	M2	< 1 oz	Primer Mixture, Lead Styphnate; Tetracene; Barium Nitrate; Antimony Sulfide; Powdered Zirconium; Lead Oxide	TM 43-0001-38	N/A
		Weight Unknown	Copper Housing		
Cord Detonating	Cord Detonating	Varies	PETN	TM 43-0001-38	N/A
		Weight Unknown	Cotton Tube, Asphalt Layer, Rayon Liner, Polyethylene Coating		
Cap, Blasting, Electric	M6	< 1 oz	Ignition Charge, Smokeless Powder	TM 43-0001-38	N/A
		< 1 oz	Intermediate Charge, Lead azide		
		< 1 oz	Base Charge, RDX		
		< 1 oz	Aluminum Alloy Cup, Copper Lead Wires		
Cap, Blasting, Non-Electric	M7	< 1 oz	Ignition Charge, Lead Styphnate	TM 43-0001-38	N/A
		< 1 oz	Intermediate Charge, Lead azide		
		< 1 oz	Base Charge, RDX		
		< 1 oz	Aluminum Alloy Cup		
Charge, Demolition, Block	TNT	Varies	TNT	TM 43-0001-38	N/A
		Varies	Cardboard		
Charge, Demolition, Block	M2	2.5-lb	Tetrytol	TM 43-0001-38	N/A
		Weight Unknown	Asphalt-Impregnated Paper		
Charge, Demolition, Block	M3	2.25 lb	Comp C2 or C3	TM 43-0001-38	N/A
		Weight Unknown	Glazed Paper		
Charge, Demolition, Block	M5 & M5A1	2.2 lb	Comp C3 or C4	TM 43-0001-38	N/A
		Weight Unknown	Plastic Container		
Charge, Demolition, Block	M112	1.25 lb	Comp C4	TM 43-0001-38	N/A
		Weight Unknown	Mylar Film Bag with Adhesive Tape		
Charge, Demolition, Block (Flex-X Sheet Explosives)	M118	2.25-lb	PETN or RDX	TM 43-0001-38	N/A
		Weight Unknown	Mylar		
Fuzes					
Fuze, Bomb, Nose	AN-M103	< 1 oz	Primer: Potassium Chlorate, Lead Sulfocyanate	CSOIII, OP 1664	N/A
		< 1 oz	Relay/Delay, Black Powder		
		< 1 oz	Detonator, Lead Azide and Tetryl		
		< 1 oz	Booster lead, Tetryl		
		1.9 oz	Booster Charge, Tetryl		
		3.0 lb	Body Steel with some Brass Components		
Fuze, Bomb, Nose	AN-M104	< 1 gram	Primer: Potassium Chlorate, Lead Thiocyanate Calcium Silicate, Antimony Sulfide, Lead Azide, Lead Styphnate	CSOIII, OP 1664	N/A
		< 1 oz	Delay Pellet, Black Powder		
		< 1 oz	Booster lead, Tetryl		
		< 1 oz	Booster, Tetryl		
		4 oz	Aluminum Alloy Body, Cadmium-Plated Components		
Fuze, Bomb, Nose	M108	< 1 gram	Primer: Potassium Chlorate, Lead Thiocyanate Calcium Silicate, Antimony Sulfide, Lead Azide, Lead Styphnate	CSOIII, OP 1664	N/A
		< 1 oz	Detonator, Lead Azide and Tetryl		
		1.5 lb	Brass Body, Cadmium-Plated Components		
Fuze, Bomb, Nose	AN-M110 Series	< 1 gram	Primer: Potassium Chlorate, Lead Thiocyanate Calcium Silicate, Antimony Sulfide, Lead Azide, Lead Styphnate	CSOIII, OP 1664, TM 9-1904, TM 9-1980	N/A
		< 1 gram	Detonator: Lead Azide, Tetryl		
		0.6 oz	Booster: Tetryl		
		1.0 lb	Aluminum Body, Steel components		
Fuze, Bomb, Nose	AN-M111 Series	< 1 oz	Detonator: Potassium Chlorate, Lead Sulfocyanate	CSOIII, OP 1664	N/A
		0.2 oz	Booster Charge, Black Powder		
		1.1 lb	Aluminum Body, Steel components		
Fuze, Bomb, Nose	AN-M120 Series	< 1 gram	Primer: Potassium Chlorate, Lead Thiocyanate Calcium Silicate, Antimony Sulfide, Lead Azide, Lead Styphnate	CSOIII, OP 1664	N/A
		< 1 oz	Delay Pellet, Black Powder		
		< 1 oz	Booster lead, Tetryl		
		0.6 oz	Booster, Tetryl		
		1.4 lb	Aluminum Alloy Body, Cadmium-Plated Components		
Bombs (up to 500lbs)					
Bomb, Fragmentation, 20-lb	AN-M41	2.7-lb	TNT	CSOIII	AN-M110A1
		20.8-lb	Bomb Body and Fin Assembly, Steel		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Bomb, Fragmentation, 23-lb	AN-M40	2.7-lb	TNT	CSOIII	AN-M104; AN-M120
		16.5-lb	Bomb Body and Fin Assembly, Steel		
Bomb, Fragmentation, 23-lb	M72	2.7-lb	TNT	CSOIII	AN-M104; AN-M120
		20.8-lb	Bomb Body and Fin Assembly, Steel		
Bomb, Photoflash	AN-M46	25-lb	Photoflash Powder	TM 9-1980, TM 9-1325-200	AN-M111A1
		0.317 oz	Booster, Black Powder		
		50-lb	Bomb Body and Fin Assembly, Steel		
Bomb, Incendiary, 100-lb	AN-M47A1, AN-M47A2	40-lb	IM or NP	TM 9-1980, TM 9-1325-200	M108, AN-M126A1
		1.6-lb	AN-M9 Igniter, White Phosphorous (WP) or Sodium (Na)		
		Weight Unknown	AN-M9 Igniter, Steel Tube		
		70 grams	AN-M13 Burster, TNT and Tetryl		
		Weight Unknown	AN-M13 Burster, Plastic Tube		
		29-lb	Steel Bomb Body		
Bomb, Smoke, PWP	AN-M47A3	74-lb	Plasticized White Phosphorous	TM 9-1325-200	AN-M159, AN-M126A1
		250 grams	AN-M20 Burster, Tetryl		
		Weight Unknown	AN-M20 Burster, Paper Tube		
		31-lb	Sheet Steel		
Bomb, General Purpose, 100-lb	AN-M30A1	1.27-lb	Adapter-Booster, M102A1 - Tetryl	CSOIII; TM 9-1904;TM 9-1325-200	AN-M103A1 (nose); AN-M100A1/2 (tail)
		0.5-lb	Booster, Auxiliary, M104 - Tetryl		
		54-lb	Amatol or		
		57-lb	TNT		
		64-lb	Tritonal		
		54.3-lb	Bomb Body and Fin Assembly, Steel		
Bomb, General Purpose, 250-lb	AN-M57A1	1.27-lb	Adapter-Booster, Tail, M102A1	CSOIII; TM 9-1904;TM 9-1325-200	AN-M103A1 (nose); AN-M100A2 (tail)
		1.0-lb	Booster, Auxiliary, M104, 2 ea - Tetryl		
		98-lb & 22-lb	Amatol and TNT or		
		125-lb	TNT		
		123-lb	Tritonal		
		129.5-lb	Bomb Body and Fin Assembly, Steel		
Bomb, General Purpose, 500-lb	AN-M65A1	0.265-lb	Adapter-Booster, Tail, M115A1	CSOIII; TM 9-1904;TM 9-1325-200	AN-M103A1 (nose); AN-M100A2 (tail)
		1.0-lb	Booster, Auxiliary, M104, 2 ea - Tetryl		
		236-lb & 24-lb	Amatol and TNT or		
		260-lb	TNT		
		283-lb	Tritonal		
		252-b	Bomb Body and Fin Assembly, Steel		
Bomb, Incendiary, 100-lb	AN-M47A4	1.6 lb	Ignitor, White Phosphorous or Na	TM 9-1980	AN-M126A1
		15.34 oz	Burster, Black Powder and Magnesium		
		40 lb	Filler, IM or NP		
		50 lb	Body, Steel		
Bomb, Incendiary, 4 lb	AN-M50	24 oz	Nose, Steel	TM 9-1980	N/A
		20 oz	Body, Magnesium Alloy		
		10 oz	Thermate		
		< 1 oz	First Fire Mixture		
		< 1 oz	Primer		
Bomb, Incendiary, 6 lb	AN-M69	5.64 oz	Igniting Charge, White Phosphorous	TM 9-1980	M1
		1 oz	Expelling Charge, Black Powder		
		2.8 lb	Filler, IM or NP		
Bomb, Incendiary, 10 lb	M74	6.0 oz	Igniting Charge, White Phosphorous	TM 9-1980	M142
		1 oz	Expelling Charge, Black Powder		
		2.7 lb	Filler, IM or NP		
Bomb Explosive Components (Boosters and Bursters)					
Adapter Booster, Bomb	M102	1.27-lb	Tetryl	TM 9-1904	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		
Adapter Booster, Bomb	M115	0.265-b	Tetryl	TM 9-1904	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		
Adapter Booster, Bomb	M117	0.29-lb	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		
Adapter Booster, Bomb	M126A1 (T45E1)	0.43-lb	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		
Adapter Booster, Bomb	T46E4	0.26-lb	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		
Adapter Booster, Bomb	T59	6 grams	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Steel and may be zinc or cadmium plated		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Auxiliary Booster, Bomb	M104	0.5-lb	Tetryl	TM 9-1904	N/A
		Weight Unknown	Bakelite Body		
Auxiliary Booster, Bomb	Mk 1 Mod 0	180 grams	TNT	TM 9-1325-200	N/A
		Weight Unknown	Chipboard Tube		
Auxiliary Booster, Bomb	Mk 4 Mod 0	63.0 grams	TNT	TM 9-1325-200	N/A
		Weight Unknown	Chipboard Tube		
Primer Detonator	M14	< 1 gram	Primer - Potassium Chlorate; Lead Sulfocyanate	TM 9-1325-200	N/A
		< 1 gram	Delay - Black Powder		
		< 1 gram	Relay/Detonator Lead Azide and Tetryl		
		Weight Unknown	Steel Body		
Primer Detonator	M16/M16A1	< 1 gram	Primer - Potassium Chlorate; Lead Sulfocyanate	TM 9-1325-200	N/A
		< 1 gram	Igniter Charge - Black Powder		
		< 1 gram	Delay - Black Powder		
		< 1 gram	Relay/Detonator Lead Azide and Tetryl		
		Weight Unknown	Steel Body		
Burster, Bomb	AN-M12	435 grams	Black Powder and Magnesium	TM 9-1325-200	N/A
		Weight Unknown	Plastic or Aluminum Tube		
Burster, Bomb	AN-M13	70 grams	TNT and Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Plastic Tube		
Burster, Bomb	AN-M18	250 grams	Black Powder	TM 9-1325-200	N/A
		Weight Unknown	Plastic Tube		
Burster, Bomb	AN-M20	250 grams	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Paper Tube		
Burster, Bomb	M31	250 grams	Tetryl	TM 9-1325-200	N/A
		Weight Unknown	Fiber Tube		
Burster, Bomb	M32	15.0-lb	Composition B	TM 9-1325-200	N/A
		Weight Unknown	Fiber Tube		
			Flares, Signals, Simulators, Obscurant Smokes		
Flare, Aircraft, Parachute	AN-M9	< 1 gram	Primer, Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide	TM 9-1981, TM 9-1370-200	N/A
		30 grains	Expelling Charge, Black Powder		
		15.43 grains	Propelling Charge, Black Powder		
		1.2 lb	Illuminant Composition		
		1.0 lb	Aluminum Body		
Flare, Surface, Trip	M49A1	5.0 oz	Illuminant Composition	TM 9-1981, TM 9-1370-200	N/A
		< 1 gram	Primer, Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide		
		< 1 oz	First Fire Composition		
		1.6 Oz	Ignition Pellet		
		5 oz	Aluminum Alloy and Steel Components		
Signal, Ground, Parachute	M7A1	< 1 oz	Propelling Charge, Black Powder	TM 9-1981, TM 9-1370-200	N/A
		< 1 oz	Time Train, Black Powder		
		< 1 oz	First Fire Composition		
		0.16 lb	Illuminant Composition		
		.85 lb	Aluminum		
Signal, Illumination, Ground, Parachutes, Red Star; White Star ; & Green Star	M126A1; M127A1; M195	< 1 oz	Primer - Potassium Chlorate; Lead Sulfocyanate	TM 9-1981, TM 9-1370-200	N/A
		0.026 oz	Initiating Charge - Black Powder		
		0.026 oz	Expelling Charge - Black Powder		
		1.38 oz	Propelling Charge - Black Powder		
		3.2 oz	Illumination Compositions		
		1.0 lb	Aluminum		
Simulator, Ground Burst	M115A2	< 1 oz	Fuse - Black Powder	TM 9-1981, TM 9-1370-200	N/A
		0.14-lb	Photoflash Powder		
		0.16-lb	Body - Paper		
Simulator, Hand Grenade	M116/M116A1	< 1 oz	Fuse - Black Powder	TM 9-1981, TM 9-1370-200	N/A
		1.25 oz	Photoflash Powder		
		0.16-lb	Body - Paper		
Simulator, Flash, Artillery	M110	0.19-lb	Photoflash Powder	TM 9-1981, TM 9-1370-200	N/A
		0.57-lb	Black Plastic		
Smoke, Pot, HC	M1	10 lb	HC-C Smoke Mixture	TM 9-1370-200	N/A
		2 oz	Starter Mixture		
		2.5 lb	Sheet Steel		
Firecracker	M80	3 grams	Potassium Perchorate; Aluminum; Sulfur; Antimony Sulfide	TM 9-1981, TM 9-1370-200	N/A
		< 1 gram	Fuse - Black Powder		
			Hand Grenades		
Grenade, Hand, Fragmentation	Mk IIA1	0.74-lb	EC Smokeless Powder	CSOIII	M10A3
		19.4-lb	Cast Iron		

Table 1
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MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Grenade, Hand, Fragmentation	Mk II	2.0 oz	TNT	CSOIII	M10A3
		19.4-lb	Cast Iron		
Grenade, Hand, Practice	Mk II	0.1 oz	Black Powder	CSOIII	M10A3
		19.4-lb	Cast Iron		
Grenade, Hand, Offensive	MK IIIA1	6.83 oz	TNT	CSOIII	M6A3
		6.17 oz	Steel		
Grenade, Hand, Irritant, CN-DM	M6	10.25 oz	CN-DM Filler	TM 43-0001-29	M10A3
		7.2 oz	Steel		
Grenade, Hand, Smoke	AN-M8	19.0 oz	HC Smoke Mixture	TM 43-0001-29	M201A1
		5 oz	Steel		
Grenade, Hand, TH-3	AN-M14	26.5 oz	Thermite - TH3	TM 43-0001-29	M201A1
		5 oz	Steel		
Grenade, Hand, Smoke	M18	11.5 oz	Smoke Mixture	TM 43-0001-29	M201A1
		5 oz	Steel		
Grenade, Hand, Smoke, WP	M34	15 oz	White Phosphorous (WP)	TM 43-0001-29	M206A2
		9 oz	Steel		
Grenade, Hand, Smoke, WP	M15	15 oz	White Phosphorous (WP)	TM 43-0001-29	M206A1
		< 1 gram	Primer, Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide		
		< 1 gram	Delay Element, Black Powder		
		< 1 oz	Detonator, Lead Azide, Lead Styphnate and RDX		
		5 oz	Grenade Body Steel; Fuze Body Aluminum and Steel		
Grenade, Hand, Smoke, WP	M34	15 oz	White Phosphorous (WP)	TM 43-0001-29	M206A2
		< 1 gram	Primer, Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide		
		< 1 gram	Delay Element, Black Powder		
		< 1 oz	Detonator, Lead Azide, Lead Styphnate and RDX		
		8 oz	Grenade Body Steel; Fuze Body Aluminum and Steel		
Grenade, Hand, Riot, CN	M7	10.25 oz	CN Filler	TM 43-0001-29	M201A1
		7.2 oz	Steel		
Grenade, Hand, Riot, CS	M7A3	10.25 oz	CS Mixture	TM 43-0001-29	M201A1
		7.2 oz	Steel		
40mm Grenades					
Cartridge, 40mm, HE	M381	32 grams	Comp B	TM 43-0001-28	M522
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, Practice	M382	4.54 grams	Filler, Yellow Dye	TM 43-0001-28	M522
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, Practice	M385	330 mg	Propelling Charge, M9	TM 43-0001-28	N/A
		< 1 gram	Percussion Primer, M42		
		300 grams	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, HE	M386	32 grams	Comp B	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, HE	M406	32 grams	Comp B	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Cartridge, 40mm, Practice	M407	< 1 oz	Filler, Smoke Pellets	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, Practice	M781	Weight Unknown	Filler, Orange Dye	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		6 oz	Projectile Body and Cartridge Case, Aluminum and/or Plastic		
Landmines					
Mine, Antitank, High Explosive	M1	6.0-lb	TNT	CSOIII; TM 9-1940	M1
		3.73-lb	Steel		
Mine, Antitank, High Explosive	M1A1	5.83-lb	TNT	CSOIII; TM 9-1940	M1A2
		3.73-lb	Steel		
Mine, Antitank, High Explosive	M4	5.83-lb	TNT	CSOIII; TM 9-1940	M1A2
		3.73-lb	Steel		
Mine, Antitank, High Explosive, Non-Metallic	M5	5.4-LB	TNT or Tetrytol	CSOIII; TM 9-1940	M5
		9.6-lb	Glass or Ceramic		
Mine, High Explosive Antitank, Heavy	M6	12-lb	TNT	TM 9-1900	M603
		8-lb	Steel		
Mine, High Explosive Antitank, Heavy	M15	22-lb	Comp B	TM 9-1900; TM 43-0001-36	M603
		9-lb	Steel		
Mine, High Explosive, Antitank, Non-Metallic	M19	21-lb	Comp B	TM 9-1900; TM 43-0001-36	M606
		6-lb	Plastic		
Mine, High Explosive, Antitank, Light	M7	3.6-lb	Tetrytol	TM 9-1900	M603
		1.5-lb	Steel		
Mine, Anti-Personnel	M2A3	0.34-lb	TNT	CSOIII; TM 9-1940	M2
		0.09 oz	Propelling Charge - Black Powder		
		6.82-lb	Cast Iron		
Mine, Anti-Personnel	M3	0.9-lb	TNT	CSOIII; TM 9-1940	M1
		8.5-lb	Cast Iron		
Mine, Antitank, Practice	M1	0.02 oz	Red Phosphorous	CSOIII; TM 9-1940	M1A2
		10.5-lb	Steel and Cast Iron		
Mine, Antitank, Practice	M1B1	0.02 oz	Red Phosphorous	CSOIII; TM 9-1940	M1A2
		3.73-lb	Steel		
Mine, Anti-Personnel	M16	1.3-lb	Main Charge - TNT	TM 9-1900; TM 43-0001-36	M605
		0.4 oz	Booster Charge - Comp A5		
		0.01 oz	Detonator - Lead Azide		
		0.01 oz	Delay - Lead Styphnate		
		0.01 oz	Delay - Black Powder		
		7.75-lb	Steel and Cast iron		
Mine, Anti-Personnel, Non-Metallic	M14	1.0 oz	Main Charge - Tetryl	TM 9-1900; TM 43-0001-36	Integral
		0.01 oz	M46 Detonator - Lead Azide and RDX		
		3.5 oz	Plastic		
Mortars					
Mortar, High Explosive (HE), 60mm	M49A2	0.34-lb	TNT	CSOIII; TM 9-1904; TM 43-0001-28	M52
		2.27-lb	Cast or Forged Steel		
Mortar, Practice, 60mm	M50A2	0.04-lb	Black Powder	CSOIII; TM 9-1904; TM 43-0001-28	M52
		2.27-lb	Cast or Forged Steel		
Mortar, Illumination, 60mm	M83	0.49-lb	Illuminant Charge	TM 43-0001-28	M65A1
		0.06-lb	Expelling Charge - Black Powder		
		2.7-lb	Steel		
Mortar, Smoke, WP, 60mm	M302	0.75-lb	White Phosphorous (WP)	TM 43-0001-28	M527
		0.38 oz	Burster M9 - Tetryl		
		2.97-lb	Steel		
Mortar, High Explosive, 81mm	M43A1	1.29-lb	Comp B	TM 9-1904; TM 43-0001-28	M52
		5.56-lb	Steel		
Mortar, Practice, 81mm	M43	24.8 gr	Black Powder	TM 9-1904; TM 43-0001-28	M52
		5.56-lb	Steel		
Mortar, High Explosive, 81mm	M45	4.48-lb	TNT	TM 9-1904	M45
		10.1-lb	Steel		
Mortar, High Explosive, 81mm	M56	4.43-lb	TNT	CSOIII; TM 9-1904	M53
		5.83-lb	Steel		

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MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Mortar, Smoke, WP, 81mm	M57	4.04-lb	White Phosphorous (WP)	CSOIII; TM 9-1904	M52
		0.08-lb	Burster M1 - Tetryl		
		10.8-lb	Steel		
Mortar, Smoke, FS, 81mm	M57	4.59-lb	FS Smoke Mixture	CSOIII; TM 9-1904	M52
		0.08-lb	Burster M1 - Tetryl		
		10.8-lb	Steel		
Mortar, Illumination, 81mm	M301A1	1.37-lb	Illuminant Charge	TM 43-0001-28	M84
		7.58-lb	Steel		
Mortar, Smoke, PWP or WP, 4.2 Inch	M2A1	7.5-lb	White Phosphorous (WP)	TM 43-0001-28	M84
		0.75 oz	Burster M14 - Tetryl		
		15.5-lb	Steel		
Mortar, High Explosive, 4.2 Inch	M3A1	7.8-lb	TNT	TM 43-0001-28	M557
		0.385-lb	Supplemtary Charge - TNT		
		17.2-lb	Steel		
Mortar, High Explosive, 4.2 Inch	M329	7.08-lb	TNT	TM 43-0001-28	M557
		0.385-lb	Supplemtary Charge - TNT		
		17.7-lb	Steel		
Medium Caliber Projectiles					
Projectile, 20mm, Target Practice	M55A2	< 1 oz	Primer	TM 43-0001-28	N/A
		605 gr	Propellant, Double Base		
		4.0 oz	Proectile Body, Steel		
		0.64 oz	Nose, Aluminum or Steel		
Projectile, 20mm, Ball	Mk I	< 1 oz	Primer	TM 43-0001-28	N/A
		507 gr	Propellant, Double Base		
		2030 oz	Proectile Body, Steel		
Projectile, 20mm, Target Practice	M99	< 1 oz	Primer	TM 43-0001-28	N/A
		500 gr	Propellant, Double Base		
		40. oz	Projectile Body, Steel		
		0.64 oz	Nose, Aluminum orZinc		
Projectile, 20mm, High Explosive, Incendiary	M58	< 1 oz	Primer	TM 43-0001-28	N/A
		605 gr	Propellant, Double Base		
		4.0 oz	Proectile Body, Steel		
		20 gr	Filler, Incendiary Mixture		
		165 gr	RDX		
Projectile, 25mm, Target Practice	M793	< 1 oz	Primer	TM 43-0001-28	N/A
		4.8 oz	Propellant, Double Base		
		8 oz	Body, Steel		
Projectile, 25mm, High Explosive Incendiary	M792	< 1 oz	Primer	TM 43-0001-28	M758
		90 gr	Propellant, Double Base		
		32 gr	HEI mixture		
		8 oz	Body, Steel		
Projectile, 30mm, Target Practice	PGU-15/B	< 1 oz	Primer	TM 43-0001-28	N/A
		5.1 oz	Propellant, Double Base		
		13.3 oz	Body, Steel		
Large Caliber Rounds					
Rounds for 37mm Automatic Gun, M4 (Aircraft)					
Shell, High Explosive, 37mm	M54	< 1 oz	Tracer	CSOIII	M56
		0.10-lb	Tetryl		
		1.24-lb	Steel		
Shot, Armor Piercing (AP), 37mm	M80	< 1 oz	Tracer	CSOIII	N/A
		1.66-lb	Steel		
Shell, Practice, 37mm	M55A1	< 1 oz	Tracer	CSOIII	M50 Dummy
		1.34-lb	Steel		
Rounds for 37mm Antitank Gun, M3A1 and Tank Guns M5A1 and M6					
Shot, Armor Piercing (AP), 37mm	M51B1	< 1 oz	Tracer	CSOIII	N/A
		1.92-lb	Steel		
Shot, Armor Piercing (AP), 37mm	M51B2	< 1 oz	Tracer	CSOIII	N/A
		1.92-lb	Steel		
Shell, High Explosive, 37mm	M63	0.085-lb	TNT	CSOIII	M58
		1.61-lb	Steel		
Canister, 37mm	M2	1.94-lb	Lead Balls (122)	CSOIII	N/A
		1.55-lb	Steel Canister		
Rounds for 37mm Automatic Gun, M9 (Aircraft)					
Shell, High Explosive, 37mm	M54	< 1 oz	Tracer	CSOIII	M56
		0.10-lb	Tetryl		
		1.24-lb	Steel		

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Shot, Armor Piercing Capped (AP-C), 37mm	M59	< 1 oz	Tracer	CSOIII	N/A
		1.91-lb	Steel		
Shot, Armor Piercing (AP), 37mm	M80	< 1 oz	Tracer	CSOIII	N/A
		1.66-lb	Steel		
Shell, Practice, 37mm	M55A1	< 1 oz	Tracer	CSOIII	M50 Dummy
		1.34-lb	Steel		
Rounds for 40mm BOFORS Gun, M1 Anti-Aircraft					
Shell, High Explosive, Tracer, (S.D, M3), 40mm	Mk II	0.05-lb	Tetryl	CSOIII	Mk 27
		< 1 oz	Tracer, M3		
		2.06-lb	Steel		
Shell, High Explosive, Tracer, (S.D., No. 12), 40mm	Mk II	0.13-lb	TNT	CSOIII	Mk 27
		< 1 oz	Tracer, No.12		
		1.93-lb	Steel		
Shell, Armor Piercing (AP), 40mm	M81A1	< 1 oz	Tracer, M3	CSOIII	N/A
		1.96-lb	Steel		
Rounds for 57mm Gun, M1 Anti-Tank					
Shot, Armor-Piercing (AP), 57mm	M70	< 1 oz	Tracer	CSOIII	N/A
		6.28-lb	Steel		
Shot, Armor-Piercing-Capped (AP-C), 57mm	M86	0.018-lb	Tetryl	CSOIII	M72
		0.076-lb	Explosive D		
		7.27-lb	Steel		
Rounds for 75mm Guns					
Projectile, Armor Piercing Capped (AP-C), 75mm	M61	0.144-lb	Explosive D	CSOIII	M66A1
		14.96-lb	Steel		
Shell, Smoke, Base Ejection, 75mm	M89	1.68-lb	HC Smoke Composition	CSOIII	N/A
		4.93-lb	Steel Canister		
Projectile, Practice, 75mm	M48	1.47-lb	Inert filler	CSOIII; TM 43-0001-28	M48A2
		13.11-lb	Steel		
Projectile, High Explosive (HE), 75mm	M48	1.47-lb	TNT or	CSOIII	M48A2
		0.11-lb and 1.36-lb	TNT and Amatol		
		13.11-lb	Steel		
Projectile, Smoke, White Phosphorous (WP), 75mm	M64	1.01-oz	Burster, M8 - Tetrytol	CSOIII	M57
		15.25-lb	White Phosphorous (WP)		
		13.11-lb	Steel		
Projectile, High Explosive Anti Tank (HEAT), 75mm	M66	1.1-lb	Pentolite	CSOIII	M62
		13.27-lb	Steel		
Projectile, Shot, 75mm	M72	14.96-lb	Steel	CSOIII	N/A
Rounds for 3 inch Guns					
Projectile, Practice, 3 inch	M42A1	0.86-lb	Inert Filler	CSOIII; TM 43-0001-28	MkIIIA2
		12.65-lb	Steel		
Projectile, High Explosive, 3 inch	M42A1	0.86-lb	TNT	CSOIII	MkIIIA2
		12.65-lb	Steel		
Projectile, Armor-Piercing-Capped (AP-C), 3 inch	M62A1	0.144-lb	Explosive D	CSOIII	MkIIIA2
		15.3-lb	Steel		
Projectile, Shot, Armor-Piercing (AP), 3 inch	M79	15.0-lb	Steel	CSOIII	N/A
Shell, Smoke, 76mm	M88	1.68-lb	HC Smoke Composition	CSOIII	N/A
		4.93-lb	Steel Canister		
Rounds for 90mm Guns					
Projectile, Practice, 90mm	M71	2.04-lb	Inert filler	CSOIII; TM 43-0001-28	M43A5
		21.36-lb	Steel		
Projectile, High Explosive, 90mm	M71	2.04-lb	TNT	CSOIII	M43A5
		21.36-lb	Steel		
Projectile, Armor-Piercing-Capped (AP-C), 90mm	M82	0.31-lb	Explosive D	CSOIII	M68
		24.06-lb	Steel		
Projectile, Shot, 90mm	M77	23.04-lb	Steel	CSOIII	N/A
Rounds for 105mm Gun, M3 Antiaircraft					
Projectile, High Explosive, 105mm	M38A1	3.59-lb	TNT	CSOIII	M43A5
		29.18-lb	Steel		
Rounds for 105mm Howitzer					
Projectile, Practice, 105mm	M1	4.8-lb	Inert filler	CSOIII; TM 43-0001-28	M48A2
		28.2-lb	Steel		
Projectile, High Explosive, 105mm	M1	4.8-lb	TNT	CSOIII	M48A2
		28.2-lb	Steel		
Projectile, High Explosive Anti Tank (HEAT), 105mm	M67	2.93-lb	Pentolite	CSOIII	M62A1
		26.29-lb	Steel		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Projectile, Smoke, WP, 105mm	M60	4.10-lb	White Phosphorous (WP)	CSOIII	M57
		1331 gr	Burster, M5 - Tetryl		
		28.2-lb	Steel		
Projectile, Smoke, Base Ejection, 105mm	M84	0.14-lb	Expelling Charge - TNT	CSOIII	M54
		7.50-lb	Smoke Composition		
		25.23-lb	Steel		
Rounds for 4.5 Inch Guns					
Projectile, High Explosive, 4.5 Inch	M65	4.49-lb	TNT	CSOIII	M67A1
		50.40-l	Steel		
Rounds for 120mm Guns					
Projectile, High Explosive, 120mm	M73	5.26-lb	TNT	CSOIII	M61A1
		44.48-lb	Steel		
Rounds for6 Inch Guns					
Projectile, Armor-Piercing (AP), 6 Inch	MK XXXIII	2.17-lb	Explosive D	CSOIII	M60
		102.8-lb	Steel		
Projectile, High Explosive, 6 Inch	MKIIA2	13.98-lb	TNT	CSOIII	M51A3
		75.55-lb	Steel		
Rounds for 155mm Guns					
Projectile, High Explosive, 155mm	M101	15.13-lb	TNT	CSOIII	M51A3; M67A1
		79.5-lb	Steel		
Projectile, Armor-Piercing (AP), 155mm	M112B1	1.44-lb	Explosive D	CSOIII	M60
		98.6-lb	Steel		
Projectile, Smoke, WP, 155mm	M104	15.68-lb	White Phosphorous (WP)	CSOIII	M51A3
		0.36-lb	M6 Burster-Tetryl		
		82.14-lb	Steel		
Rounds for 155mm Howitzers					
Projectile, High Explosive, 155mm	M107	15.13-lb	TNT	CSOIII	M51A3; M67A1
		80.88-lb	Steel		
Projectile, High Explosive, 155mm	M102	15.13-lb	TNT	CSOIII	M51A3; M55A1
		79.9-lb	Steel		
Projectile, Smoke, Smoke (FS), 155mm	M110	11.70-lb	FS Smoke	CSOIII	M51A3
		0.36-lb	M6 Burster-Tetryl		
		82.15-lb	Steel		
Projectile, Smoke, WP, 155mm	M105	15.60-lb	White Phosphorous (WP)	CSOIII	M51A3
		0.36-lb	M6 Burster-Tetryl		
		81.72-lb	Steel		
Projectile, Smoke, Base Ejection, 155mm	M115	0.28-lb	Expelling Charge -Black Powder	CSOIII	M54
		15.16	Smoke Composition		
		79.44-lb	Steel		
Projectile, Smoke, Base Ejection, 155mm	M116	0.28-lb	Expelling Charge -Black Powder	CSOIII	M54
		15.16	Smoke Composition		
		79.66-lb	Steel		
Projectile, Shrapnel, 155mm	Mk I	0.28-lb	Expelling Charge -Black Powder	CSOIII	
		15.16	Lead Balls (800)		
		79.66-lb	Steel		
Tow/Dragon Missiles					
Missile, Surface-to Surface, Wire Guided (TOW)	BGM-71A/BGM-71B	27 g	Booster, PBX	TM 9-1300-200	Integral S&A Device
		5.30-lb	Main Charge, Octol		
		< 1 g	S&A Device, Detonator, Lead Azide/PETN		
		< 1 g	S&A Device, Piston Actuator, Mono-nitroresorcinate		
		5.9-lb	Flight Rocket Motor, Double-Base Propellant		
		16 g	Igniter, Pyrogen/Solid Propellant		
		20-lb	Body, Aluminum		
Missile, Surface-to Surface, Wire Guided (ITOW)	BGM-71C	27 g	Booster, PBXN-5	TM 9-1300-200	Integral S&A Device
		5.30-lb	Main Charge, HMX		
		< 1 g	Precision Initiating Coupler (PIC), PBXN-5		
		< 1 g	S&A Device, Detonator, Lead Azide/PETN		
		< 1 g	S&A Device, Piston Actuator, Mono-nitroresorcinate		
		5.9-lb	Flight Rocket Motor, Double-Base Propellant		
		16 g	Igniter, Pyrogen/Solid Propellant		
		20-lb	Body, Aluminum		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Missile, Surface-to Surface, Wire Guided (TOW2)	BGM-71E	2.5 oz	Probe Shaped Charge, PBXN-5	TM 9-1300-200	Integral S&A Device
		< 1 g	Precision Initiating Coupler (PIC), PBXN-5		
		< 1 g	S&A Device, Detonator, Lead Azide/PETN		
		< 1 g	S&A Device, Piston Actuator, Mono-nitroresorcinate		
		6.81-lb	Main Charge, LX-14		
		< 1 g	ISD Detonator, RDX		
		< 1 g	ISD Booster, CH-6		
		< 1 g	Transfer Line, Transfer Cord, HMX		
		< 1 g	Transfer Line, Ignition Strand, Potassium Perchlorate/Potassium Picrate		
		< 1 g	Output Charge, Boron Potassium Nitrate		
		11 g	Flight Motor Igniter, N14 Propellant		
		7.05-lb	Flight Motor, M7		
		< 1 gr	Thermal Battery, Lithium Lead Styphnate		
Missile, Antitank Assault Weapon, Dragon	Mk I	3 g	Booster, PBX Type I	TM 9-1300-200	Integral S&A Device
		3.80-lb	Main Charge, Octol		
		< 1 g	S & A Device, Piston Actuator, Solid Propellant		
		< 1 g	Detonator, PETN and Lead Azide		
		< 1 g	Lead Charge, CH-6		
		8 g each	Rocket Motors (60), HEN-12/M-36 Propellant		
		< 1 g each	Rocket Motor Igniters (60), Lead Styphante		
		< 1 g each	Squibs (4), Pyrotechnic Mixture		
Shaped Charges					
Charge, Demolition, Shaped, 15-lb	M2A3	9.5-lb	Comp B	TM 43-0001-38	N/A
		2.0-lb	Booster - Pentolite		
		1.5-lb	Fiber Container		
		2.0-lb	Glass Cone		
Charge, Demolition, Shaped, 15-lb	M2A4	11.3-lb	Comp B	TM 43-0001-38	N/A
		1.8 oz	Comp A3		
		1.5-lb	Fiber Container		
		2.0-lb	Glass Cone		
Charge, Demolition, Shaped, 40-lb	M3	28.3-lb	Comp B	TM 43-0001-38	N/A
		1.7-lb	Booster - Pentolite		
		1.5-lb	Fiber Container		
		2.0-lb	Glass Cone		
		6.5-lb	Tripod - Steel		
Charge, Demolition, Shaped, 40-lb	M3A1	29.75-lb	Comp B	TM 43-0001-38	N/A
		50 g	Comp A3		
		1.5-lb	Fiber Container		
		2.0-lb	Glass Cone		
		6.5-lb	Tripod - Steel		
Charge, Demolition, Shaped	Mk 74 Mod 1	140 gr	CH-6	TM 43-0001-38	N/A
		Weight Unknown	Liner - Copper		
		Weight Unknown	Container - Glass Filled Phenolic Plastic		
		Weight Unknown	Base - Plastic		
Charge, Demolition, Shaped, Linear, Flexible	Variable (grains per foot)	Varies (20. 30, 40, 60, 75 gpf)	CH-6	TM 43-0001-38	N/A
			Lead Alloy		
Charge, Demolition, Shaped, Linear, Flexible	Variable (grains per foot)	Varies (125, 225, 300, 400, 500, & 600 gpf)	CH-6	TM 43-0001-38	N/A
			Lead Alloy		
Charge, Demolition, Shaped, Clipped	M221	< 1 g	Lead Charge - RDX	TM 43-0001-38	N/A
		1.8 oz	Shape Charge - Comp A5		
		Weight Unknown	Body - Steel		
		Weight Unknown	Clip - Mild Steel		
Charge, Demolition, EOD	Mk 86 Mod 0	1.2 oz	CH-6	TM 43-0001-38	N/A
		Weight Unknown	Aluminum Housing		
Charge, Demolition, EOD	Mk 87 Mod 0	2.4 oz	CH-6	TM 43-0001-38	N/A
		Weight Unknown	Aluminum Housing		
Charge, Demolition, EOD	Mk 88 Mod 0	1 gr	CH-6	TM 43-0001-38	N/A
		Weight Unknown	Copper Cone		
		Weight Unknown	Aluminum Housing		
Charge, Demolition, EOD	Mk 89 Mod 0	7.9 oz	Comp A3	TM 43-0001-38	N/A
		Weight Unknown	Copper Cone		
		Weight Unknown	Plastic Case		

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Cutter, Powder Actuated, EXROD	Mk 23 Mod 0	4.0 oz	Octol	TM 43-0001-38	N/A
		Weight Unknown	Booster - CH-6		
		Weight Unknown	Plastic Case		
		Weight Unknown	Metal Disc		
Cutter, Powder Actuated, EXROD	Mk 24 Mod 0	1.1-lb	Octol	TM 43-0001-38	N/A
		Weight Unknown	Booster - CH-6		
		Weight Unknown	Plastic Case		
		Weight Unknown	Metal Disc		
Rockets					
Sub-Caliber Aircraft Rocket (SCAR)	2.25 inch	< 1 oz	Electric Squib, Pyrotechnic Composition	OP 1187	N/A
		14 gr	Ignitor, Black Powder		
		1.75 lb	Propellant, Double Base		
		1.6 lb	Body, Cast Iron or Zinc		
		8.5 lb	Motor Tube, Nozzle and Fins, Steel		
Rocket, Motor, 2.75 Inch	Mk 40	35 oz	Ignitor, Black Powder and Magnesium Powder	TM 9-1900, TM 9-1300-200	N/A
		5.9 lb	Propellant, Double Base		
		4.5 lb	Motor Tube, Nozzle and Fins, Aluminum		
Rocket, Motor, 2.75 Inch	Mk 66	.35 oz	Ignitor, Black Powder and Magnesium Powder	TM 9-1900, TM 9-1300-200	N/A
		7.0 lb	Propellant, Double Base		
		5.0 lb	Motor Tube, Nozzle and Fins, Aluminum		
Rocket, Warhead, 2.75 Inch, High Explosive	M229	4.8 lb	Comp B	TM 9-1900, TM 9-1300-200	M423
		13.1 lb	Boby, Steel		
Rocket, Warhead, 2.75 Inch, High Explosive	W/M 151	2.3 lb	Comp B	TM 9-1900, TM 9-1300-200	M423
		6.4 lb	Boby, Steel		
Rocket, Motor, 3.25 Inch	Mk 7	55 gr	Ignitor, Black Powder	TM 9-1900, TM 9-1300-200	N/A
		8.5 lb	Propellant, Double Base		
Rocket, Warhead, 3.5 Inch, Smoke	Mk 6	9.4 lb	White Phosphorous	TM 9-1900, TM 9-1300-200	Mk 155
		10.5 lb	Body, Steel		
Rocket, Motor, 5 Inch	Mk 2	55 gr	Ignitor, Black Powder	TM 9-1900, TM 9-1300-200	Mk 148
		24 lb	Propellant, Double Base		
Rocket, Warhead, 5 Inch	Mk I	8.6 lb	TNT	TM 9-1900, TM 9-1300-200	Mk 149
		37.9 lb	Body Steel		
Low Sensitivity Explosives					
Ammonium Nitrate	N/A	N/A	Ammonium Nitrate	TM 9-1900; TM 9-1300-200	N/A
Explosive D	N/A	N/A	Tetryl;TNT (75/25)	TM 9-1900; TM 9-1300-200	N/A
Primary and Initiating Explosives					
Ammonium Nitrate	N/A	N/A	Ammonium Nitrate (NH4N03)	TM 9-1300-214	N/A
Lead Azide	N/A	N/A	Lead Azide	TM 9-1900; TM 9-2900; TM 9-1300-200 TM 9-1300-214	N/A
Mercury Fulminate	N/A	N/A	Mercury Fulminate	TM 9-1900; TM 9-2900; TM 9-1300-200 TM 9-1300-214	N/A
Diazodinrophenol (DDNP)	N/A	N/A	4,5-dinitrobenzene-2-diazo-1-oxide, dinol, diazol	TM 9-1900; TM 9-2900; TM 9-1300-200 TM 9-1300-214	N/A
Explosive D	N/A	N/A	Tetryl;TNT (75/25)	TM 9-1900; TM 9-1300-200	N/A
Lead Styphnate	N/A	N/A	Lead Styphnate	TM 9-1900; TM 9-2900; TM 9-1300-200 TM 9-1300-214	N/A
Tetracene			guanyidiazoguanyl tetrazene or 4-guanyl-1-(nitrosoaminoguanyl)-1-tetrazine	TM 9-1300-214	N/A
Black Powder	N/A	N/A	Potassium Nitrate or Sodium Nitrate; Charcoal or Bituminous Coal; Sulphur (75/15/10)	TM 9-1900; TM 9-2900; TM 9-1300-200	N/A

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Composition B (Comp B)	N/A	N/A	TNT and RDX	TM 9-1900; TM 9-2900; TM 9-1300-200; TM 9-1300-214	N/A
Diethyleneglycol Dinitrate (DEGN)	N/A	N/A	2,2'-oxybisethanol dinitrate	TM 9-1300-214	N/A
HMX	N/A	N/A	HMX	TM 9-1900; TM 9-1300-200	N/A
Tetryl	N/A	N/A	Trinitrophenylmethylnitramine	TM 9-1300-200	N/A
PETN	N/A	N/A	Pentaerythritol tetranitrate	TM 9-1300-200	N/A
RDX	N/A	N/A	Cyclotrimethylenetrinitramine	TM 9-1300-200	N/A
TNT	N/A	N/A	Trinitrotoluene	TM 9-1900; TM 9-2900; TM 9-1300-200; TM 9-1300-214	N/A
Propellants					
Single Base Propellants					
Propellant	M6	N/A	Nitrocellulose (13.15%), Diphenylamine, Dinitrotoluene,	TM 9-2900, TM 9-1300-214	N/A
Propellant	M10	N/A	Nitrocellulose (13.15%), Potassium Sulfate, Diphenylamine	TM 9-2900, TM 9-1300-214	N/A
Propellant	IMR	N/A	Nitrocellulose	TM 9-2900, TM 9-1300-214	N/A
Propellant	EC	N/A	Nitrocellulose, Ethyl Centralite, Basic Lead Carbonate, Ethyl Alcohol, Dibutyl Ether	TM 9-2900, TM 9-1300-214	N/A
Double Base Propellants					
Propellant	M2	N/A	Nitrocellulose (13.15%), Nitroglycerine, Potassium Nitrate, Ethyl Centralite, Graphite	TM 9-2900, TM 9-1300-214	N/A
Propellant	M5	N/A	Nitrocellulose (13.15%), Nitroglycerine, Potassium Nitrate, Ethyl Centralite, Graphite	TM 9-2900, TM 9-1300-214	N/A
Propellant	M8	N/A	Nitrocellulose (13.15%), Nitroglycerine, Potassium Nitrate, Ethyl Centralite	TM 9-2900, TM 9-1300-214	N/A
Propellant	M21	N/A	Nitrocellulose (13.15%), Nitroglycerine, Ethyl Centralite, Triacetin, Lead Sterate, Carbon Black	TM 9-2900, TM 9-1300-214	N/A
Propellant	N5	N/A	Nitrocellulose (13.15%), Nitroglycerine, Diethyl Phthalate, 2-Nitrodiphenylamine, Lead Salts, Candelilla Wax	TM 9-2900, TM 9-1300-214	N/A
Triple Base Propellants					
Propellant	M15	N/A	Nitroguanidine, Nitrocellulose (13.15%), Nitroglycerin, Ethyl Centralite, Sodium Aluminum Fluoride	TM 9-2900, TM 9-1300-214	N/A
Propellant	M16	N/A	Nitrocellulose (12.6%), Nitroglycerin, Ethyl Centralite, Dinitrotoluene, Potassium Sulfate, Carbon Black, Lead Sterate	TM 9-2900, TM 9-1300-214	N/A
Propellant	M17	N/A	Nitroguanidine, Nitrocellulose (13.15%), Nitroglycerin, Ethyl Centralite, Sodium Aluminum Fluoride	TM 9-2900, TM 9-1300-214	N/A
Propellant	M31	N/A	Nitroguanidine, Nitrocellulose (13.15%), Nitroglycerin, Sodium Aluminum Fluoride, 2-Nitrodiphenylamine	TM 9-2900, TM 9-1300-214	N/A

Table 1
Potential Munitions and Munitions Constituents Present at RVAAP

Munitions Constituent Components	
Amatol	TNT, Ammonium Nitrate
CH-6	RDX, Calcium Stearate, Polyisobutylene, Graphite
CN Mixture	Chloroacetophenone
CN-DM Filler	Chloroacetophenone, Adamsite (50/50)
Comp A3	RDX, Wax (91/9)
Composition A5	RDX, Wax, Stearic Acid
Comp C2	RDX, Nitro cotton, Plasticizer
Comp C3	RDX, Nitro cotton, Plasticizer with Tetryl
Comp C4	RDX, Plasticizing Oil, Diethylhexylsebacate and polyisobutylene
EC Smokeless Powder	Nitrocellulose, Ethyl Centralite, Basic Lead Carbonate, Ethyl Alcohol, Dibutyl Ether
Explosive D	Ammonium Picrate
First Fire Composition	Barium nitrate, Strontium nitrate, Potassium nitrate, Magnesium, Dechlorane and Black Powder
FS Smoke Mixture	Sulfur Trioxide-Chlorosulfonic Acid
HC Smoke Composition	Hexachlorethane, Zinc Oxide, Aluminum
Ignition Pellet	Potassium Nitrate, Charcoal, Sulfur
Illumination Composition	Barium nitrate, Strontium nitrate, Potassium nitrate, Magnesium, Dechlorane
IM	Gasoline thickened with fatty soaps, fatty acids and isobutyl methacrylate polymer, napthenic acid.
LX-14	HMX, Estane (95.5/4.5)
NP	Aviation Gasoline thickened with a napalm thickener (Fatty acids and fatty soaps)
Octol	HMX, TNT
PBX	HMX, Viton (95/5)
Pentolite	PETN (50%) and TNT (50%)
Percussion Primer	Lead Styphnate; Tetracene; Barium Nitrate; Antimony Sulfide; Powdered Zirconium; Lead Oxide
Photoflash Powder	Barium Nitrate, Aluminum, Potassium Perchlorate
Primer Mixture	Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide
Propellant M9	Nitrocellulose, Nitroglycerin, Barium nitrate, Potassium nitrate
Propellant, M-36	Nitrocellulose (13.15%), Nitroglycerine, Potassium Nitrate, Ethyl Centralite, Graphite
Pyrotechnic Mixture	Magnesium, Aluminum, Barium Peroxide, Zinc Stearate, Polyvinyl Chloride
Smoke Composition	Potassium chlorate, Lactose, Colored dye
Smokeless Powder	Nitrocellulose, Nitroglycerin, Diethylphthalate, Potassium Nitrate, Ethyl Centralite
Starter Mixture	Barium nitrate, Strontium nitrate, Potassium nitrate, Magnesium, Dechlorane, Potassium Nitrate, Charcoal, Sulfur
Tetrytol	Tetryl, TNT (75/25)
Thermate - TH3	Powdered Aluminum, Iron Oxide, Barium Nitrate and Oil.
Tracer Composition	Magnesium, Aluminum, Strontium Peroxide, Strontium Nitrate
Tritonal	TNT, Powdered or Flaked Aluminum

References	
CSOIII	Office of the Chief of Ordnance, Technical Division, Catalogue of Standard Ordnance Items, Volume III. 1944
OP 1664	Ordnance Publication, U.S. Explosive Ordnance, May 1947
TM 9-1940	War Department, Technical Manual, Landmines, July 1943
TM 43-0001-28	Technical Manual, Army Ammunition Data Sheets for Artillery Ammunition, Guns, Howitzers, Mortars, Recoilless Rifles, Grenade Launchers and Artillery Fuzes, April 1977
TM 43-0001-29	Technical Manual, Army Technical Data Sheets for Grenades, June 1994
TM 43-0001-36	Technical Manual, Army Technical Data Sheets for Landmines, September 1994
TM 43-0001-38	Technical Manual, Army Technical Data Sheets for Demolition Materials, July 1994
TM 9-1300-200	Technical Manual, Ammunition General, October 1969
TM 9-1300-214	Technical Manual, Military Explosives, September 1994
TM 9-1325-200	Technical Manual, Bombs and Bomb Components, April 1966
TM 9-1370-200	Technical Manual, Military Pyrotechnics, September 1966
TM 9-1900	War Department, Technical Manual, Ammunition General, June 1945
TM 9-1904	War Department, Technical Manual, Ammunition Inspection Guide, March 1944
TM 9-1980	War Department, Technical Manual, Bombs for Aircraft, November 1944
TM 9-1981	Technical Manual, Military Pyrotechnics, January 1951

Table 2
Potenial Munitions and Munintions Constituents present at the 40mm Firing Range

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Cartridge, 40mm, HE	M406	32 grams	Comp B	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		
Cartridge, 40mm, Practice	M407	< 1 oz	Filler, Smoke Pellets	TM 43-0001-28	M551
		330 mg	Propelling Charge, M9		
		< 1 gram	Percussion Primer, M42		
		< 1 gram	Fuze, Detonator, Lead Azide and Tetryl		
		< 1 gram	Lead, Tetryl or RDX		
		2 grams	Booster, RDX		
		6 oz	Projectile Body and Cartridge Case, Aluminum		

Munitions Constituents

Composition B	RDX, TNT, Wax (59.5/39.5/1)	
Mortar Propellant M9	Nitrocellulose, Nitroglycerin, Potassium Nitrate, Diphenylamine	
Percussion primer	Lead Styphnate, Tetracene, Barium Nitrate, Antimony Sulfide, Powdered Zirconium, Lead Oxide	
Lead Azide	Lead, Carbon/Nitrogen/Oxygen/Hydrogen (69.9/30.4)	
Tetryl	Trinitrophenylmethylnitramine	
RDX	Cyclotrimethylenetrinitramine	
TNT	2, 4, 6, Trinitrotoluene	
Lead	Lead	
Aluminum	Aluminum	

References

TM 43-0001-28	Technical Manual, Armmy Ammunition Data Sheets for Artillery Ammunition, Guns, Howitzers, Mortars, Recoilless Rfles, Grenade Launchers and Artillery Fuzes, April 1977	

Table 3
Summary of Potential MEC and MC Present at the Block D Igloo - TD

MEC Item/Size	Nomenclature	Weight	Munitions Constituents	MC Ref Pub(s)	Fuzes
Bomb, Fragmentation, 20-lb	AN-M41	2.7-lb	TNT	CSOIII	AN-M110A1
		20.8-lb	Bomb Body and Fin Assembly, Steel		
Fuze, Bomb, Nose	AN-M110 Series	< 1 gram	Primer: Potassium Chlorate, Calcium Silicate, Antimony Sulfide, Lead Azide, Lead Styphnate	CSOIII, OP 1664, TM 9-1904, TM 9-1980	N/A
		< 1 gram	Detonator: Lead Azide, Tetryl		
		0.6 oz	Booster: Tetryl		
		1.0 lb	Aluminum Body, Steel components		

Munitions Constituents (MC) in Fillers, Fuzes, and Primers	
Antimony Sulfide	Antimony Sulfide
Calcium Silicate	Calcium Silicate
Lead Azide	Lead, Carbon/Nitrogen/Oxygen/Hydrogen (69.9/30.4)
Lead Styphnate	Lead, 2,4,6-Trinitroresorcinate
Potassium Chlorate	Potassium, Chlorine and Oxygen
Tetryl	Trinitrophenylmethylnitramine
TNT	2, 4, 6-Trinitrotoluene

Casing Materials
Aluminum
Steel

References	
CSOIII	Office of the Chief of Ordnance, Technical Division, Catalogue of Standard Ordnance Items, Volume III. 1944
OP 1664	Ordnance Publication, U.S. Explosive Ordnance, May 1947
TM 9-1904	War Department, Technical Manual, Ammunition Inspection Guide, March 1944
TM 9-1980	War Department, Technical Manual, Bombs for Aircraft, November 1944

magnesium, and iron) are included in the MC lists in **Tables 1** through **3**. Aluminum is considered an MC at all seven MRSs; therefore, it will not be evaluated in the geochemical analysis. In addition, iron is considered an MC at six of the seven MRSs and will only be evaluated in the geochemical analysis at one MRS (40mm Firing Range). Although magnesium is a contributor to the MC lists, it is an extremely minor contributor. Magnesium is a major contributor to the earth's crust. Therefore, magnesium is more useful for assessing background than it is for assessing the impacts from munitions items that contain a few grains of magnesium in their makeup. Manganese will be used as a reference element for geochemical analysis; manganese concentrations will be evaluated in order to determine whether any elevated concentrations are associated with MC contamination. The geochemical analysis will be evaluated for calcium, magnesium and manganese at all MRSs.

Erie Burning Grounds (RVAAP-02-R-01)

From 1941 to 1951, Erie Burning Grounds was used to thermally treat bulk, obsolete, off-spec propellants, conventional explosives, rags and large explosive contaminated items (e.g., railcars) by open burning on the ground surface. Bodies of bombs were brought to the MRS after washing for flashing. According to the ASR, Erie Burning Grounds is located too close to the installation boundary to have burned filled bombs. Erie Burning Grounds also served as an open burn (OB) area for propellants, explosives, rags, and explosives contaminated items. During the SI, one MD item (250-lb bomb) was found partially buried. In addition, subsurface anomalies were identified in the MRS. However, the nature of anomalies are unknown since an intrusive investigation was not performed. MEC is also suspected in the flooded portions of the MRS. Therefore, there is a potential for MEC/MD on the surface, subsurface, and wetlands areas.

The predominant pathway for introducing MC to the environment at Erie Burning Grounds MRS is from a source area to the unsaturated zone. Source areas include OB and open detonation (OD) and bomb flashing areas where MEC was potentially distributed to the surface and subsurface soil. No additional soil or dry sediment sampling is recommended at the MRS based on the *Final Record of Decision for Soil and Dry Sediment at the Erie Burning Grounds* (ROD; SAIC, 2007) performed under the Installation Restoration Program (IRP); however, additional MC sampling may be warranted for these environmental media if source areas of MEC/MD or a suspected MC release from MEC is identified during this MMRP RI. During the SI at this MRS, MC sampling was not performed; however, the SI Report (e^2M, 2008) did provide recommendation for MC sampling of wet sediments at the MRS. Surface water samples will also be collected and collocated with the sediment samples.

A minimum of three surface water and six wet sediment samples will be collected for the MMRP RI at this MRS. The predetermined locations are presented on **Figure 3-1** in the work plan addendum. The final number of samples and locations will be selected with stakeholder approval following the MEC investigation at the Erie Burning Grounds MRS. Further details on the

decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the *Sampling and Analysis Plan and Quality Assurance Project Plan Addendum* in **Appendix A** of the work plan addendum.

The details on MC associated with the potential MEC used at RVAAP are located on **Table 1**. Based on the information provided in **Table 1** and stakeholder approval, a list of MEC metals (aluminum, cadmium, copper, chromium (Cr^{3+}, Cr^{6+}), iron, lead, zinc, antimony, strontium, barium, and mercury) to be analyzed were identified. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended since the types of munitions cannot be conclusively identified. Sampling for semivolatile organic compounds (SVOCs), including polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs) are recommended at Erie Burning Grounds MRS based on historical evidence that waste oil may have been used during OB/OD operations at RVAAP.

It should be noted that sampling for PCBs in surface water is not recommended. In general, PCBs have low water solubility adsorb strongly to soil particles with adsorption generally increasing with the degree of chlorination of the PCB. Log K_{oc} values for the various congeners range from 4.0 for monochlorobiphenyl to 5.5 for nonachlorobiphenyl, estimated using a structure fragment constant method. In addition, volatilization from water surfaces is expected to be an important fate process based upon PCBs estimated Henry's Law constant values ranging from 7.36×10^{-4} for monochlorobiphenyl to 1.8×10^{-8} atm-cu m/mole for octachlorobiphenyl. Estimated volatilization half-lives for a model river and model lake will range from 2.5 to 70 hrs and 6 to 39 days, respectively. However, volatilization from water surfaces is expected to be attenuated by adsorption to suspended solids and sediment in the water column.

Sampling for hexachlorethane, potassium perchlorate and zirconium, which are present in trace amounts in the tracer, HC Smoke composition, EC smokeless powder, and percussion primers, sampling is not planned for the RI. This is based on a determination that for these analytes, the MC mass listed in **Table 1** is insignificant relative to other analytes identified in MEC items potentially used at Erie Burning Grounds, and; therefore, would not be a good indicator for MC contamination at the MRS. White phosphorous sampling is also not recommended at Erie Burning Grounds as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous and/or phosphorous sampling is necessary at the MRS. MEC identification procedures including the general ordnance safety procedures for white phosphorus are presented in Section 3.6.7 of the work plan addendum.

The remaining compounds identified in **Table 1** were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 4**.

Table 4
Erie Burning Grounds Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Cadmium	Yes	
Copper	Yes	
Chromium (Cr^{3+}, Cr^{6+})	Yes	
Iron	Yes	
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Zinc	Yes	
Antimony	Yes	
Strontium	Yes	
Barium	Yes	
Mercury	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6-Dinitrotoluene Mixture (2,4/2,6-DNT Mix)	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Semivolatile Organic Compounds (SVOCs) USEPA Method SW846 8270C		
1,2,4-Trichlorobenzene	Yes	
1,2-Dichlorobenzene	Yes	
1,3-Dichlorobenzene	Yes	
1,4-Dichlorobenzene	Yes	
2,4,5-Trichlorophenol	Yes	

Analyte	Analysis Available?	Notes
2,4,6-Trichlorophenol	Yes	
2,4-Dichlorophenol	Yes	
2,4-Dimethylphenol	Yes	
2,4-Dinitrophenol	Yes	
2-Chloronaphthalene	Yes	
2-Chlorophenol	Yes	
2-Methylphenol	Yes	
2-Nitroaniline	Yes	
2-Nitrophenol	Yes	
3 & 4-Methylphenol	Yes	
3,3'-Dichlorobenzidine	Yes	
3-Nitroaniline	Yes	
4,6-Dinitro-2-methylphenol	Yes	
4-Bromophenyl-phenyl ether	Yes	
4-Chloro-3-methylphenol	Yes	
4-Chloroaniline	Yes	
4-Chlorophenyl-phenyl ether	Yes	
4-Nitroaniline	Yes	
4-Nitrophenol	Yes	
Acenaphthene	Yes	
Acenaphthylene	Yes	
Anthracene	Yes	
Benzo(a)anthracene	Yes	
Benzo(a)pyrene	Yes	
Benzo(b)fluoranthene	Yes	
Benzo(g,h,i)perylene	Yes	
Benzo(k)fluoranthene	Yes	
Chrysene	Yes	
Dibenzo(a,h)anthracene	Yes	
Fluoranthene	Yes	
Fluorene	Yes	
Indeno(1,2,3-cd)pyrene	Yes	
2-Methylnaphthalene	Yes	
Naphthalene	Yes	
Phenanthrene	Yes	
Pyrene	Yes	
Benzoic acid	Yes	
Benzyl alcohol	Yes	
Bis(2-chloroethoxy)methane	Yes	
Bis(2-chloroethyl)ether	Yes	
Bis(2-chloroisopropyl)ether	Yes	
Bis(2-ethylhexyl)phthalate	Yes	
Butylbenzylphthalate	Yes	
Carbazole	Yes	
Di-n-butylphthalate	Yes	

Analyte	Analysis Available?	Notes
Di-n-octylphthalate	Yes	
Dibenzofuran	Yes	
Diethylphthalate	Yes	
Dimethylphthalate	Yes	
Hexachlorobenzene	Yes	
Hexachlorobutadiene	Yes	
Hexachlorocyclopentadiene	Yes	
Hexachloroethane	Yes	
Isophorone	Yes	
N-Nitroso-di-n-propylamine	Yes	
Diphenylamine (as N-Nitrosodiphenylamine)	Yes	
Pentachlorophenol	Yes	
Phenol	Yes	
Polychlorinated biphenyls (PCBs), Method USEPA SW846 8082A		
Aroclor-1016	Yes	
Aroclor-1221	Yes	
Aroclor-1232	Yes	
Aroclor-1242	Yes	
Aroclor-1248	Yes	
Aroclor-1254	Yes	
Aroclor-1260	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 4**, the following MCs and geochemical parameters are proposed for samples collected during the RI at the Erie Burning Grounds MRS:

- MEC Metals, Method United States Environmental Protection Agency (USEPA) SW846 6010C: aluminum (Al), cadmium (Cd), copper (Cu), chromium (Cr 3+, Cr 6+), iron (Fe), lead (Pb), zinc (Zn), antimony (Sb), strontium (Sr), barium (Ba), and mercury (Hg).
- Explosives and propellants, Method USEPA SW846 8330B: 1,3,5,7-tetranitro-1,3,5,7-tetraazacyclooctane (HMX), cyclotrimethylenetrinitramine (RDX), 1,3,5-Trinitrobenzene (1,3,5-TNB), 1,3-Dinitrobenzene (1,3-DNB), tetryl, nitrobenzene (NB), 2,4,6-trinitrotoluene (2,4,6-TNT), 4-amino-2,6-dinitrotoluene (4-Am-DNT), -amino-4,6-dinitrotoluene (2-Am-DNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2,4/2,6- Dinitrotoluene Mixture (2,4/2,6-DNT Mix), 2-nitrotoluene (2-NT), 3-nitrotoluene (3-NT), 4-nitrotoluene (4-NT), nitroglycerin (NG), pentaerythritol tetranitrate (PETN), 3,5-Dinitroaniline (3,5-DNA), and nitroguanidine (NQ).
- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-

Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

- PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260 (sediment only).
- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: calcium (Ca), magnesium (Mg), and manganese (Mn).
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (sediment).

Fuze and Booster Quarry (RVAAP-016-R-1)

The Fuze and Booster Quarry consists of three elongated ponds separated by berms that were constructed within an abandoned rock quarry. Prior to the construction of the ponds in 1976, the quarry was used as a landfill for various types of munitions. Therefore, there is a potential for MEC/MD on the surface, buried MEC/MD on the banks of the three ponds, and in the submerged portions of the three ponds at the Fuze and Booster Quarry MRS.

The predominant pathway for introducing MC to the environment at the Fuze and Booster Quarry MRS is from a source area to the unsaturated zone. Source areas include dumping areas where MEC/MD was distributed to the surface, subsurface soil, surface water, and sediment. The SI Report (e^2M, 2008) stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP. However, also it is understood that contaminants possibly related to MMRP operations (MC metals and explosives) were detected in the IRP sediment samples and will require further delineation under the MMRP using IS rather than discrete samples that were originally collected under the IRP. Four IS wet sediment samples will be collected for the MMRP RI activities at this MRS. The need for additional MC sampling will be evaluated for the surface/subsurface soils at this MRS if source areas of MEC/MD are identified around the pond areas. The final number of samples and locations will be selected with stakeholder approval following the MEC investigation at the Fuze and Booster Quarry MRS. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations

are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum.

Samples will be analyzed for MC associated with the MEC used at RVAAP presented on **Table 1**. Based on the information provided in **Table 1** and stakeholder approval, a list of MEC metals (aluminum, cadmium, copper, chromium (Cr^{3+}, Cr^{6+}), iron, lead, zinc, antimony, strontium, barium, and mercury) were identified. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended since the types of munitions cannot be conclusively identified. Any additional sampling at the Fuze and Booster MRS would require analysis for SVOCs, including PAHs, since the former dump accepted residual ash.

Sampling for hexachlorethane, potassium perchlorate and zirconium, which are present in trace amounts in the tracer, HC Smoke composition, EC smokeless powder, percussion primers, is not planned for the RI. This is based on a determination that for these analytes, the MC mass listed in **Table 1** is insignificant relative to other analytes identified in MEC items potentially used at the Fuze and Booster Quarry, and; therefore, would not be a good indicator for MC contamination at the MRS. White phosphorous sampling is also not recommended at the Fuze and Booster Quarry MRS as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous and/or phosphorous sampling is necessary at the MRS.

These compounds were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 5**.

Table 5
Fuze and Booster Quarry MRS Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Cadmium	Yes	
Copper	Yes	
Chromium (Cr^{3+}, Cr^{6+})	Yes	
Iron	Yes	
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Zinc	Yes	
Antimony	Yes	
Strontium	Yes	
Barium	Yes	

Analyte	Analysis Available?	Notes
Mercury	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6-DNT Mix	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Semivolatile Organic Compounds (SVOCs) USEPA Method SW846 8270C		
1,2,4-Trichlorobenzene	Yes	
1,2-Dichlorobenzene	Yes	
1,3-Dichlorobenzene	Yes	
1,4-Dichlorobenzene	Yes	
2,4,5-Trichlorophenol	Yes	
2,4,6-Trichlorophenol	Yes	
2,4-Dichlorophenol	Yes	
2,4-Dimethylphenol	Yes	
2,4-Dinitrophenol	Yes	
2-Chloronaphthalene	Yes	
2-Chlorophenol	Yes	
2-Methylphenol	Yes	
2-Nitroaniline	Yes	
2-Nitrophenol	Yes	
3 & 4-Methylphenol	Yes	
3,3'-Dichlorobenzidine	Yes	
3-Nitroaniline	Yes	
4,6-Dinitro-2-methylphenol	Yes	
4-Bromophenyl-phenyl ether	Yes	
4-Chloro-3-methylphenol	Yes	
4-Chloroaniline	Yes	
4-Chlorophenyl-phenyl ether	Yes	
4-Nitroaniline	Yes	

Analyte	Analysis Available?	Notes
4-Nitrophenol	Yes	
Acenaphthene	Yes	
Acenaphthylene	Yes	
Anthracene	Yes	
Benzo(a)anthracene	Yes	
Benzo(a)pyrene	Yes	
Benzo(b)fluoranthene	Yes	
Benzo(g,h,i)perylene	Yes	
Benzo(k)fluoranthene	Yes	
Chrysene	Yes	
Dibenzo(a,h)anthracene	Yes	
Fluoranthene	Yes	
Fluorene	Yes	
Indeno(1,2,3-cd)pyrene	Yes	
2-Methylnaphthalene	Yes	
Naphthalene	Yes	
Phenanthrene	Yes	
Pyrene	Yes	
Benzoic acid	Yes	
Benzyl alcohol	Yes	
Bis(2-chloroethoxy)methane	Yes	
Bis(2-chloroethyl)ether	Yes	
Bis(2-chloroisopropyl)ether	Yes	
Bis(2-ethylhexyl)phthalate	Yes	
Butylbenzylphthalate	Yes	
Carbazole	Yes	
Di-n-butylphthalate	Yes	
Di-n-octylphthalate	Yes	
Dibenzofuran	Yes	
Diethylphthalate	Yes	
Dimethylphthalate	Yes	
Hexachlorobenzene	Yes	
Hexachlorobutadiene	Yes	
Hexachlorocyclopentadiene	Yes	
Hexachloroethane	Yes	
Isophorone	Yes	
N-Nitroso-di-n-propylamine	Yes	
Diphenylamine (as N-Nitrosodiphenylamine)	Yes	
Pentachlorophenol	Yes	
Phenol	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 5,** the following MCs and geochemical parameters are proposed for samples collected during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al, Cd, Cu, Cr ($^{3+}$ and $^{6+}$), Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
- Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC and pH.

40mm Firing Range (RVAAP-032-R-01)

The 40mm Firing Range was used from approximately 1969 to 1971 to test 40mm grenade cartridges. Rounds tested at the 40mm Firing Range MRS may have included both the M407A1 practice round and the M406 high explosive (HE) round. No MEC was discovered during the SI. However, numerous MD items (40mm rounds) were found scattered approximately 100 feet beyond the former impact area.

The predominant pathway for introducing MC to the environment at the 40mm Firing Range MRS is from a source area to the unsaturated zone. Source areas include the range where MEC/MD was distributed to the surface and shallow subsurface soil. At the time of MEC release into the environment, the potential medium receiving the item was surface soil and subsurface

soil. Minimal data exists for the 40mm Firing Range MRS; therefore, MC sampling is proposed following the MEC investigation. The proposed media to be sampled at this MRS consists of two IS surface soil samples for the MC presented in **Table 6**. In addition, Shaw will collect one IS surface soil sample at the firing point located at the eastern edge of the range and off of the MRS that will be analyzed for propellants only. The predetermined locations are presented on **Figure 3-3** in the work plan addendum Additional sampling of surface soils, and potentially subsurface soils, is recommended if evidence of source area MEC/MD or a suspected MC release from MEC is observed during the RI field work. The details on MC associated with the MEC used at the 40mm Firing Range are located on **Table 2**.

Based on the information provided in **Table 2** and stakeholder approval, a list of MEC metals (aluminum and lead) were identified at the MRS. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended due to the history of contamination at RVAAP. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum.

Sampling for diphenylamine, antimony, barium, and zirconium, which are present in Mortar Propellant M9 and percussion primer for the 40mm grenade, is not planned for the MRS based on a determination that for these analytes, the mass of contamination from each item is very small for the potentially used items at RVAAP. White phosphorous sampling is also not recommended at the 40mm Firing Range MRS, as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous sampling is necessary at the MRS.

The remaining compounds identified in **Table 2** were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 6**.

Table 6
40mm Firing Range Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Iron	Yes	Used for background evaluation
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	

Analyte	Analysis Available?	Notes
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6-DNT Mix	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 6**, the following MCs and geochemical parameters are proposed for the IS soil samples collected from the MRS during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al and Pb.
- Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, Mn and Fe.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC and pH.

The IS surface soil sample to be collected at the firing point of the former 40mm Firing Range will be analyzed for propellants (nitrocellulose, nitroguanidine and nitroglycerine) only.

Sand Creek Dump MRS (RVAAP-034-R-01)

The Sand Creek Dump MRS was formerly used as a disposal area for primarily construction debris. Two 75mm projectiles MD items were discovered during a 2003 removal action at the

northern portion of the Sand Creek Dump MRS. Although no MEC was identified at the site during the SI, one 105mm projectile MD item was found in Sand Creek adjacent to the northern portion of the MRS. In addition, multiple subsurface anomalies were recorded during the SI, which was expected due to the presence of the dump.

The predominant pathway for introducing MC to the environment at the Sand Creek Dump MRS is from a source area to the unsaturated zone. Source areas include dumping areas where MEC was distributed to the surface and subsurface soil. At the time of MEC release into the environment, the potential medium receiving the item was surface soil and subsurface soil. Based on the extensive data collected at the Sand Creek Dump MRS under the IRP, additional sampling for MC is not proposed. However, discrete samples may be collected if MEC/MD items are identified during the intrusive investigation based on the digital geophysical mapping (DGM) results. If the MEC are intact and there is no obvious release of MC, a determination would be made in conjunction with the USACE and Ohio EPA as to whether sampling is required. The medium to be sampled at this MRS would be expected to be soil beneath the MEC/MD items. The final number of samples and locations will be selected with stakeholder approval following the MEC investigation at the Sand Creek Dump MRS. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum. The details on MC associated with the MEC used at RVAAP are located on **Table 1**.

Based on the information provided in **Table 1** and stakeholder approval, a list of MEC metals (aluminum, cadmium, copper, chromium (Cr^{3+}, Cr^{6+}), iron, lead, zinc, antimony, strontium, barium, and mercury) were identified. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended since the types of munitions cannot be conclusively identified. Samples for SVOC, including PAHs, is recommended at the Sand Creek Dump MRS based on unknown disposal activities that may have occurred at the site.

Sampling for hexachlorethane, potassium perchlorate and zirconium, which are present in trace amounts in the tracer, HC Smoke composition, EC smokeless powder, and percussion primers, is not planned for the RI. This is based on a determination that for these analytes, the MC mass listed in **Table 1** is insignificant relative to other analytes identified in MEC items potentially used at the Sand Creek Dump, and; therefore, would not be a good indicator for MC contamination at the MRS. White phosphorous sampling is also not recommended at Sand Creek Dump MRS as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous and/or phosphorous sampling is necessary at the MRS.

These compounds were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 7**.

Table 7
Sand Creek Dump Grounds Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Cadmium	Yes	
Copper	Yes	
Chromium (Cr^{3+}, Cr^{6+})	Yes	
Iron	Yes	
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Zinc	Yes	
Antimony	Yes	
Strontium	Yes	
Barium	Yes	
Mercury	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6/-DNT Mix	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Semivolatile Organic Compounds (SVOCs) USEPA Method SW846 8270C		
1,2,4-Trichlorobenzene	Yes	
1,2-Dichlorobenzene	Yes	
1,3-Dichlorobenzene	Yes	
1,4-Dichlorobenzene	Yes	

Analyte	Analysis Available?	Notes
2,4,5-Trichlorophenol	Yes	
2,4,6-Trichlorophenol	Yes	
2,4-Dichlorophenol	Yes	
2,4-Dimethylphenol	Yes	
2,4-Dinitrophenol	Yes	
2-Chloronaphthalene	Yes	
2-Chlorophenol	Yes	
2-Methylphenol	Yes	
2-Nitroaniline	Yes	
2-Nitrophenol	Yes	
3 & 4-Methylphenol	Yes	
3,3'-Dichlorobenzidine	Yes	
3-Nitroaniline	Yes	
4,6-Dinitro-2-methylphenol	Yes	
4-Bromophenyl-phenyl ether	Yes	
4-Chloro-3-methylphenol	Yes	
4-Chloroaniline	Yes	
4-Chlorophenyl-phenyl ether	Yes	
4-Nitroaniline	Yes	
4-Nitrophenol	Yes	
Acenaphthene	Yes	
Acenaphthylene	Yes	
Anthracene	Yes	
Benzo(a)anthracene	Yes	
Benzo(a)pyrene	Yes	
Benzo(b)fluoranthene	Yes	
Benzo(g,h,i)perylene	Yes	
Benzo(k)fluoranthene	Yes	
Chrysene	Yes	
Dibenzo(a,h)anthracene	Yes	
Fluoranthene	Yes	
Fluorene	Yes	
Indeno(1,2,3-cd)pyrene	Yes	
2-Methylnaphthalene	Yes	
Naphthalene	Yes	
Phenanthrene	Yes	
Pyrene	Yes	
Benzoic acid	Yes	
Benzyl alcohol	Yes	
Bis(2-chloroethoxy)methane	Yes	
Bis(2-chloroethyl)ether	Yes	
Bis(2-chloroisopropyl)ether	Yes	
Bis(2-ethylhexyl)phthalate	Yes	
Butylbenzylphthalate	Yes	
Carbazole	Yes	

Analyte	Analysis Available?	Notes
Di-n-butylphthalate	Yes	
Di-n-octylphthalate	Yes	
Dibenzofuran	Yes	
Diethylphthalate	Yes	
Dimethylphthalate	Yes	
Hexachlorobenzene	Yes	
Hexachlorobutadiene	Yes	
Hexachlorocyclopentadiene	Yes	
Hexachloroethane	Yes	
Isophorone	Yes	
N-Nitroso-di-n-propylamine	Yes	
Diphenylamine (as N-Nitrosodiphenylamine)	Yes	
Pentachlorophenol	Yes	
Phenol	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 7**, the following MCs and geochemical parameters are proposed for samples collected during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al, Cd, Cu, Cr (3+, 6+), Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
- Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene,

Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC and pH.

Block D Igloo–TD MRS (RVAAP-061-R-01)

The Block D Igloo–TD MRS represents the off-site documented debris field locations that were not investigated as part of the SI in 2007. On 24 March 1943, Igloo 7-D-15 exploded as a result of 2,516 clusters of 20-lb fragmentation bombs accidentally detonating. During the SI, no samples were collected within the current Block D Igloo-TD MRS boundary. Shaw reevaluated the Block D Igloo MRS boundaries based on the maximum fragmentation distance of the M41 bomb. Based on the results of the evaluation, MEC/MD associated with the 1943 explosion at the Block D Igloo-TD is not expected off-site.

The predominant pathway for introducing MC to the environment at the Block D Igloo–TD MRS is from a source area to the unsaturated zone. Source areas include kick-out areas where MEC was distributed to the surface and subsurface soil. At the time of MEC release into the environment, the potential medium receiving the item was surface soil and subsurface soil. A field effort is currently not anticipated for the Block D Igloo–TD MRS. If evidence of MEC/MD is observed during the RI at the Block D Igloo MRS, a MEC and MC investigation may be warranted at the Block D Igloo–TD. In the event that an MC investigation is warranted at Block D Igloo–TD, sampling of surface soils is recommended if evidence of concentrated areas of MEC/MD is observed during the RI field work. These samples are recommended to be collected as discrete samples from worst-case areas where concentrated MEC/MD is observed during the RI if a MEC investigation is warranted. MC sampling locations in the worst-case areas will be biased by visual survey and geophysical investigation results as well. The final number of samples and locations will be selected with stakeholder approval following the MEC investigation at the Block D Igloo-TD. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum.

The details on MC associated with the 20-lb fragmentation bombs that exploded at Block D Igloo–TD are located on **Table 3**. Based on the information provided in **Table 3**, a list of MEC metals (aluminum, iron, lead, and antimony) were identified at the MRS. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended due to the history of contamination at RVAAP. The compounds identified in **Table 3** were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 8**.

Table 8
Block D Igloo–TD Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Iron	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Lead	Yes	
Antimony	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6-DNT Mix	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 3** and the evaluation of which MC have developed laboratory methods provided in **Table 8**, the following MCs and geochemical parameters are proposed for samples collected during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al, Fe, Pb, and Sb.
- Explosives, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Memo, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.

- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC and pH.

Water Works #4 Dump (RVAAP-062-R-01)

The MRS was reportedly used as a disposal site from 1941 to 1949. However, the type and origin of MEC/MD present at the MRS is unknown. During the SI, approximately twenty 155mm shrapnel projectile MD items were scattered throughout the wooded area to the north of the current MRS. Since the MD items did not have an explosive hazard and subsequent surface soil sampling did not detect any related MC, this portion of the MRS was removed from further consideration. According to the SI, subsurface anomalies were detected in the open area of the current MRS and may represent potential buried MEC. However, the nature of anomalies remains unknown since an intrusive investigation was not performed. Based on available information, there is a potential for MEC/MD on the surface and subsurface at the current MRS boundary as well as the area where MD items were previously found. It should be noted that the depth at which there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Water Works #4 Dump MRS.

The predominant pathway for introducing MCs to the environment at the Water Works #4 Dump MRS is from a source area to the unsaturated zone. Source areas include dumping areas where MEC/MD may have been distributed to the surface and subsurface soil. At the time of MEC release into the environment, the potential medium receiving the item was surface soil and subsurface soil. Additional sampling for MC was not recommended for the Water Works #4 Dump MRS in the SI Report (e^2M, 2008)since the results of MC samples collected during the SI were below screening criteria. However, IS or discrete samples may be collected if MEC/MD items are identified during the target anomaly investigation based on the DGM field activities. The final number of samples and locations will be selected with stakeholder approval following the MEC investigation at the Water Works #4 Dump MRS. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum.

If sample collection is determined to be necessary, they will be analyzed for the MC associated with the MEC used at RVAAP on **Table 1**. Based on the information provided in **Table 1** and stakeholder approval, a list of MEC metals (aluminum, cadmium, copper, chromium (Cr^{3+}, Cr^{6+}), iron, lead, zinc, antimony, strontium, barium, and mercury) to be analyzed were identified. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended since the

types of munitions cannot be conclusively identified. Sampling for SVOCs, including PAHs, is recommended at this MRS due to the unknown disposal history at the site.

Sampling for hexachlorethane, potassium perchlorate and zirconium, which are present in trace amounts in the tracer, HC Smoke composition, EC smokeless powder, and percussion primers, is not planned for the RI. This is based on a determination that for these analytes, the MC mass listed in **Table 1** is insignificant relative to other analytes identified in MEC items potentially used at the Water Works #4 Dump, and; therefore, would not be a good indicator for MC contamination at the MRS. White phosphorous sampling at the Water Works #4 Dump MRS is also not recommended as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous and/or phosphorous sampling is necessary at the MRS.

The remaining compounds identified in **Table 1** were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 9**.

Table 9
Water Works #4 Dump Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Cadmium	Yes	
Copper	Yes	
Chromium (Cr^{3+}, Cr^{6+})	Yes	
Iron	Yes	
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation
Zinc	Yes	
Antimony	Yes	
Strontium	Yes	
Barium	Yes	
Mercury	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	

Analyte	Analysis Available?	Notes
2,6-Dinitrotoluene	Yes	
Dinitrotoluene (2,4/2,6-) Mixture (ca)	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Semivolatile Organic Compounds (SVOCs) USEPA Method SW846 8270C		
1,2,4-Trichlorobenzene	Yes	
1,2-Dichlorobenzene	Yes	
1,3-Dichlorobenzene	Yes	
1,4-Dichlorobenzene	Yes	
2,4,5-Trichlorophenol	Yes	
2,4,6-Trichlorophenol	Yes	
2,4-Dichlorophenol	Yes	
2,4-Dimethylphenol	Yes	
2,4-Dinitrophenol	Yes	
2-Chloronaphthalene	Yes	
2-Chlorophenol	Yes	
2-Methylphenol	Yes	
2-Nitroaniline	Yes	
2-Nitrophenol	Yes	
3 & 4-Methylphenol	Yes	
3,3'-Dichlorobenzidine	Yes	
3-Nitroaniline	Yes	
4,6-Dinitro-2-methylphenol	Yes	
4-Bromophenyl-phenyl ether	Yes	
4-Chloro-3-methylphenol	Yes	
4-Chloroaniline	Yes	
4-Chlorophenyl-phenyl ether	Yes	
4-Nitroaniline	Yes	
4-Nitrophenol	Yes	
Acenaphthene	Yes	
Acenaphthylene	Yes	
Anthracene	Yes	
Benzo(a)anthracene	Yes	
Benzo(a)pyrene	Yes	
Benzo(b)fluoranthene	Yes	
Benzo(g,h,i)perylene	Yes	
Benzo(k)fluoranthene	Yes	
Chrysene	Yes	
Dibenzo(a,h)anthracene	Yes	
Fluoranthene	Yes	
Fluorene	Yes	
Indeno(1,2,3-cd)pyrene	Yes	

Analyte	Analysis Available?	Notes
2-Methylnaphthalene	Yes	
Naphthalene	Yes	
Phenanthrene	Yes	
Pyrene	Yes	
Benzoic acid	Yes	
Benzyl alcohol	Yes	
Bis(2-chloroethoxy)methane	Yes	
Bis(2-chloroethyl)ether	Yes	
Bis(2-chloroisopropyl)ether	Yes	
Bis(2-ethylhexyl)phthalate	Yes	
Butylbenzylphthalate	Yes	
Carbazole	Yes	
Di-n-butylphthalate	Yes	
Di-n-octylphthalate	Yes	
Dibenzofuran	Yes	
Diethylphthalate	Yes	
Dimethylphthalate	Yes	
Hexachlorobenzene	Yes	
Hexachlorobutadiene	Yes	
Hexachlorocyclopentadiene	Yes	
Hexachloroethane	Yes	
Isophorone	Yes	
N-Nitroso-di-n-propylamine	Yes	
Diphenylamine (as N-Nitrosodiphenylamine)	Yes	
Pentachlorophenol	Yes	
Phenol	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 9**, the following MCs and geochemical parameters are proposed for samples collected during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al, Cd, Cu, Cr ($^{3+}$ and $^{6+}$), Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
- Explosives and propellants, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT, 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA, and NQ.
- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-

Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).

- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.
- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC and pH.

Group 8 MRS (RVAAP-063-R-01)

The Group 8 site is not currently used by the OHARNG since it is an MRS. The 2.65-acre MRS may have been historically used for debris and rubbish burning. One HE anti-personnel fragmentation bomb and one demilitarized 175mm projectile were previously found at the MRS. During the SI, potential MEC consisting of unidentifiable T-bar fuzes were identified. In addition, a large amount of MD was found at this MRS. Based on historical evidence and the findings of the SI, there is a potential for MEC/MD on the ground surface and buried in the shallow subsurface at the Group 8 MRS. It should be noted that the depth at which there is a potential for MEC/MD will not be known until the intrusive investigation is performed at the Group 8 MRS.

The predominant pathway for introducing MC to the environment at the Group 8 MRS is from a source area to the unsaturated zone. Source areas include potential disposal areas where MEC/MD was potentially distributed to the surface and subsurface soil. At the time of MEC release into the environment, the potential medium receiving the item was surface soil, subsurface soil, sediment, or surface water. The SI report (e^2M, 2008) recommended additional MC sampling at the Group 8 MRS based on previous surface soil results above screening criteria. Currently, a total of 4 IS surface soil samples are proposed at the site as shown on **Figure 3-7** in the work plan addendum. Discrete surface and/or subsurface samples may be collected based on the results of the DGM field activities and target anomaly investigation if MEC/MD is identified. Further details on the decision rules for the determination of the sampling methods, sample types, and sample locations are provided in Worksheets #11, 17, and 18 of the SAP addendum in **Appendix A** of the work plan addendum.

The details on MC associated with the potential MEC used at RVAAP are located on **Table 1**. Based on the information provided in **Table 1** and stakeholder approval, a list of MEC metals (aluminum, cadmium, copper, chromium (Cr^{3+}, Cr^{6+}), iron, lead, zinc, antimony, strontium, barium, and mercury) to be analyzed were identified. Although, thallium, and arsenic were detected above background and one-tenth the residential soil USEPA PRGs, sampling for these analytes is not recommended since they are not associated with munitions used/produced at RVAAP. Manganese will be used as a reference element for the geochemical evaluation. The manganese concentration will be evaluated in order to determine whether any elevated concentrations are associated with military munitions use. In addition, sampling of explosives (8330B suite) to include the propellants nitroglycerin and nitroguanidine, and additional analysis for the propellant nitrocellulose is recommended since the types of munitions cannot be conclusively identified. Sampling for SVOCs, including PAHs, and PCBs are recommended at the Group 8 MRS based on historical evidence that waste oil may have been used during burning operations at RVAAP.

Sampling is not recommended for hexachlorethane, potassium perchlorate and zirconium, which are present in trace amounts in the tracer, HC Smoke composition, EC smokeless powder, and percussion primers. This is based on a determination that for these analytes, the MC mass listed in **Table 1** is insignificant relative to other analytes identified in MEC items potentially used at the Group 8 MRS, and; therefore, would not be a good indicator for MC contamination at the MRS. White phosphorous sampling is also not recommended at the Group 8 MRS as the compound spontaneously combusts in air. In the event that white phosphorous is encountered during the RI, Shaw and the stakeholders will determine whether white phosphorous and/or phosphorous sampling is necessary at the MRS.

The remaining compounds identified in **Table 1** were evaluated to determine the technical feasibility of analysis based on available laboratory methods as presented in **Table 10**.

Table 10
Group 8 MRS Analyte Evaluation

Analyte	Analysis Available?	Notes
Metals USEPA Method SW-846 3010A/3050B/6010C		
Aluminum	Yes	
Calcium	Yes	Used for background evaluation
Cadmium	Yes	
Copper	Yes	
Chromium (Cr^{3+}, Cr^{6+})	Yes	
Iron	Yes	
Lead	Yes	
Magnesium	Yes	Used for background evaluation
Manganese	Yes	Used for background evaluation

Analyte	Analysis Available?	Notes
Zinc	Yes	
Antimony	Yes	
Strontium	Yes	
Barium	Yes	
Mercury	Yes	
Explosives USEPA Method SW-846 8330B Modified		
HMX	Yes	
RDX	Yes	
1,3,5-Trinitrobenzene	Yes	
1,3-Dinitrobenzene	Yes	
Tetryl	Yes	
Nitrobenzene	Yes	
2,4,6-Trinitrotoluene	Yes	
4-Amino-2,6-dinitrotoluene	Yes	
2-Amino-4,6-dinitrotoluene	Yes	
2,4-Dinitrotoluene	Yes	
2,6-Dinitrotoluene	Yes	
2,4/2,6-DNT Mix	Yes	
2-Nitrotoluene	Yes	
3-Nitrotoluene	Yes	
4-Nitrotoluene	Yes	
Nitroglycerin	Yes	
PETN	Yes	
3,5-Dinitroaniline	Yes	
Nitroguanidine	Yes	
Nitrocellulose MCAWW 353.2 Modified		
Nitrocellulose	Yes	
Semivolatile Organic Compounds (SVOCs) USEPA Method SW846 8270C		
1,2,4-Trichlorobenzene	Yes	
1,2-Dichlorobenzene	Yes	
1,3-Dichlorobenzene	Yes	
1,4-Dichlorobenzene	Yes	
2,4,5-Trichlorophenol	Yes	
2,4,6-Trichlorophenol	Yes	
2,4-Dichlorophenol	Yes	
2,4-Dimethylphenol	Yes	
2,4-Dinitrophenol	Yes	
2-Chloronaphthalene	Yes	
2-Chlorophenol	Yes	
2-Methylphenol	Yes	
2-Nitroaniline	Yes	
2-Nitrophenol	Yes	
3 & 4-Methylphenol	Yes	
3,3'-Dichlorobenzidine	Yes	
3-Nitroaniline	Yes	
4,6-Dinitro-2-methylphenol	Yes	

Analyte	Analysis Available?	Notes
4-Bromophenyl-phenyl ether	Yes	
4-Chloro-3-methylphenol	Yes	
4-Chloroaniline	Yes	
4-Chlorophenyl-phenyl ether	Yes	
4-Nitroaniline	Yes	
4-Nitrophenol	Yes	
Acenaphthene	Yes	
Acenaphthylene	Yes	
Anthracene	Yes	
Benzo(a)anthracene	Yes	
Benzo(a)pyrene	Yes	
Benzo(b)fluoranthene	Yes	
Benzo(g,h,i)perylene	Yes	
Benzo(k)fluoranthene	Yes	
Chrysene	Yes	
Dibenzo(a,h)anthracene	Yes	
Fluoranthene	Yes	
Fluorene	Yes	
Indeno(1,2,3-cd)pyrene	Yes	
2-Methylnaphthalene	Yes	
Naphthalene	Yes	
Phenanthrene	Yes	
Pyrene	Yes	
Benzoic acid	Yes	
Benzyl alcohol	Yes	
Bis(2-chloroethoxy)methane	Yes	
Bis(2-chloroethyl)ether	Yes	
Bis(2-chloroisopropyl)ether	Yes	
Bis(2-ethylhexyl)phthalate	Yes	
Butylbenzylphthalate	Yes	
Carbazole	Yes	
Di-n-butylphthalate	Yes	
Di-n-octylphthalate	Yes	
Dibenzofuran	Yes	
Diethylphthalate	Yes	
Dimethylphthalate	Yes	
Hexachlorobenzene	Yes	
Hexachlorobutadiene	Yes	
Hexachlorocyclopentadiene	Yes	
Hexachloroethane	Yes	
Isophorone	Yes	
N-Nitroso-di-n-propylamine	Yes	
Diphenylamine (as N-Nitrosodiphenylamine)	Yes	
Pentachlorophenol	Yes	
Phenol	Yes	

Analyte	Analysis Available?	Notes
Polychlorinated biphenyls (PCBs), Method USEPA SW846 8082A		
Aroclor-1016	Yes	
Aroclor-1221	Yes	
Aroclor-1232	Yes	
Aroclor-1242	Yes	
Aroclor-1248	Yes	
Aroclor-1254	Yes	
Aroclor-1260	Yes	
Total Organic Carbon, Lloyd Kahn Method		
TOC	Yes	Used for risk assessment
pH, Method 9045D		
pH	Yes	Used for risk assessment

Based on the information provided in **Table 1** and the evaluation of which MC have developed laboratory methods provided in **Table 10**, the following MCs and geochemical parameters are proposed for samples collected during the RI:

- MEC Metals, Method USEPA SW846 6010C: Al, Cd, Cu, Cr ($^{3+}$ and $^{6+}$), Fe, Pb, Zn, Sb, Sr, Ba, and Hg.
- Explosives and propellants, Method USEPA SW846 8330B: HMX, RDX, 1,3,5-TNB, 1,3-DNB, tetryl, NB, 2,4,6-TNT, 4-Am-DNT), 2-Am-DNT, 2,4-DNT, 2,6-DNT, 2,4/2,6-DNT Mix, 2-NT, 3-NT, 4-NT, NG, PETN, 3,5-DNA) and NQ.
- SVOCs, Method USEPA SW846 8270C: 1,2,4-Trichlorobenzene, 1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chloronaphthalene, 2-Chlorophenol, 2-Methylnaphthalene, 2-Methylphenol, 2-Nitroaniline, 2-Nitrophenol, 3 & 4-Methylphenol, 3,3'-Dichlorobenzidine, 3-Nitroaniline, 4,6-Dinitro-2-methylphenol, 4-Bromophenyl-phenyl ether, 4-Chloro-3-methylphenol, 4-Chloroaniline, 4-Chlorophenyl-phenyl ether, 4-Nitroaniline, 4-Nitrophenol, Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Benzoic acid, Benzyl alcohol, Bis(2-chloroethoxy)methane, Bis(2-chloroethyl)ether, Bis(2-chloroisopropyl)ether, Bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Carbazole, Chrysene, Di-n-butylphthalate, Di-n-octylphthalate, Dibenzo(a,h)anthracene, Dibenzofuran, Diethylphthalate, Dimethylphthalate, Fluoranthene, Fluorene, Hexachlorobenzene, Hexachlorobutadiene, Hexachlorocyclopentadiene, Hexachloroethane, Indeno(1,2,3-cd)pyrene, Isophorone, N-Nitroso-di-n-propylamine, Naphthalene, Pentachlorophenol, Phenanthrene, Phenol, Pyrene, and Diphenylamine (as N-Nitrosodiphenylamine).
- Nitrocellulose, Method MCAWW 353.2 Modified: Nitrocellulose.
- PCBs, Method USEPA SW846 8082A: Aroclor-1016, Aroclor-1221, Aroclor-1232, Aroclor-1242, Aroclor-1248, Aroclor-1254, and Aroclor-1260.
- Geochemical Parameters, Method USEPA SW846 6010C: Ca, Mg, and Mn.

- Total Organic Carbon, Lloyd Kahn Method and pH, Method 9045D: TOC (soil and sediment) and pH (soils only).

Summary

The selection of the decision units for IS samples are site-specific. The two primary rationales for a decision unit size are (1) the contaminant release area and (2) the area for potential receptor exposure. In general, a decision unit will only encompass areas where surface contamination (0 to 1 foot) is suspected since the sampling objective is to characterize a known or suspected release. In addition, since the sample results will be used to determine exposure risk and will be compared to the risk-based FWCUGs or PRGs for soil, the decision unit will include areas of equally probably anticipated use by the future receptor. The MRSs with known IS surface soil decision units based on this rationale include the 40mm Firing Range and the Group 8 MRSs. MEC/MD was identified at the 40mm Firing Range MRS during the SI and no MC samples were collected. The size of the MRS was reduced from approximately 6 acres to 1.27 acres (the suspected target area) based on the recommendations in the SI. Two IS samples will be collected from the 1.27-acre MRS (approximately 0.63 acres per sample) to characterize where MEC/MD was previously identified; however, the sample areas may be modified (scaled down or broken into smaller IS samples) based on the location of the MEC/MD in order to provide a representative sample of potential source areas. In addition, Shaw will collect one IS surface soil sample at the former 0.05-acre firing point for the range to evaluate for propellants only. This location is not part of the MRS but is being evaluated since it has never been sampled and has the potential to have been impacted by propellants associated with the mortar propellant M9 used in the the 40mm grenade

A total of five IS samples were collected from the Group 8 MRS during the SI and identified potential MC metals above the screening criteria and low concentrations of explosives that warrant further investigation for additional analyses. The MRS is approximately 2.65 acres and may have been used for debris and rubbish burning. It is not known if open burning of MEC/MD was conducted at the MRS; however, MEC and concentrated areas of MD have been found at the site. Based on the accessibility to potential receptors, unknown areas where debris burning or MEC/MD storage occurred and previous data that identifies MC, a total of 4 IS samples (approximately 0.66 acres per sample) are recommended to further characterize the MRS.

Sampling for MC will be conducted for wet sediments at the Erie Burning Ground MRS based on the recommendations in the SI Report. In addition, surface water samples will also be collected and collocated with the sediment samples. A total of 6 IS wet sediment and 3 surface water samples each are proposed for the wetland areas at this MRS. The decision units for the sediment samples range from 1.5 to 3.2 acres based on the size of the drainage area and one surface water sample will be collected from each of the major drainage areas.

The SI Report stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP; however, additional wet sediment samples will be collected under the MMRP based on MC explosives and metals that were detected in the IRP data sets. A total of 4 IS wet sediment samples will be collected from the three pond areas at this MRS which decision units ranging from 0.4 to 0.6 acres.

The need to collect additional samples at the MRSs where samples have already been predetermined (Erie Burning Grounds, Fuze and Booster Quarry, 40mm Firing Range, and Group 8 MRSs) as well as the remaining MRSs (Sand Creek Dump, Block D Igloo-TD, and Water Works #4 Dump) will be evaluated if source areas of MEC/MD or suspected release from MEC/MD are identified. The environmental media requiring sampling, number of samples required, and sample locations will be evaluated on a site-specific basis and require approval from both the USACE and Ohio EPA.

Table 11 summarizes the proposed MC analyte list for the RI samples and the additional geochemical metals. **Table 11** indicates the analytical methods to be used, cleanup goals, and the associated risk-based screening levels that will be used to evaluate the analytical results. The project comparison limits listed in **Table 11** for human health is for proposed National Guard future use receptors and Adult and Child Residential Farmer. The most likely future use receptors at the RVAAP MRSs are those associated with National Guard reuse, and; therefore, they are more representative of the risk. Evaluation of the MRSs for unrestricted use (Residential Farmer) is required under CERCLA.

Additional project comparison limits listed in **Table 11** are risk-based eco-toxicity screening values for ecological endpoints. Soil, surface water and sediment screening values have been selected using the following hierarchy in accordance with the unified approach that integrates the Ohio EPA, USEPA and the USACE ERA processes:

Surface soil, subsurface soil and dry sediment screening values have been selected using the following hierarchy:

- Ecological Soil Screening Levels (EcoSSLs) (USEPA, 2010), online updates from http://www.epa.gov/ecotox/ecossl/.
- Oak Ridge National Laboratory (ORNL): Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2.
- Ecological Screening Levels (ESLs), US EPA Region V, August 2003.
- Oak Ridge National Laboratory (ORNL): Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2.

- Los Alamos National Laboratory (LANL): Eco Risk Database, Release 2.5, October 2010.
- Talmage et al. 1999. Nitroaromatic Munitions Compounds: Environmental Effects and Screening Values, Rev. Environ. Contamin. Toxicol., 161: 1-156.

Sediment screening values have been selected using the following hierarchy:

- MacDonald et al., 2000, Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems, Arch. Environ. Contam. Toxicol. 39:20-31. Threshold effect concentration (TEC).
- Ecological Screening Levels (ESLs), US EPA Region V, August 2003.
- ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2.
- LANL: Eco Risk Database, Release 2.5, October 2010.
- Talmage et al. 1999. Nitroaromatic Munitions Compounds: Environmental Effects and Screening Values, Rev. Environ. Contamin. Toxicol., 161: 1-156.

Surface water screening values have been selected using the following hierarchy:

- Ohio Administrative Code 3745-1, Ohio River Basin Aquatic Life Criteria, OMZA, October 20, 2009. Based on total recoverable metals and assuming a hardness value of 100 mg/L for hardness dependent criteria. Iron criterion is based on protection of agricultural use.
- Ecological Screening Levels (ESLs), US EPA Region V, August 2003.
- ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints, ES/ER/TM-162/R2.
- LANL: Eco Risk Database, Release 2.5, October 2010.
- Talmage et al. 1999. Nitroaromatic Munitions Compounds: Environmental Effects and Screening Values, Rev. Environ. Contamin. Toxicol., 161: 1-156.
- ORNL: Water Quality Criteria for White Phosphorus, 1987, Final Report, AD-ORNL-6336, August

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Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

Analyte	CAS Number	Surface and Subsurface Soil																																	
				Human Health Screening Values[a]																												Ecological Screening Values					
				National Guard Trainee				National Guard Dust/Fire Control Worker				National Guard Range Maintenance Soldier				National Guard Engineering School Instructor				Security Guard/Maintenance Worker				Resident Farmer Adult				Resident Farmer Child									
		Surface Soil Background Values	Subsurface Soil Background Values	Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		USEPA EcoSSLs (2010)[b]	ORNL PRGs (1997)[d]	Region 5 ESLs (2003)[c]	LANL ESLs (2010)[e]	Talmage et al. (1999)[f]	Recommended Soil Ecological Screening Value[g]
				0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}						
Explosives (USEPA SW-846 8330B)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
1,3,5-Trinitrobenzene	99-35-4	NA	NA	16,542	165,422	TBC	TBC	144,038	1.00E+06	TBC	TBC	20,584	205,835	TBC	TBC	7,292	72,925	TBC	TBC	6,380	63,800	TBC	TBC	1,528	15,280	TBC	TBC	225	2,252	TBC	TBC	NA	NA	0.376	6.6	9.7	0.376
1,3-Dinitrobenzene	99-65-0	NA	NA	59.6	596	TBC	TBC	641	6,412	TBC	TBC	86.1	861	TBC	TBC	28.7	287	TBC	TBC	37.5	375	TBC	TBC	5.94	59.4	TBC	TBC	0.765	7.65	TBC	TBC	NA	NA	0.655	0.073	0.41	0.655
2,4,6-Trinitrotoluene	118-96-7	NA	NA	249	2,488	464	4,643	1,762	17,616	3,288	32,883	265	2,652	495	4,950	100	996	186	1,859	65.4	654	122	1,222	21.1	211	32.8	328	3.65	36.5	28.4	284	NA	NA	NA	6.4	5.6	6.4
2,4-Dinitrotoluene	121-14-2	NA	NA	652	6,519	13.4	134	2,896	28,957	59.6	596	477	4,772	9.82	98.2	202	2,020	4.16	41.6	85.2	852	1.75	17.5	43.9	439	0.753	7.53	12.8	128	1.1	11	NA	NA	1.28	0.52	NA	1.28
2,6-Dinitrotoluene	606-20-2	NA	NA	331	3,309	13.6	136	1,485	14,853	61.2	612	244	2,444	10.1	101	103	1,032	4.25	42.5	43.9	439	1.81	18.1	22.4	224	0.769	7.69	6.42	64.2	1.1	11	NA	NA	0.0328	0.37	NA	0.0328
Dinitrotoluene (2,4/2,6-) Mixture (ca)	25321-14-6	NA	NA	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	NA	124	1,237	TBC	TBC	1,507	15,069	TBC	TBC	194	1,943	TBC	TBC	62.4	624	TBC	TBC	113	1,134	TBC	TBC	12.8	128	TBC	TBC	1.54	15.4	TBC	TBC	NA	NA	NA	2.1	80	2.1
2-Nitrotoluene	88-72-2	NA	NA	5,961	59,611	72.6	726	64,115	641,154	781	7,805	8,613	86,128	105	1,049	2,869	28,685	34.9	349	3,748	37,482	45.6	456	594	5,945	6.03	60.3	76.5	765	3.88	38.8	NA	NA	NA	2	NA	2
3-Nitrotoluene	99-08-1	NA	NA	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	NA	NA	NA	2.4	NA	2.4
3,5-Dinitroaniline	618-87-1	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	NA	124	1,237	TBC	TBC	1,507	15,069	TBC	TBC	194	1,943	TBC	TBC	62.4	624	TBC	TBC	113	1,134	TBC	TBC	12.8	128	TBC	TBC	1.54	15.4	TBC	TBC	NA	NA	NA	0.73	NA	0.73
4-Nitrotoluene	99-99-0	NA	NA	5,961	59,611	982	9,818	64,115	641,154	10,560	105,602	8,613	86,128	1,419	14,186	2,869	28,685	472	4,725	3,748	37,482	617	6,173	594	5,945	81.6	816	76.5	765	52.5	525	NA	NA	NA	4.4	NA	4.4
HMX	2691-41-0	NA	NA	23,464	234,645	TBC	TBC	151,363	1.00E+06	TBC	TBC	23,265	232,653	TBC	TBC	8,963	89,630	TBC	TBC	5,292	52,917	TBC	TBC	1,909	19,090	TBC	TBC	359	3,594	TBC	TBC	NA	NA	NA	27	5.6	27
Nitrobenzene	98-95-3	NA	NA	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	NA	NA	1.31	2.2	NA	1.31
Nitroglycerin	55-63-0	NA	NA	0.61*	6.1*	982	9,818	0.61*	6.1*	10,560	105,602	0.61*	6.1*	1,419	14,186	0.61*	6.1*	472	4,725	0.61*	6.1*	617	6,173	0.61*	6.1*	81.6	816	0.61*	6.1*	52.5	525	NA	NA	NA	71	NA	71
Nitroguanidine	556-88-7	NA	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	NA	NA	NA	NA	NA
PETN	78-11-5	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	8600	NA	8600
RDX	121-82-4	NA	NA	1,711	17,113	145	1,452	16,214	162,136	1,376	13,757	2,263	22,629	192	1,920	782	7,823	66.4	664	790	7,899	67.0	670	163	1,632	11.5	115	22.7	227	8.03	80.3	NA	NA	NA	7.5	15	7.5
Tetryl	479-45-8	NA	NA	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	NA	NA	NA	0.99	4.4	0.99
Metals (USEPA SW-846 6010B)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	7429-90-5	17,700	19,500	3,496	34,960	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	775,289	1.00E+06	TBC	TBC	6,210	62,103	TBC	TBC	366,343	1.00E+06	TBC	TBC	52,923	529,229	TBC	TBC	7,380	73,798	TBC	TBC	Narrative	NA	NA	Narrative	NA	NA
Antimony	7440-36-0	0.96	0.96	175	1,753	TBC	TBC	1,030	10,297	TBC	TBC	161	1,614	TBC	TBC	63.7	637	TBC	TBC	34.2	342	TBC	TBC	13.6	136	TBC	TBC	2.82	28.2	TBC	TBC	0.27	5	0.142	0.05	NA	0.27
Barium	7440-39-3	88.4	124	351	3,506	TBC	TBC	810,909	1.00E+06	TBC	TBC	128,223	1.00E+06	TBC	TBC	627	6,272	TBC	TBC	53,190	531,903	TBC	TBC	8,966	89,656	TBC	TBC	1,413	14,129	TBC	TBC	330	283	1.04	110	NA	330
Cadmium	7440-43-9	0	0	329	3,292	10.9	109	1,473	14,726	94,527	945,273	242	2,424	24,133	241,332	102	1,024	19.7	197	43.5	435	50,364	503,642	22.3	223	1,249	12,491	6.41	64.1	2,677	26,767	0.36	4	0.00222	0.27	NA	0.36
Calcium	7440-70-2	15,800	35,500	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
Copper	7440-50-8	17.7	32.3	25,368	253,680	TBC	TBC	341,235	1.00E+06	TBC	TBC	42,486	424,860	TBC	TBC	13,240	132,401	TBC	TBC	34,449	344,494	TBC	TBC	2,714	27,138	TBC	TBC	311	3,106	TBC	TBC	28	60	5.4	15	NA	28
Chromium (as Cr^{3+})	7440-47-3	17.4	27.2	329,763	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	202,189	1.00E+06	TBC	TBC	89,618	896,177	TBC	TBC	32,885	328,852	TBC	TBC	19,694	196,942	TBC	TBC	8,147	81,473	TBC	TBC	26	0.4	0.4	2.3	NA	26
Chromium (as Cr^{6+})	18540-29-9	NA	NA	5.61	5.61E+01	1.64	16.4	6,666	66,659	14,179	141,791	1,103	11,030	3,620	36,200	10	100	2.96	29.6	254	2,537	7,555	75,546	90.4	904	187	1874	19.9	199	401.5	4015	130	NA	NA	0.34	NA	130
Iron	4739-89-6	23,100	35,200	184,370	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	285,369	1.00E+06	TBC	TBC	92,205	922,050	TBC	TBC	156,695	1.00E+06	TBC	TBC	19,010	190,104	TBC	TBC	2,313	23,125	TBC	TBC	Narrative	NA	NA	NA	NA	NA
Lead	7439-92-1	26.1	19.1	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	11	40.5	0.0537	14	NA	11
Magnesium	7439-95-4	3,030	8,790	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	1,450	3,030	35.1	351	TBC	TBC	116,634	1.00E+06	TBC	TBC	20,467	204,672	TBC	TBC	63.1	631	TBC	TBC	7,253	72,529	TBC	TBC	1,482	14,817	TBC	TBC	293	2,927	TBC	TBC	220	NA	NA	220	NA	220
Mercury	7439-97-6	0.036	0.044	172	1,722	TBC	TBC	1,659	16,586	TBC	TBC	230	2,304	TBC	TBC	79.3	793	TBC	TBC	82.5	825	TBC	TBC	16.5	165	TBC	TBC	2.27	22.7	TBC	TBC	NA	0.00051	0.1	0.013	NA	NA
Strontium	7440-24-6	NA	NA	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	NA	NA	NA	96	NA	NA
Zinc	7440-66-0	61.8	93.3	187,269	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	301,090	1+E06	TBC	TBC	95,621	956,213	TBC	TBC	195,080	1.00E+06	TBC	TBC	19,659	196,589	TBC	TBC	2,321	23,209	TBC	TBC	46	8.5	6.62	48	NA	46
SVOCs (USEPA SW-846 8270C)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
1,2,4-Trichlorobenzene	120-82-1	NA	NA	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	NA	20	11.1	0.27	NA	20
1,2-Dichlorobenzene	95-50-1	NA	NA	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	NA	NA	2.96	0.92	NA	2.96
1,3-Dichlorobenzene	541-73-1	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	37.7	0.73	NA	37.7
1,4-Dichlorobenzene	106-46-7	NA	NA	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	NA	20	0.546	0.88	NA	20
2,4,5-Trichlorophenol	95-95-4	NA	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	9	14.1	NA	NA	9
2,4,6-Trichlorophenol	88-06-2	NA	NA	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	NA	4	9.94	NA	NA	4
2,4-Dichlorophenol	120-83-2	NA	NA	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	NA	NA	87.5	NA	NA	87.5
2,4-Dimethylphenol	105-67-9	NA	NA	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	NA	NA	0.01	NA	NA	0.01
2,4-Dinitrophenol	51-28-5	NA	NA	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	NA	20	0.0609	NA	NA	20
2-Chloronaphthalene	91-58-7	NA	NA	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	NA	NA	0.0122	NA	NA	0.0122
2-Chlorophenol	95-57-8	NA	NA	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	NA	NA	0.243	0.39	NA	0.243
2-Methylnaphthalene	91-57-6	NA	NA	2,384	23,845	TBC	TBC	25,646	256,462	TBC	TBC	3,445	34,451	TBC	TBC	1,147	11,474	TBC	TBC	1,499	14,993	TBC	TBC	238	2,378	TBC	TBC	30.6	306	TBC	TBC	NA	NA	3.24	2.5	NA	3.24
2-Methylphenol	95-48-7	NA	NA	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	310*	3,100*	TBC	TBC	NA	NA	40.4	0.67	NA	40.4
2-Nitroaniline	88-74-4	NA	NA	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	NA	NA	74.1	5.4	NA	74.1
2-Nitrophenol	88-75-5	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	1.6	NA	NA	1.6
3 & 4-Methylphenol	CASID30030	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	3.49	0.69	NA	3.49
3,3'-Dichlorobenzidine	91-94-1	NA	NA	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	NA	NA	0.646	NA	NA	0.646
3-Nitroaniline	99-09-2	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	3.16	NA	NA	3.16
4,6-Dinitro-2-methylphenol	534-52-1	NA	NA	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	NA	NA	0.144	NA	NA	0.144
4-Bromophenyl-phenyl ether	101-55-3	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
4-Chloro-3-methylphenol	59-50-7	NA	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	NA	7.95	NA	NA	7.95
4-Chloroaniline	106-47-8	NA	NA	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	NA	NA	1.1	1	NA	1.1
4-Chlorophenyl-phenyl ether	7005-72-3	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
4-Nitroaniline	100-01-6	NA	NA	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	NA	NA	21.9	NA	NA	21.9
4-Nitrophenol	100-02-7	NA	NA	4,769	47,689	TBC	TBC	51,292	512,923	TBC	TBC	6,890	68,903	TBC	TBC	2,295	22,948	TBC	TBC	2,999	29,985	TBC	TBC	476	4,756	TBC	TBC	61.2	612	TBC	TBC	NA	7	5.12	NA	NA	7
Acenaphthene	83-32-9	NA	NA	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	29	20	682	0.25	NA	29
Acenaphthylene	208-96-8	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	29	NA	682	120	NA	29
Anthracene	120-12-7	NA	NA	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	29	NA	1480	6.8	NA	29
Benzo(a)anthracene	56-55-3	NA	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	2.62	26.2	TBC	TBC	1.19	11.9	TBC	TBC	0.403	4.03	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	1.1	NA	5.21	3	NA	1.1
Benzo(a)pyrene	50-32-8	NA	NA	TBC	TBC	0.477	4.77	TBC	TBC	1.51	15.1	TBC	TBC	0.262	2.62	TBC	TBC	0.119	1.19	TBC	TBC	0.04	0.403	TBC	TBC	0.022	0.221	TBC	TBC	0.065	0.65	1.1	NA	1.52	53	NA	1.1
Benzo(b)fluoranthene	205-99-2	NA	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	2.62	26.2	TBC	TBC	1.19	11.9	TBC	TBC	0.403	4.03	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	1.1	NA	59.8	18	NA	1.1
Benzo(g,h,i)perylene	191-24-2	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	1.1	NA	119	24	NA	1.1
Benzo(k)fluoranthene	207-08-9	NA	NA	TBC	TBC	47.7	477	TBC	TBC	151	1,513	TBC	TBC	26.2	262	TBC	TBC	11.9	119	TBC	TBC	4.03	40.3	TBC	TBC	2.21	22.1	TBC	TBC	6.5	65	1.1	NA	148	62	NA	1.1
Benzoic acid	65-85-0	NA	NA	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	NA	NA	NA	1	NA	1
Benzyl alcohol	100-51-6	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	65.8	120	NA	65.8
Bis(2-chloroethoxy)methane	111-91-1	NA	NA	1,788	17,883	TBC	TBC	19,235	192,346	TBC	TBC	2,584	25,839	TBC	TBC	861	8,606	TBC	TBC	1,124	11,244	TBC	TBC	178	1,783	TBC	TBC	23	230	TBC	TBC	NA	NA	0.302	NA	NA	0.302
Bis(2-chloroethyl)ether	111-44-4	NA	NA	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	NA	NA	23.7	NA	NA	23.7
Bis(2-chloroisopropyl)ether	108-60-1	NA	NA	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	NA	NA	19.9	NA	NA	19.9
Bis(2-ethylhexyl)phthalate	117-81-7	NA	NA	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	NA	NA	0.925	0.02	NA	0.925
Butylbenzylphthalate	85-68-7	NA	NA	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	NA	NA	0.239	90	NA	0.239
Carbazole	86-74-8	NA	NA	TBC	TBC	835	8,346	TBC	TBC	8,976	89,762	TBC	TBC	1,206	12,058	TBC	TBC	402	4,016	TBC	TBC	525	5247	TBC	TBC	69.4	694	TBC	TBC	44.6	446	NA	NA	NA	0.00008	NA	0.00008
Chrysene	218-01-9	NA	NA	TBC	TBC	477	4,774	TBC	TBC	1,513	15,129	TBC	TBC	262	2,619	TBC	TBC	119	1,194	TBC	TBC	40.3	403	TBC	TBC	22.1	221	TBC	TBC	65	650	1.1	NA	4.73	2.4	NA	1.1
Di-n-butylphthalate	84-74-2	NA	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	200	0.15	0.011	NA	200
Di-n-octylphthalate	117-84-0	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	709	1.1	NA	709
Dibenzo(a,h)anthracene	53-70-3	NA	NA	TBC	TBC	0.477	4.77	TBC	TBC	1.51	15.1	TBC	TBC	0.262	2.62	TBC	TBC	0.119	1.19	TBC	TBC	0.04	0.403	TBC	TBC	0.022	0.221	TBC	TBC	0.065	0.65	1.1	NA	18.4	12	NA	1.1
Dibenzofuran	132-64-9	NA	NA	1,192	11,922	TBC	TBC	12,823	128,231	TBC	TBC	1,723	17,226	TBC	TBC	574	5,737	TBC	TBC	750	7,496	TBC	TBC	119	1,189	TBC	TBC	15.3	153	TBC	TBC	NA	NA	NA	6.1	NA	6.1
Diethylphthalate	84-66-2	NA	NA	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	NA	100	24.8	100	NA	100
Dimethylphthalate	131-11-3	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	734	10	NA	734
Fluoranthene	206-44-0	NA	NA	5,087	50,868	TBC	TBC	15,778	157,779	TBC	TBC	2,732	27,316	TBC	TBC	1,249	12,486	TBC	TBC	420	4,202	TBC	TBC	276	2,765	TBC	TBC	163	1,627	TBC	TBC	29	NA	122	10	NA	29
Fluorene	86-73-7	NA	NA	11,458	114,583	TBC	TBC	46,870	468,700	TBC	TBC	7,823	78,227	TBC	TBC	3,374	33,739	TBC	TBC	1,343	13,427	TBC	TBC	737	7,366	TBC	TBC	243	2,433	TBC	TBC	29	NA	122	3.7	NA	29
Hexachlorobenzene	118-74-1	NA	NA	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	NA	NA	0.199	0.079	NA	0.199
Hexachlorobutadiene	87-68-3	NA	NA	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	NA	NA	0.0398	NA	NA	0.0398
Hexachlorocyclopentadiene	77-47-4	NA	NA	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	NA	10	0.755	NA	NA	10
Hexachloroethane	67-72-1	NA	NA	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	NA	NA	0.596	NA	NA	0.596
Indeno(1,2,3-cd)pyrene	193-39-5	NA	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	2.62	26.2	TBC	TBC	1.19	11.9	TBC	TBC	0.403	4.03	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	1.1	NA	109	62	NA	1.1
Isophorone	78-59-1	NA	NA	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	NA	NA	139	NA	NA	139
N-Nitroso-di-n-propylamine	621-64-7	NA	NA	TBC	TBC	1.88	18.8	TBC	TBC	12.1	121	TBC	TBC	1.86	18.6	TBC	TBC	0.717	7.17	TBC	TBC	0.423	4.23	TBC	TBC	0.127	1.27	TBC	TBC	0.12	1.2	NA	NA	0.544	NA	NA	0.544
N-Nitrosodiphenylamine & Diphn	86-30-6	NA	NA	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	NA	NA	0.545	NA	NA	0.545
Naphthalene	91-20-3	NA	NA	1,541	15,407	TBC	TBC	23,405	234,049	TBC	TBC	3,908	39,081	TBC	TBC	1,169	11,687	TBC	TBC	671	6,713	TBC	TBC	368	3,678	TBC	TBC	122	1,215	TBC	TBC	29	NA	0.0994	1	NA	29
Pentachlorophenol	87-86-5	NA	NA	5,656	56,558	44	440	19,344	193,438	150	1,505	3,309	33,092	25.7	257	1,483	14,833	11.5	115	527	5,271	4.1	41	327	3,269	2.12	21.2	151	1,514	4.91	49.1	2.1	3	0.119	0.36	NA	2.1
Phenanthrene	85-01-8	NA	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	29	NA	45.7	5.5	NA	29
Phenol	108-95-2	NA	NA	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	NA	30	120	0.79	NA	30
Pyrene	129-00-0	NA	NA	3,815	38,151	TBC	TBC	11,833	118,334	TBC	TBC	2,049	20,487	TBC	TBC	936	9,364	TBC	TBC	315	3,151	TBC	TBC	207	2,074	TBC	TBC	122	1,220	TBC	TBC	1.1	NA	78.5	10	NA	1.1

Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

		Surface and Subsurface Soil																																	
		Human Health Screening Values [a]																												Ecological Screening Values					
				National Guard Trainee				National Guard Dust/Fire Control Worker				National Guard Range Maintenance Soldier				National Guard Engineering School Instructor				Security Guard/Maintenance Worker				Resident Farmer Adult				Resident Farmer Child									
				Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk							
Analyte	CAS Number	Surface Soil Background Values	Subsurface Soil Background Values	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	USEPA EcoSSLs (2010) [b]	ORNL PRGs (1997) [d]	Region 5 ESLs (2003) [c]	LANL ESLs (2010) [e]	Talmage et al. (1999) [f]	Recommended Soil Ecological Screening Value [g]
PCBs (Method SW-846 8082A)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aroclor 1016	12674-11-2	NA	NA	19.2	192	3.46	34.6	76.8	768	15.4	154	12.9	129	2.57	25.7	5.58	55.8	1.1	11	2.18	21.8	0.437	4.37	1.22	12.2	0.203	2.03	0.419	4.19	0.349	3.49	NA	0.371	0.000332	1	NA	0.371
Aroclor 1221	11104-28-2	NA	NA	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	NA	0.371	0.000332	NA	NA	0.371
Aroclor 1232	11141-16-5	NA	NA	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	NA	0.371	0.000332	NA	NA	0.371
Aroclor 1242	53469-21-9	NA	NA	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	NA	0.371	0.000332	0.041	NA	0.371
Aroclor 1248	12672-29-6	NA	NA	TBC	TBC	3.46	34.6	TBC	TBC	15.4	154	TBC	TBC	2.57	25.7	TBC	TBC	1.1	11	TBC	TBC	0.437	4.37	TBC	TBC	0.203	2.03	TBC	TBC	0.349	3.49	NA	0.371	0.000332	0.0072	NA	0.371
Aroclor 1254	11097-69-1	NA	NA	5.49	54.9	3.46	34.6	21.9	219	15.4	154	3.67	36.7	2.57	25.7	1.59	15.9	1.1	11	0.624	6.24	0.437	4.37	0.348	3.48	0.203	2.03	0.12	1.2	0.349	3.49	NA	0.371	0.000332	0.041	NA	0.371
Aroclor 1260	11096-82-5	NA	NA	TBC	TBC	3.46	34.6	TBC	TBC	15.4	15.4	TBC	TBC	2.57	25.7	TBC	TBC	1.1	11	TBC	TBC	0.437	4.37	TBC	TBC	0.203	2.03	TBC	TBC	0.349	3.49	NA	0.371	0.000332	0.14	NA	0.371
Nitrocellulose (Method MCAWW 353.2 Modified)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Nitrocellulose	9004-70-0	NA	NA	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	NA	NA	NA	NA	NA	NA
Total Organic Carbon (Method 9060A Modified/Lloyd Kahn/Walkley Black)																																			
Total Organic Carbon	TOC (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	pH (Units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

[a] Screening levels are from the Science Application International Corporation (SAIC), *Final Facility-Wide Human Health Remediation Goals at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio, March 2010*.

[*] Available Regional Screening Level values for a contaminant were taken from the *EPA Regional Screening Level Resident Soil Supporting Table* (December 2009) in the event no screening level was available in the Final *Facility-Wide Human Health Remediation Goals at the RVAAP, March 2010*.

[b] Ecological Soil Screening Levels (EcoSSLs), (USEPA, 2011) online updates from http://www.epa.gov/ecotox/ecossl/.

[c] Ecological Screening Levels (ESLs), US EPA Region V, August 2003.

[d] ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. *Preliminary Remediation Goals for Ecological Endpoints*, ES/ER/TM-162/R2.

[e] Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.5, October 2010.

[f] From *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values*, Talmage et al., 1999, Rev. Environ. Contamin. Toxicol., 161: 1-156. Sediment benchmarks originally reported as mg compound per kg total organic carbon (TOC) in sediment, and 10% TOC assumed.

[yyy] Analyte identified as a persistent, bioaccumulative, and toxic (PBT) compound (OEPA DERR ERA Guidance, April 2008).

[g] The following hierarchy (based on OEPA DERR ERA Guidance, April 2008) was used to select the soil screening values:

1. USEPA EcoSSL (plants, invertebrates, wildlife)
2. ORNL (1997) [plants, invertebrates, wildlife]
3. USEPA Region 5 ESLs (2003)
4. LANL (2010) [various endpoints]
5. Talmage et al. (1999)

[h] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, Arch. Environ. Contam. Toxicol. 39:20-31. TEC = threshold effect concentration.

[i] The following hierarchy (based on OEPA DERR ERA Guidance, April 2008) was used to select the sediment screening values:

1. MacDonald et al. (2000)
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2010) [various endpoints]
5. Talmage et al. (1999)

[j] Ohio Administrative Code 3745-1, *Ohio River Basin Aquatic Life Criteria, OMZA, October 20, 2009*. Based on total recoverable metals, assuming a hardness of 100 mg/L for hardness-dependent criteria, and a pH of 7.0 for pH-dependent criteria. Iron criterion is based on protection of agricultural use. PCBs criteria are based on wildlife protection.

[k] The following hierarchy (based on OEPA DERR ERA Guidance, April 2008) was used to select the surface water screening values:

1. Ohio water quality criteria (2009) [aquatic life, OMZA]
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2010) [various endpoints]
5. Talmage et al. (1999)

[L] use 2-nitroaniline as surrogate.

CAS = Chemical Abstract Service.
CUG = cleanup goal.
HI = Hazard Index
MDL = method detection limit.
mg/kg = milligrams per kilogram.
(µg/L) = micrograms per liter
NA = RVAAP-specific screening level or RSL not available.
RVAAP = Ravenna Army Ammunition Plant.
RL = reporting limit.
RSL = Regional screening level
SVOC = semivolatile organic compound
SAP/QAPP = Sampling and Analysis Plan/Quality Assurance Project Plan.
TBC = To be calculated; no available screening level or RSL is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent.

Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

		Sediment																						
		Human Health Screening Values [a]																Ecological Screening Values						
			National Guard Trainee				National Guard Dust/Fire Control Worker				Resident Farmer Adult				Resident Farmer Child									
			Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		MacDonald et al. (2000) [b]	Region 5 ESLs (2003) [c]	ORNL PRGs (1997) [d]	LANL ESLs (2010) [e]	Talmage et al. (1999) [f]	Recommended Sediment Ecological Screening Value [i]
Analyte	CAS Number	Sediment Background Value	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}						
Explosives (USEPA SW-846 8330B)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
1,3,5-Trinitrobenzene	99-35-4	NA	220*	2,200*	TBC	TBC	220*	2,200*	TBC	TBC	220*	2,200*	TBC	TBC	220*	2,200*	TBC	TBC	NA	NA	NA	1300	0.024	1300
1,3-Dinitrobenzene	99-65-0	NA	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	NA	0.00861	NA	0.92	0.067	0.00861
2,4,6-Trinitrotoluene	118-96-7	NA	249	2,488	464	4,643	1,762	17,616	3,288	32,883	21.1	211	32.8	328	3.65	36.5	28.4	284	NA	NA	NA	420	0.92	420
2,4-Dinitrotoluene	121-14-2	NA	652	6,519	13.4	134	2,896	28,957	59.6	596	43.9	439	0.753	7.53	12.8	128	1.1	11	NA	0.0144	NA	0.29	NA	0.0144
2,6-Dinitrotoluene	606-20-2	NA	6.1*	61*	TBC	TBC	6.1*	61*	TBC	TBC	6.1*	61*	TBC	TBC	6.1*	61*	TBC	TBC	NA	0.0398	NA	1.9	NA	0.0398
Dinitrotoluene (2,4/2,6-) Mixture (ca)	25321-14-6	NA	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	TBC	TBC	0.71*	7.1*	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	124	1,237	TBC	TBC	1,507	15,069	TBC	TBC	12.8	128	TBC	TBC	1.54	15.4	TBC	TBC	NA	NA	NA	7	NA	7
2-Nitrotoluene	88-72-2	NA	7.0*	70*	2.9*	29*	7.0*	70*	2.9*	29*	7.0*	70*	2.9*	29*	7.0*	70*	2.9*	29*	NA	NA	NA	5.6	NA	5.6
3-Nitrotoluene	99-08-1	NA	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	0.61*	6.1*	TBC	TBC	NA	NA	NA	4.9	NA	4.9
3,5-Dinitroaniline	618-87-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	124	1,237	TBC	TBC	1,507	15,069	TBC	TBC	12.8	128	TBC	TBC	1.54	15.4	TBC	TBC	NA	NA	NA	1.9	NA	1.9
4-Nitrotoluene	99-99-0	NA	24*	240*	30*	300*	24*	240*	30*	300*	24*	240*	30*	300*	24*	240*	30*	300*	NA	NA	NA	10	NA	10
HMX	2691-41-0	NA	23,464	234,645	TBC	TBC	151,363	1.00E+06	TBC	TBC	1,909	19,090	TBC	TBC	359	3,594	TBC	TBC	NA	NA	NA	27000	0.047	27000
Nitrobenzene	98-95-3	NA	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	13*	130*	4.8*	48*	NA	0.145	NA	32	NA	0.145
Nitroglycerin	55-63-0	NA	0.61*	6.1*	982	9,818	0.61*	6.1*	10,560	105,602	0.61*	6.1*	816	816	0.61*	6.1*	52.5	525	NA	NA	NA	1700	NA	1700
Nitroguanidine	556-88-7	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	NA	NA	NA	NA	NA
PETN	78-11-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	120000	NA	120000
RDX	121-82-4	NA	1,711	17,113	145	1,452	16,214	162,136	1,376	13,757	163	1,632	11.5	115	22.7	227	8.03	80.3	NA	NA	NA	45	0.13	45
Tetryl	479-45-8	NA	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	24.4*	244*	TBC	TBC	NA	NA	NA	100	NA	100
Metals (USEPA SW-846 6010B)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aluminum	7429-90-5	13,900	3,496	34,960	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	52,923	529,229	TBC	TBC	7,380	73,798	TBC	TBC	NA	NA	NA	280	NA	280
Antimony	7440-36-0	NA	175	1,753	TBC	TBC	1,030	10,297	TBC	TBC	13.6	136	TBC	TBC	2.82	28.2	TBC	TBC	NA	NA	NA	0.36	NA	0.36
Barium	7440-39-3	123	351	3,506	TBC	TBC	810,909	1.00E+06	TBC	TBC	8,966	89,,656	TBC	TBC	1,413	14,129	TBC	TBC	NA	NA	NA	48	NA	48
Cadmium	7440-43-9	NA	329	3,292	10.9	109	1,473	14,726	94,527	945,273	22.3	223	1.249	12.491	6.41	64.1	2.677	26,767	0.99	0.99	4.2	0.33	NA	0.99
Calcium	7440-70-2	5,510	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
Copper	7440-50-8	27.6	25,368	253,680	TBC	TBC	341,235	1.00E+06	TBC	TBC	2,714	27,138	TBC	TBC	311	3,106	TBC	TBC	31.6	31.6	77.7	23	NA	31.6
Chromium (as Cr-3)	7440-47-3	18.1	329,763	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	16,694	169,942	TBC	TBC	8,147	81,473	TBC	TBC	43.4	43.4	159	56	NA	43.4
Chromium (as Cr^{6+})	18540-29-9	NA	5.61	56.1	1.64	16.4	6666	66659	14179	141791	90.4	904	187	1874	19.9	199	402	4015	NA	NA	NA	8	NA	8
Iron	4739-89-6	28,200	184,370	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	19,010	190,104	TBC	TBC	2,313	23,125	TBC	TBC	NA	NA	NA	20	NA	20
Lead	7439-92-1	27.4	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	40*	400*	TBC	TBC	35.8	35.8	110	27	NA	35.8
Magnesium	7439-95-4	2,760	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
Manganese	7439-96-5	1,950	35.1	351	TBC	TBC	116,634	1.00E+06	TBC	TBC	1,482	14,817	TBC	TBC	293	2,927	TBC	TBC	NA	NA	NA	720	NA	720
Mercury	7439-97-6	0.059	172	1,722	TBC	TBC	1,659	16,586	TBC	TBC	16.5	165	TBC	TBC	2.27	22.7	TBC	TBC	0.18	0.174	0.7	0.00046	NA	0.18
Strontium	7440-24-6	NA	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	4,700*	47,000*	TBC	TBC	NA	NA	NA	1700	NA	1700
Zinc	7440-66-0	532	187,269	1.00E+06	TBC	TBC	1.00E+06	1.00E+06	TBC	TBC	19,659	196,589	TBC	TBC	2,321	23,209	TBC	TBC	121	121	270	65	NA	121
SVOCs (USEPA SW-846 8270C)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
1,2,4-Trichlorobenzene	120-82-1	NA	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	6.2*	62*	22*	220*	NA	5.062	9.7	0.33	NA	5.062
1,2-Dichlorobenzene	95-50-1	NA	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	190*	1,900*	TBC	TBC	NA	0.294	0.33	1.1	NA	0.294
1,3-Dichlorobenzene	541-73-1	NA	TBC	TBC	TBC	TBC	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	350*	3,500*	2.4*	24*	NA	1.315	1.7	0.92	NA	1.315
1,4-Dichlorobenzene	106-46-7	NA	350*	3,500*	2.4*	24*	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.318	0.35	0.35	NA	0.318
2,4,5-Trichlorophenol	95-95-4	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	NA	NA	NA	NA	NA
2,4,6-Trichlorophenol	88-06-2	NA	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	6.1*	61*	44*	440*	NA	0.208	NA	NA	NA	0.208
2,4-Dichlorophenol	120-83-2	NA	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	NA	0.0817	NA	NA	NA	0.0817
2,4-Dimethylphenol	105-67-9	NA	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	120*	1,200*	TBC	TBC	NA	0.304	NA	NA	NA	0.304
2,4-Dinitrophenol	51-28-5	NA	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	12*	120*	TBC	TBC	NA	0.00621	NA	NA	NA	0.00621
2-Chloronaphthalene	91-58-7	NA	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	630*	6,300*	TBC	TBC	NA	0.417	NA	NA	NA	0.417
2-Chlorophenol	95-57-8	NA	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	39*	390*	TBC	TBC	NA	0.0319	NA	0.057	NA	0.0319
2-Methylnaphthalene	91-57-6	NA	31*	310*	TBC	TBC	31*	310*	TBC	TBC	31*	310*	TBC	TBC	31*	310*	TBC	TBC	NA	0.0202	NA	0.18	NA	0.0202
2-Methylphenol	95-48-7	NA	310*	3100*	TBC	TBC	310*	3100*	TBC	TBC	310*	3100*	TBC	TBC	310*	3100*	TBC	TBC	NA	0.0554	0.012	1900	NA	0.0554
2-Nitroaniline	88-74-4	NA	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	61*	610*	TBC	TBC	NA	NA	NA	8.1	NA	8.1
2-Nitrophenol	88-75-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
3 & 4-Methylphenol	CASID30030	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.0202	NA	NA	NA	0.0202
3,3'-Dichlorobenzidine	91-94-1	NA	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	TBC	TBC	1.1*	11*	NA	0.127	NA	NA	NA	0.127
3-Nitroaniline	99-09-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	8.1 [h]	NA	8.1
4,6-Dinitro-2-methylphenol	534-52-1	NA	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	0.49*	4.9*	TBC	TBC	NA	0.104	NA	NA	NA	0.104
4-Bromophenyl-phenyl ether	101-55-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	1.55	1.2	NA	NA	1.55
4-Chloro-3-methylphenol	59-50-7	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	0.388	NA	NA	NA	0.388
4-Chloroaniline	106-47-8	NA	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	24*	240*	2.4*	24*	NA	0.146	NA	NA	NA	0.146
4-Chlorophenyl-phenyl ether	7005-72-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
4-Nitroaniline	100-01-6	NA	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	24*	240*	NA	NA	NA	8.1 [h]	NA	8.1
4-Nitrophenol	100-02-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.0133	NA	NA	NA	0.0133
Acenaphthene	83-32-9	NA	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	340*	3,400*	TBC	TBC	NA	0.00671	0.089	0.62	NA	0.00671
Acenaphthylene	208-96-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.00587	0.13	0.044	NA	0.00587
Anthracene	120-12-7	NA	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	1,700*	17,000*	TBC	TBC	0.0572	0.0572	0.25	0.00039	NA	0.0572
Benzo(a)anthracene	56-55-3	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	0.108	0.108	0.69	0.11	NA	0.108
Benzo(a)pyrene	50-32-8	NA	TBC	TBC	0.477	4.7	TBC	TBC	1.51	15.1	TBC	TBC	0.022	0.221	TBC	TBC	0.065	0.65	0.15	0.15	0.394	0.35	NA	0.15
Benzo(b)fluoranthene	205-99-2	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	NA	10.4	4	0.24	NA	10.4
Benzo(g,h,i)perylene	191-24-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.17	6.3	0.29	NA	0.17
Benzo(k)fluoranthene	207-08-9	NA	TBC	TBC	47.7	477	TBC	TBC	151	1,513	TBC	TBC	2.21	22.1	TBC	TBC	6.5	65	NA	0.24	4	0.24	NA	0.24
Benzoic acid	65-85-0	NA	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	24,000*	240,000*	TBC	TBC	NA	NA	NA	0.065	NA	0.065
Benzyl alcohol	100-51-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.00104	0.0011	330	NA	0.00104
Bis(2-chloroethoxy)methane	111-91-1	NA	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	18*	180*	TBC	TBC	NA	NA	NA	NA	NA	NA
Bis(2-chloroethyl)ether	111-44-4	NA	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	TBC	TBC	0.21*	2.1*	NA	3.52	NA	NA	NA	3.52
Bis(2-chloroisopropyl)ether	108-60-1	NA	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	310*	3,100*	4.6*	46*	NA	NA	NA	NA	NA	NA
Bis(2-ethylhexyl)phthalate	117-81-7	NA	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	120*	1,200*	35*	350*	NA	0.182	2.7	0.026	NA	0.182
Butylbenzylphthalate	85-68-7	NA	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	1,200*	12,000*	260*	2,600*	NA	1.97	NA	13	NA	1.97
Carbazole	86-74-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	0.00014	NA	0.00014
Chrysene	218-01-9	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.166	0.166	0.85	0.5	NA	0.166
Di-n-butylphthalate	84-74-2	NA	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	610*	6,100*	TBC	TBC	NA	1.114	240	0.014	NA	1.114
Di-n-octylphthalate	117-84-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	40.6	NA	1.3	NA	40.6
Dibenzo(a,h)anthracene	53-70-3	NA	TBC	TBC	0.477	4.77	TBC	TBC	1.51	15.1	TBC	TBC	0.022	0.221	TBC	TBC	0.065	0.65	0.033	0.033	0.0292	0.015	NA	0.033
Dibenzofuran	132-64-9	NA	7.8*	78*	TBC	TBC	7.8*	78*	TBC	TBC	7.8*	78*	TBC	TBC	7.8*	78*	TBC	TBC	NA	0.449	0.42	2.3	NA	0.449
Diethylphthalate	84-66-2	NA	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	4,900*	49,000*	TBC	TBC	NA	0.295	0.61	4500	NA	0.295
Dimethylphthalate	131-11-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	120	NA	120
Fluoranthene	206-44-0	NA	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	0.423	0.423	0.834	2.9	NA	0.423
Fluorene	86-73-7	NA	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	230*	2,300*	TBC	TBC	0.0774	0.0774	0.14	0.54	NA	0.0774
Hexachlorobenzene	118-74-1	NA	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	4.9*	49*	0.3*	3.0*	NA	0.02	NA	0.1	NA	0.02
Hexachlorobutadiene	87-68-3	NA	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	6.1*	61*	6.2*	62*	NA	0.0265	NA	NA	NA	0.0265
Hexachlorocyclopentadiene	77-47-4	NA	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	37*	370*	TBC	TBC	NA	0.901	NA	NA	NA	0.901
Hexachloroethane	67-72-1	NA	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	6.1*	61*	35*	350*	NA	0.584	1	NA	NA	0.584
Indeno(1,2,3-cd)pyrene	193-39-5	NA	TBC	TBC	4.77	47.7	TBC	TBC	15.1	151	TBC	TBC	0.221	2.21	TBC	TBC	0.65	6.5	NA	0.2	0.837	0.078	NA	0.2
Isophorone	78-59-1	NA	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	1,200*	12,000*	510*	5,100*	NA	0.432	NA	NA	NA	0.432
N-Nitroso-di-n-propylamine	621-64-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA
N-Nitrosodiphenylamine & Diphn	86-30-6	NA	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	TBC	TBC	99*	990*	NA	NA	NA	NA	NA	NA
Naphthalene	91-20-3	NA	14*	140*	3.6*	36*	14*	140*	3.6*	36*	14*	140*	3.6*	36*	14*	140*	3.6*	36*	0.176	0.176	0.39	0.47	NA	0.176
Pentachlorophenol	87-86-5	NA	23*	230*	0.89*	8.9*	23*	230*	0.89*	8.9*	23*	230*	0.89*	8.9*	23*	230*	0.89*	8.9*	NA	23	NA	0.48	NA	23
Phenanthrene	85-01-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.204	0.204	0.54	0.85	NA	0.204
Phenol	108-95-2	NA	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	1,800*	18,000*	TBC	TBC	NA	0.0491	0.032	840	NA	0.0491
Pyrene	129-00-0	NA	170*	1,700*	TBC	TBC	170*	1,700*	TBC	TBC	170*	1,700*	TBC	TBC	170*	1,700*	TBC	TBC	0.195	0.195	1.4	0.57	NA	0.195

Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

		Sediment																					
		Human Health Screening Values [a]																Ecological Screening Values					
			National Guard Trainee				National Guard Dust/Fire Control Worker				Resident Farmer Adult				Resident Farmer Child									
			Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk							
Analyte	CAS Number	Sediment Background Value	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	MacDonald et al. (2000) [b]	Region 5 ESLs (2003) [c]	ORNL PRGs (1997) [d]	LANL ESLs (2010) [e]	Talmage et al. (1999) [f]	Recommended Sediment Ecological Screening Value [i]
PCBs (Method SW-846 8082A)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Aroclor 1016	12674-11-2	NA	19.2	192	3.46	34.6	76.8	768	15.4	154	1.22	12.2	0.203	2.03	0.419	4.19	0.349	3.49	0.0598	0.0598	0.53	0.01	NA	0.0598
Aroclor 1221	11104-28-2	NA	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	0.0598	0.0598	0.12	NA	NA	0.0598
Aroclor 1232	11141-16-5	NA	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	TBC	TBC	0.14*	1.4*	0.0598	0.0598	0.6	NA	NA	0.0598
Aroclor 1242	53469-21-9	NA	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	0.0598	0.0598	29	0.031	NA	0.0598
Aroclor 1248	12672-29-6	NA	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	TBC	TBC	0.22*	2.2*	0.0598	0.0598	1	0.009	NA	0.0598
Aroclor 1254	11097-69-1	NA	5.49	54.9	3.46	34.6	21.9	219	15.4	154	0.348	3.48	0.203	2.03	0.12	1.2	0.349	3.49	0.0598	0.0598	72	0.031	NA	0.0598
Aroclor 1260	11096-82-5	NA	TBC	TBC	3.46	34.6	TBC	TBC	15.4	154	TBC	TBC	0.203	2.03	TBC	TBC	0.349	3.49	0.0598	0.0598	63	0.031	NA	0.0598
Nitrocellulose (Method MCAWW 353.2 Modified)		(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
Nitrocellulose	9004-70-0	NA	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	1.8E+07*	1.8E+08*	TBC	TBC	NA	NA	NA	NA	NA	NA
Total Organic Carbon (Method 9060A Modified/Lloyd Kahn/Walkley Black)																								
Total Organic Carbon	TOC (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	pH (Units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
[a] Screening levels are from the Science Application International Corporation (SAIC), *Final Facility-Wide Human Health Remediation Goals at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio, March 2010*.
* Available Regional Screening Level values for a contaminant were taken from the *EPA Regional Screening Level Resident Soil Supporting Table* (December 2009) in the event no screening level was available in the Final *Facility-Wide Human Health Remediation Goals at the RVAAP, March 2010*.
[b] Ecological Soil Screening Levels (EcoSSLs), (USEPA, 2010) online updates from http://www.epa.gov/ecotox/ecossl/.
[c] Ecological Screening Levels (ESLs), US EPA Region V, August 2003.
[d] ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. *Preliminary Remediation Goals for Ecological Endpoints*, ES/ER/TM-162/R2.
[e] Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.3, October 2008.
[f] From *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values*, Talmage et al., 1999, Rev. Environ. Contamin. Toxicol., 161: 1-156. Sediment benchmarks originally reported as mg compound per kg total organic carbon (TOC) in sediment, and 10% TOC assumed.

[g] The following hierarchy was used to select the soil screening values:
1. USEPA EcoSSL (plants, invertebrates, wildlife)

2. USEPA Region 5 ESLs (2003)
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)
[h] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, Arch. Environ. Contam. Toxicol. 39:20-31. TEC = threshold effect concentration.
[i] The following hierarchy was used to select the sediment screening values:
1. MacDonald et al. (2000)
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)
[j] Ohio Administrative Code 3745-1, *Ohio River Basin Aquatic Life Criteria, OMZA, October 20, 2009*. Based on total recoverable metals and assuming a hardness value of 100 mg/L for hardness dependent criteria. Iron criterion is based on protection of agricultural use.
[k] The following hierarchy was used to select the surface water screening values:
1. Ohio water quality criteria (2010) [aquatic life, OMZA]
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)

CAS = Chemical Abstract Service.
CUG = cleanup goal.
HI = Hazard Index
MDL = method detection limit.
mg/kg = milligrams per kilogram.
(µg/L) = micrograms per liter
NA = RVAAP-specific screening level or RSL not available.
RVAAP = Ravenna Army Ammunition Plant.
RL = reporting limit.
RSL = Regional screening level
SVOC = semivolatile organic compound
SAP/QAPP = Sampling and Analysis Plan/Quality Assurance Project Plan.
TBC = To be calculated; no available screening level or RSL is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent.

Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

		Surface Water																									
		Human Health Screening Values [a]																Ecological Screening Values									
			National Guard Trainee				National Guard Dust/Fire Control Worker				Resident Farmer Adult				Resident Farmer Child												
			Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk										
Analyte	CAS Number	Surface Water Background Values	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	Ohio WQC (2009) [j]	Region 5 ESLs (2003) [c]	ORNL PRGs (1997) [d]	LANL ESLs (2010) [e]	Talmage et al. (1999) [f]	Recommended Surface Water Ecological Screening Value [k]	Minimum Soil Criteria Level	Minimum Sediment Criteria Level	Minimum Surface Water Criteria Level
Explosives (USEPA SW-846 8330B)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)	(µg/L)
1,3,5-Trinitrobenzene	99-35-4	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	11	NA	NA	60000	11	11	225	220*	TBC
1,3-Dinitrobenzene	99-65-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	22	22	NA	26	20	22	0.765	0.61*	TBC
2,4,6-Trinitrotoluene	118-96-7	NA	328	3,276	611	6,115	852	8,517	1,590	15,898	36.5	365	56.8	568	7.82	78.2	60.8	608	13	NA	NA	40000	90	13	3.65	3.65	7.82
2,4-Dinitrotoluene	121-14-2	NA	356	3,556	7.32	73.2	2,079	20,793	TBC	TBC	116	1,160	1.99	19.9	28.4	284	2.44	24.4	44	44	NA	310	NA	44	0.753	0.753	1.99
2,6-Dinitrotoluene	606-20-2	NA	232	2,324	9.57	95.7	1,189	11,891	49	490	62.1	621	2.13	21.3	14.7	147	2.51	25.1	81	81	NA	60	NA	81	0.769	6.1*	2.13
Dinitrotoluene (2,4/2,6-) Mixture (ca)	25321-14-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	0.71*	0.71*	TBC
2-Amino-4,6-dinitrotoluene	35572-78-2	NA	131	1,310	TBC	TBC	341	3,407	TBC	TBC	14.6	146	TBC	TBC	3.13	31.3	TBC	TBC	18	NA	NA	12000	20	18	1.54	1.54	3.13
2-Nitrotoluene	88-72-2	NA	6,551	65,513	79.8	798	17,033	170,333	207	2,074	730	7,300	TBC	TBC	156	1,564	7.93	79.3	71	NA	NA	8000	NA	71	3.88	2.9*	7.93
3-Nitrotoluene	99-08-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	42	NA	NA	9600	NA	42	0.61*	0.61*	TBC
3,5-Dinitroaniline	618-87-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	70	NA	NA	NA	NA	70	TBC	TBC	TBC
4-Amino-2,6-dinitrotoluene	19406-51-0	NA	131	1,310	TBC	TBC	341	3,407	TBC	TBC	14.6	146	TBC	TBC	3.13	31.3	TBC	TBC	11	NA	NA	8600	na	11	1.54	1.54	3.13
4-Nitrotoluene	99-99-0	NA	6,551	65,513	1,079	10,790	17,033	170,333	2,805	28,055	730	7,300	TBC	TBC	156	1,564	107	1,074	46	NA	NA	17000	NA	46	52.5	24*	107
HMX	2691-41-0	NA	32,756	327,564	TBC	TBC	85,167	851,667	TBC	TBC	3,650	36,500	TBC	TBC	782	7,821	TBC	TBC	220	NA	NA	330000	330	220	359	3.594	782
Nitrobenzene	98-95-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	380	220	NA	270	NA	380	4.8*	4.8*	TBC
Nitroglycerin	55-63-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	18	NA	NA	43000	NA	18	0.61*	0.61*	TBC
Nitroguanidine	556-88-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	610*	610*	TBC
PETN	78-11-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	26000000	NA	26000000	TBC	TBC	TBC
RDX	121-82-4	NA	1,965	19,654	167	1,668	5,110	51,100	434	4,336	219	2,190	15.5	155	46.9	469	16.6	166	79	NA	NA	44000	190	79	8.03	8.03	15.5
Tetryl	479-45-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	5800	NA	5800	24.4*	24.4*	TBC
Metals (USEPA SW-846 6010B)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)	(µg/L)
Aluminum	7429-90-5	3,370	73,445	734,449	TBC	TBC	734195	7.30E+06	TBC	TBC	63,895	638,950	TBC	TBC	14,827	148,274	TBC	TBC	NA	NA	87	87	NA	87	3496	3496	14827
Antimony	7440-36-0	NA	6.45	64.5	TBC	TBC	89.6	896	TBC	TBC	17.1	171	TBC	TBC	4.91	49.1	TBC	TBC	190	80	30	100	NA	190	2.82	2.82	4.91
Barium	7440-39-3	47.5	10,640	106,401	TBC	TBC	118,053	1.20E+06	TBC	TBC	12,131	121,306	TBC	TBC	2,901	29,007	TBC	TBC	220	220	4	3.8	NA	220	351	351	2901
Cadmium	7440-43-9	NA	4.08	40.8	TBC	TBC	60	600	TBC	TBC	15.1	151	TBC	TBC	5.05	50.5	TBC	TBC	2.5	0.15	1.1	0.15	NA	2.5	6.41	6.41	4.08
Calcium	7440-70-2	41,400	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	TBC	TBC	TBC
Copper	7440-50-8	7.9	7,199	71,992	TBC	TBC	47,315	473,148	TBC	TBC	2,788	27,876	TBC	TBC	614	6,144	TBC	TBC	9.3	1.58	12	5	NA	9.3	311	311	614
Chromium (as Cr-3)	7440-47-3	NA	6,165	61,649	TBC	TBC	93,248	932,482	TBC	TBC	28,442	284,416	TBC	TBC	11,173	111,735	TBC	TBC	86	42	210	77	NA	86	8147	8147	6165
Chromium (as Cr^{6+})	18540-29-9	NA	24.5	245	TBC	TBC	360	3,599	TBC	TBC	90.3	903	TBC	TBC	30.3	303	TBC	TBC	11	42	11	11	NA	11	1.64	1.64	24.5
Iron	4739-89-6	2,560	31,296	312,959	TBC	TBC	271,809	2.70E+06	TBC	TBC	20,000	200,000	TBC	TBC	4,527	45,269	TBC	TBC	NA	NA	1000	1000	NA	1000	2313	2313	4527
Lead	7439-92-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	6.4	1.17	3.2	1.2	NA	6.4	40*	40*	TBC
Magnesium	7439-95-4	10,800	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	TBC	TBC	TBC
Manganese	7439-96-5	391	1,449	14,488	TBC	TBC	18,222	182,217	TBC	TBC	2,476	24,759	TBC	TBC	633	6,326	TBC	TBC	NA	NA	120	80	NA	120	35.1	35.1	633
Mercury	7439-97-6	NA	16	160	TBC	TBC	177	1,771	TBC	TBC	18.2	182	TBC	TBC	4.35	43.5	TBC	TBC	0.91	0.0013	0.0026	0.0028	NA	0.91	2.27	2.27	4.35
Strontium	7440-24-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	21000	NA	1500	620	NA	21000	4,700*	4700*	TBC
Zinc	7440-66-0	42	58,216	582,164	TBC	TBC	366,046	3.70E+06	TBC	TBC	21,002	210,022	TBC	TBC	4,617	46,167	TBC	TBC	120	65.7	110	66	NA	120	2321	2321	4617
SVOCs (USEPA SW-846 8270C)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)	(µg/L)
1,2,4-Trichlorobenzene	120-82-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	30	110	110	NA	30	6.2*	6.2*	TBC
1,2-Dichlorobenzene	95-50-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	23	14	14	NA	NA	23	190*	190*	TBC
1,3-Dichlorobenzene	541-73-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	22	38	71	NA	NA	22	2.4*	2.4*	TBC
1,4-Dichlorobenzene	106-46-7	NA	TBC	TBC	24.6	246	TBC	TBC	249	2,493	TBC	TBC	18.7	187	TBC	TBC	36.6	366	9.4	9.4	15	15	NA	9.4	TBC	TBC	18.7
2,4,5-Trichlorophenol	95-95-4	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	610*	610*	TBC
2,4,6-Trichlorophenol	88-06-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	4.9	4.9	NA	NA	NA	4.9	6.1*	6.1*	TBC
2,4-Dichlorophenol	120-83-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	11	11	NA	NA	NA	11	18*	18*	TBC
2,4-Dimethylphenol	105-67-9	NA	1,299	12,986	TBC	TBC	12,040	120,397	TBC	TBC	899	8,985	TBC	TBC	TBC	TBC	TBC	TBC	15	0.1	NA	NA	NA	15	120*	120*	899
2,4-Dinitrophenol	51-28-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	19	NA	NA	NA	19	12*	12*	TBC
2-Chloronaphthalene	91-58-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.396	NA	NA	NA	0.396	630*	630*	TBC
2-Chlorophenol	95-57-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	32	24	NA	43	NA	32	39*	39*	TBC
2-Methylnaphthalene	91-57-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	330	NA	2	NA	330	30.6	31*	TBC
2-Methylphenol	95-48-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	67	67	13	NA	NA	67	310*	310*	TBC
2-Nitroaniline	88-74-4	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	61*	61*	TBC
2-Nitrophenol	88-75-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	73	NA	NA	NA	NA	73	TBC	610*	TBC
3 & 4-Methylphenol	CASID30030	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	53	25	NA	NA	NA	53	TBC	TBC	TBC
3,3'-Dichlorobenzidine	91-94-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	4.5	NA	NA	NA	4.5	1.1*	1.1*	TBC
3-Nitroaniline	99-09-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	TBC	TBC	TBC
4,6-Dinitro-2-methylphenol	534-52-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	23	NA	NA	NA	23	0.49*	0.49*	TBC
4-Bromophenyl-phenyl ether	101-55-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	1.5	NA	NA	NA	1.5	TBC	TBC	TBC
4-Chloro-3-methylphenol	59-50-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	34.8	NA	NA	NA	34.8	610*	610*	TBC
4-Chloroaniline	106-47-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	232	NA	NA	NA	232	2.4*	2.4*	TBC
4-Chlorophenyl-phenyl ether	7005-72-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	TBC	TBC	TBC
4-Nitroaniline	100-01-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	24*	24*	TBC
4-Nitrophenol	100-02-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	60	300	NA	NA	60	61.2	TBC	TBC
Acenaphthene	83-32-9	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	15	38	23	23	NA	15	340*	340*	TBC
Acenaphthylene	208-96-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	4840	NA	30	NA	4840	TBC	TBC	TBC
Anthracene	120-12-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.02	0.035	0.73	0.0013	NA	0.02	1,700*	1700*	TBC
Benzo(a)anthracene	56-55-3	NA	TBC	TBC	0.032	0.322	TBC	TBC	0.165	1.65	TBC	TBC	0.014	0.136	TBC	TBC	0.037	0.375	NA	0.025	0.027	0.027	NA	0.025	0.221	0.221	0.014
Benzo(a)pyrene	50-32-8	NA	TBC	TBC	0.002	0.019	TBC	TBC	0.01	0.097	TBC	TBC	8.00E-04	0.008	TBC	TBC	0.002	0.022	NA	0.014	0.014	0.014	NA	0.014	0.022	0.022	0.0008
Benzo(b)fluoranthene	205-99-2	NA	TBC	TBC	0.019	0.185	TBC	TBC	0.095	0.952	TBC	TBC	0.008	0.079	TBC	TBC	0.022	0.217	NA	9.07	NA	30	NA	9.07	0.221	0.221	0.008
Benzo(g,h,i)perylene	191-24-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	7.64	NA	30	NA	7.64	TBC	TBC	TBC
Benzo(k)fluoranthene	207-08-9	NA	TBC	TBC	251	2,513	TBC	TBC	653	6,533	TBC	TBC	23.3	233	TBC	TBC	25	250	NA	NA	NA	30	NA	30	2.21	2.21	23.3
Benzoic acid	65-85-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	42	41	NA	42	24,000*	24000*	TBC
Benzyl alcohol	100-51-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	8.6	8.6	NA	NA	8.6	TBC	TBC	TBC
Bis(2-chloroethoxy)methane	111-91-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	23	18*	TBC
Bis(2-chloroethyl)ether	111-44-4	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	19000	NA	NA	NA	19000	0.21*	0.21*	TBC
Bis(2-chloroisopropyl)ether	108-60-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	4.6*	4.6*	TBC
Bis(2-ethylhexyl)phthalate	117-81-7	NA	67.9	679	6.79	67.9	429	4,294	42.9	429	41.9	419	3.49	34.9	22.3	223	9.27	92.7	8.4	0.3	0.12	32	NA	8.4	35*	35*	3.49
Butylbenzylphthalate	85-68-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	23	23	19	22	NA	23	260*	260*	TBC
Carbazole	86-74-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	44.6	TBC	TBC
Chrysene	218-01-9	NA	TBC	TBC	3.22	32.2	TBC	TBC	16.5	165	TBC	TBC	1.36	13.6	TBC	TBC	3.75	37.5	NA	NA	NA	30	NA	30	22.1	TBC	1.36
Di-n-butylphthalate	84-74-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	9.7	1	32	NA	9.7	610*	610*	TBC
Di-n-octylphthalate	117-84-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	30	NA	320	NA	30	TBC	TBC	TBC
Dibenzo(a,h)anthracene	53-70-3	NA	TBC	TBC	0.001	0.011	TBC	TBC	0.008	0.083	TBC	TBC	5.20E-04	0.005	TBC	TBC	0.001	0.014	NA	NA	NA	30	NA	30	0.022	0.022	0.00092
Dibenzofuran	132-64-9	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	4	4	3.7	20	NA	4	15.3	7.8*	TBC
Diethylphthalate	84-66-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	220	110	210	NA	NA	220	4,900*	4900*	TBC
Dimethylphthalate	131-11-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	1100	NA	NA	330	NA	1100	TBC	TBC	TBC
Fluoranthene	206-44-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.8	1.9	6.2	6.1	NA	0.8	163	230*	TBC
Fluorene	86-73-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	19	19	3.9	3.9	NA	19	243	230*	TBC
Hexachlorobenzene	118-74-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.0003	NA	NA	NA	0.0003	0.3*	0.3*	TBC
Hexachlorobutadiene	87-68-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	0.053	NA	NA	NA	0.053	6.1*	6.1*	TBC
Hexachlorocyclopentadiene	77-47-4	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	77	NA	NA	NA	77	37*	37*	TBC
Hexachloroethane	67-72-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	8	12	NA	NA	8	6.1*	6.1*	TBC
Indeno(1,2,3-cd)pyrene	193-39-5	NA	TBC	TBC	0.017	0.171	TBC	TBC	0.095	0.95	TBC	TBC	0.008	0.078	TBC	TBC	0.022	0.217	NA	4.31	NA	30	NA	4.31	0.221	0.221	0.008
Isophorone	78-59-1	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	920	920	NA	NA	NA	920	510*	510*	TBC
N-Nitroso-di-n-propylamine	621-64-7	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	0.12	TBC	TBC
N-Nitrosodiphenylamine & Diphn	86-30-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	210	NA	NA	210	99*	99*	TBC
Naphthalene	91-20-3	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	21	13	12	23	NA	21	122	3.6*	TBC
Pentachlorophenol	87-86-5	NA	78	780	0.607	6.07	434	4,336	3.37	33.7	42.6	426	0.276	2.76	22.9	229	0.743	7.43	6.7	4	NA	2.4	NA	6.7	2.12	0.89*	0.276
Phenanthrene	85-01-8	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	2.3	3.6	6.3	6.3	NA	2.3	TBC	TBC	TBC
Phenol	108-95-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	160	180	110	110	NA	160	1,800*	1800*	TBC
Pyrene	129-00-0	NA	19,654	196,538	TBC	TBC	51,100	511,000	TBC	TBC	2,190	21,900	TBC	TBC	469	4,693	TBC	TBC	4.6	0.3	NA	30	NA	4.6	122	170*	469

Table 11
Proposed Human Health and Ecological Screening Levels for Ravenna AAP MRSs

		Surface Water																								
		Human Health Screening Values [a]																Ecological Screening Values								
			National Guard Trainee				National Guard Dust/Fire Control Worker				Resident Farmer Adult				Resident Farmer Child											
			Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk		Non-Cancer Risk (HI)		Cancer Risk									
Analyte	CAS Number	Surface Water Background Values	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	0.1	1	10^{-6}	10^{-5}	Ohio WQC (2009) [j]	Region 5 ESLs (2003) [c]	ORNL PRGs (1997) [d]	LANL ESLs (2010) [e]	Talmage et al. (1999) [f]	Recommended Surface Water Ecological Screening Value [k]	Minimum Soil Criteria Level	Minimum Sediment Criteria Level	Minimum Surface Water Criteria Level
PCBs (Method SW-846 8082A)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)	(µg/L)
Aroclor 1016	12674-11-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	0.23	0.014	NA	0.001	0.203	0.203	TBC
Aroclor 1221	11104-28-2	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	0.28	NA	NA	0.001	0.14*	0.14*	TBC
Aroclor 1232	11141-16-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	0.58	NA	NA	0.001	0.14*	0.14*	TBC
Aroclor 1242	53469-21-9	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	0.047	0.06	NA	0.001	0.22*	0.22*	TBC
Aroclor 1248	12672-29-6	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	0.0019	0.01	NA	0.001	0.203	0.22*	TBC
Aroclor 1254	11097-69-1	NA	13.1	131	45.9	459	34.1	341	119	1,192	1.46	14.6	4.26	42.6	0.313	3.13	4.56	45.6	0.001	0.00012	0.0019	0.02	NA	0.001	0.12	0.12	0.313
Aroclor 1260	11096-82-5	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	0.001	0.00012	94	10	NA	0.001	0.203	0.203	TBC
Nitrocellulose (Method 9056/CRREL-ECB ERDC SOP M-NC-ECB)		(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/kg)	(mg/kg)	(µg/L)
Nitrocellulose	9004-70-0	NA	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	NA	NA	NA	NA	NA	NA	1.8E+07*	1.8E+07*	TBC
Total Organic Carbon (Method 9060A Modified/Lloyd Kahn/Walkley Black)																											
Total Organic Carbon	TOC (mg/kg)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH	pH (Units)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.5 - 9	NA	NA	NA	NA	pH =6.5 - 9	NA	NA	NA

Notes:
[a] Screening levels are from the Science Application International Corporation (SAIC), *Final Facility-Wide Human Health Remediation Goals at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio, March 2010*.
* Available Regional Screening Level values for a contaminant were taken from the *EPA Regional Screening Level Resident Soil Supporting Table* (December 2009) in the event no screening level was available in the Final *Facility-Wide Human Health Remediation Goals at the RVAAP, March 2010*.
[b] Ecological Soil Screening Levels (EcoSSLs), (USEPA, 2010) online updates from http://www.epa.gov/ecotox/ecossl/.
[c] Ecological Screening Levels (ESLs), US EPA Region V, August 2003.
[d] ORNL: Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. *Preliminary Remediation Goals for Ecological Endpoints*, ES/ER/TM-162/R2.
[e] Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.3, October 2008.
[f] From *Nitroaromatic Munition Compounds: Environmental Effects and Screening Values*, Talmage et al., 1999, Rev. Environ. Contamin. Toxicol., 161: 1-156. Sediment benchmarks originally reported as mg compound per kg total organic carbon (TOC) in sediment, and 10% TOC assumed.

[g] The following hierarchy was used to select the soil screening values:
1. USEPA EcoSSL (plants, invertebrates, wildlife)

2. USEPA Region 5 ESLs (2003)
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)
[h] MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*, Arch. Environ. Contam. Toxicol. 39:20-31. TEC = threshold effect concentration.
[i] The following hierarchy was used to select the sediment screening values:
1. MacDonald et al. (2000)
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)
[j] Ohio Administrative Code 3745-1, *Ohio River Basin Aquatic Life Criteria, OMZA, October 20, 2009*. Based on total recoverable metals and assuming a hardness value of 100 mg/L for hardness dependent criteria. Iron criterion is based on protection of agricultural use.
[k] The following hierarchy was used to select the surface water screening values:
1. Ohio water quality criteria (2010) [aquatic life, OMZA]
2. USEPA Region 5 ESLs (2003)
3. ORNL (1997) [plants, invertebrates, wildlife]
4. LANL (2008) [various endpoints]
5. Talmage et al. (1999)

CAS = Chemical Abstract Service.
CUG = cleanup goal.
HI = Hazard Index
MDL = method detection limit.
mg/kg = milligrams per kilogram.
(µg/L) = micrograms per liter
NA = RVAAP-specific screening level or RSL not available.
RVAAP = Ravenna Army Ammunition Plant.
RL = reporting limit.
RSL = Regional screening level
SVOC = semivolatile organic compound
SAP/QAPP = Sampling and Analysis Plan/Quality Assurance Project Plan.
TBC = To be calculated; no available screening level or RSL is available and one will be calculated for risk if it is found in analysis and is considered a munitions constituent.

APPENDIX B
MINIMUM SEPARATION DISTANCE CALCULATION SHEETS

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Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Air-Launched HE Rounds	DODIC:	E207
Munition:	20 lb Frag Bomb M41 (Composition B filled)		
Case Material:	Steel, Mild	Date Record Created:	9/21/2004
		Record Created By:	MC
Fragmentation Method:	Pre-formed Fragmenting	Last Date Record Updated:	12/23/2009
Secondary Database Category:	Bomb	Individual Last Updated Record:	SDH
Munition Case Classification:	Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	2.8
Diameter (in):	3.7000
Cylindrical Case Weight (lb):	14.81686
Maximum Fragment Weight (Intentional) (lb):	0.1298
Design Fragment Weight (95%) (Unintentional) (lb):	0.1298
Critical Fragment Velocity (fps):	4170

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	3.248
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	27
Public Traffic Route Distance (2.3 psi); K24 Distance:	36
Inhabited Building Distance (1.2 psi), K40 Distance:	59
Intentional MSD (0.0655 psi), K328 Distance:	486

Required Sandbag Thickness

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	3.192
Kinetic Energy 10^6 (lb-ft²/s²):	1.1280
Required Wall & Roof Sandbag Thickness (in)	24
Expected Maximum Sandbag Throw Distance (ft):	125
Minimum Separation Distance (ft):	200

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	67
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1707
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1322

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	7.25	7.25
Mild Steel:	1.41	1.41
Hard Steel:	1.16	1.16
Aluminum:	2.82	2.82
LEXAN:	7.21	7.21
Plexi-glass:	5.59	5.59
Bullet Resist Glass:	4.83	4.83

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	3.192
Kinetic Energy 106 (lb-ft²/s²):	1.1280
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft):	200

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Grenades & Mines	DODIC:	B568
Munition:	40 mm M406 Grenade		
Case Material:	Steel, Mild	Date Record Created:	9/21/2004
		Record Created By:	MC
Fragmentation Method:	Pre-formed Fragmenting	Last Date Record Updated:	3/30/2010
Secondary Database Category:	Shoulder Fired Grenade	Individual Last Updated Record:	SDH
Munition Case Classification:	Non-Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	0.071
Diameter (in):	1.5000
Cylindrical Case Weight (lb):	0.06560
Maximum Fragment Weight (Intentional) (lb):	0.0004
Design Fragment Weight (95%) (Unintentional) (lb):	0.0004
Critical Fragment Velocity (fps):	7778

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	0.082
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	8
Public Traffic Route Distance (2.3 psi); K24 Distance:	10
Inhabited Building Distance (1.2 psi), K40 Distance:	17
Intentional MSD (0.0655 psi), K328 Distance:	142

Required Sandbag Thickness

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	0.080
Kinetic Energy 10^6 (lb-ft²/s²):	0.0110
Required Wall & Roof Sandbag Thickness (in)	12
Expected Maximum Sandbag Throw Distance (ft):	25
Minimum Separation Distance (ft):	200

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	124
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	339
MFD-V [Maximum Fragment Distance, Vertical] (ft):	278

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.47	1.47
Mild Steel:	0.27	0.27
Hard Steel:	0.22	0.22
Aluminum:	0.63	0.63
LEXAN:	2.42	2.42
Plexi-glass:	1.31	1.31
Bullet Resist Glass:	0.94	0.94

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1.14
TNT Equivalent Weight - Impulse (lbs):	0.080
Kinetic Energy 106 (lb-ft²/s²):	0.0110
Water Containment System:	5 gal carboys/ inflatable pool
Minimum Separation Distance (ft):	200/200

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Surface-Launched HE Rounds	DODIC:	C445
Munition:	105 mm M1		
Case Material:	Steel, Mild	Date Record Created:	9/21/2004
		Record Created By:	MC
Fragmentation Method:	Naturally Fragmenting	Last Date Record Updated:	2/26/2010
Secondary Database Category:	Projectile	Individual Last Updated Record:	SDH
Munition Case Classification:	Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	5.07
Diameter (in):	4.1340
Cylindrical Case Weight (lb):	18.15800
Maximum Fragment Weight (Intentional) (lb):	0.1701
Design Fragment Weight (95%) (Unintentional) (lb):	0.0414
Critical Fragment Velocity (fps):	5058

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	5.881
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	32
Public Traffic Route Distance (2.3 psi); K24 Distance:	43
Inhabited Building Distance (1.2 psi), K40 Distance:	72
Intentional MSD (0.0655 psi), K328 Distance:	592

Required Sandbag Thickness

TNT Equivalent (Impulse):	1.16
TNT Equivalent Weight - Impulse (lbs):	5.881
Kinetic Energy 10^6 (lb-ft²/s²):	2.1759
Required Wall & Roof Sandbag Thickness (in)	24
Expected Maximum Sandbag Throw Distance (ft):	135
Minimum Separation Distance (ft):	200

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	335
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	1886
MFD-V [Maximum Fragment Distance, Vertical] (ft):	1475

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	9.88	4.54
Mild Steel:	1.87	0.89
Hard Steel:	1.54	0.73
Aluminum:	3.73	1.82
LEXAN:	8.38	5.43
Plexi-glass:	6.82	3.83
Bullet Resist Glass:	5.97	3.18

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1.16
TNT Equivalent Weight - Impulse (lbs):	5.881
Kinetic Energy 106 (lb-ft²/s²):	2.1759
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft):	200

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Surface-Launched HE Rounds	DODIC:	D571
Munition:	155 mm M107 (Composition B filled)		
Case Material:	Steel, Mild	Date Record Created:	9/21/2004
		Record Created By:	MC
Fragmentation Method:	Naturally Fragmenting	Last Date Record Updated:	2/4/2010
Secondary Database Category:	Projectile	Individual Last Updated Record:	SDH
Munition Case Classification:	Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Composition B
Explosive Weight (lb):	15.448
Diameter (in):	6.1020
Cylindrical Case Weight (lb):	73.50200
Maximum Fragment Weight (Intentional) (lb):	0.6641
Design Fragment Weight (95%) (Unintentional) (lb):	0.1372
Critical Fragment Velocity (fps):	3584

Overpressure Distances

TNT Equivalent (Pressure):	1.16
TNT Equivalent Weight - Pressure (lbs):	17.920
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	47
Public Traffic Route Distance (2.3 psi); K24 Distance:	63
Inhabited Building Distance (1.2 psi), K40 Distance:	105
Intentional MSD (0.0655 psi), K328 Distance:	858

Required Sandbag Thickness

TNT Equivalent (Impulse):	1.16
TNT Equivalent Weight - Impulse (lbs):	17.920
Kinetic Energy 10^6 (lb-ft²/s²):	4.2663
Required Wall & Roof Sandbag Thickness (in)	36
Expected Maximum Sandbag Throw Distance (ft):	220
Minimum Separation Distance (ft):	220

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	450
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2630
MFD-V [Maximum Fragment Distance, Vertical] (ft):	2022

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	14.45	6.68
Mild Steel:	2.74	1.29
Hard Steel:	2.25	1.06
Aluminum:	5.30	2.61
LEXAN:	10.69	6.73
Plexi-glass:	9.43	5.10
Bullet Resist Glass:	8.58	4.39

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1.16
TNT Equivalent Weight - Impulse (lbs):	17.920
Kinetic Energy 106 (lb-ft²/s²):	4.2663
Water Containment System:	1100 gal tank
Minimum Separation Distance (ft):	275

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Black Powder Rounds
Munition:	155 mm Mk I Shrapnel
Case Material:	Steel, Mild with Lead Shrapnel
Fragmentation Method:	Shrapnel
Secondary Database Category:	Shrapnel Round
Munition Case Classification:	Extremely Heavy Case

DODIC:	
Date Record Created:	3/4/2008
Record Created By:	MC
Last Date Record Updated:	4/13/2010
Individual Last Updated Record:	SDH
Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Black Powder
Explosive Weight (lb):	1.35
Diameter (in):	6.1000
Cylindrical Case Weight (lb):	3.64600
Maximum Fragment Weight (Intentional) (lb):	0.0434
Design Fragment Weight (95%) (Unintentional) (lb):	0.0434
Critical Fragment Velocity (fps):	256

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	215
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	558
MFD-V [Maximum Fragment Distance, Vertical] (ft):	373

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.46	1.46
Mild Steel:	0.03	0.03
Hard Steel:	0.03	0.03
Aluminum:	0.07	0.07
LEXAN:	0.94	0.94
Plexi-glass:	0.41	0.41
Bullet Resist Glass:	0.31	0.31

Overpressure Distances

TNT Equivalent (Pressure):	0.4
TNT Equivalent Weight - Pressure (lbs):	0.540
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	15
Public Traffic Route Distance (2.3 psi); K24 Distance:	20
Inhabited Building Distance (1.2 psi), K40 Distance:	33
Intentional MSD (0.0655 psi), K328 Distance:	267

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	0.4
TNT Equivalent Weight - Impulse (lbs):	0.540
Kinetic Energy 106 (lb-ft²/s²):	0.0014
Water Containment System:	5 gal carboys/ inflatable pool
Minimum Separation Distance (ft):	264/200

Required Sandbag Thickness

TNT Equivalent (Impulse):	0.4
TNT Equivalent Weight - Impulse (lbs):	0.540
Kinetic Energy 10^6 (lb-ft²/s²):	0.0014
Required Wall & Roof Sandbag Thickness (in)	20
Expected Maximum Sandbag Throw Distance (ft):	125
Minimum Separation Distance (ft):	200

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	Surface-Launched HE Rounds	DODIC:	D571
Munition:	155 mm M107 (TNT filled)		
Case Material:	Steel, Mild	Date Record Created:	2/4/2010
		Record Created By:	SDH
Fragmentation Method:	Naturally Fragmenting	Last Date Record Updated:	
Secondary Database Category:	Projectile	Individual Last Updated Record:	
Munition Case Classification:	Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	TNT
Explosive Weight (lb):	14.6
Diameter (in):	6.1020
Cylindrical Case Weight (lb):	73.50200
Maximum Fragment Weight (Intentional) (lb):	1.0548
Design Fragment Weight (95%) (Unintentional) (lb):	0.2710
Critical Fragment Velocity (fps):	4035

Overpressure Distances

TNT Equivalent (Pressure):	1
TNT Equivalent Weight - Pressure (lbs):	14.600
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	44
Public Traffic Route Distance (2.3 psi); K24 Distance:	59
Inhabited Building Distance (1.2 psi), K40 Distance:	98
Intentional MSD (0.0655 psi), K328 Distance:	802

Required Sandbag Thickness

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	14.600
Kinetic Energy 10^6 (lb-ft²/s²):	8.5845
Required Wall & Roof Sandbag Thickness (in)	Not Permitted
Expected Maximum Sandbag Throw Distance (ft):	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	389
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	2894
MFD-V [Maximum Fragment Distance, Vertical] (ft):	2208

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	14.62	7.33
Mild Steel:	2.82	1.43
Hard Steel:	2.31	1.17
Aluminum:	5.39	2.85
LEXAN:	11.10	7.30
Plexi-glass:	9.91	5.69
Bullet Resist Glass:	9.14	4.99

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1
TNT Equivalent Weight - Impulse (lbs):	14.600
Kinetic Energy 106 (lb-ft²/s²):	8.5845
Water Containment System:	Not Permitted
Minimum Separation Distance (ft):	Not Permitted

Item Notes

Fragmentation Data Review Form

Database Revision Date 1/31/2011

Category:	HE Fuzes	DODIC:	N335
Munition:	M557 Fuze w/ M125A1 Booster Cup		
Case Material:	Aluminum 7075	Date Record Created:	9/21/2004
		Record Created By:	MC
Fragmentation Method:	Naturally Fragmenting	Last Date Record Updated:	11/13/2009
Secondary Database Category:	Fuze & Booster	Individual Last Updated Record:	SDH
Munition Case Classification:	Non-Robust	Date Record Retired:	

Munition Information and Fragmentation Characteristics

Explosive Type:	Tetryl
Explosive Weight (lb):	0.0501
Diameter (in):	1.7030
Cylindrical Case Weight (lb):	0.02115
Maximum Fragment Weight (Intentional) (lb):	0.0023
Design Fragment Weight (95%) (Unintentional) (lb):	0.0010
Critical Fragment Velocity (fps):	9001

Overpressure Distances

TNT Equivalent (Pressure):	1.07
TNT Equivalent Weight - Pressure (lbs):	0.054
Unbarricaded Intraline Distance (3.5 psi), K18 Distance:	7
Public Traffic Route Distance (2.3 psi); K24 Distance:	9
Inhabited Building Distance (1.2 psi), K40 Distance:	15
Intentional MSD (0.0655 psi), K328 Distance:	124

Required Sandbag Thickness

TNT Equivalent (Impulse):	1.07
TNT Equivalent Weight - Impulse (lbs):	0.054
Kinetic Energy 10^6 (lb-ft²/s²):	0.0925
Required Wall & Roof Sandbag Thickness (in)	12
Expected Maximum Sandbag Throw Distance (ft):	25
Minimum Separation Distance (ft):	200

Theoretical Calculated Fragment Distances

HFD [Hazardous Fragment Distance: distance to no more than 1 hazardous fragment per 600 square feet] (ft):	56
MFD-H [Maximum Fragment Distance, Horizontal] (ft):	310
MFD-V [Maximum Fragment Distance, Vertical] (ft):	255

Minimum Thickness to Prevent Perforation

	Intentional	Unintentional
4000 psi Concrete (Prevent Spall):	1.68	1.19
Mild Steel:	0.23	0.17
Hard Steel:	0.19	0.14
Aluminum:	0.51	0.37
LEXAN:	1.44	1.17
Plexi-glass:	0.92	0.70
Bullet Resist Glass:	0.71	0.52

Water Containment System and Minimum Separation Distance:

TNT Equivalent (Impulse):	1.07
TNT Equivalent Weight - Impulse (lbs):	0.054
Kinetic Energy 106 (lb-ft²/s²):	0.0925
Water Containment System:	5 gal carboys/ inflatable pool
Minimum Separation Distance (ft):	200/200

Item Notes

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APPENDIX C
COMMENT RESPONSE TABLE

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Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
Ohio EPA – Eileen Mohr (October 7, 2011)					
O-1	1-11/Section 1.6.2		Do we have the document that shows materials were moved from the F&B Quarry and put somewhere else?		There are no site-specific documents available that show the materials that were moved from the FBQ. The Historical Records Review in the SI Report (e^2M, 2008) indicates that the debris from the FBQ was "reportedly" moved and transferred to Ramsdell Quarry Landfill in 1976.
O-2	1-11/Line 25		Define M9 Propellant, I think its double base.		M9 Propellant is double base. The text will be revised as follows: "The M406 HE rounds contain Composition B and double base M9 Propellant for use in ignition cartridges."
O-3	Figure 1-6		On the Figure-How did we determine to investigate the suspected impact area and not the known 40mm impact area?		The proposed investigation area is the identified MRS and is based on the results of the SI. The MRS includes the impact area and 100 feet beyond it. Shaw is proposing to investigate the entire 40mm Firing Range including areas inside and outside of the MRS. Please refer to Figure 3-2 and Figure 3-3 in the draft work plan.
O-4	Figure 1-9		On the Figure- Add the OGIVE layer or a new map.		The location of the ogives will be shown on Figure 1-9.
O-5	Table 1-3		Overall question on this table- How do we rectify the current/future uses on this table based on an Army meeting that		Per direction of the Army and in coordination with the Ohio EPA, all references to the Land Use and Future Land Use (including land users) will be removed from the document.

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
			the OHEPA wasn't involved with. Comment is also applicable to Sections 1.7.1 through 1.7.7		
O-6	Table 1-3/ EBG Current Land Use		How are people in here if it hasn't been cleared to date?		Please see response to Comment O-5
O-7	Table 1-3/ FBQ Current Land Use		How are people in here if it hasn't been cleared to date?		Please see response to Comment O-5
O-8	Table 1-3/ 40mm Firing Range OHARNG Future Land Use		The proposed future land use should be the same for both the known impact (MRS) and suspected impact area outside of the MRS.		Please see response to Comment O-5
O-9	Table 1-3/ Sand Creek OHARNG Future Land Use		Why will occasional foot traffic occur if it is going to be a SDZ?		Please see response to Comment O-5
O-10	Table 1-3/ Water Works #4 Dump OHARNG		Refer to Map/Figure comment. Show OGIVE area.		The location of the ogives will be shown on Figure 1-9.

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
	Future Land Use				
O-11	Table 1-3/ Group 8 MRS Current Land Use		People should NOT be in this area currently.		According to the OHARNG, the Group 8 MRS is no longer used to store/stage vehicles due to the fact that it is a MRS and is Siebert staked (which indicates it is a no-go area). The OHARNG still uses the road to the MRS for ingress and egress of equipment to the surrounding area but do not access the MRS. The area surrounding the MRS is used for vehicle and equipment storage and staging.
O-12	Table 1-4/ FBQ MRS	Now Table 1-3	Need to perform sediment sampling for MC at FBQ.		The SI Report stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP. However, it is also understood that contaminants possibly related to MMRP operations (MC metals and explosives) were detected in the IRP sediment samples and will require further delineation under the MMRP using IS rather than discrete samples that were originally collected under the IRP. Four IS wet sediment samples will be collected for the MMRP RI activities at this MRS to allow for adequate information to be collected to substantiate the conceptual site model in the RI report. The proposed decision units follow the rationale for decision unit size evaluation as presented in the *Implementation of IS for the MMRP Interim*

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					Guidance (USACE, 2009). The text in Table 1-4 under Basis of Recommendation for MC will be revised to: "MC in wet sediments will require further characterization based on IRP sediment results that exhibited elevated metals and explosives MC concentrations. All other media is addressed under IRP AOC RVAAP-16".
O-13	Table 1-4/ 40mm Firing Range MRS	Now Table 1-3	Is the reduced footprint of the MRS accurate?		The reduced footprint of the 40mm Firing Range MRS is accurate. The SI Report (e^2M, 2008) recommended that the MRS be reduced from 5.17 acres to the current 1.27 acres and includes the impact area and 100 feet beyond. Please refer to Figure 1-6 in the work plan addendum.
O-14	Table 1-4/ Water Works #4 Dump MRS	Now Table 1-3	Is the reduced footprint of the MRS accurate?		The reduced footprint of the Water Works #4 Dump MRS is accurate. The SI Report (e^2M, 2008) recommended that the MRS be reduced from 6.15 acres to the current 0.77 acres and includes only the open field where subsurface anomalies were detected. Please refer to Figure 1-9 in the work plan addendum.
O-15	1-24/Line 10	1-16	Surface water and sediment issue at Erie.		The intent of this section is to discuss previous investigations and is not meant to provide strategies to be proposed in this RI work plan addendum. Discussion regarding

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					proposed sampling at the Erie Burning Grounds is presented in Section 3.2.1 of the addendum. Revised discussion regarding surface water and wet sediment sampling at the Erie Burning Grounds to be included in Section 3.2.1 is presented in Response to Comment O-21.
O-16	1-24/Line 26-28	1-18	Surface water and sediment issue at F&B Ponds.		The intent of this section is to discuss previous investigations and is not meant to provide strategies to be proposed in this RI work plan addendum. Discussion regarding proposed sampling at the Fuze and Booster Quarry is presented in Section 3.2.2 of the addendum.
O-17	1-29/Table 1-6 Notes	Table 1-5	Surface water and sediment at F&B is not covered under the IRP.		The HHE module rating included in Table 1-6 includes the recommendations from the SI Report (e^2M, 2008). It does not include the proposed sampling strategy presented in Section 3.0 of the work plan addendum. Surface water and sediment samples were collected during the IRP RI phase of the CERCLA investigation process at the FBQ in 2005. The SI Report did not recommend additional sampling of sediment or surface water since it was being addressed under the IRP. The text in the notes will be revised as follows: "The Fuze & Booster Quarry and Sand Creek

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					Dump received a HHE Module Rating "No Longer Required" during the SI (e^2M, 2008) because they are covered under the IRP. The proposed investigation and sampling strategy is presented in Section 3.0 of this work plan addendum."
O-18	3-7/Line 5		Could there be MEC in the woods where the OGIVEs were found?		The SI Report (e^2M, 2008) did not identify any MEC in the woods and the ogives were verified as inert. Although not considered part of the current MRS, the proposed strategy is to perform a limited visual survey in the woods outside of the current MRS to confirm that no MEC is present. The rationale for performing additional surveys is to conduct a more formal survey than was performed during the SI. This is discussed in Section 3.2.6 of the work plan addendum.
O-19	3-9/Section 3.2.1		What percentage of coverage are we going to have with the DGM at EBG?		The percent DGM coverage at Erie Burning Grounds will be 15.4% of the MRS based on UXO Estimator calculations to reach the DQOs. For clarification the first paragraph in Section 3.2.1 will be revised as follows: "The RI field work at the Erie Burning Grounds MRS will include a DGM survey and intrusive investigation in order to evaluate subsurface MEC/MD at the MRS. The DGM transects proposed at Erie Burning Grounds are presented on **Figure 3-1**. Each

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					DGM transect is proposed as a straight line, although the field team may deviate as needed to negotiate terrain conditions. The proposed transect spacing for the Erie Burning Grounds DGM transects is 20 feet. Each transect will consist of one line of DGM data corresponding to an effective width of 3 feet. Shaw proposes approximately 14.5 miles of DGM transects at Erie Burning Grounds. The total percent DGM coverage is 5.2 acres (15.4%) of the 33.93 acre MRS. The final transect distance was determined using UXO Estimator (95 percent confidence and 0.5 UXO/acre)."
O-20	3-9/Line 6-8		What percentage coverage do we get?		Please see response to Comment O-19.
O-21	3-11/Line 15-16		Why are we doing discrete versus MI sampling?		Discrete samples were originally proposed rather than IS samples for wet sediment since contaminants are considered migratory in surface water and are expected to be ubiquitous throughout the bottom of the ponds. In addition, the *Facility-wide Sampling and Analysis Plan* does not provide a specific method (i.e., discrete or IS) for the collection of wet sediments. However, IS sampling of wet sediment is currently the standard practice at the facility. In order to maintain consistency Shaw will change the text to incorporate IS samples rather than

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					discrete. The text will be revised as follows: "In accordance with the recommendations in the SI, MC sampling will be conducted for wet sediments and surface water at the MRS. A total of six IS wet sediment samples will be collected from the wetland areas; three IS sediment samples will be collected from the North Surface Water Basin, two IS sediment samples will be collected from the South Surface Water Basin and one IS sediment sample will be collected from the East Surface Water Basin. The rationale for the number of wet sediment samples is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). A total of three surface water samples will be collected, one from each of the water basin areas. The proposed wet sediment and surface water sample locations are shown on **Figure 3-1**."
O-22	3-11/Line 16		Need more sediment sample		Please see response to Comment O-21.

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
			locations at EBG.		
O-23	Table 3-2		Comments from above for EBG will impact this table. Also comments from above table changes.		The fourth paragraph in Step 5 of Table 3-2 will be revised in accordance with the response to Comment O-21
O-24	Table 3-3	3-15	F&B Info doesn't appear to match that in the QAPP. Double check.		The disconnect appears to be that Table 3-3 says that no MC sampling is proposed for the FBQ; however, the SAP (WS #14) identifies MCs that are associated with munitions for the MRS. To clarify, the MC list shown in the SAP is provided in the event samples are required (i.e., source areas of MEC/MD are identified during the investigation). In order to avoid further confusion, the following statement will be added to "Analysis Tasks" on pg 51 in the SAP: "The overall analytical groups and overall target lists (as noted in work sheets #18 and #19) based on the types of munitions used at the RVAAP MRSs as well as the MC and geochemical analytes to be evaluated for each MRS are presented in this worksheet. It should be noted that sampling is not proposed for all MRSs based on the rationale provided in the work plan. If the investigation activities identify the need to collect samples at an MRS not initially proposed for sampling then the samples will be analyzed for the MC presented in this

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					worksheet."
O-25	3-16/Line 28-31	3-19	Explain this more clearly and describe the percent coverage. If not 100%, why isn't it?		100% coverage is not proposed for the 40mm Firing Range since any MEC/MD would be expected on or just below ground surface. No subsurface burial is expected which requires 100% coverage. Based on the calculated impact of 10 meters from a 40mm round, it is anticipated that spacing of transects by 10 meters will adequately cover the MRS for any MEC/MD that resulted from the firing point. The text in lines 28 through 31 will be revised as follows to clarify this: "The RI field work at the 40mm Firing Range MRS will include a DGM survey followed by intrusive investigation in order to evaluate potential detected subsurface MEC/MD at the MRS. Each transect will consist of one line of DGM data corresponding to an effective width of 3 feet. Each DGM transect is proposed as a straight line, although the field team may deviate as needed to negotiate terrain conditions. The final transect spacing was determined using Visual Sample Plan (VSP). The "Transect Sampling for UXO Target Traversal" module of VSP suggests a transect spacing based on the anticipated target size for a typical 40mm Firing Range that ranges from 2 to 10 meters (Army, 2003). In order to ensure the footprint

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					of the target area is traversed with 100 percent certainty, Shaw is proposing 10-meter transect spacing assuming that not every round hit its intended target when the range was in operation. The total distance of the transects at the 40mm Firing Range (within and outside of the MRS) is 1.88 miles. The area of DGM coverage within the entire 8.55 acre investigation area is 0.75 acres (9%). The total distance of transects within the 1.27 acre MRS portion of the 40mm Firing Range is 0.1 acres (9%). The DGM transects proposed at the 40mm Firing Range MRS are presented on **Figure 3-3**. Total DGM coverage (100 percent) is not proposed at the 40mm Firing Range MRS because the extent of any MEC/MD is expected to be located on or just beneath ground surface due to the previous use of the site as a firing range. No burial areas or concentrated areas of MEC/MD are anticipated. Reacquisition of 100 percent of the identified anomalies will be performed following the DGM investigation. The final dig list for the 40mm Firing Range will be sent to USACE and Ohio EPA for approval prior to reacquisition. The presence of surface MEC/MD will be investigated during the DGM survey. All MEC items visible on the ground surface or discovered via DGM survey and intrusive investigation will be

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
					identified and disposed of according to the procedures specified in Sections 3.6.9 and 3.6.12. The location, MEC type, and disposition of each item will be recorded according to Section 3.6.3."
O-26	3-19/Line 9		Are 2 samples enough?		By definition of the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009) the entire MRS can be considered one decision unit (DU) and could be collected as a single sample. The MMRP IS Guidance considers an acceptable DU to range from 1m x 1m to 100m x 100m as long as you don't "dilute" or "miss" potential COCs. For the 40mm Firing Range, it is expected that any MEC/MD identified will be well distributed across the target area because of the nature of disposition and the same would be expected for MC. However, in order to be conservative, the target area is being split in half; thereby, reducing the chances of missing any COCs.
O-27	Table 3-4/ Step 5/4th paragraph		Is this adequate sampling?		Please see response to Comment O-26
O-28	3-21/Lines 31-42		If we need to sample at Sand Creek, what precautions will we take for asbestos?		Further discussion is required for this comment based on on-going asbestos issues at the Ramsdell Quarry Landfill MRS Area 1 under the work plan for the first 7 sites.

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O-29	Table 3-5		This doesn't all connect with the uniform QAPP sheets.		Please see response to Comment O-24
O-30	Table 3-6/ Step 5		What does this mean? Extend to where? Off-site discussion issue.		The text in Step 5 will be revised to state: "If evidence of MEC/MD is identified beyond the Block D Igloo investigation area and indicates that properties outside of the RVAAP property boundaries may have been impacted, then off-site investigation will be warranted. The investigation strategy at the Block D Igloo–TD, if investigation is required, will be performed in the same manner as the Block D Igloo MRS."
O-31	3-28/Line 3-5		Have Col. Tadsen visit site with Shaw prior to start of investigation. Length and number of transects?		Per this comment, Col. Tadsen was contacted by Shaw to assist with identifying the areas outside of the current Water Works #4 Dump MRS where the inert ogives were previously identified. Shaw talked with Col. Tadsen on November 2, 2011 and he has confirmed the areas with the Shaw UXO Team as to where these items are located. It is assumed that the commenter is requiring further clarification on the length and number of transects at the Water Works #4 Dump MRS. The text in lines 3-5 will be revised as follows: "The RI field work at the Water Works #4 Dump MRS will include performing a visual survey of the expanded investigation area.

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					The MRS footprint at the Water Works #4 Dump has been reduced based on the recommendations in the SI Report (e^2M, 2008) that the area outside of the disposal area was clear of MEC. The RI strategy includes performing limited visual survey transects in the investigation area outside of the current MRS boundary to provide a more formal investigation than was performed during the SI in order to confirm that no MEC/MD is present at these locations. The visual survey transects were placed using VSP "90 percent confidence that 95 percent of transects will not contain UXO." In all, 42 transects with a total distance of 2.3 miles will be performed at the expanded investigation area. **Figure 3-6** depicts the visual survey transects at the Water Works #4 Dump."
O-32	3-41/Lines 12-14	3-42	Cross reference the section in the HASP about lightning. Using a meter, etc.		The following text will be added after Line 14: "Lighting safety is discussed further in Section 9.21.2 of the Accident Prevention Plan Addendum (Shaw, 2011c)."
O-33	3-42/Line 19		Provide a quick description of what is 1D and what is 2D.		1D is coverage over less than 100% of the MRS. 2D coverage is 100% coverage of the entire MRS. The text will be revised as follows for clarity: "A system of 1D transects (less than 100%

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					MRS coverage) or 2D (full coverage of an MRS) grids will be generated over the survey areas prior to DGM activities."
O-34	Table 3-10		Justify the low % of coverage of at EBG and 40mm Firing Range.		Per the *MMRP RI/FS Guidance* (USACE, 2009), 100% DGM coverage is typically not performed at sites where subsurface dense anomalies or burial areas are not anticipated which are the cases for the EBG and 40mm Firing Range MRSs. For these sites, the disposition of MEC/MD is expected to be on or just below the surface and well distributed across the site. The UXO Estimator© model was used for EBG using an input of 95% confidence that there is 0.5 UXO/acre. The Transect Sampling for UXO Target Traversal module of VSP© was used for the 40mm Firing Range and was based on a 10 meter target range. The rationale for less than 100% coverage at the 40mm Firing Range MRS to be included in the text is provided in response to Comment O-25. The rationale for less than 100% coverage at the EBG will be included in Section 3.2.1 as follows: "The RI field work at the Erie Burning Grounds MRS will include a DGM survey and intrusive investigation in order to evaluate subsurface MEC/MD at the MRS.

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					Complete DGM coverage (100%) is typically not warranted for sites where subsurface dense anomalies or burial areas are not anticipated which is situation expected for the Erie Burning Grounds MRS. For sites such as this, the disposition of MEC/MD is expected to be on or just below the surface and well distributed across the site."
O-35	3-46/Lines 31-32 and 35	3-48	Add details on spacing.		Lines 32-34 will be revised as follows: "The UXO Estimator© software was used to determine the sampling strategy for Erie Burning Grounds MRS based on the homogeneous distribution of MEC anticipated and the size of the MRS. The transects at Erie Burning Grounds MRS are randomly spaced per the UXO Estimator© output. The VSP© program was used to determine the sampling strategy for the 40mm Firing Range MRS based on the minimum transect spacing required for target traversal. A 10-meter transect spacing was used for the 40mm Firing Range MRS based on the typical target diameter of 2 to 10 meters for a firing range and the assumption that not every round hit the target when the range was in operation."
O-36	3-47/Line 18-19	3-49	Provide a ball park % of coverage.		Lines 18-19 will be revised as follows: "The extent of float mounted geophysical

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					investigation and former U.S. Navy EOD diver geophysical investigations will be dependent on site conditions at the time of the survey; however, the majority of the wetland areas at the Erie Burning Grounds MRS are less than 2 feet deep and the expected percent coverage is approximately 15 percent."
O-37	3-48/Lines 5-6	3-49	Provide a ball park % of coverage.		Lines 5-6 will be revised as follows: "The extent of float mounted geophysical investigation and former U.S. Navy EOD diver geophysical investigations will be dependent on site conditions at the time of the survey; however, Shaw expects to achieve the proposed investigation coverage of 100 percent of the pond areas."
O-38	3-48/Line 9-10		Does this include the area where the OGIVEs are?		The 100 percent coverage for the Water Works #4 Dump does not include the area where the ogives are since the wooded area is not considered part of the MRS per the SI. Shaw is proposing to perform visual survey transects in the woods to the north of the MRS where the ogives have been observed.
O-39	Figure 3-14	3-55	Indicate if what is shown here is the industry standard.		The Oasis/Montaj™ program is considered an industry standard for MMRP investigations. The USACE Huntsville CX contracted with Geosoft to write specific

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					routines for data processing and evaluation, analysis, interpretation, and QC. The text on page 3-55, lines 21-24 will be revised as follows: "The Oasis/Montaj™ program "gridpeak.gx" (or the Blakely method in UX Process) is an industry standard application that Shaw will use for threshold selection using interpolated data for EM61 MK2 channel 2."
O-40	3-59 to 3-60/performance metrics bullets		Are these the industry standard or based on the first phase of work?		The performance metrics stated in the text are the results of DID MMRP-09-004 and the more recent USACE Performance Requirements Tables. The text on page 3-60, lines 17-20 will be revised as follows: "Based on the pre-project tests and Shaw's experience in using the EM61 MK2, Shaw will use the following initial performance metrics that are the results of DID MR-09-004, *Geophysics* (USACE, 2009b) and the more recent *USACE Performance Requirements Tables* in Appendix E of the work plan:"
O-41	3-62/Line 4		Why not 95%?		The 90% metric is a USACE requirement in the "Performance Requirements for RI/FS using DGM Methods" table. This table is

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					included in Appendix E of the final work plan (July 2011) for the first 7 sites as referenced in the text.
O-42	Figure 3-6		Why is the line spacing not consistent? UXO estimator?		The transect spacing for the Water Works #4 Dump MRS was provided by VSP© as discussed in Section 3.2.6 in the work plan addendum. VSP© provides an unbiased random transect pattern based on a confidence percentage (90% confidence that 95% of transects will not contain UXO for the Water Works #4 Dump). Lines 20 to 26 on pg 3-29 will be revised as follows: "The visual survey transects at the Water Works #4 Dump MRS were placed using VSP© based on a confidence percentage (90% confidence that 95% of transects will not contain UXO). VSP© provides an unbiased random visual survey transect pattern based on the confidence percentage used which is shown on **Figure 3-6**."
O-43	3-63/Line 5	3-64	Why is the line spacing not consistent? UXO estimator?		Lines 3-5 will be revised as follows: "The proposed visual survey areas, transect spacing, and the anticipated total length of the transects for the Water Works #4 Dump MRS is 2.3 total miles of visual transects with transect spacing ranging from 3 to 70. The placement and spacing of transects is

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					derived from VSP© assuming a 90 percent confidence that 95 percent of transects will not contain UXO."
O-44	3-65/Line 33	3-67	This is the work plan. What is the depth?		Lines 30-33 will be revised as follows: "The excavation will continue until 1) the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with a metal detector, 2) native material has been identified (i.e., a clear delineation between native and fill materials is evident), 3) or the water table is reached." This wording is consistent with the MEC procedures used for the first 7 sites.
O-45	3-66/Lines 4-9		What will we do if it is MEC?		The following text will be added after Line 7: "If the anomaly is determined to be a MEC item, it will be removed, stored and disposed as discussed in the following sections."
O-46	Table 3-11		Col. Tadsen found a anti-personnel mine at the Group 8 MRS. Was that practice? If not, would that be the MGFD?		Shaw has reviewed available publications for anti-personnel fragmentation bombs (aka, hammerhead) as described in the SI; however, no information regarding this MEC item has been identified or provided to Shaw by Army personnel in previous reports/documents as being found at the Group 8 MRS. Since there is no information available to Shaw, Shaw cannot comment on

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					whether that was a practice round and the MGFD will not be revised.
O-47	3-67/Lines 30-31		What bombs are being dropped on the MRS??		This bullet will be revised as follows: • "In general, ordnance containing a spotting charge will be considered armed."
O-48	3-69/Section 3.6.9		Note when demo will be conducted. NEW lbs? 100 lbs?		Section 3.6.9 references Section 5.4 which will be revised to include the following statement: "The Explosives Site Plan for this project states that the maximum NEW allowable for on-site storage is 100 lbs. Shaw will limit the amount of MEC/MPPEH stored on-site and proposes to perform demolition activities as the explosives storage approaches 25 lbs NEW, the maximum NEW of explosive allowed for destruction at the Open Demolition Area #2 Operation Area per a single charge."
O-49	3-72/Lines 1-3		Discuss why we don't want bias samples.		This statement is meant to imply that MC is not expected to concentrate at one location in wet sediment and will be ubiquitous throughout the sediment in surface water. In accordance with the response to Comment O-21, the collection of wet sediment samples using IS is currently the standard practice at

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					the facility. In order to maintain consistency, the text will be revised to incorporate IS samples rather than discrete. The text will be revised as follows: "Wet sediment samples will be collect similarly as IS surface soil samples. The sample aliquots for the IS wet sediment samples will be collected from 0 to 6 inches and will be representative of submerged conditions in the surface water areas."
O-50	3-76/Section 3.11		Where did it come from that we would only be doing screening level risk assessments for human and eco risks?		The proposed screening procedures for HHRA and ERA are consistent with the process in the work plan for the first 7 sites. Shaw is evaluating for human health in accordance with the procedures described in the USACE Position Paper included in the final version of the FWCUG document. The Position Paper utilizes the FWCUGs which is a streamlined approach for human health risk assessments at the RVAAP. Although described as a screening level human health risk assessment in the work plan addendum due to the streamlined approach using the FWCUGs, the determination step of the process for COCs is actually a baseline risk assessment. The SLERA process is proposed since a refined screening process for eco is currently being coordinated by Louisville USACE.

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					Shaw discussed this approach with the Louisville USACE before including it in the work plan. Shaw agrees that a full scale BERA may be required as is discussed in Section 3.11 of the work plan addendum.
O-51	3-79/Section 3.11.2.1		Confirm that this is the same process as the first 7 MRSs.		Please see response to Comment O-50.
O-52	3-81/Line 4	3-82	Where are these future uses and receptors coming from?		This text has been removed per coordination between USACE and Ohio EPA. Please see response to Comment O-5.
O-54	3-81/Line 6		Is there a map that shows the Multipurpose Training areas?		”Multipurpose Training Area” is military terminology used by OHARNG. According to the Army, there are maps of training areas in the Master Plan which is not available to Shaw; however, these locations do not correspond to locations of AOCs/MRSs.
O-54	3-82/Line 8		Confirm that the evaluation of COCs follows what was done in the first 7 MRSs.		Please see response to Comment O-50.
O-55	3-83/Section 3.11.3.1	3-84	Have we lumped together SLERAs before? What if we have to go to a baseline?		The intent of the statement in this section regarding grouping of SLERAs together is that similar sites with similar conditions may be combined together into a single report when possible. Individual SLERAs will still be required for each of the sites and will not be lumped together into a single SLERA. If

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					a BERA is required for an individual site(s) that is combined in a report with other sites, then the site(s) in question will have to be further evaluated individually. Lines 27-33 on page 3-83 will be revised as follows: "During preparation of the RI reports, sites may be combined into a single document whenever possible; however, a SLERA will be required for each MRS. The results of the SLERAs will provide sufficient information for risk managers to make a decision of either negligible ecological risk at the each of the MRS (no further ERA is necessary) or further baseline ERA (BERA) is warranted."
O-56	5-2/Section 5.4		Whats the maximum NEW that we will store? Do we rethink demo after 25 lbs and make it 100 lbs for cost impacts?		Please see response to Comment O-48.
O-57	App A/pg 19		Please identify where we are getting the land uses from.		This text has been removed per coordination between USACE and Ohio EPA. Please see response to Comment O-5.
O-58	App A/pgs 25 and 53	23	Add analysis for PCBs for the Fuze and Booster Quarry MRS.		PCB analysis will be added to the sediment samples to be collected from FBQ.

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O-59	App A/pgs 26 and 54		Add analysis for PCBs for the Sand Creek Site.		PCB sampling under the MMRP is not required since PCBs are not considered an MC associated with munitions at this MRS. In addition, many samples have been collected for PCBs at this site under the IRP.
O-60	App A/pg 27		This should already be stated in the explosives method for each site. Was this a repeated statement?		This is just an informational statement and will be removed to avoid confusion. These analytes are already called out in the explosives method.
O-61	App A/pg 31		Please confirm that this is the OHEPA Hierarchy.		The hierarchies presented for soil, surface water and sediment at a minimum follow Chapter 3, Level II Screening of the *Ohio EPA DERR Ecological Risk Assessment Guidance* (April 2008). The text before the hierarchies discussion will be revised as follows: "The following screening value ecological hierarchy will be used for the media types anticipated and are in accordance with Chapter 3, Level II Screening of the *Ohio EPA DERR Ecological Risk Assessment Guidance* (Ohio EPA, 2008):"
O-62	App A/pg 37		Will we have the Phase I data back for the grinding vs non-grinding in time to remove this and use only one method?		We have received most of the grinding vs. non-grinding sample results back and have recently submitted more samples for ODA2. The intent is to put a memo or power point presentation together that provides a summary of results before we start the

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					sampling for the second 7 sites. A note will be placed at the bottom of WS #12.2 that states the following: "Currently, no grinding of metals is anticipated for IS soils/sediment samples per the *Implementation of IS of Soil for the MMRP Interim Guid*ance (USACE, 2009). The determination of whether or not grinding is needed will be coordinated with the Army based on the grinding versus non-grinding comparison of metals in soil samples from the initial seven MRSs in the work plan. The Ohio EPA will make the final determination as whether grinding is required. The laboratory shall confirm with Shaw if grinding of IS soil/sediment samples is necessary prior to processing."
O-63	App A/pg 82		Again ground vs. not issue.		Please see response to Comment O-62
O-64	App A/pg 85		OHEPA will not allow Shaw to put solid waste back in the trench.		Shaw will revise the line to state the following: "Any buried debris will be removed for off-site disposal and only soils that are not visibly contaminated will be returned back to the excavation."
O-65	App A/pg 85		This is not enough sediment samples for EBG. Discuss with OHEPA.		The sampling program in the document has been reviewed and the number of wet sediment samples on WS #18 will be

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					increased to six samples in accordance with the response to Comment O-21. The first paragraph under "Underwater Sediment" would also be revised as follows: "A predetermined number of sediment samples will be collected at Erie Burning Grounds MRS (6) and the Fuze and Booster Quarry MRS (4). Sediment samples at the Erie Burning Grounds MRS were recommended in the SI Report (e^2M, 2008) since MEC/MD items have reportedly been seen in the water bodies. The SI Report (e^2M, 2008) did not suggest that additional wet sediment samples were necessary at the Fuze and Booster Quarry MRS based on the available IRP data; however, additional wet sediment samples to be collected using IS are proposed based on detections of MC explosives and metals in the IRP sediment data. The rationale for the number of wet sediment samples at each of the MRSs is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the*

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					MMRP Interim Guidance (USACE, 2009). The final number and location of samples at these MRSs will be based on the findings during the MEC investigation."
O-66	App A/pg 86		This is not enough surface water samples for EBG. Discuss with OHEPA.		Shaw has discussed the surface water sampling program with the Ohio EPA and stated that the intent of the surface water sampling program at this MRS was to collect one surface water sample from each primary water basin which will provide adequate characterization in accordance with the decision unit criteria presented in the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). In addition, wet sediment samples will be collected using IS in conjunction with the surface water samples. Based on this discussion, the Ohio EPA is in agreement with the current number of surface water samples proposed (3).
O-67	App A/pg 89		This is not enough sediment or surface water samples for EBG. Discuss with OHEPA		Please see responses to Comments O-65 and O-66.

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O-68	App A/pg 90		For the FBQ site, soil sampling program and available information is adequate, but, sediment still needs more samples.		The SI Report stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP. However, it is understood that contaminants possibly related to MMRP operations (MC metals and explosives) were detected in the IRP sediment samples and will require further delineation under the MMRP using IS rather than discrete samples that were originally collected under the IRP. Four IS wet sediment samples will be collected for the MMRP RI activities at this MRS. The text under "Rationale for Sampling Locations" will be revised to: "The SI Report did not recommend additional MC sampling since it is being performed under the IRP; however, based on the previous detections of MC explosives and metals in the wet sediment under the IRP, further delineation of wet sediment will be performed under the MMRP using IS. A minimum of 4 wet sediment samples will be collected from the ponds at the Fuze and Booster Quarry MRS. The rationale for the number of wet sediment samples is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and

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					sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). The need for additional MC sampling will be evaluated for the environmental media at this MRS if source areas of MEC/MD are identified. If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required."
O-69	App A/pg 91		Is a .63 acre sample unit for the 40mm Firing Range acceptable to the risk assessor? Do we need a IS location at the firing point?		Please see response to Comment O-26 regarding the DU sample size for the 40mm Firing Range MRS. One IS sample will be collected at the firing point for propellants only. The text under "Rationale for Sampling Locations" on WS #18 for this MRS will be revised to: "Minimal IRP data exists for this MRS; therefore, MC sampling will be performed at the MRS for further characterization of surface soil as recommended in the SI Report. The MRS boundaries consist of the target area portion of the MRS that is approximately 1.27 acres in area. Sampling will be for two IS sample from the MRS (approximately 0.63 acres each). In addition, the potential for propellants exist at the 60' x 60' firing point area since propellants are

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					associated with the ignition charge for the 40mm round. Therefore, an IS soil sample will be collected at the firing point of the range and analyze for propellants only. The rationale for the number of IS samples at the MRS is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009). If unacceptable risks to human health or the environment are encountered, delineation of the areas of elevated MC will be required."
O-70	App A/pg 98		This is not enough sediment or surface water samples for EBG. Discuss with OHEPA		Please see responses to Comments O-65, O-66 and O-67. WS #20 for EBG will be revised to include collection and analysis for 6 wet sediment samples and 3 surface water samples.
O-71	App A/pg 99		This is not enough sediment samples for FBQ. Discuss with OHEPA.		Please see response to Comment O-68. WS #20 for FBQ will be revised to include collection and analysis for 4 wet sediment samples.
O-72	App A/pg		Do we need a sample at the firing		Please see response to Comment O-69. WS

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	101		point for the 40mm Firing Range?		#20 will be revised to include analysis for one IS sample at the firing point for propellants only. Only analysis for propellants is proposed since this would be considered the primary MC at this location that is associated with the 40mm round ignition source. The rationale for the number of IS samples at the MRS is to develop an adequate conceptual site model and meet the project objects based on providing representative sized decisions units that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit and sampling rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009).
O-73	App A/pg 101		For the Sand Creek Site, discuss if an asbestos sample needs to be taken for worker safety.		Please see response to Comment O-28
O-74	App A/pg 104		Is the DU size for the Group 8 MRS acceptable to the risk assessor?		The SI Report recommended additional MC sampling at the Group 8 MRS based on previous soil results with MC above the screening criteria as is discussed in Section 3.2.7 of the work plan addendum. A total of 4 IS samples are proposed to further delineate the MRS and to analyze for additional potential MC that was not analyzed during the SI that will include SVOCs and PCBs. The rationale for the size

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					of the DUs (0.66 acres each) is to develop an adequate conceptual site model and meet the project objects based on providing representative sized DUs that are not underestimating (i.e. diluting) or missing contamination that may be present at a level of concern. The decision unit rationale was evaluated in accordance with the *Implementation of IS for Soil for the MMRP Interim Guidance* (USACE, 2009).
O-75	App A/pg 192		Add DFFO citation to the references.		The DFFO citation will be added to the references in Appendix A.
O-76	App A/ Attach F/ pg A.F-16		Need more surface water and sediment samples for EBG.		Please see responses to Comments O-65, O-66 and O-67. The text will be revised to reflect the additional wet sediment samples for EBG: "A minimum of three surface water and six IS wet sediment samples will be collected for the MMRP RI at this MRS."
O-77	App A/ Attach F/ pg A.F-21		Need MC sampling on sediments at FBQ.		Please see response to Comment O-68. The text will be revised to reflect the additional wet sediment samples for FBQ: "The SI Report stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP. However, also it is understood that contaminants possibly related to MMRP operations (MC metals and

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					explosives) were detected in the IRP sediment samples and will require further delineation under the MMRP using IS rather than discrete samples that were originally collected under the IRP. Four IS wet sediment samples will be collected for the MMRP RI activities at this MRS."
O-78	App A/ Attach F/ pg A.F-25		Is the DU size correct for the 40mm Firing Range? Why no sampling at the firing point?		Please see response to Comment O-26 regarding the size of the DU and Comment O-69 regarding additional sampling at the firing point.
O-79	App A/ Attach F/ pg A.F-27		Need to discuss how we will handle asbestos at Sand Creek Site.		Please see response to Comment O-28
O-80	App A/ Attach F/ pg A.F-33		Confirm if any MC sampling was preformed where the OGIVEs are at WW4 Dump Site.		The ogives in the woods at the WW4 Dump MRS were verified as inert during the SI and no sampling was performed where they are located.
O-81	App A/ Attach F/ pg A.F-42/ last sentence		Is the DU size appropriate for the 40mm Firing Range?		Please see response to Comment O-69
O-82	App A/ Attach F/ pg		Is the DU size appropriate for the Group 8 MRS?		Please see response to Comment O-74.

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	A.F-43/ 2nd paragraph				
O-83	App A/ Attach F/ pg A.F-43/ 3rd paragraph		Need more samples at EBG.		Please responses to Comments O-65, O-66, and O-67. The text will be revised as follows: "MC sampling will be conducted for wet sediments at the Erie Burning Ground MRS based on the recommendations in the SI Report. In addition, surface water samples will also be collected and collocated with the sediment samples. A total of 6 IS wet sediment and 3 surface water samples each are proposed for the wetland areas at this MRS."
O-84	App A/ Attach F/ pg A.F-43/ 4th paragraph		Samples need to be taken at FBQ. That will move this to the above line of MRSs		Please response to Comment O-68. If agreed, the text will be revised as follows: "The SI Report stated that MC sampling at the Fuze and Booster Quarry MRS would continue under the IRP; however, wet sediment samples will be collected under the MMRP based on MC explosives and metals that were detected in the IRP data sets. A total of 4 IS wet sediment samples will be collected from the three pond areas at this MRS."
O-85	App A/ Attach F/ pg A.F-44		Confirm that the screening value hierarchies for soil, surface water and sediment agree to EPA		The reference for the LANL in the hierarchies has since been updated. This will be revised in the text as:

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			guidance.		"Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.5, October 2010." The text before the hierarchies will be revised as follows: "Soil, surface water and sediment screening values have been selected using the following hierarchy in accordance with the unified approach that integrates Ohio EPA, USEPA and the USACE ERA processes."

APPENDIX D
OHIO EPA APPROVAL LETTER

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