FINAL

Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12)

Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio

Contract No. W912QR-12-D-0005
Delivery Order No. W912QR19F0952

Prepared for

U.S. Army Corps of Engineers
Louisville District
600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by

CH2M HILL Constructors, Inc.
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OCTOBER 2020

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13. SUPPLEMENTARY NOTES

None.

14. ABSTRACT

The Remedial Design Work Plan presents the activities to implement ex situ thermal treatment of soil at RVAAP Load Lines 1, 2, 3, 4 and 12 per the Final Record of Decision Amendment for Soil, Sediment, and Surface Water at RVAAP Load Lines 1, 2, 3, 4, and 12 (Leidos, 2019).

15. SUBJECT TERMS

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Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

October 1, 2020

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Army National Guard
Installation and Environment
Clean-up Branch
IPA Designation
1438 State Route 534 SW
Newton Falls, OH 44444

RE: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859263

Subject: Receipt and Review of the "Final Remedial Design Work Plan for RVAAP Load Lines 1 – 4 and 12 (RVAAP-08 through RVAAP-12)," Dated September 23, 2020

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the document entitled, "Final Remedial Design for RVAAP Load Lines 1 – 4 and 12." This document, received by Ohio EPA's NEDO on September 23, 2020, was prepared for the U.S. Army Corps of Engineers (USACE) Louisville District, by CH2M HILL Constructors, Inc., 2411 Dulles Corner Park, Suite 500, Herndon, VA.

Ohio EPA has no further comments and we concur with the Final Remedial Design Work Plan for RVAAP Load Lines 1-4 and 12.

As a precautionary response to COVID-19, Ohio EPA is currently operating with most staff working remotely. During this time, we will not be issuing hard-copy mail. This letter is an official response from Ohio EPA that will be maintained as a public record.

If you have any questions or concerns, please do not hesitate to contact me at (330) 963-1201, or by email at Susan.Netzly-Watkins@epa.ohio.gov.

Sincerely,

Sue Netzly-Watkins

Sue Netzly-Watkins
Site Coordinator
Division of Environmental Response and Revitalization

SNW/sc

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Kelly Kanoza, Akron Regional Air Quality Management District

STATEMENT OF INDEPENDENT TECHNICAL REVIEW

CH2M HILL Constructors, Inc. (CH2M) has completed the Preliminary Draft Remedial Design Work Plan for Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12), Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio.

Notice is hereby given that an independent technical review has been conducted which 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, using justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing U.S. Army Corps of Engineers policy. Significant concerns and an explanation of the resolutions are documented within the project file. As noted above, all concerns resulting from independent technical review of the project have been considered.

DIGITAL SIGNATURE

Date: September 21, 2020

Sarah Meyers
Project Manager, CH2M

Date: September 21, 2020

Jeffrey Minchak
Independent Technical Reviewer, CH2M

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September 2020

DOCUMENT DISTRIBUTION
for the
FINAL
Remedial Design Work Plan for
Load Lines 1, 2, 3, 4, and 12 (RVAAP 08 to 12)
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Name/Organization	Number of Printed Copies	Number of Electronic Copies
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ARNG = Army National Guard
CD = compact disc
CJAG = Camp James A. Garfield
ftp = file transfer protocol
OHARNG = Ohio Army National Guard
REIMS = Ravenna Environmental Information Management System
USACE = U.S. Army Corps of Engineers
WPRO = Wright Patterson Area Office

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Appendixes

Tables

Exhibits

Figures (compiled at the end of the document)

Acronyms and Abbreviations

%	percent
°F	degrees Fahrenheit
2,6-DNT	2,6-dinitrotoluene
amsl	above mean sea level
AOC	Area of Concern
APP	Accident Prevention Plan
ARNG	Army National Guard
B(a)a	benz(a)anthracene
BaP	benzo(a)pyrene
BbF	benzo(b)fluoranthene
bgs	below ground surface
BMP	best management practice
BTU	British thermal units
BTUH	British thermal units per hour
CD	compact disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CH2M	CH2M HILL Constructors, Inc.
CJAG	Camp James A. Garfield
CM	Construction Manager
CO	carbon monoxide
CO_2e	carbon dioxide equivalents
COC	contaminant of concern
COR	Contracting Officer's Representative
CQCP	Construction Quality Control Plan
CY	cubic yard(s)
DA	dibenz(a,h)anthracene
DFOW	definable feature of work
DNT	dinitrotoluene
EPA	U.S. Environmental Protection Agency
ETC	enhanced thermal conduction
FP	Follow-up Phase
FQM	Field Quality Manager

FS	Feasibility Study
ftp	file transfer protocol
HAP	hazardous air pollutant
HSM	Health and Safety Manager
I.D.	induced draft
ICG	Iron Creek Group
IP	Initial Phase
ISM	incremental sampling methodology
km	kilometers
kw	kilowatt
LUC	land use control
MBTU	million British thermal units
MEC	munitions and explosives of concern
mg/kg	milligram per kilogram
NA	not applicable
NCR	nonconformance report
NOx	nitrogen oxides
OAC	Ohio Administrative Code
OHARNG	Ohio Army National Guard
Ohio EPA	Ohio Environmental Protection Agency
OSR	Off-Site Rule
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PM	particulate matter or Project Manager
PP	Preparatory Phase
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
QCM	Quality Control Manager
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RGO	remedial goal option
ROD	Record of Decision

RVAAP	Ravenna Army Ammunition Plant
SC	Safety Coordinator
SCADA	supervisory control and data acquisition
SF	square feet
SO_2	sulfur dioxide
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
TBD	to be determined
TCLP	Toxicity Characteristic Leaching Procedure
TNT	2,4,6-trinitrotoluene
tpy	tons per year
UL	Underwriter Laboratories
USACE	U.S. Army Corps of Engineers
VFD	variable frequency drive
VOC	volatile organic compound
WPAO	Wright Patterson Area Office

Introduction

1.1 Purpose

This Remedial Design (RD) Work Plan describes the activities to implement the approved soil remedial action for the former Ravenna Army Ammunition Plant (RVAAP) Load Lines 1, 2, 3, 4 and 12, designated as Areas of Concern (AOCs) RVAAP-08, -09, -10, -11, and -12, respectively, as described in the Final Record of Decision (ROD) Amendment (Leidos, 2019a). Load Lines 1-4 and 12 all had previous RODs signed by the Army that addressed the soil and dry sediment media (Shaw, 2007; SAIC, 2009). The remedial actions identified in the previous RODs have been implemented to achieve Military Training Land Use. The remedy described in the ROD Amendment and discussed in this RD Work Plan is being implemented to achieve Commercial/Industrial Land Use.

Following are the specific objectives of the RD Work Plan:

- Identify project administrative responsibilities.
- Present planning activities to be completed prior to remedy implementation.
- Describe procedures and performance criteria to implement the remedy.
- Describe reporting requirements after remedy implementation.
- Provide a schedule for the remedy implementation.

1.2 Scope

The ROD identifies 24 locations at Load Lines 1-4 and 12 which require soil removal in order to achieve the Remedial Action Objective (RAO) to reduce risk from contaminants of concern (COCs) in surface and subsurface soil to acceptable levels (remedial goal options [RGOs]) for likely future use (i.e., Commercial/Industrial Land Use) that are protective of human health. COCs include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), explosives and metals. The approved remedy includes excavation of soil from 24 locations, ex-situ thermal treatment of the majority of the excavated soil, off-site disposal of the remaining portion of the excavated soil (metals-contaminated), confirmation sampling, backfill and site restoration. On-site activities are expected to occur over a period of approximately 6 months.

The approved remedy in the ROD Amendment also includes administrative land use controls (LUCs) that will be implemented outside of the scope of this RD Work Plan.

SECTION 2

Facility and Site Description

2.1 Facility Description and History

The former RVAAP, currently named Camp James A. Garfield (CJAG), is located in northeastern Ohio within Portage and Trumbull counties, approximately 1.6 kilometers (km) (1 mile) northwest of the City of Newton Falls and 4.8 km (3 miles) east-northeast of the City of Ravenna (Figure 1). The facility is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garrett, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east.

The former RVAAP was a load, assemble, and pack facility built to produce large caliber artillery projectiles and bombs. Administrative control of the facility (21,683 acres) has been transferred to the U.S. Property and Fiscal Officer for Ohio and subsequently licensed to the Ohio Army National Guard (OHARNG) for use as a military training site. The RVAAP Installation Restoration Program, managed by the Army National Guard (ARNG) and the OHARNG, administers investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP.

The ROD Amendment provides a detailed site history for Load Lines 1-4 and 12. Load Lines 1-4 were all used in the 1940s and 1950s for various activities including loading bulk explosives into munitions, munitions rehabilitation and demilitarization projects, with each line handling millions of munitions items. In the 1940s Load Line 12 was used as an ammonium nitrate manufacturing facility and for munitions renovation and demilitarization operations. Beginning in the mid-1940s, various activities were conducted in Load Line 12 including production of fertilizer grade ammonium nitrate, aluminum chloride, and primers. A pinkwater treatment plant was also operated at Load Line 12.

Load Lines 1-4 and 12 are not known to contain munitions and explosives of concern (MEC). An explosive hazard is not known or suspected to exist at Load Line 1-4 and 12 and therefore, the probability of MEC is considered to be low.

Load Lines 1-4 and 12 all had previous RODs signed by the Army that addressed the soil and dry sediment media (Shaw, 2007; SAIC, 2009). The remedial actions identified in the previous RODs for soil and dry sediment have been implemented consisting of excavation with off-site disposal as an interim remedy to address COCs in soil that exceeded human health Facilitywide Cleanup Goals established for the National Guard Trainee.

- Load Lines 1-4. Removal of approximately 1,752 tons of hazardous and 9,484 tons of nonhazardous contaminated soil occurred at Load Lines 1 through 4 from August to November 2007 to achieve Military Training Land Use (National Guard Mounted Training – No Digging land use). The buildings also were removed in 2007; however, removal of the floor slabs and associated foundation walls was not completed until 2009. A sampling program was implemented after the floor slab removal. Based on the sampling results, approximately 2,804 cubic yards (CY) of sub-slab soil were removed at Load Lines 1-3 in 2010.
- Load Line 12. Building demolition and slab removal occurred from 1998 to 2000. Removal of 1,181 tons of contaminated sediment from the Main Ditch at Load Line 12 was completed in 2010 to achieve Military Training Land Use for soil and dry sediment (National Guard Mounted Training – Digging to 4 feet bgs land use) (Leidos, 2019b). A separate ROD for Load Line 12 selected no further action for wet sediment and surface water to attain Unrestricted (Residential) Land Use (Leidos, 2019a).

After the removal actions were completed to achieve Military Training Land Use, the Army conducted multiple sampling events to assess if additional remedial actions are necessary to achieve potential future Commercial/Industrial Land Use or Unrestricted (Residential) Land Use. Based on the investigation results, Load Lines 1- 4 and 12 have been adequately characterized and the nature and extent of the contamination has been defined. The ecological risk assessment concluded that no further action is necessary to be protective of important ecological resources and no further action is recommended from the ecological risk perspective. Extensive investigations of each load line concluded that a portion of each load line did not require further action to attain Unrestricted (Residential) Land Use. Limited areas of surface and subsurface soil at each load line were identified as posing unacceptable risk to the Industrial Receptor and/or Resident Receptor. The Feasibility Study (FS) Addendum (Leidos, 2017), Proposed Plan (Leidos, 2018) and ROD Amendment (Leidos, 2019b) identified the preferred alternative to be Ex Situ Thermal Treatment of Soil and Administrative LUCs for Commercial/Industrial Land Use, and identified the planned excavation locations that are the subject of this RD Work Plan.

All buildings at Load Lines 1-4 and 12 have been demolished. Currently vegetative cover is present throughout the load lines consisting of rough grass, scrub vegetation, immature hardwoods, wetland areas, and hardwood forest. Former production infrastructure features that remain consist mainly of asphalt and gravel access roads, man-made ditches, sanitary and storm sewer lines, manholes, elevated walkways and railroad beds.

2.2 Nature and Extent Summary

Figure 2 presents the planned excavation locations. Table 2-1 provides details of the planned excavations including square footage, soil volume, and COCs. The following sections include a description of each AOC and the planned excavations within.

2.2.1 Load Line 1

Load Line 1 is located in the southeastern portion of the former RVAAP and contains five (5) planned excavations (Figure 3: Load Line 1 Excavation Plan). Planned excavations within Load Line 1 are located adjacent to or beneath former buildings except for one small planned excavation located at an outlet channel immediately outside of the load line fence. The load line is characterized by moderately subdued topography and ground surface elevations range from approximately 975 to 1,016 feet above mean sea level (amsl). At Load Line 1, soil cover is very thin to nonexistent in the vicinity of Buildings CB-4, CB-4A, CA6, CA-6A, and CB-14, as these buildings were constructed on excavated bedrock. The presence of soil greater than 0.5 feet in thickness is observed at locations where fill material was brought in or reworked during either the active life of the load line or during demolition. Native soil in the vicinity of Load Line 1 belongs to the Mahoning silt loam series, which is one of the five major soil types found within the RVAAP facility. Depths to groundwater range from 19 to 35 feet below ground surface (bgs), with the exception of one well in the southwestern portion of the planned excavation where groundwater is encountered at approximately 10 feet bgs (EQM, 2010).

2.2.2 Load Line 2

Load Line 2 is located in the southeastern portion of the former RVAAP and contains one (1) planned excavation (Figure 4: Load Line 2 Excavation Plan). The load line is characterized by moderately subdued topography and ground surface elevations range from approximately 990 to 1,010 feet amsl. However, topography decreases sharply to the south of the load line. The primary surface water conveyance at Load Line 2 drains to the south and ultimately discharges into Kelly’s Pond; water from the pond is discharged to Sand Creek. Soil across Load Line 2 exhibits seasonal wetness, rapid runoff, and low permeability. During site investigations, bedrock was encountered at depths ranging from 4 to 16 feet bgs. Groundwater depths range from approximately 5 to 14.7 feet bgs (EQM, 2010).

2.2.3 Load Line 3

Load Line 3 is located in the southeastern portion of the former RVAAP and contains ten (10) planned excavations (Figure 5: Load Line 3 Excavation Plan). All but one of the planned excavations within Load Line 3 are located adjacent to or beneath former buildings. The load line is characterized by sloping topography on a reworked sandstone bedrock surface. Elevations vary from approximately 980 to 1,020 feet amsl. Ditches comprise the primary surface water conveyance at Load Line 3, which, ultimately, drain into Upper and Lower Cobbs Ponds. Poorly drained, silty clay loam or clay loam is formed over glacial till and bedrock is generally encountered at depths greater than 6 feet bgs. Runoff is typically medium to rapid, and the soil is seasonally wet. Groundwater depths range from approximately 8 to 27 feet bgs (EQM, 2010).

2.2.4 Load Line 4

Load Line 4 is located in the south central portion of the former RVAAP and contains four (4) planned excavations (Figure 6: Load Line 4 Excavation Plan). Three of the planned excavations within Load Line 4 are located adjacent to or beneath former buildings. The final planned excavation is located adjacent to a former water tower and is characterized by its more remote location within the load line. The topography is subdued on a glacial till surface. Elevations vary from approximately 980 to 1,000 feet amsl. A perennial stream crosses the AOC from northwest to southeast and flows into the large settling pond, which discharges to a surface stream that exits the facility at a point south of the load line. Poorly drained, silty clay loam or clay loam is formed over glacial till and bedrock is generally encountered at depths greater than 6 feet bgs. Runoff is typically medium to rapid, and the soil is seasonally wet. Groundwater depths range from approximately. 3.4 to 15.8 feet bgs (EQM, 2010).

2.2.5 Load Line 12

Load Line 12 is located in the south central portion of the former RVAAP and contains four (4) planned excavations (Figure 7: Load Line 12 Excavation Plan). The primary north-south drainage feature (Main Ditch) flows north until its intersection with the Active Area Channel, the primary surface water conveyance. Poorly drained, silty clay loam or clay loam is formed over glacial till and bedrock is generally encountered at depths greater than 6 feet bgs. Runoff is typically medium to rapid, and the soil is seasonally wet. Depth to groundwater ranges from 3.25 to 18.21 feet below top of well casings. (USACE, 2004; MKM, 2007).

2.3 Anticipated Future Land Use

Load Lines 1 through 4 and 12 will be used for military training with the representative use of Commercial/Industrial Use.

Commercial/Industrial Land Use represents receptors who work full time at the former RVAAP AOCs and is characterized by activities consistent with full-time employees or career military personnel who are expected to work daily at the facility over their career. Activities can include work that will be conducted in office buildings, schools, maintenance buildings, and manufacturing facilities. Activities will also include outdoor work that will be conducted by full-time personnel to maintain military training lands. Commercial/Industrial Land Use will provide protectiveness for the National Guard Trainee.

Because unacceptable risk will remain for the Resident Receptor, LUCs will be implemented to prevent residential use.

Table 2-1. Planned Excavation Area Details [a]
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Load Line	Planned Excavation	Area (SF)	Contaminated Interval (feet bgs)	Thickness of Contaminated Interval (feet)	In-Situ Soil Volume (CY)	In-Situ Soil Volume with Constructability [b] (CY)	Ex-Situ Soil Volume [c] (CY)	Ex-Situ Soil Weight (tons)	Associated Concrete Removal [d] (CY)	Contaminants of Concern
1	CB-4	1,403	2-3	1	52	65	78	97	30	PCB-1254
1	CB-4A	9,212	1-5	4	1,365	1,706	2,047	2,559		RDX, TNT
1	CB-2	400	0-2	2	30	37	44	56		Antimony, lead
1	CB-13B (LL1-252)	400	0-1.5	1.5	22	28	33	42		Lead
1	Outlet Channel D (LL1-049)	400	0-1.5	1.5	22	28	33	42		Antimony, lead
2	DB-4A	400	0-2	2	30	37	46	56		TNT
3	EB-10 (a)	9,962	3-5	2	738	922	1,107	1,384	899	PAHs: B(a)a, BaP, BbF, DA
3	EB-10 (b)	400	0-2	2	30	37	44	56		PCB-1254
3	EA-7	400	0-1	1	15	19	22	28		PCB-1254
3	EA-6 (a)	400	0-1	1	15	19	22	28	56	PAHs: B(a)a, BaP, BbF, DA
3	EA-6 (b)	400	0-1	1	15	19	22	28		PAHs: BaP, DA
3	EA-6 (c)	4,062	4.5-6	1.5	226	282	339	423		PAHs: B(a)a, BaP, BbF, DA
3	EB-4	6,996	1-3	2	518	648	777	972		PCB-1254
3	EB-9A	1,009	0-1	1	37	47	56	70		TNT
3	West Perimeter	625	0-0.5	0.5	12	14	17	22		PAHs: B(a)a, BaP, BbF, DA
3	EB-803	400	0-1	1	15	19	22	28		PCB-1254
4	Former Water Tower	400	0-1	1	15	19	22	28		Lead
4	Building G-16	400	0-1	1	15	19	22	28		PCB-1260
4	Building G-8 (a)	400	1-7	6	89	111	133	167	23	PAHs: B(a)a, BaP, BbF, DA
4	Building G-8 (b)	4,794	3-5	2	355	444	533	666		PAHs: B(a)a, BaP, BbF, DA

Table 2-1. Planned Excavation Area Details (continued) [a]
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Load Line	Planned Excavation	Area (SF)	Contaminated Interval (feet bgs)	Thickness of Contaminated Interval (feet)	In-Situ Soil Volume (CY)	In-Situ Soil Volume with Constructability [b] (CY)	Ex-Situ Soil Volume [c] (CY)	Ex-Situ Soil Weight (tons)	Associated Concrete Removal [d] (CY)	Contaminants of Concern
12	Active Area Channel	400	0-2	2	30	37	44	56		TNT, 2,6-DNT, BaP
12	FF-19 (a)	625	0-1	1	23	29	35	43		PAHs: B(a)a, BaP, BbF, DA
12	FF-19 (b)	625	0-4.5	4.5	104	130	156	195		PAHs: B(a)a, BaP, BbF, DA
12	FF-19 (c)	983	0-2.5	2.5	91	114	137	171		PAHs: B(a)a, BaP, BbF, DA

Table notes:

[a] Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation to confirm that the RGOs have been met. If an RGO applicable to a particular excavation is exceeded, CH2M will inform USACE to discuss removal of additional soil at that location. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance.
[b] Constructability factor accounts for over excavation, sloping of sidewalls, and addresses limitations of removal equipment. The in-situ volume is increased by 25% for a constructability factor. The soil to be treated shall be tracked by in-situ volume based on surveying.
[c] Includes 20% swell factor.
[d] Demolition and disposal of concrete will be required for walkway and foundation structures located within selected excavation areas in Load Lines 1-4 and 12.

% = percent
B(a)a = benz(a)anthracene
BaP = benzo(a)pyrene
BbF = benzo(b)fluoranthene
bgs = below ground surface
CH2M = CH2M HILL Constructors, Inc.
COR = Contracting Officer’s Representative
CY = cubic yards
DA = dibenz(a,h)anthracene
2,6-DNT = 2,6-dinitrotoluene
PAH= polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
RGO = remedial goal option
SF = square feet
TNT = 2,4,6-trinitrotoluene
USACE = U.S. Army Corps of Engineers

Project Organization and Coordination

Key personnel for executing this RD Work Plan and their responsibilities are summarized below.

3.1 U.S. Army Corps of Engineers Contracting Officer's Representative

Nat Peters will serve as the USACE Contracting Officer's Representative (COR) duties include overseeing CH2M to ensure work is completed in accordance with this RD Work Plan. The USACE COR also coordinates responses for any unexpected materials encountered.

3.2 Ohio Army National Guard/Army National Guard Restoration Representative

National Guard representatives include David Connolly (ARNG Program Manager), Katie Tait (OHARNG Restoration Representative), and Kevin Sedlak, ARNG Restoration Representative. Mr. Sedlak will provide health and safety oversight, overall coordination support, and field and document review. Ms. Tait will be responsible for signing waste profiles and manifests, waste management, assisting with project coordination and access, and document review.

3.3 Ohio Environmental Protection Agency

The Ohio Environmental Protection Agency (Ohio EPA) is the regulatory agency for this project. Ohio EPA will review project documents and ensure that the RD/remedial action are completed in accordance with the RD Work Plan and regulatory requirements.

3.4 CH2M HILL Constructors Project Manager

Sarah Meyers will serve as the Project Manager and is the person in charge of the overall project and has full authority for coordination and direction of the project. The Project Manager will be assisted by the onsite personnel. The Project Manager will communicate with U.S. Army Corps of Engineers (USACE) Louisville District and ARNG. Specific responsibilities of the Project Manager are as follows:

- Manage and execute overall scope, budget, and schedule.
- Interpret and plan overall work effort.
- Oversee preparation and planning of documents for the work.
- Respond to resource requirements by defining resource needs and securing the commitments for staff and equipment.
- Communicate with the Construction Manager regarding day-to-day activities and alert the appropriate manager and/or the Project Engineers to potential problems.
- Monitor subcontractor performance, schedules, budgets, and invoices.
- Develop, review, and meet work schedule and budget objectives.
- Ensure technical adequacy of field, laboratory, data management, and construction activities.
- Manage and coordinate group interfaces.

- Document the need for contract modifications, if needed.

3.5 Project Engineers

Key Rosebrook and Jason Cole will provide project engineering services. The Project Engineers are responsible for the technical aspects of the project. The Project Engineers support the Project Manager. Specific responsibilities of the Project Engineers are as follows:

- Approve work products, plans, and deliverables.
- Review requests for information from subcontractors.
- Review and accept/reject proposed design changes.
- Oversee planning and preparation of documents for the work.
- Communicate with the Construction Manager regarding day-to-day activities and alert the appropriate manager to potential problems.
- Ensure technical adequacy of field, laboratory, data management, and construction activities.

3.6 Health and Safety Manager

Josh Painter will function as the Health and Safety Manager (HSM). He is responsible for all health and safety factors involved with the project. Specific responsibilities of the HSM are as follows:

- Review and accept or reject subcontractor prequalification questionnaires.
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor’s field operations.
- Support the Safety Coordinator’s (SC’s) oversight of subcontractors’ (and lower-tier subcontractors’) health and safety practices and interface with onsite third parties in accordance with the site-specific Accident Prevention Plan/Site Safety and Health Plan (APP/SSHP) procedures.
- Maintain copies of all qualifications and training records for site personnel.

3.7 Construction Manager/Quality Control

The Construction Manager is the contact at the Site and is responsible for performing the remediation activities in accordance with this RD Work Plan and other project plans. The Construction Manager is also responsible for Quality Control, ensuring that work is conducted in accordance with the RD Work Plan. The Construction Manager/Quality Control Manager's (CM/QCM) responsibilities include, but are not limited to the following:

- Manage the day-to-day execution of the project at the Site, including oversight of the subcontractors and implementation of the day-to-day aspects of the APP/SSHP.
- Coordinate engineering activities at the Site as directed by the CH2M Project Manager and the CH2M Project Engineer.
- Monitor work progress and schedule and advise the CH2M Project Manager of any variances identified at the Site.
- Comply with state and federal regulations pertinent to the work.
- Assist in preparation of work progress schedules, project reports, record drawings, and required compliance submittals.

- Prepare daily production reports and compile them into a weekly report that will be forwarded to the CH2M Project Manager.
- Lead work progress meetings.
- Report to the CH2M Project Manager changes desired in the contract documents so that required review and approval can be accomplished before the change is made, and report for review and approval changes necessitated by unanticipated site conditions.
- Maintain and keep control of all site files, including but not limited to survey documents, confirmation sampling results, and shipping manifests.
- Prepare and submit QC reports to the CH2M Project Manager and Project Engineers.
- Ensure compliance with the RD Work Plan.
- Track all waste shipments and maintain shipping paperwork, including manifests and landfill weight tickets.

3.8 Safety Coordinator

The SC will oversee the day-to-day implementation of the APP/SSHP. The SC may take actions independent of the project team to stop the project, if required, for compliance with the APP/SSHP. The Construction Manager may perform the role of SC. The SC is responsible for the following:

- Oversee the maintenance and use of field monitoring equipment necessary to define onsite hazards associated with remediation.
- Work with the HSM to designate appropriate personal protective equipment level, and determine upgrades and downgrades as site conditions require or allow.
- Provide necessary guidance to the project personnel so they can safely perform their functions in accordance with federal and state regulations.

SECTION 4

Project Approach

4.1 Remedial Action Objective

The RAO for Load Lines 1-4 and 12 is to reduce risk from COCs in surface and subsurface soil to acceptable levels (RGOs) that are protective of human health and congruent with likely future land use (i.e., Commercial/Industrial Land Use). The selected alternative to achieve the RAO includes ex situ thermal treatment for soil with PAH, explosives, or PCB contamination above Industrial RGOs; soil containing metals exceeding the RGOs will be excavated and disposed off-site. Under this remedy, unacceptable risk will remain on site for the Resident Receptor at each load line; therefore, this alternative also will rely on LUCs to prevent Resident Receptor exposure to contaminants in soil in those areas. The design and implementation of LUCs as part of the selected remedy is outside the scope of this RD Work Plan and per the ROD Amendment will be presented in an LUC RD that will include LUC objectives, land restrictions (i.e., no residential use), potential modification and termination of LUCs, monitoring and reporting requirements, 5-year reviews in compliance with Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121(c) to ensure the remedy remains protective of human health and the environment, LUC enforcement, and property transfers (Leidos, 2019a).

The selected remedy was chosen because it is cost effective and it is premised on treatment, the statutory preference for alternatives capable of reducing the toxicity, mobility, and volume of environmental contaminants.

The following is a brief list of activities associated with implementing the selected remedy:

- Soil anticipated for treatment will be excavated and placed into a thermal treatment system to remove COCs from soil.
- The excavated areas will be sampled and analyzed, and the sample results will be compared to the RGOs. As required by sampling results, soil excavations will be extended as needed until analytical results for sidewall and bottom samples indicate that the applicable RGOs have been met at each excavation area.
- Thermally treated soil will be sampled and analyzed, and the sample results will be compared to the RGOs.
- Once the treated soil is sampled and confirmed to be below RGOs, the treated soil will be used to backfill the excavated areas.
- Soil with metals concentrations above RGOs will be excavated and disposed of off-site.
- Disturbed areas will be restored to grade, using approved clean backfill, as necessary; revegetated using an OHARNG-approved seed mixture; and mulched.

4.2 Treatment Goals

Table 4-1 presents the RGOs for each Load Line. RGOs are cleanup goals that establish acceptable exposure levels to be protective of human health while considering potential land uses. In addition to the RGOs, applicable or relevant and appropriate requirements were developed to be applied during the evaluation of FS alternatives.

Table 4-1. Remedial Goal Options for Soil at Load Lines 1-4 and 12
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Load Line Number	Chemical of Concern	Cleanup Goals (mg/kg) Industrial RGO
Load Line 1	Antimony	470
	Lead	800
	TNT	510
	RDX	280
	Benz(a)anthracene	29
	Benzo(a)pyrene	2.9
	Benzo(b)fluoranthene	29
	PCB-1254	9.7
Load Line 2	TNT	510
Load Line 3	TNT	510
	Benz(a)anthracene	29
	Benzo(a)pyrene	2.9
	Benzo(b)fluoranthene	29
	Dibenza(a,h)anthracene	2.9
	PCB-1254	9.7
Load Line 4	Lead	800
	Benz(a)anthracene	29
	Benzo(a)pyrene	2.9
	Benzo(b)fluoranthene	29
	Dibenz(a,h)anthracene	2.9
	PCB-1260	9.9
Load Line 12	TNT	510
	2,6-DNT	15
	Benz(a)anthraceme	29
	Benzo(a)pyrene	2.9
	Benzo(b)fluoranthene	29
	Dibenz(a,h)anthracene	2.9

Table notes:

DNT = dinitrotoluene
mg/kg = milligram per kilogram
PCB = polychlorinated biphenyl
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
RGO = remedial goal option
TNT = 2,4,6-trinitrotoluene

4.3 Overview of Field Effort

Planned excavations will be field located using the boundaries designated in the ROD Amendment (Leidos, 2019a). Once the boundaries are established, topsoil and uncontaminated overburden soil will be removed to access materials targeted for remediation.

Planned excavations with metals-impacted soil are not suitable for thermal remediation and will be excavated, loaded into lined roll-off boxes, and transported for off-site disposal. Roll off boxes will be staged near select excavations in LL-1 and LL-4, as shown in Figures 3 and 6, immediately prior to excavation. To minimize the time the roll offs are staged before transport and disposal, the number of roll off boxes will be coordinated with excavation schedule and expedited turnaround times will be requested for the disposal characterization samples. Boxes will be covered after loading to eliminate potential contact and rain water accumulation. Disposal characterization samples will be collected from the excavated metals-impacted soil.

Soil designated for removal and thermal treatment in each area will be excavated and directly loaded for transport to the ex situ thermal treatment area. Treatment verification samples will be collected from the thermally treated soil and analyzed for the applicable COCs (expedited turnaround will be requested for the laboratory analysis). Once the RGOs have been met, the treated soil will be used to backfill excavations. Additional backfill material will also be obtained from an approved off-site source as needed to backfill the excavations to match the surrounding grade.

Excavation areas will remain open following soil removal. This will allow for excavation confirmation soil collection and to minimize the need for imported fill. The excavation boundary will be bermed slightly to prevent the entry of surface runoff and safety of open areas will be maintained with signage and fencing to prevent accidental entry. Small excavations will be covered if needed based on site conditions and weather to avoid water accumulation. Larger excavations will not be covered. Water accumulating in an uncovered excavation where confirmation testing proves “clean” will be pumped out of the excavation and discharged at the surface according to site requirements. Water accumulating in an uncovered excavation that does not pass confirmation testing will be collected for treatment in the ETC.

Expedited turnaround times will be requested for analysis of applicable COCs in the excavation confirmation samples collected from the sidewalls and bottom of the excavations. If the analytical results indicate that the RGOs have not been met, additional soil will be removed and additional excavation confirmation samples will be collected. Once the RGOs have been met, the excavation will be backfilled.

Description of Activities

5.1 Premobilization

A 15-day notice will be provided to Ohio EPA prior to mobilization.

Prior to mobilization, the following plans will be submitted for approval:

- Vegetation removal plan for trees greater than or equal to 3 inches in diameter (see Appendix A)
- Remedial Design Work Plan
- Accident Prevention Plan/Site Safety and Health Plan

Removal of trees greater than 3 inches in diameter at breast height must be conducted between October 1 and March 31. Because this activity will occur prior to completion of this RD Work Plan, a separate vegetation removal plan will be submitted to describe this activity.

A designated area in Building 1036 will be assigned to ICG.

5.2 Mobilization and Site Preparation

Once the premobilization plans have been approved, ICG will mobilize heavy equipment, Ex-Situ Enhanced Thermal Conduction (ETC) equipment, and support gear to the job site in the sequence listed below. Placement of the ETC and surrounding support areas are provided on Figure 9. Figure 10 provides the main access route for the ETC cell and operations centralized at LL-1. In addition, Figure 11 shows the transfer routes between LL-2 and LL-4 with signage locations for trucks entering the south service road. The Construction Manager will place a call to Range Control to check in and out each day.

5.2.1 Sanitary Facilities

Portable sanitary facilities (Figure 9) will be installed at the ETC treatment pad location within Load Line 1 adjacent to the staging areas and trailers.

5.2.2 Heavy Equipment

Earthmoving equipment typically consists of one 320 CAT Excavator (or equivalent) and two 928 CAT Wheel Loaders (or equivalent). In addition, the following equipment may be utilized on this project:

- A compact track loader CAT 259 (or equivalent)
- An all-terrain 35-ton rock truck
- Truck and pup dump truck
- A wheeled excavator

5.2.3 Enhanced Thermal Conduction Equipment

ETC equipment typically consists of 8-semi trailer flatbed loads of piping, Quonset hut panels, and thermal oxidizer(s). The ETC equipment can be unloaded with ICG wheel loaders.

5.2.4 Support Equipment

ICG's support equipment consists of a portable office trailer, two 20' shipping containers (tool crib and crew shack), propane-fired 125 kilowatt (kw) generator, power distribution panel, and portable light stands. This equipment will be located on Load Line 1 adjacent to the ETC treatment pad and staging area as shown on Figure 9.

A minimal volume of water will be needed for excavation and thermal treatment. Any water that is needed will be obtained from the City of Newton Falls, OH municipal water supply and will be brought onsite by ICG.

5.2.5 Communications Setup

ICG utilizes a wireless Local Area Network connected to a cellular data network to facilitate ETC process monitoring. The setup of this communications network will coincide with the setup/placement of the mobile office trailer.

5.2.6 Site Preparation

5.2.6.1 Preconstruction Photographs

Preconstruction photographs will be taken to document site conditions prior to work, including the excavation locations to document vegetation and general conditions for comparison to post-restoration conditions, elevated walkways, the ETC treatment pad location and support facility areas, and roadways (paved and unpaved).

5.2.6.2 Utility Survey

An active power line is located in Load Line 2 outside of the planned excavation areas. All utilities have been abandoned within the limits of the remaining load lines included in this effort. A third party utility locate will be performed prior to any ground disturbance. In addition, the OHARNG Restoration Representative will check with the CJAG Engineering Office regarding utilities prior to any ground disturbance. This is to ensure the safety of the field staff working in and around the load lines.

5.2.6.3 Land Survey

Planned excavation areas within each of the five specified Load Lines will be professionally surveyed in advance of excavation activities commencing so that complete excavation boundaries and depths are accurately identified prior to starting work.

The corners and any inflection point along the perimeter of the planned excavation areas will be located using either global positioning system or traditional land surveying methods to a horizontal accuracy of +/- 0.5 feet and marked. Accuracy will be demonstrated and documented.

Prior to excavation, areas to be excavated will be surveyed to establish preexcavation existing conditions which will be documented with a topographic map. The topographic survey can be performed using local control points and a local datum. The vertical accuracy of the survey will be within +/- 0.1 feet, which will be demonstrated and documented by closing a level loop. Horizontal accuracy shall be within +/- 0.5 feet and will also be documented. The survey will be conducted using a horizontal grid spacing of not larger than five feet. Additional points will be added, as needed, to capture grade changes. The topographic map developed from the survey will have 0.5-foot contour intervals and show relative elevations of the grid points.

5.2.6.4 Vegetation Removal

Removal of trees greater than 3 inches in diameter at breast height and limbs greater than 3 inches in diameter must be conducted between October 1 and March 31. Because this activity was completed in March 2020 prior to finalizing this RD Work Plan, a separate vegetation removal plan was submitted to describe this activity and approved by the Army (Appendix A). The trees that are felled will be cut into eight foot lengths and piled neatly adjacent to where it was cut at the time of the remedial activities, or during the tree cutting activities as time permits. Trees and limbs will not be bucked into firewood and any mulched wood chips will not be left in stockpiles.

No stump grinding will occur during tree and brush removal activities. Stumps encountered during site prep and excavation activities will be removed and properly disposed using an excavator. Stumps that do not hinder Site activities will be left in place to prevent soil destabilization.

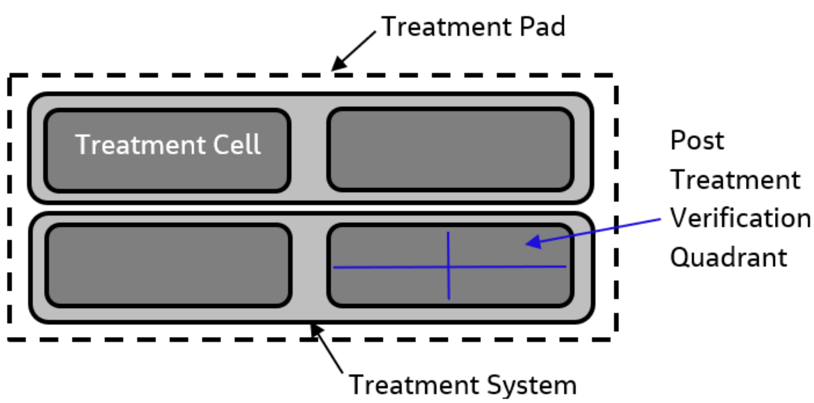
Vegetation clean up, removal of smaller trees and brush clearing will be performed as needed at the planned excavation areas, ETC treatment pad areas, support areas and access routes after full-scale Contractor mobilization.

Vegetation does not need to be removed from the soil, and is not a part of the soil volume estimates. Herbaceous vegetation will be cut as necessary and piled neatly adjacent to the removal area for eventual decomposition. Woody vegetation will be chipped and broadcast across the surrounding area (not stockpiled). Every effort will be made to separate contaminated soil from vegetation to ensure contaminants present in the excavation area are properly treated.

5.2.6.5 Enhanced Thermal Conduction Treatment Pad Construction

Once mobilization is complete, an ETC treatment pad will be constructed for the two ETC treatment systems. There will be one treatment pad, two treatment systems, and four treatment cells. Exhibit 1 presents a schematic to illustrate the difference between the ETC treatment pad, system, and cell.

Exhibit 1. Typical ETC Soil Treatment Nomenclature Organization



In order to construct the ETC treatment pad, the following construction sequence will be performed.

- ETC treatment pad will be located on a clean portion in one of the Load Lines, currently anticipated to be in Load Line 1, in the vicinity of former building CB-801. The laydown/staging area will be directly adjacent to the ETC treatment pad (Figure 9). The decontamination area will be adjacent to the ETC as shown in the ETC Treatment Cell at LL-1 Diagram.
- Brush and tree removal will be performed as required.
- The top layer of organic soil/vegetation will be stripped and stockpiled.
- Site grading will occur to promote drainage. A 20 mil impervious liner will be installed under the ETC cell locations by excavating approximately 12 inches of soil, placing the liner, and replacing the excavated soil to provide a working surface for heavy equipment and preserve liner integrity.
- After installation of the 20-mil liner, 12-inch wide steel I-beams (base rails) will be placed along both sides of the lined treatment cells and will be spaced approximately 37 feet apart. These I-beams will run the length of each treatment pad – approximately 190 feet.

- Once the ETC treatment pad has been constructed, contaminated soil excavated from the load lines will be piled between the base rails, covered with Quonset hut panels and thermally treated.

5.3 Excavation

Ground disturbance protocols will be initiated to establish safe excavation zones prior to starting work. Excavation that is scheduled to be undertaken as part of the remedial site activities will be completed via tracked excavator, wheeled excavator or rubber-tired backhoe depending on site logistics considerations and intra-facility travel requirements. As material is excavated it will be loaded, transported and handled with wheel loaders and either all terrain or tandem gravel trucks.

Confirmation samples will be taken immediately after completion of excavation. Once confirmatory soil samples verify the excavation boundaries meet the RGOs, the individual excavations will be resurveyed to validate actual volume of soil removed for treatment and/or disposal.

5.3.1 Metals Impacted Soils

The four planned excavations with metals-impacted soil (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4) are not suitable for thermal remediation. The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas (Figures 3 and 6), sampled as described in Section 5.6.3, and prepared for off-site transport and disposal. The total estimated volume of metals impacted soil scheduled for disposal is +/- 160 CY. In areas that have only metals contamination, the surface soil and groundcover vegetation will not be segregated from soil to be disposed; this material will be loaded with the contaminated soil for off-site disposal. Stormwater Pollution Prevention best management practices (BMPs) outlined in Section 8 will be integrated into the excavation operations, as required.

5.3.2 Soil for Ex Situ Thermal Treatment

For each planned excavation area with soil that will be thermally treated, the overlying uncontaminated surface soil, if applicable (see Table 2-1), will be removed and stockpiled nearby; erosion/runoff mitigation for the stockpiled uncontaminated surface soil will be implemented per Section 8. The impacted soils will then be excavated to the boundaries of the surveyed area as shown on Figures 3 through 7, and placed into a truck to be transported immediately to the ETC pad shown on Figure 8. Once the material arrives at the ETC pad wheel loaders will be used to place it directly into one of the ETC cells for thermal treatment. Each ETC cell will contain a soil volume of +/-525 CY. Stockpiling of the impacted pre-treatment soil is generally not required at either the excavation area or at the ETC treatment pad. Stormwater Pollution Prevention BMPs outlined in Section 8 will be integrated into the excavation operations, as required.

Soils will be consolidated by contaminant within a treatment cell where possible for verification testing. For example, soils requiring verification testing for explosives will be consolidated within a treatment cell wherever possible for laboratory testing organization and chain of custody simplification. Therefore, the planned excavation sequence is grouped by COCs as shown in Table 5-1.

Upon completion of soil treatment, each batch will be sampled and verified by CH2M to confirm applicable COC levels within the treated soil meet the required RGOs as described in Section 5.6.2. Treated soil meeting the applicable RGOs will be transported by truck and used as backfill. As previously described, soil excavation areas will remain open during thermal treatment operations; safety fence and hazard-warning signage will be installed to prevent accidental entry to open areas.

5.3.3 Concrete Demolition and Disposal

Demolition and disposal of concrete will be required for walkway and foundation structures located within selected excavation areas in Load Lines 1-4 and 12 (Table 2-1). For areas where elevated walkways are within the footprint of the work, the footers will also be removed and any soil will be knocked off during removal. Concrete material will be demolished and broken down to required debris sizing with excavator mounted hydraulic concrete breaking equipment. Composite samples will be collected for disposal characterization (see Section 5.6). Once the concrete has been demolished to the appropriate size it will be loaded onto trucks for transportation and disposal at an off-site facility.

Table 5-1. Planned Excavation Sequence
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Excavation Sequence	Load Line	Planned Excavation	Area (SF)	Contaminated Interval (feet bgs)	Ex Situ Soil Volume [a] (CY)	Associated Concrete Removal [b] (CY)	COC Group	COCs
1	1	CB-4A	9,212	1-5	2,047		Explosives	RDX, TNT
2	2	DB-4A	400	0-2	46		Explosives	TNT
3	3	EB-9A	1,009	0-1	56		Explosives	TNT
4	12	Active Area Channel	400	0-2	44		Explosives	TNT, 2,6-DNT, BAP
5	12	FF-19 (a)	625	0-1	35		PAHs	PAHs: B(a)a, BaP, BbF, DA
6	12	FF-19 (b)	625	0-4.5	156		PAHs	PAHs: B(a)a, BaP, BbF, DA
7	12	FF-19 (c)	983	0-2.5	137		PAHs	PAHs: B(a)a, BaP, BbF, DA
8	4	Building G-8 (a)	400	1-7	133	23	PAHs	PAHs: B(a)a, BaP, BbF, DA
9	4	Building G-8 (b)	4,794	3-5	533		PAHs	PAHs: B(a)a, BaP, BbF, DA
10	3	West Perimeter	625	0-0.5	17		PAHs	PAHs: B(a)a, BaP, BbF, DA
11	3	EA-6 (c)	4,062	4.5-6	339		PAHs	PAHs: B(a)a, BaP, BbF, DA
12	3	EA-6 (b)	400	0-1	22		PAHs	PAHs: BaP, DA
13	3	EA-6 (a)	400	0-1	22	56	PAHs	PAHs: B(a)a, BaP, BbF, DA
14	3	EB-10 (a)	9,962	3-5	1,107	899	PAHs	PAHs: B(a)a, BaP, BbF, DA
15	1	CB-2	400	0-2	44		Metals	Antimony, Lead
16	1	CB-13B (LL1-252)	400	0-1.5	33		Metals	Lead
17	1	Outlet Channel D (LL1-049)	400	0-1.5	33		Metals	Antimony, Lead
18	4	Former Water Tower	400	0-1	22		Metals	Lead
19	4	Building G-16	400	0-1	22		PCBs	PCB-1260
20	3	EB-4	6,996	1-3	777		PCBs	PCB-1254
21	3	EA-7	400	0-1	22		PCBs	PCB-1254
22	3	EB-10 (b)	400	0-2	44		PCBs	PCB-1254
23	3	EB-803	400	0-1	22		PCBs	PCB-1254
24	1	CB-4	1,403	2-3	78	30	PCBs	PCB-1254

Table 5-1. Planned Excavation Sequence (continued)

Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Excavation Sequence	Load Line	Planned Excavation	Area (SF)	Contaminated Interval (feet bgs)	Ex Situ Soil Volume [a] (CY)	Associated Concrete Removal [b] (CY)	COC Group	COCs

Table notes:

[a] Includes 20% swell factor.

[b] Demolition and disposal of concrete will be required for walkway and foundation structures located within selected excavation areas in Load Lines 1-4 and 12.

% = percent
bgs = below ground surface
COC = constituent of concern
CY = cubic yard
SF = square feet
B(a)a = benz(a)anthracene
BaP = benzo(a)pyrene
BbF = benzo(b)fluoranthene
DA = dibenz(a,h)anthracene
2,6-DNT = 2,6-dinitrotoluene
PAH= polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
TNT = 2,4,6-trinitrotoluene

5.3.4 Treatment Cell/Pile Construction

As soil is excavated from multiple excavation areas, it will be loaded and transported to Load Line 1 for thermal treatment. The transported soil will be unloaded onto a lined portion of the ETC treatment pad where excavators and front-end loaders will place it into a ETC treatment cell. Details of how each ETC cell is constructed are provided in the following sections.

5.3.5 Soil Stacking

Each treatment cell consists of four layers of soil embedded with three rows of manifolds and radial pipes. The first layer of contaminated soil placed within an ETC treatment cell will be approximately 37 feet wide by 80 feet long. Once this layer has been placed, a 12-inch diameter steel pipe manifold will be placed down the layer center, running the length of the cell. Perforated lateral steel pipes (3.5-inch x 16-feet) will be attached to each side of the manifold using tees placed along the cell length. The second layer of contaminated soil will be placed upon the pipes and manifolds. A second layer of pipes composed of 12-foot perforated laterals and a 12-inch diameter manifold will be placed on top of the second layer of contaminated soil. A third layer of contaminated soil will be placed upon the pipes and manifolds. Followed by installation of a third layer of perforated lateral pipes (9-foot laterals) and 12-inch diameter manifolds. Finally, a fourth layer of contaminated soil will be placed on top to cover the third layer of laterals and manifolds. The total height of the typical soil cell will be approximately 9.5 feet at the top. During operation of the ETC treatment cell, hot air is injected into each manifold where it flows into each lateral. As the heated air exits each perforated lateral, it is forced through the soil providing treatment. Air and contaminant vapor pushed through the soil is subsequently captured by the Quonset hut cover (described below). Vapor extracted from the Quonset hut cover is destroyed using a standalone Thermal Oxidizer described in section 5.4.2.

5.3.6 Installation of Mineral Wool Insulation in I-beams

Once the soil cell is constructed, 1-inch thick by 8-inch wide mineral wool insulation will be placed in the I-Beams in order to create a seal where the foot of the Quonset hut panels sit in the I-Beams.

5.3.7 Quonset Hut Assembly

A temporary Quonset hut will be constructed over the pile of soil to be treated. The Quonset hut will be assembled on the ground, in three-panel sections. Each panel is 5 feet wide, making each 3-panel section 15 feet wide once they're bolted together. Once the sections are bolted together, they are lifted over the treatment cell and the 15-foot sections are bolted together to create a sealed cover. After the Quonset hut is completely assembled, aluminum tape is utilized to seal the bolted panel connections to eliminate the escape of vapors during treatment operations. A diagram of a typical ETC soil cell is shown in Exhibit 2.

5.4 Thermal Treatment

ICG's thermal equipment consists of the following components:

- 12-inch steel manifolds and 3.5-inch steel lateral pipes
- Aluminum Quonset hut (soil cover)
- Thermal Oxidizer
- Six to ten 1,000-gallon propane storage tanks
- Thermocouple temperature sensors
- Electrical generator
- Power distribution panel
- System communication panel with cellular and satellite transmission capacity
- Supervisory control and data acquisition (SCADA) monitoring and control platform

Exhibit 2. Typical ETC Soil Treatment Cell

5.4.1 Aluminum Quonset Hut (soil cover)

The Quonset hut soil cover is designed to prevent the escape of contaminated vapors generated from the heating of contaminated soil. As the Quonset hut is assembled, each bolted section is sealed with a high temperature aluminum tape to prevent the escape of vapors.

5.4.2 Thermal Oxidizer

The thermal oxidizer consists of an insulated steel chamber (4-feet wide by 5-feet high by 15-feet long) with an 8-foot high exhaust stack. Heat is supplied to the chamber using a single 5-million British thermal unit (MBTU) propane-fueled burner. During the ETC process, contaminated vapors (from the heated soil) are collected within the Quonset hut and are drawn into the thermal oxidizer by an induced draft (I.D.) fan. The I.D. fan is controlled by a variable frequency drive (VFD) in order to maintain negative vacuum inside the Quonset hut. The minimum operating temperature of the thermal oxidizer is 950 degrees Fahrenheit (°F); the typical operating range for this type of waste is 1,400 to 1,600°F. This is monitored daily, both during the documented daily equipment and temperature checks as well as casually throughout the workday by ICG operators working on the system. If the temperature is observed to drop below this threshold, process adjustments are manually implemented to bring the temperature back into the required range. These process changes include a change in burner/heat input settings and/or a change in air volume or velocity settings for either the thermal oxidizer, the inlet burner or both. The thermal oxidizer’s 5-MBTU burner is equipped with Underwriter Laboratories (UL) approved burner controls, which include a high-limit temperature shutdown control as well as high and low limit gas pressure controls.

Hot exhaust gas from the thermal oxidizer will be the primary source of energy for heating soil stacked within each treatment cell. The thermal oxidizer performs the destruction of contaminated vapors while also providing heating air to the embedded pipe and manifolds system within the soil. This approach enhances the efficiency of treatment operations and promotes energy recovery during system operations. The oxidizer is connected to the 12-inch manifolds by flexible stainless steel ducting. The oxidizer’s I.D. fan is connected to the Quonset hut by flexible ducting. A portion of the oxidizer’s exhaust is routed out the exhaust stack while the balance is redirected into the 12-inch manifolds.

If supplemental heating of soil within the ETC system is required to reach the desired treatment temperature (approximately 350 °F to 600 °F) an additional stand-alone 5-MBTU propane-fueled burner can be operated. The auxiliary burner is an exact duplicate to equipment used in the thermal oxidizer combustion chamber including the UL certified fuel gas equipment and burner controls.

5.4.3 Thermocouple Temperature Sensors

During soil cell construction, thermocouple temperature sensors (9) are embedded in the contaminated soil at nine locations per active cell (located front, middle and back, and at three depth intervals at each location). These sensors are monitored during treatment in order to track the heating process. The thermocouple temperatures are the primary indicator of treatment progress. The sensors provide ICG operators with real-time data to adjust parameters like airflow or inlet temperatures to optimize treatment efficacy and also provide a rough guideline of where in the treatment process the operation is at the time of data collection. Treatment timing is ultimately driven by things like contaminant type, target endpoints, soil type, and soil moisture content. Based on initial mass balance calculations for Load Lines 1-4 and 12, ICG is expecting treatment operations to run for 8 to 10 days per cell. Endpoint temperatures will be used as a rough guideline to initiate treatment verification sampling (see Section 5.6) and ultimately the corresponding analytical results will verify if treatment goals have been met.

5.4.4 Electrical Generator

A portable, 3-phase, 480-volt generator with a minimum output of 25kw powers each ETC unit. These generators are fully enclosed, sound attenuated and provide for secondary containment of engine fluids within the engine compartment. Because the unit utilizes propane or natural gas as fuel, it does not require additional fuel containment. For this project, propane will be utilized. An on-site propane storage tank will provide a constant propane supply to both the ETC equipment and generator – eliminating the need for refueling operations.

This generator provides electricity to the thermal oxidizer (which includes the 5-MBTU burner and I.D. fan), the portable office trailer, and the portable power distribution panel.

5.4.5 Power Distribution Panel/Communications Unit

Electricity from the electrical generator is routed into a power distribution panel which houses the main power disconnect switches. In addition, the panel is equipped with a SCADA unit that provides a data uplink (via satellite and/or cellular signal). The SCADA does not record data but allows ICG to monitor the equipment remotely, outside of normal working hours. Remote cameras and thermocouple sensors are connected to the SCADA unit and provide ICG with real-time video feeds and process temperature information.

5.4.6 Fuel Management

Heavy equipment fuel (diesel) will be supplied by 100 US gallon fuel transfer tanks (DOT approved single wall) mounted in ICG's service trucks equipped with spill response supplies, or by a stationary 1,000 US gallon, double walled fuel tank located at the treatment pad areas. During refueling operations, portable containment trays will be utilized to ensure that no fuel is spilled. It is the policy of ICG that operators will not leave refueling operations unattended. Spill kits will be staged near refueling areas.

ETC fuel (propane) will be stored on-site in portable tanks (up to ten 1,000 U.S. gallon tanks). It is anticipated that a minimum of 4,000 gallons of propane will be stored on-site for use. Impact barriers will be utilized around the propane tanks to conform to local regulations. It is anticipated that these barriers will be concrete blocks or equivalent. ICG will inspect the propane tanks weekly using the form in Appendix B.

5.4.7 Condensate Management

Condensate, if generated by the ETC process, will be transferred via electric sump pump into a portable 250-gallon poly tank for storage – prior to being pumped onto an untreated ETC cell for thermal processing.

5.5 Thermal Operations Sequence and Staffing

Once an ETC cell has been constructed and is ready for processing, the following operations sequence will be initiated:

- Purge ETC equipment, commission thermal oxidizer burner.
- Monitor fuel feeds, burner temperatures and thermal oxidizer parameters, as required.
- Heat soil to target treatment temperature (350 to 600 °F).
- Once soil achieves target temperature and the expected treatment duration based on initial mass balance calculations:
  - Shut off the burner.
  - Remove cover panels (as required) and complete treatment cell post treatment verification soil sampling.

- Upon receipt of verification analysis that the treated soil meets applicable RGOs, complete ETC cell decommissioning (pipe removal and soil removal for backfilling operations).
- Backfill clean, treated soil to excavated areas where excavation confirmation samples have met applicable RGOs.
- Repeat as required to accommodate impacted soil volumes.

On weekdays, ICG will employ a minimum crew of four ETC technicians/operators. Daily work hours will coincide with the Base operating hours. After hours, and on weekends, ICG personnel will remotely monitor the ETC process by use of ICG's SCADA unit.

5.6 Confirmation Sampling

Excavation confirmation samples will be collected to confirm the extent of the planned excavations has removed all soil exceeding the RGOs. Treatment verification samples will be collected to confirm that treated soil meets the RGOs. Disposal characterization samples will be collected for metals-contaminated soils that will be excavated for off-site disposal.

5.6.1 Excavation Confirmation Samples

Soil will initially be excavated to the extent shown in Figures 3 to 7. Once excavated to these limits, ICG will use GPS to survey the midpoint of each sidewall and measure the excavation depth. Excavation confirmation samples will be collected from each sidewall and the bottom of the excavation using incremental sampling methodology (ISM) as described in the quality assurance project plan (QAPP) (Appendix C). ISM samples collected for confirmation will include 30 to 50 aliquots per sample. Excavation confirmation samples will be analyzed for the COCs applicable to each excavation as shown in in Table 2-1 and results compared to the applicable RGOs as shown in Table 4-1. Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days.

If an excavation confirmation sample meets the applicable RGOs, the excavation will be backfilled.

If an excavation confirmation sample exceeds an applicable RGO, CH2M will inform USACE to discuss removal of additional soil at that location. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the RGOs, the excavation may be increased by more than 1-foot dependent on authorization from USACE). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet bgs in depth, whichever is encountered first. Following removal of the additional soil, ICG will use GPS to survey the midpoint/depth of the extended portion, as applicable, and an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the RGO in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from USACE.

Once an excavation meets the applicable RGOs and prior to backfill, a post-excavation topographic survey will be completed to establish the final volume of soil treated.

5.6.2 Treatment Verification Samples

One composite treatment verification sample will be collected per 150 CY of treated soil. As each ETC treatment cell contains approximately 500 CY, the cell will be divided into quadrants for sampling and one composite treatment verification sample will be analyzed from each quadrant. After the soil achieves the target treatment temperature and the burners are disconnected, ICG will utilize the excavator bucket to expose the soil in an approximately 4-foot by 6-foot area to a depth of approximately one foot in each quadrant in order to collect the treatment verification sample. While all of the soil will reach the target treatment temperature, the soil in the outer layer of the quadrant is farthest from the heating elements and therefore will reach the target treatment temperature last. Therefore sampling the outer layer of soil is most conservative for treatment verification. Decontaminated or disposable sampling tools will be used to collect aliquots of approximately equal volume from 10 locations within the 4 by 6 by 1-foot exposed area. Each aliquot will be placed in a decontaminated stainless steel bowl to allow for further cooling. The aliquots will then be homogenized and placed into laboratory containers for analysis as described in the QAPP (Appendix C).

Treatment verification samples for explosives will be submitted for laboratory analysis with projected turnaround time of 7 days. Treatment verification samples for soil from locations with PAHs and/or PCBs only are planned for laboratory analysis with projected turnaround time of 48 hours.

- If a treatment verification sample meets the applicable RGOs, the associated soil will be cleared by CH2M for use as backfill. ETC soil pile covers, endcaps and piping will be removed to allow for treated soil removal and backfilling operations.
- If a treatment verification sample exceeds an applicable RGO, the excavator bucket will be used to expose another approximately 4 by 6 by 1-foot area in the outer layer of the quadrant and a second treatment verification sample will be collected for analysis of the COC that exceeded the RGO.
    - If the magnitude of the exceedance is small, a second composite treatment verification sample will be collected immediately for analysis of the COC that exceeded the RGO in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected).
    - If the magnitude of the exceedance is large, the active heating system will be restarted to provide additional treatment prior to collecting the second treatment verification sample.
    - The decision to restart the heating system will be based on laboratory analytical measurements and the professional judgement of the team members including the system operator.
    - Should a quadrant not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling.
    - This process will be repeated until the quadrant meets the applicable RGOs. The CH2M CM/FQM and project chemist will review the sampling results to ensure the applicable RGOs have been met, and the CH2M CM/FQM will provide approval before the material can be used as backfill.

5.6.3 Disposal Characterization Samples for Metals-Contaminated Soils

Composite disposal characterization samples will be collected from the metals-contaminated soils that will be excavated for off-site disposal from four locations (one composite sample for excavations in Load Line 1: Building CB-2, Building CB-13B and the Outlet Channel; and one composite sample for the Former Water Tower in Load Line 4). The samples will be analyzed for Toxicity Characteristic Leaching Procedure (TCLP) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, herbicides; PCBs; ignitability; and corrosivity. If the land disposal facility requires additional testing, then required testing will be performed as necessary. Based on generator knowledge, it is expected that these soils will be characterized as nonhazardous.

5.6.4 Disposal Characterization Samples for Concrete

A composite disposal characterization sample will be collected from the demolished concrete prior to off-site disposal or recycling. Approximately 1,000 CY of concrete will be removed. Concrete will be sampled at a frequency of approximately one sample per 500 CY and analyzed for PCBs and Resource

Conservation and Recovery Act (RCRA) metals. These results will be reviewed against U.S. Environmental Protection Agency (EPA) residential soil regional screening levels to determine disposition. If concrete analytical results are below this criteria, concrete will be recycled. If concrete results are at or above this criteria, concrete will be disposed at a permitted, CERCLA OSR approved landfill (Republic Services Carbon Limestone Landfill).

5.6.5 Rainwater

If an excavation fills with rainwater prior to being deemed clean by the excavation confirmation samples, the water will be sent to the ETC for treatment. If the excavation has been confirmed clean by the excavation confirmation samples, water may be disposed of on site with prior approval from the Ohio EPA and OHARNG at designated areas pumped out into vegetated areas at low velocities that does not create erosion. Clean water release from an excavation area will be conducted in accordance with Ohio Administrative Code (OAC) 3745-42-13 (C) and (J). Water will be filtered through a 100-micrometer bag filter and straw bale before being discharged to a well vegetated area. Water will pass through the filter before the end of the outlet hose is inserted into the straw bale as a further filtering mechanism and to prevent erosion. Water will be released at a rate that will prevent ponding of water and/or erosion and will not be released directly to surface water features, such as creeks, diches, streams, or storm/sanitary sewer lines. Prior to initiating land application, the procedure and setup will be reviewed by the Army for final approval.

5.7 Material Handling and Transport

Ground disturbance protocols established to ensure safe excavation zones (Section 5.3) prior to starting work will include traffic paths across and between the Load Lines (Figure 11). Equipment and truck traffic will be focused along the abandoned rail lines where subgrades can support heavy traffic loads. As material is excavated it will be loaded, transported and handled with wheel loaders and either all terrain or tandem gravel trucks. All vehicles will comply with CJAG speed limits and traffic regulations.

Soil staging is not expected on site as treated soil is effectively "staged" in its treatment cell until test results are received. Upon confirmation for use as backfill, the treated soil will be taken directly from the ETC cell to the open excavation for placement as backfill. Trucks used for transporting contaminated soil material will be decontaminated utilizing a pressure washer prior to transporting treated soil. The equipment will be decontaminated at the lined, decontamination area located within the treatment pad and waste water collected from the process will be added to the treatment cells for processing with the impacted soil material.

A lined staging area will be established adjacent to the ETC pad (Figure 9) for transient storage of any unpredicted containers of waste generated during the project. The staging area will be managed by ICG including all inspection, cleaning and housekeeping responsibilities. Good housekeeping will include disposing and picking up garbage and waste material regularly; inspecting equipment daily and performing material inspections for leaks and/or conditions that could potentially lead to a discharge of a petroleum product, chemical or waste; performing preventative maintenance on equipment to ensure it operates properly and to help detect potential leaks before they occur; and ensuring that spill cleanup procedures are understood by employees, contractors, and/or subcontractors, and established storage areas are away from streams and water bodies.

The staging area will also be away from direct traffic routes to prevent accidental spills. The staging area may also be used to stage equipment and materials required to implement this RD. Inventories of material located within the staging area will be maintained by ICG and will be monitored by CH2M. Final inventories of waste will be created to document waste quantities and final disposal volumes. These inventories will be provided to the OHARNG Restoration Representative upon project completion.

5.8 Backfill and Site Restoration

Upon demonstration of soil treatment goals (both excavation confirmation testing and treatment verification testing), thermally treated soils will be used as backfill for open excavations. Additional backfill material will also be obtained from an approved off-site source (see Section 12) as needed to backfill the excavations to match the surrounding grade.

After each excavation is complete, the volume and depth of removed soil will be documented by developing a topographic map of the excavated surface with tie-in to the existing edges. The post-excavation survey and topographic map developed will be consistent with the requirements of the preexcavation survey and topographic map.

Backfill within each excavation will be placed in the excavated areas in eight-inch lifts (+/- 25%) and mechanically compacted in place until the excavated area is restored to match surrounding grade. Grade stakes will be placed within the excavation area and markers placed on the excavation walls placed for operator reference during placement and compaction of the backfill lifts. Any clean overburden soil previously stockpiled adjacent to an excavation will be used as the top layer of backfill to promote revegetation. Once an excavation is backfilled, it will be graded and seeded as described below. Restoration of sites will occur progressively, as remediation and backfill of areas is completed.

Upon completion of excavation restoration, the ETC system and staging areas will be decommissioned. ETC system components will be demobilized, ICG will sample the underlying surface soil for the presence of operations-related contamination, and surface soil reclamation activities detailed below within the ETC treatment pad and staging area will be completed.

- Removal of 20 mil impervious liner from treatment cell subgrade
- Grading of areas to match surrounding conditions to promote positive drainage.

Areas overturned will be seeded in accordance with CJAG requirements and covered with a layer of organic materials such as straw, woodchips, or similar to promote revegetation of the excavated areas. Options for seed are provided in Tables 5-2 and 5-3.

Table 5-2. Shaded and Partial Sun Openings in the Wood Seed Mixtures
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Seed Type	Mixture Percentage
Deertongue *(Panicum clandestinum)*	31.0
Virginia wild rye *(Elymus virginicus)*	25
Nodding Wild Rye *(Elymus Canadensis)*	25
Big Bluestem *(Andropogon gerardii)*	10
Side-Oats Grama *(Bouteloua curtipendula)*	9
Specifications: Broadcast at 30 pounds per acre. Add 20 pounds per of annual rye grass (*Lolium multiflorum*) to the broadcast mix. Mulch with a minimum of three bales of straw per 1,000 square feet.	

Table 5-3. Open Area Seed Mixtures
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Seed Type	Mixture Percentage
Nodding Wild Rye (*Elymus Canadensis*)	23.5
Virginia wild rye (*Elymus virginicus*)	25
Little Bluestem (*Schizachyrium scoparium*)	22
Partridge Pea (*Chamaecrista fasciculate*)	18.75
Thin-leaved Coneflower (*Rudbeckia triloba*)	7.75
Brown fox sedge (*Carex vulpinoidea*)	1.5
Black-eyed Susan (*Rudbeckia hirta*)	1.5
Specifications: Broadcast at 18 pounds per acre. Add 20 pounds per acre of annual rye grass (*Lolium multiflorum*) to the broadcast mix mulch with a minimum of three bales of straw per 1,000 square feet.	

Where necessary, ruts and depressions along equipment movement areas and construction support areas will be backfilled with clean fill, regraded, seeded, and mulched. Where roads have been modified, restoration of these areas and/or areas of travel damage will be completed as remediation activities are completed. The final grade of all areas disturbed during remedial activities will be approved by the CH2M Construction Manager and the USACE COR, with input from ARNG and OHARNG representatives.

5.9 Weekly Progress Reports

During operation and treatment, CH2M will submit a weekly progress report to USACE to provide a high-level summary of excavation area completion status, in-situ volume of soil excavated for treatment at each planned excavation area, relevant information on the treatment system operation including any system interruption or upset conditions, and confirmation sampling results. Information from the daily reports submitted to the CH2M PM by the CH2M Construction Manager and ICG's weekly summaries provided to the CH2M Construction Manager by close of business each Monday will be used to generate the weekly progress reports to USACE. On a daily basis, ICG will also provide input for the CH2M Construction Manager's daily reports and biweekly QC reports (see Section 9).

5.10 Remedial Action Completion Report

Upon completion of excavation, thermal treatment, testing, and backfill, CH2M will submit a Remedial Action Completion Report (RACR) for approval. The RACR will summarize the RA activities performed at Load Lines 1-4 and 12 and will describe the remediation, including results of confirmation testing.

The RACR will include the following:

- Description of field activities completed and justifications for deviations from the RD Work Plan (if applicable)
- Summary of schedule milestones
- Copies of permits
- Summary of remediation and restoration activities, including the following:
  - Excavation quantities
  - Soil and Concrete disposal locations
  - Backfill source, quantities, and analytical data

- As-built red-line drawings showing final excavation locations and depths, and confirmation sample locations
- Photograph log of the remediation activities
- Summary of monitoring activities and data
- Tabulated confirmation sampling data
- Waste tracking logs
- Stormwater control inspections
- Corrective action logs
- Description provided by USACE of Land Use Controls

The RACR will also contain laboratory data sheets, QC data sheets, and copies of disposal manifests on a compact disc attached to the final report.

SECTION 6

Construction Sequence and Schedule

A preliminary mobilization occurred in March 2020 prior to the larger remediation mobilization to cut trees larger than three inches in diameter at chest height before March 31, 2020. During this preliminary mobilization, the required trees were felled with removal to occur upon larger mobilization later within the same calendar year.

The larger remediation mobilization will occur after all required approvals are obtained on this Work Plan, and is currently anticipated to occur in August 2020.

Remediation milestones are presented in Table 6-1.

Table 6-1. Remediation Schedule
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Task	Start Date	Duration	End Date
Preliminary Mobilization for Tree Removal and Land Survey	March 2020	6 days	March 2020
Mobilization and Site Set Up	October 2020	6 days	October 2020
Excavation, Treatment and Backfill	October 2020	60 to 100 days	November 2020 to January 2021
Final Restoration and Demobilization	November 2020 to January 2021	5 days	November 2020 to January 2021

SECTION 7

Environmental Management

The excavation and thermal treatment work presented in this RD is contained within former load lines within the facility. As such, this work will not impact any known environmentally sensitive areas.

A desktop study was performed to ensure the protection of any threatened and endangered species. The load lines are home to a nesting bat known as the Northern Long Eared Bat. Felling of trees larger than 3 inches in diameter at breast height in areas of excavation was performed prior to March 31, 2020 to prevent wildlife (including the Northern Long Eared Bat) from nesting within the areas of excavation. Because this activity occurred prior to completion of this RD Work Plan, a separate vegetation removal plan (Appendix A) was submitted under separate cover to describe this activity and approved by the Army.

7.1 Permitting

Remediation activities will be performed under and are relieved from permitting requirements as stipulated by CERCLA Law, Chapter 103, Subchapter I, Section 9621(e). Under CERCLA, air or water permits are not required for remediation system operation; however, substantive requirements of applicable regulations must be satisfied. The federal based exemptions under Ohio Administrative Code Section 3745-31-03 (B)(2) exempt “Cleanup activities associated with the removal or remedial action conducted entirely on site, where such remedial action is selected and carried out in compliance with the CERCLA Section 121(e) and where such action meets all applicable air pollution emission limits and policies.”

At a minimum, the project will comply with the substantive requirements of the Ohio EPA Authorization for Stormwater Discharges Associated with Construction Activity under the National Pollution Discharge Elimination System per the OAC Rule 3745-38-02 and will implement Proposed Stormwater Pollution Prevention best management practices (BMPs) in accordance with the rules. These requirements are discussed in Section 8 of this RD Work Plan.

If an excavation fills with rainwater prior to being deemed clean by the excavation confirmation samples, the water will be sent to the ETC for treatment. If the excavation has been confirmed clean by the excavation confirmation samples, water may be disposed of on site with prior approval from the Ohio EPA and OHARNG at designated areas pumped out into vegetated areas at low velocities that does not create erosion. Clean water release from an excavation area will be conducted in accordance with Ohio Administrative Code (OAC) 3745-42-13 (C) and (J) (see Section 5.6.5)

7.2 Air Permitting

7.2.1 Emissions Sources and Estimate of Emissions

The thermal oxidizer specified for use is propane-fueled with a nominal heat input rating of 16.25 million British thermal units per hour (BTUH). The ETC Structure burner is propane fired with a nominal heat input rating of 4.3 BTUH. Exhaust gases from the ETC Structure will be routed to the thermal oxidizer. Operation of the vapor treatment equipment will be continuous 24 hours per day and 7 days per week for the duration of the operations, which are expected to last approximately 60 to 100 days. Emissions from propane usage were estimated using EPA’s AP-42 Compilation of Air Emission Factors, Section 1.5, Liquified Petroleum Gas Combustion emission factors for industrial boilers.

Weighted average volatile organic compound (VOC) and hazardous air pollutant (HAP) emission estimates were developed using the measured pollutant concentrations in soil along with the amount of material to be removed from each load line. Calculations conservatively assume that the total mass in the soil will volatilize and be treated (50% removal in the ETC Structure with the remaining 50% volatilized and sent to the thermal oxidizer for further treatment). The emissions estimates assume a 95% removal rate in the thermal oxidizer.

No additional roadways will be constructed for this project. The existing roads in the load lines and south service road were built in the early 1940s as the facility was constructed. Many of the existing load line roads are old railroad beds that were used for area access following removal of the rails that formerly served facility operations. Access to the excavation and treatment areas will be gained using existing travel paths within the various load lines (primarily the former rail beds) which will remain unimproved. External travel between the load lines will be via existing road infrastructure at the facility.

Potential air emissions from the project are summarized in Table 7-1.

Table 7-1. Total Project Controlled Emissions
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Emission Source	NOx (tpy)	CO (tpy)	SO_2 (tpy)	PM/PM_{10}/ $PM_{2.5}$ (tpy)	VOC (tpy)	Total HAPs [a] (tpy)	CO_2e (tpy)
Remediation emissions (post control)	-	-	-	-	0.26	0.01	-
Thermal oxidizer and ETC structure heater (combustion)	3.5	2.0	0.005	0.19	0.27	-	3,360
Total	**3.5**	**2.0**	**0.005**	**0.19**	**0.53**	**0.01**	**3,360**

Table notes:

[a] Conservatively assumed thermal oxidizer control efficiency of 95%.

% = percent
CO = carbon monoxide
CO_2e = carbon dioxide equivalents
ETC = enhanced thermal conduction
HAPs= hazardous air pollutants
NOx = nitrogen oxides
PM = particulate matter
PM_{10} = particulate matter less than 10 micrometers in aerodynamic diameter
$PM_{2.5}$ = particulate matter less than 2.5 micrometers in aerodynamic diameter
SO_2 = sulfur dioxide;
tpy = tons per year

7.2.2 Regulatory Review

The project is exempt from air permitting requirements per CERCLA and OAC 3745-31-3(B)(2) but will comply with applicable Federal and state-specific requirements protective of air quality. A summary of the potential air regulatory requirements is included in Table 7-2. The portable engine is propane fired and meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq).

Table 7-2. Review of Rule Applicability
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Regulation	Code	Applicable (Yes or No)	Comments
Federal Air Quality Regulations	40 CFR 60, NSPS Subpart A – General Provisions	No	No applicable NSPS standards.
	40 CFR 60, NSPS Subpart JJJJ – Stationary Spark Ignition Internal Combustion Engines	No	The project may employ a small (less than 150 kw) portable propane-fired generator. The portable engine meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine will also be on site less than 12 months. As a result, the engine is not classified as a stationary source subject to this rule.
	40 CFR 63, NESHAP Subpart A – General Provisions	No	No applicable NESHAP standards.
	40 CFR 63, NESHAP Subpart ZZZZ – Stationary Reciprocating Internal Combustion Engines	No	The project may employ a small (less than 150 kw) portable propane-fired generator. The portable engine meets the definition of nonroad engine in 40 CFR Part 1068.30 and will be onsite less than 12 months. As a result, the engine is not classified as a stationary source subject to this rule.
	40 CFR 63, NESHAP GGGGG – Site Remediation	No	Project emissions are below major source thresholds for HAPs. As such, NESHAP Subpart GGGGG is not applicable.
	40 CFR 98, Mandatory Reporting of Greenhouse Gas	No	The total heat capacity of fuel combustion units and total greenhouse gas emissions are below applicable thresholds.
State of Ohio Army Quality Regulations (OAC 3745)	Chapter 15- General Provisions on Air Pollution Control	Yes	The facility will submit required reports and conduct monitoring if required by Ohio EPA.
	Chapter 17- Particulate Matter Standards	Yes	Rule requires visible particulate emissions from any stack be maintained at less than 20-percent opacity, as a 6-minute average. Sources of particulate will comply with applicable standards. Emissions of fugitive dust from roadways and construction activities will be minimized by the use of water or other suitable dust suppression chemicals. Erosion control measures, as outlined in the Section 8 of the Work Plan, will be implemented as needed to prevent runoff and/or fugitive dust emissions at all work areas and during all stages of the RA. This includes regular inspection of excavation areas and soil piles, implementation of non-structural BMPs (minimizing disturbance, quick turnaround of backfilling and vegetation reestablishment, etc.), installation of structural BMPs (berms, silt fence, etc.), and application of dust suppressant, as required.
	Chapter 18- Sulfur Dioxide Standards	No	No applicable sources.
	Chapter 21 - Carbon Monoxide, Ozone, Hydrocarbon Air Quality Standards, and Related Emission Requirements	No	No applicable sources.

Table 7-2. Review of Rule Applicability (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Regulation	Code	Applicable (Yes or No)	Comments
	Chapter 23 - Nitrogen Oxide Standards	No	Repealed
	Chapter 31- Permit-to-Install New sources and Permit-to-Install and Operate Program	No	While the requirements of Chapter 31 do not apply due to the CERCLA exemption, this regulatory applicability analysis is meant to demonstrate compliance with state air regulations. The propane-fired 125 kw generator meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq). Note the ETC structure heater is also exempt from permitting per OAC 3745-31-3(B)(1)(a).
	Chapter 77- Title V Permits	No	The requirements of Chapter 77 do not apply due to the CERCLA exemption. In addition, potential emissions of criteria pollutants are well below 100 tpy and emissions of HAPs are below 10 tpy for a single HAP and 25 tpy for total HAPs.
	Chapter 78- Air Pollution Control Fees	No	Emissions are below applicable reporting and fee thresholds.
	Chapter 114- Toxic Air Contaminants	No	Air toxics emissions do not exceed 1 tpy.

Table notes:

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CFR = Code of Federal Regulations
ETC = enhanced thermal conduction
HAP = hazardous air pollutants
kW = kilowatt
NESHAP = National Emissions Standards for Hazardous Air Pollutants
NSPS = New Source Performance Standard
OAC = Ohio Administrative Code
Ohio EPA = Ohio Environmental Protection Agency
tpy = ton(s) per year

7.2.3 Stack Vent Parameters

Vapors collected and treated by the thermal oxidizer will be discharged vertically to the atmosphere through an 18-inch (diameter) exhaust stack at a height of 14 feet above the ground surface. The exhaust stack will be the only discharge point for the vapor treatment system. The maximum vapor flow rate is estimated to be 7,900 dry standard cubic feet per minute.

7.2.4 Process Monitoring

To demonstrate and document that the air emissions-control equipment is operating within its intended operating range, the thermal oxidizer temperature will be measured and recorded at least daily for the duration of system operation. If the thermal oxidizer chamber temperature falls below its set-point, then the system will alarm and alert site staff of deviations in system operations. Upon notification of set-point deviation(s), site personnel will troubleshoot system equipment using established standard operating procedures to correct the alarm conditions as required.

Stormwater Pollution Prevention

Based on the proposed excavation boundaries outlined in the SOW, the aggregate total of disturbed area from soil excavation activities is 1.04 acres. An additional 1.38 acres of surface will be disturbed for development of the ETC treatment pad and soil stockpile area for a total of 2.42 acres of surface disturbance between the five Load Lines. ICG will install stormwater controls, as required, prior to initiating ground disturbing activities . BMPs will be employed to protect the excavation areas, staging area, ETC treatment pad, and any other work areas from stormwater run-off and minimize stormwater run-on into disturbed areas. Erosion and sedimentation controls will include both nonstructural BMPs and structural BMPs. An inspection checklist (Appendix D) will be completed weekly and after ½-inch rain events. Nonstructural BMPs to be employed at the project site include:

- Minimizing disturbance
- Backfilling open excavations as soon as possible
- Restoring vegetation as soon as possible
- Maintaining good housekeeping practices

Structural BMPs that may be employed include:

- Bermed soil around excavation perimeters
- Straw wattles/bales
- Silt fence
- Compost sock
- Plastic sheeting

To further minimize erosion and sediment run-off potential, excavation activities will be limited when working in areas that may be impacted during or following periods of inclement weather. The existing Load Line entrances will be the main access points for the planned remedial activities. These entrances will be maintained to ensure that no excessive rutting is created by trucking between Load Lines. Rumble strips or temporary construction entrances will be utilized where dirt roads between Load Lines transition to paved roads. Existing asphalt surface roadways will be inspected daily when working in that Load Line and an equipment mounted powered sweep will be used to remove dirt or mud tracked onto the road as a result of remedial operations.

Straw wattles and/or bales will be installed at excavations and any clean overburden soil stockpiles near drainage ditches or natural water features. The straw wattles/bales will undergo daily inspections during active excavation and backfill operations. Ruts and depressions along equipment movement areas and ETC treatment pad support areas will be regraded, seeded, and mulched where necessary.

Erosion/sedimentation control features will remain in place until excavation restoration activities are completed and a minimum of 70% of the preconstruction vegetation has been restored within each Load Line. Removal of BMPs shall be requested by ICG and approved by the CH2M Construction Manager, USACE COR, and U.S. Army. ICG will inspect stormwater controls daily during the treatment operations period. Post soil treatment stormwater control monitoring will be consistent with the Ohio EPA requirement of weekly and after a ½ inch rain event until 70% vegetative cover is established in each disturbed area.

8.1 Equipment Maintenance

Daily equipment checklists are completed for ICG heavy equipment and vehicles. Preventive maintenance will be performed on equipment to ensure proper operation and to detect potential leaks before they occur and manufacturer's maintenance schedules are followed for all equipment. Good housekeeping practices will be maintained at all times during construction activities. All employees will practice due diligence to prevent any damage to the stormwater control measures. Containers will be provided at all necessary locations for collecting trash and general construction debris. Fueling activities will be conducted at the staging area away from stormwater conveyances. Drip trays will be utilized during equipment refueling operations. It is the policy of ICG that operators will not leave equipment refueling operations unattended. Spill kits will be staged near refueling areas.

In summary, all equipment will be inspected prior to the start of daily activities. A small volume of equipment lubricants will be stored in the ICG tool crib. This includes DEF, grease, motor oil & engine coolant. These lubricants are stored in their commercial containers and would have an aggregate total of less than 100 gallons. Spill kits are maintained at various locations around the treatment pad, including near equipment refueling areas. Drip trays are utilized during equipment refueling events.

8.2 Dust Controls

Dust may be generated during activities such as excavation, ETC pile construction, ETC pile deconstruction, and transportation. Iron Creek personnel, including the Site Supervisor, will monitor working conditions and fugitive dust throughout daily operations. During operations, the crew will be working along the active haul routes, excavation area(s) and at the treatment pad itself. Real time conditions will be communicated to the Iron Creek Site Supervisor and work stoppage related to mitigating fugitive dust will be at the Site Supervisor's discretion.

Dust control will be maintained by keeping traffic on abandoned rail lines and improved roads wherever possible, maintaining the posted speed limit, and applying preapproved water for dust suppression as required. Water applied for dust suppression will be applied in such a way as to not cause run-off from the project site. In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust. During instances of high winds resulting in excessive dust, additional dust control measures or work stoppage may be implemented. At a minimum, ICG will perform visual monitoring of fugitive dust emissions on a daily basis during representatively normal operating conditions and implement mitigations measures as needed.

Construction Quality Control Plan

This section describes the steps and associated documentation that will be implemented during the remedial action to ensure compliance with contract requirements and this Work Plan.

9.1 Three Phases of Control

The CM/QCM is responsible for verifying compliance with this portion of the Work Plan through implementation of a three-phase control process, which ensures that project activities comply with the approved plans and procedures. The specific QC monitoring requirements for each definable feature of work (DFOW) are discussed below. This section specifies the minimum requirements that must be met and to what extent QC monitoring must be conducted and documented by the CM/QCM.

The CM/QCM will ensure that the three-phase control process is implemented for each DFOW. Each phase is considered relevant for obtaining necessary product quality. However, the preparatory and initial inspections are particularly invaluable in preventing problems. Work will not be performed on a DFOW until the preparatory and initial phase inspections have been completed and any nonconformance issues are resolved.

9.1.1 Definable Features of Work

The DFOWs for the remedial action are listed below:

- Mobilization and Site Preparation
- Excavation
- Thermal Treatment
- Transportation and Disposal
- Backfill and Site Restoration

9.1.2 Preparatory Phase Inspection

The Preparatory Phase comprises the planning and design process leading up to the actual remedial action field activities. The CM/QCM will perform a Preparatory Phase inspection before beginning each DFOW. The purposes of this inspection are to review applicable specifications and plans to verify that the necessary resources, conditions, and controls are in place and compliant before work activities start. Upon completion of the inspection, the CM/QCM will complete the Preparatory Phase Inspection Checklist provided in Appendix E.

To perform the inspection, the CM/QCM or designee will review work plans and operating procedures. The CM/QCM will verify that required plans and procedures have been approved and are available to the field staff; field equipment is appropriate, available, functional, and properly calibrated for its intended/stated use; staff responsibilities have been assigned and communicated; the staff members have the necessary knowledge, expertise, and information to perform their jobs; arrangements for support services have been made; training in accordance with the requirements of this Work Plan has occurred; and the prerequisite mobilization tasks have been completed. As part of the Preparatory Phase inspection, the CM/QCM will verify that lessons learned during previous similar work have been incorporated, as appropriate, into the project procedures to prevent recurrence of past challenges.

Project personnel must correct or resolve discrepancies between existing conditions and the approved plans/procedures identified by the CM/QCM during the Preparatory Phase inspection. The CM/QCM or designee will verify that unsatisfactory and/or nonconforming conditions have been corrected in this Work Plan before beginning work.

9.1.3 Initial Phase Inspection

The Initial Phase occurs at the startup of field activities associated with a specific DFOW. At the onset of a particular DFOW, the CM/QCM will perform an Initial Phase inspection and complete the Initial Phase Inspection Checklist provided in Appendix E. The main objectives of the inspection are to check preliminary work for compliance with procedures and specifications, establish an acceptable level of workmanship, check for omissions, and resolve differences of interpretation. The Initial Phase inspection will also verify that the APP/SSHP adequately identifies all hazards associated with actual field conditions and promulgates the appropriate safe work practices. The inspection results will be documented by the CM/QCM in the field logbook and summarized in the daily report and bi-weekly QC report. Should results of the inspection be unsatisfactory, the Initial Phase will be rescheduled and performed again.

During the Initial Phase inspection, the CM/QCM will ensure that discrepancies between site practices and approved plans or specifications are identified and resolved. The resolution of discrepancies is a critical step in the Initial Phase inspection. As applicable, the appropriate Senior Technical Consultant will guide the PM and CH2M team members in resolving discrepancies. If discrepancies arise in establishing the baseline quality for a DFOW, the responsibility for resolution falls to the PM. If the discrepancy cannot be resolved in a manner that satisfies the project requirements, it will be elevated to the program level (to the Program Manager) and a nonconformance report (NCR) will be issued. With concurrence of the CH2M HILL team, the appropriate Senior Technical Consultant may direct a cessation of work activity if an unresolved discrepancy jeopardizes the results of the DFOW or puts the project at risk of nonconformance.

9.1.4 Follow-Up Phase Inspection

Completion of the Initial Phase of QC activity leads directly into the Follow-up Phase, which covers the routine day-to-day activities at the site. The CM/QCM will perform a Follow-up Phase inspection at regular intervals while a particular DFOW is performed. This inspection ensures continuous compliance and verifies an acceptable level of workmanship. To conduct and document these inspections, the CM/QCM will complete the Follow-up Phase Inspection Checklist provided in Appendix E. The CM/QCM will monitor onsite practices and operations taking place and verify continued compliance with the specifications and requirements of this Work Plan and approved amendments. Information documented on the Follow-Up Phase Inspection forms may be accompanied by Field QC Inspection Form provided in Appendix E. The CM/QCM will also verify that daily health and safety inspections are performed and documented as prescribed in the APP/SSHP. Discrepancies between site practices and approved plans/procedures will be resolved, and corrective actions for unsatisfactory and nonconforming conditions or practices will be resolved by the CM/QCM or designee before continuing work.

9.1.5 Additional Inspections

Additional inspections performed on a particular DFOW may be required at the discretion of USACE, the PM, the appropriate Senior Technical Consultant, or the CM/QCM. Additional preparatory and initial inspections would be warranted under the following conditions: unsatisfactory work, as determined by CH2M HILL or USACE; changes in key personnel; resumption of work after a substantial period of inactivity (2 weeks or more); or changes to the project scope of work. These additional inspections will be documented on the appropriate inspection checklist forms and in the Field Logbook by the CM/QCM.

9.1.6 Final Phase Inspection

The Final Phase inspection is performed upon conclusion of the DFOW and before closeout to verify that project requirements relevant to the particular DFOW have been satisfied. Outstanding and nonconforming items will be identified and documented on the Final Inspection Checklist provided in Appendix E.

9.1.7 Notification of Definable Features of Work and Three Phases of Control

The CM/QCM will ensure that the three-phase control process is implemented for each DFOW. Implementation and tracking of the DFOWs will be accomplished through the use of the QC Inspections , Testing and Verification Log provided in Appendix E.

9.2 Quality Control Documentation

9.2.1 Daily Report

The daily report is the definitive record for reporting the daily operations and production, safety, and QC activities of the project. These reports are the official record of compliance with this Work Plan. It is, therefore, critical that the reports are correct and timely.

The CM/QCM is responsible for preparing the daily report, submitting it every day to the PM. The report at a minimum:

- Summary of weather conditions
- Summary of work performed/Job Progress
- Job safety summary
- Crafts, personnel, and equipment onsite
- Quantities of material received, placed, or installed
- Waste disposal and stockpile inspection documentation
- Inspections/tests and results of inspections/tests
- Quality-associated inspections, tests and audits, and results/resolution of each task being performed
- Waste accumulation/inspections
- Photographs representative of the day's work

The project team must review the daily reports for accuracy and completeness because they are often used to prepare the final reports for the project.

9.2.2 Biweekly Quality Control Report

The CM/QCM is responsible for preparing and submitting a bi-weekly QC report (every other day/twice per week) with the daily report to the Project Manager. The QC report is to provide an overview of QC activities conducted, including those performed by subcontractors. The QC reports must present an accurate and complete picture of QC activities by reporting both conforming and deficient conditions, and the reports should be precise, factual, legible, and objective. Copies of supporting documentation, such as checklists and surveillance reports, are to be attached.

Project staff input for the QC report is to be provided in writing to the CM/QCM at a previously agreed-upon time and place, generally no later than 1 hour before normal close of business. For the sake of simplicity and completeness, the format for staff input should follow the same format as the QC report, with only the relevant sections completed.

Copies of biweekly QC reports with attachments and field QC logs no longer in use are to be maintained in the project QC file. Upon project closeout, all QC reports are to be included in the project QC file.

9.2.3 Field Log Book

The CM/QCM will maintain a record of daily QC activities during construction in a field log book. The field log book will be available for review upon request. Field log books and data forms are necessary to provide sufficient data and record observations to enable participants to reconstruct events that took place during the project, and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. All field log books will be in a bound log book with sequentially numbered pages. All entries will be made in waterproof ink, dated, and signed, with no blank pages or spaces. The CM/QCM will sign or initial the bottom of each page of the field log and date the entry to show that notes are being taken daily.

As an operating procedure for log book entries, the following items will be recorded by the CM/QCM, at a minimum:

- Date, project name, and location
- Time that work starts every day
- Summary of weather conditions
- General description of work activities, size of work crew, and the equipment and personnel onsite
- Name of person making log entry (signature)
- Names of CH2M or contractor team members onsite
- Names of subcontractor personnel onsite
- Equipment used by CH2M
- Equipment used by subcontractor
- Levels of personal protective equipment (PPE) used
- Changes in PPE, if required, and reasons for changes
- Summary of work performed that day
- Duration of lunch break
- Start time and duration of weather, or plant emergencies
- Summaries of safety and QC meetings, and actions recommended to be performed
- QC testing equipment and personnel
- Identification of work locations
- Record of decisions made regarding defective work, corrective measures implemented, or both
- Field tests
- Field observations and remarks
- Unusual circumstances or difficulties
- Initials of person recording the information
- Description of materials delivered, inspection of material (if applicable, acceptance of materials by subcontractor), and storage of materials

A summary of this information will be documented in the daily report. No pages will be removed for any reason. If corrections are necessary, they will be made by drawing a single line through the original entry (so that the original entry can still be readable) and writing the corrected entry alongside. The correction will be initialed and dated. Corrected errors may require a footnote explaining the correction.

The CM/QCM will sign or initial the bottom of each page of their QC field log and date the entry to show notes are being taken daily. A line through will be placed on any portion of a log book page that is unused, and all pages of the logbook must be numbered.

9.2.4 Photographic Record

A project photographic record will maintained to document the history and evolution of the project. The location, date, and subject of each photo taken will be recorded in the field log book. In addition to recording preconstruction conditions and construction progress, the photographic record will document deviations from specifications and nonconformance items or work.

9.2.5 Test, Maintenance, and Calibration Records

Any equipment test, maintenance, or calibration task will be documented on an appropriate subcontractor form and in a field log book by the individual performing the task. Testing and maintenance of equipment such as radios, cell phones, vehicles, and machinery will be performed according to the manufacturer's specifications, this Work Plan, and applicable standard operating procedures. Upon project closeout, all tests, maintenance, and calibration records will be included in the project QC file.

The CM/QCM is responsible for ensuring that the tests are performed and that the results are summarized and provided with the daily report and biweekly QC reports. To track each failing test for future retesting, the failing test must be noted on the NCR Log. Resolution of the failing test is complete when retesting is performed and the corrective action is verified on a NCR Log.

9.2.6 Training Records

The CM/QCM will maintain a file for each site employee to document qualifications and the successful completion of the required training courses for that particular employee. The documentation may be a certificate, letter, memorandum, or other written form of documentation but must include the training completion date(s). If any required refresher training courses do not take place by the anniversary date of the employee's initial training, there should be a record in the employee's file indicating why the training has been delayed and when the training will be completed. The CM/QCM will complete the Personnel Qualification and Verification form in Appendix E to document employee qualifications and training.

9.3 Daily Review of Field Data

At the conclusion of each work day, the field teams will return to the project field office and provide the CM/QCM any completed investigation forms, field notes, and inspection reports from that day's activities. Any issues arising from the day's activities will be discussed among the CM/QCM and appropriate field personnel. The CM/QCM will record these discussions, and resolutions or corrective actions arising from these discussions will be addressed during the following morning's safety meeting and recorded on the daily report.

9.4 Inspections

Table 9-1 lists the inspections to be conducted for each of the DFOWs, including frequency, pass/fail criteria, and corrective actions. Details regarding QC of chemical data generated for the remedial action is provided in the QAPP (Appendix C).

Table 9-1. Quality Control Inspections
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Definable Feature of Work with Auditable Function	Responsible Person(s) [a]	Inspection Procedure [b]	Quality Control Phase [c]	Frequency of Audit [d]	Pass/Fail Criteria	Action if Failure Occurs	Documentation
Mobilization and Site Preparation							
RD Work Plan Approval	PM	Verify RD Work Plan has been approved by Army and Ohio EPA.	PP	O	RD Work Plan has been approved by Army and Ohio EPA.	Do not mobilize. Obtain necessary approvals.	PP Form
APP/SSHP Approval	PM	Verify APP/SSHP has been accepted by Army.	PP	O	APP/SSHP has been accepted by Army.	Do not mobilize until APP/SSHP is accepted by the Army.	PP Form
Subcontracting (Premobilization Activities)	PM	Verify purchase orders in place including subcontractor qualifications, training, and licenses. Verify subcontractor Activity Hazard Analyses approved by CH2M HSM.	PP/IP	O	Purchase orders in place including subcontractor qualifications, training, and licenses. Activity Hazard Analyses approved by CH2M HSM.	Do not mobilize. Ensure purchase orders in place including subcontractor qualifications, training, and licenses. Ensure subcontractor Activity Hazard Analyses approved by CH2M HSM.	PP/IP Forms; Personnel Qualification and Verification Form
15-day notice to Ohio EPA	PM	Verify Ohio EPA has been given notice at least 15 days prior to mobilization.	PP	O	Ohio EPA has been given notice at least 15 days prior to mobilization.	Do not mobilize, Provide Ohio EPA with at least 15-day notice prior to mobilization.	PP Form
Site preparation (Mobilization)	PM	Hold premobilization meeting and Operations Readiness Review with the project team.	PP/IP	O	Project plans are reviewed and acknowledged by team members.	Do not proceed with field activities until criterion is passed.	PP/IP Forms
Site preparation (Mobilization)	PM	Verify site-specific training is performed and acknowledged.	PP/IP	O	Site-specific training is performed and acknowledged	Do not proceed with field activities until criterion is passed.	PP/IP Forms; Daily Reports; QC Log and Report
Utility Survey	CM/QCM	Verify third-party utility locate has been completed and that OHARNG Restoration Representative has checked with the CJAG Engineering Office regarding utilities prior to any ground disturbance.	IP	O	Third-party utility locate has been completed and OHARNG Restoration Representative has checked with the CJAG Engineering Office regarding utilities prior to any ground disturbance.	Do not perform ground disturbing activities until verify that third-party utility locate has been completed and that OHARNG Restoration Representative has checked with the CJAG Engineering Office regarding utilities prior to any ground disturbance.	PP Form Daily Reports; QC Log and Report
Land Survey - Boundaries	CM/FQM	Verify boundaries of the planned excavations have been marked by a land surveyor prior to excavation.	IP	O	Boundaries of the planned excavations have been marked by a land surveyor prior to excavation.	Do not perform excavation until the boundaries of the planned excavations have been marked by a land surveyor prior to excavation.	PP Form Daily Reports; QC Log and Report
Land Survey – Topographic Survey	CM/FQM	Verify that preexcavation topographic survey has been completed by land surveyor prior to excavation.	IP	O	Preexcavation topographic survey has been completed by land surveyor prior to excavation.	Do not perform excavation until the preexcavation topographic survey has been completed by land surveyor prior to excavation.	PP Form; QC Log and Report
Erosion and Sedimentation Control	CM/FQM	Verify that erosion and sedimentation controls are installed prior to ground disturbing activities.	IP/FP	E	Erosion and sedimentation controls are installed prior to ground disturbing activities.	ICG install erosion and sedimentation controls prior to ground disturbing activities.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)
Traffic Control	CM/FQM	Verify that traffic control signs and barricades are installed as shown on Figures 10 and 11, and rumble strips or temporary construction entrances are installed where dirt roads transition to paved roads.	IP	O	Traffic control signs and barricades are installed as shown on Figures 10 and 11, and rumble strips or temporary construction entrances are installed where dirt roads transition to paved roads.	ICG install traffic control signs and barricades as shown on Figures 10 and 11, and rumble strips or temporary construction entrances where dirt roads transition to paved roads.	IP Form; Daily Reports; QC Log and Report
Equipment Inspection	CM/FQM	Verify heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	IP/FP	D	Heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	ICG operators check heavy equipment for leaks, general equipment condition, fluid levels, etc.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Excavation							
Erosion and sedimentation Controls	CM/FQM	Verify that erosion and sedimentation controls are installed, maintained and inspected.	IP/FP	D	Erosion and sedimentation controls are installed, maintained and inspected.	ICG install, maintain and inspect erosion and sedimentation controls per Work Plan.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)
Initial excavation at each excavation location	CM/FQM	Initial excavation: Verify soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1	FP	O	Soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1.	Excavate to the marked boundaries.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM	Verify initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	FP	O	Initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	Collect sample.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	FP	O	Initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	Analyze for the applicable COCs.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify each COC concentration in the initial ISM samples is less than or equal to the RGO (see table 5-1).	FP	E	Each COC concentration in the initial ISM samples is less than or equal to the RGO.	Discuss with USACE removal of additional soil in the direction of the exceedance. Once approved by USACE COR, excavate additional soil (typically in one-foot increments but may be more depending on magnitude of the exceedance; do not excavate past groundwater or 10 feet bgs, whichever is encountered first).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates meet the DQOs specified in QAPP Table 11-1; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	FP	E	The DQO goals in QAPP Table 11-1 have been met for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	Provide the data for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates to Ohio EPA for concurrence. If the DQO goals are not met, the Ohio EPA will work with the Army to determine whether there are concerns with the data quality (see QAPP Table 11-1).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM and Project Chemist	Verify follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	FP	E	Follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	Collect and analyze for the failed COC.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Final: Verify each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1).	FP	E	Each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC.	Excavation is not complete, return to steps above for sampling and excavation.	FP Form; Daily Reports; QC Log and Report
Excavation dewatering	CM/FQM	Verify analytical results of excavation sidewall and bottom samples meet RGOs AND that Ohio EPA and OHARNG approval has been obtained prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	FP	E	Analytical results of excavation sidewall and bottom samples meet RGOs AND approval obtained from Ohio EPA and OHARNG approval prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	Do not discharge the water onsite. Obtain Ohio EPA and OHARNG approval prior to onsite discharge for water from excavations that meet the RGOs. If the excavation does not meet the RGOs, treat the water in the ETC.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Equipment Inspection	CM/FQM	Verify heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	FP	D	Heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	ICG operators check heavy equipment for leaks, general equipment condition, fluid levels, etc.	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Thermal Treatment						
Erosion and sedimentation Controls	CM/FQM	Verify that erosion and sedimentation controls are installed, maintained and inspected.	IP/FP	D	Erosion and sedimentation controls are installed, maintained and inspected.	ICG install, maintain and inspect erosion and sedimentation controls per Work Plan.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)
					ETC fuel storage and distribution system:		
Tank level(s)	*ICG*	*NA*	*FP*	*D*	*NA*	*NA*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Liquid propane lines and connections	*ICG*	*Verify line & fittings are leak free.*	*FP*	*D*	*Line & fittings are leak free.*	*Repair/replace*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Propane vaporizers	*ICG*	*Verify equipment is online and functioning normally (proprietary).*	*FP*	*D*	*Equipment is online and functioning normally (proprietary).*	*Adjust vaporizer settings, potentially start spare vaporizer capacity, as required. Take malfunctioning vaporizer out of service and repair or replace.*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Fuel feed header pressure	*ICG*	*Verify vaporizer settings (proprietary).*	*FP*	*D*	*Vaporizer settings verified (proprietary).*	*Adjust vaporizer settings to modify pressure (proprietary).*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Fuel riser pressures (where gauges are equipped)	*ICG*	*Verify fuel system pressure continuity.*	*FP*	*D*	*Fuel system pressure continuity verified (proprietary).*	*Adjust vaporizer settings to modify pressure (proprietary).*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Burner fuel inlet pressures (where gauges are equipped)	*ICG*	*Verify burner fuel inlet pressures (proprietary).*	*FP*	*D*	*Burner fuel inlet pressures verified (proprietary).*	*Adjust vaporizer settings to modify pressure (proprietary).*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Observe fabric indicators on ETC system	ICG	Verify that the system is operating under vacuum.	FP	D	System is operating under vacuum.	Make process adjustments (inlet/exhaust air flow and temperature parameters) to adjust/correct.	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs
					ETC inlet air temperature(s):		
Burner settings	*ICG*	*Verify burner settings (proprietary).*	*FP*	*D*	*Burner settings verified (proprietary).*	*Adjust, as required*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Excess air fan settings	*ICG*	*Verify excess air fan settings (proprietary).*	*FP*	*D*	*Excess air fan settings verified (proprietary).*	*Adjust, as required*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
					ETC thermal oxidizer operating temperature:		
Airflow/VFD settings	*ICG*	*Verify airflow/VFD settings (proprietary).*	*FP*	*D*	*Airflow/VFD settings verified (proprietary).*	*Adjust, as required*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Burner settings	*ICG*	*Verify burner settings (proprietary).*	*FP*	*D*	*Burner settings verified (proprietary).*	*Adjust, as required*	*FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs*
Thermal oxidizer exhaust opacity	ICG	20% or less	FP	D	>20%	Adjust process settings so that thermal oxidizer exhaust is 20% or less	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Soil temperature readings for all nine locations in each active ETC cell	ICG	Collect soil temperature readings.	FP	D	NA (data used for process trending).	Adjust process settings to equalize heat distribution, as required.	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs
ETC system(s) walk around	ICG	Verify all equipment is operating normally (proprietary) and safety equipment is in place and either functioning or ready for use (e.g., fire extinguishers, spill kits, waste management bins & sanitary facilities).	FP	D	All equipment is operating normally and safety equipment is in place and either functioning or ready for use (e.g., fire extinguishers, spill kits, waste management bins & sanitary facilities).	Correct any deficiencies (e.g.,: locate and replace spill kits, fire extinguishers, etc. Have waste bins and/or sanitary facilities emptied/refreshed)	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs
Off-site checks: SCADA Unit, live camera feeds and thermocouple sensors	ICG	Verify systems are functioning normally (proprietary).	FP	D	Systems are functioning normally (proprietary).	Adjust process settings, as required (Manual process, operator required to be onsite with the ETC equipment)	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs
Treatment Verification Sampling	CM/FQM and Project Chemist	Verify one composite treatment verification sample collected per 150 CY and analyzed for applicable COCs.	FP	E	One composite treatment verification sample collected per 150 CY and analyzed for applicable COCs.	Collect one composite treatment verification sample per 150 CY and analyze for applicable COCs.	FP Form; Daily Reports; QC Log and Report
Treatment Verification Sampling	Project Chemist	Verify applicable COCs are less than or equal to the RGO.	FP	E	Applicable COCs are less than/equal to the RGO.	Depending on the magnitude of the exceedance, collect another composite sample from the treated soil and analyze for the failed COC, or ICG turn on the active heating system for further treatment prior to collection of another sample.	FP Form; Daily Reports; QC Log and Report
Transportation and Disposal							
Disposal Characterization Sampling – Metals Impacted Soil	CM/FQM and Project Chemist	Verify that one composite sample is collected from the Load Line 1 metals impacted soil and one composite sample is collected from the Load Line 4 metals impacted soil, for analysis of TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.	FP	E	One composite sample collected from the Load Line 1 metals impacted soil and one composite sample collected from the Load Line 4 metals impacted soil, for analysis of TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.	Collect samples and analyze for required parameters.	FP Form; Daily Reports; QC Log and Report
Off-site disposal of metals impacted soil	CM/FQM and CH2M Waste Specialist	Verify analytical results meet requirements for disposal as nonhazardous waste.	FP	E	Analytical results meet requirements for disposal as nonhazardous waste.	Soil cannot be disposed as nonhazardous waste. Contract modification required and soil will be disposed at an appropriate facility in coordination with USACE and CJAG.	FP Form; Daily Reports; QC Log and Report; Waste Tracking Log
Disposal Characterization Sampling - Concrete	CM/FQM and Project Chemist	Verify that approximately one composite sample collected per 500 CY and analyzed for PCBs and RCRA metals.	FP	E	Approximately one composite sample collected per 500 CY and analyzed for PCBs and RCRA metals.	Collect samples and analyze for required parameters.	FP Form; Daily Reports; QC Log and Report
Off-site disposal of Concrete	CM/FQM and CH2M Waste Specialist	Verify analytical results are less than EPA residential regional screening levels prior to shipping concrete for recycling.	FP	E	Analytical results are less than EPA residential regional screening levels.	Transport concrete to permitted, CERCLA OSR approved landfill (Republic Services Carbon Limestone Landfill).	FP Form; Daily Reports; QC Log and Report; Waste Tracking Log
Waste Profiles and Manifests	CM/FQM and CH2M Waste Specialist	Verify OHARNG Restoration Representative has signed all waste profiles and waste manifests for the disposal of project wastes at an approved disposal facility.	FP	E	OHARNG Restoration Representative has signed all waste profiles and waste manifests for the disposal of project wastes at an approved disposal facility.	Obtain OHARNG Restoration Representative signature for all waste profiles and waste manifests for the disposal of project wastes at an approved disposal facility.	FP Form; Daily Reports; QC Log and Report; Waste Tracking Log
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Backfill and Site Restoration							
Backfill of Excavations	CM/FQM	Verify sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP	E	Sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	Do not backfill. Obtain sidewall and bottom excavation confirmation sample results that are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND perform a post-excavation topographic survey of the open excavation to calculate excavated volume AND obtain Ohio EPA concurrence on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP Forms; Daily Reports; QC Log and Report
Off-site backfill material	CM/FQM	Verify off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP	E	Off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	Do not bring the off-site backfill material to the site. ICG obtain samples of backfill material and analyze for the parameters in Table 12-1, and obtain approval from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP Forms; Daily Reports; QC Log and Report
Treated Soil	CM/FQM	Verify treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	IP/FP	E	Treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	Do not use the treated soil as backfill until all applicable COCs are less than or equal to the applicable RGOs.	IP/FP Forms; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify excavations backfilled in lifts approximately 8 inches thick (+/- 25%).	FP	E	Backfill placed in lifts approximately 8-inches thick (+/- 25%).	Add or remove backfill to meet lifts of approximately 8 inches thick (+/- 25%).	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify each lift track packed/wheel packed	FP	E	Each lift track packed/wheel packed.	Track pack/wheel pack each lift before placement of the next lift.	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify backfilled excavation matches surrounding grade.	FP	E	Backfilled excavation matches surrounding grade.	Add/remove backfill, grade etc. until backfilled excavation matches surrounding grade.	FP Form; Daily Reports; QC Log and Report
Seeding	CM/FQM	Verify that excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	FP	E	Excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	Obtain the approved seed mixture and apply, followed by mulching such as straw, woodchips or similar.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Erosion and sedimentation Controls	CM/FQM	Until 70% vegetative cover is established, verify that erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	FP	W	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly by ICG after backfill and restoration (as well as after a ½-inch rain event).	FP Form; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)

Table notes:
[a] The responsible person (if other than the CM/QCM) is the individual with whom the CM/QCM will coordinate to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.
[c] Quality control phase: PP = preparatory phase, IP = initial phase, and FP = follow-up phase
[d] Frequency: O = once, D = daily, W = weekly, E = each occurrence

% = percent
APP = Accident Prevention Plan
ARNG = Army National Guard
bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CH2M = CH2M HILL Constructors, Inc.
CJAG = Camp James A. Garfield
CM = construction manager
COC = contaminant of concern
COR = Contracting Officer's Representative
CY = cubic yard(s)
ETC = enhanced thermal conduction
FQM = Field Quality Manager
HSM = Health and Safety Manager
ICG = Iron Creek Group
ISM = incremental sampling methodology
NA = not applicable
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
OSR = Off-Site Rule
PCB = polychlorinated biphenyl
PM = Project Manager
QC = quality control
QCM = Quality Control Manager
RCRA = Resource Conservation and Recovery Act
RD = remedial design
RGO = remedial goal option
SCADA = supervisory control and data acquisition
SSHP = Site Safety and Health Plan
SVOC = semivolatile organic compound
TCLP = toxicity characteristic leaching procedure
USACE = U.S. Army Corps of Engineers
VFD = variable frequency drive
VOC = volatile organic compound

SECTION 10

Traffic Plan

The project site will be controlled at ingress and egress points of Load Line 1 and the base entrance. Site controls will include:

- Controlling and monitoring access to the project work sites
- Adhering to CJAG traffic rules

The use of two-way radios and cell phones is permitted at CJAG. Workers must be able to contact CJAG Range Control at all times.

ICG will post signs and erect barricades to provide traffic directions to key locations at the former RVAAP. As shown in Figures 10 and 11, signs will be placed along the proposed traffic routes and at each planned excavation work area for vehicles and heavy equipment entering and exiting to ensure that traffic flows with minimal interference. These signs will be in visible locations and be updated and maintained as necessary. ICG will establish transportation routes for incoming and outgoing vehicles and heavy equipment to minimize the impact on the former RVAAP and surrounding community.

The proposed truck routes will optimize the transportation requirements of transporting soil to and from the ETC treatment pad within Load Line 1 to the primary roadway (State Route 5) wherever possible. All traffic control devices used on the project will conform to Department of Transportation applicable standards. A traffic control plan for vehicle access to each of the excavation areas will be communicated to and understood by all responsible parties. The site-specific traffic control plan will assure that adequate consideration is given to the safety of motorists, pedestrians, and workers during construction. The traffic routes to each work area will ensure that traffic flows without impedance for vehicles and heavy equipment entering and exiting. The uses of haul routes will be coordinated with and approved by OHARNG.

The traffic plan will limit the track out of soil from the excavation areas and focus traffic to the abandoned railway lines where road subbase is more competent than other abandoned roadways. As stated in Section 8, rumble strips or temporary construction entrances will be utilized where dirt roads between Load Lines transition to paved roads. If dirt/mud is tracked out onto base road ways, roads will be swept with a brush attachment on a skid steer as needed.

SECTION 11

Waste Management Plan

Waste materials expected include vegetation, soils containing metal contamination, sized concrete, municipal waste and minimal contaminated water. Waste materials will be managed as described in the facilitywide sampling and analysis plan (Leidos, 2011). A third party solid waste bin will be located at the treatment area for municipal waste.

Water is not expected in large quantities as the majority of water expected for handling will be rainwater. Water will be managed according to CJAG rules stated in Section 5.6.4, with any water collected from decontamination efforts for treatment added to ETC treatment cell soil prior to treatment for processing through the ETC oxidizers as opposed to off-site disposal.

At least one roll-off box for concrete rubble (including elevated walkways) will be used and these materials disposed off-site (preferably by recycling). Composite samples will be analyzed for PCBs and RCRA metals.

Rocks (including railroad ballast/aggregate) will not be segregated from excavated soil. Small diameter vegetation will be chipped and spread on the ground during cutting. Larger diameter wood cut per the seasonal restriction will be cut to no more than 8-foot lengths piled neatly adjacent to where it was cut at the time of the remedial activities, or during the tree cutting activities as time permits. Otherwise, removed trees and large woody vegetation will be disposed of off-site or processed with a wood chipper/grinder. Any resulting wood chips will be spread on site.

Soil containing metals and identified for off-site disposal will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity. If the land disposal facility requires additional testing, then required testing will be performed as necessary.

All municipal waste (trash) will be removed. Contractors are not permitted to use CJAG municipal waste dumpsters, except for scrap metal (scrap metal is not anticipated).

The management, transportation, and disposal of all waste streams will be coordinated with the OHARNG Restoration Representative. The OHARNG Restoration Representative will sign all waste profiles and waste manifests for the disposal of project wastes at an approved disposal facility. All transportation paperwork (manifests or shipping papers) and on-road haul truck placards must be in accordance with federal, state, and local regulatory requirements, and disposal facility requirements. A draft of the transportation paperwork containing “base” information will be submitted to the OHARNG Restoration Representative for review and approval a minimum of one week prior to shipment of any material. The approved transportation paperwork will then be completed as appropriate by the CH2M Construction Manager together with the OHARNG Restoration Representative in the field during remedial activities. Waste will be transported by licensed waste haulers to OHARNG-approved licensed off-site disposal facilities. All transportation requirements, including proper labeling, placarding, and weight limits will be followed. All manifests, shipping documents, and disposal facility approval letters will be incorporated into the RACR.

SECTION 12

Sampling and Analysis Plan

To evaluate the effectiveness of the remedial construction activities, and to obtain necessary soil characterization data, the following sampling activities will be conducted:

- Excavation confirmation – Post-excavation confirmation sampling of excavation sidewalls and bottom to confirm removal of soil exceeding the RGOs.
- Ex-situ Thermal Treatment Verification – Post-treatment verification sampling of treated soil at a rate of one sample per 150 CY to track thermal performance and confirm soil meets RGOs prior to using soil as backfill on site.
- Import material – Sampling and analysis of import backfill material from potential sources prior to import to confirm that it meets the criteria set forth by CJAG. Only a small volume of off-site fill is anticipated (+/-165 cu. Yd) and is proposed to come from Freedom Material located approximately 5 miles west of CJAG on Route 5. Table 12-1 presents the required analyses and analytical methods; one sample will be collected for every 4,000 CY. Tabulated analytical results for proposed import material will be provided to Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA in a Field Change Request for approval prior to bringing import material to the load lines. Table 12-2 presents background concentrations in soil as a point of comparison for metals.
- Waste characterization – Both solid and liquid (if any) waste characterization sampling will be performed prior to transport to disposal facility.

Sampling activities will be conducted according to QAPP provided as Appendix C to this RD Work Plan.

Table 12-1. Approved Analytical Sampling Methods
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Parameter	Methods
VOCs, TCL	SW-846 5030/8260B
SVOCs, TCL	SW-846 3540/8270C
Pesticides, TCL	SW-846 3540/8081A
PCBs	SW-846 3540/8082
Explosives	SW-846 3540/8330
Nitroglycerin	SW-846 3540/8330
Nitroguanidine	SW-846 3540/8330 Modified
Nitrocellulose	MCAWW353.2 Modified
Metals, TAL	SW-846 6010B/6010A/7471
pH	SW-846 9040/9045
TCLP	SW-846 1311

Table notes:

PCB = polychlorinated biphenyl
SVOC = semivolatile organic compound
TAL = target analyte list
TCL = target compound list
TCLP = toxicity characteristic leaching procedure
VOC = volatile organic compound

Table 12-2. Facilitywide Background Criteria for Metals in Surface Soils
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Parameter	Background Criteria (mg/kg)
Aluminum	17,700
Antimony	0.96
Arsenic	15.4
Barium	88.4
Beryllium	0.88
Cadmium	0
Calcium	15,800
Chromium	17.4
Cobalt	10.4
Copper	17.7
Cyanide	0
Iron	23,100
Lead	26.1
Magnesium	3,030
Manganese	1,450
Mercury	0.036
Nickel	21.1
Potassium	927
Selenium	104
Silver	0
Sodium	123
Thallium	0
Vanadium	31.1
Zinc	61.8

Table notes:

[a] Background concentrations for 0-1 ft bgs from final facilitywide background concentrations, published in the *Phase II Remedial Investigation Report for Winklepeck Burning Grounds* (SAIC, 2001).

bgs = below ground surface
mg/kg = milligrams per kilogram

References

Environmental Quality Management, Inc. (EQM). 2010. Facilitywide Groundwater Monitoring Program Report on the January 2010 Sampling Event, Ravenna Army Ammunition Plant, Ravenna, Ohio. July.

Leidos. 2011. Final Facilitywide Sampling and Analysis Plan. Prepared for USACE. February 2011.

Leidos. 2017. *Feasibility Study Addendum for Soil, Sediment, and Surface Water at RVAAP Load Lines 1, 2, 3, 4, and 12*, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. June 2017.

Leidos. 2018. Final Proposed Plan for Soil, Sediment, and Surface Water at RVAAP Load Lines 1, 2, 3, 4, and 12, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. October 2018.

Leidos. 2019a. Final Record of Decision Amendment for Soil, Sediment, and Surface Water at RVAAP Load Lines 1, 2, 3, 4, and 12, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. December 2019.

Leidos. 2019b. Record of Decision for Wet Sediment and Surface Water at RVAAP-12 Load Line 12, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. February 2019.

MKM Engineers, Inc. (MKM). 2007. Final Characterization of 14 AOCs at Ravenna Army Ammunition Plant. March.

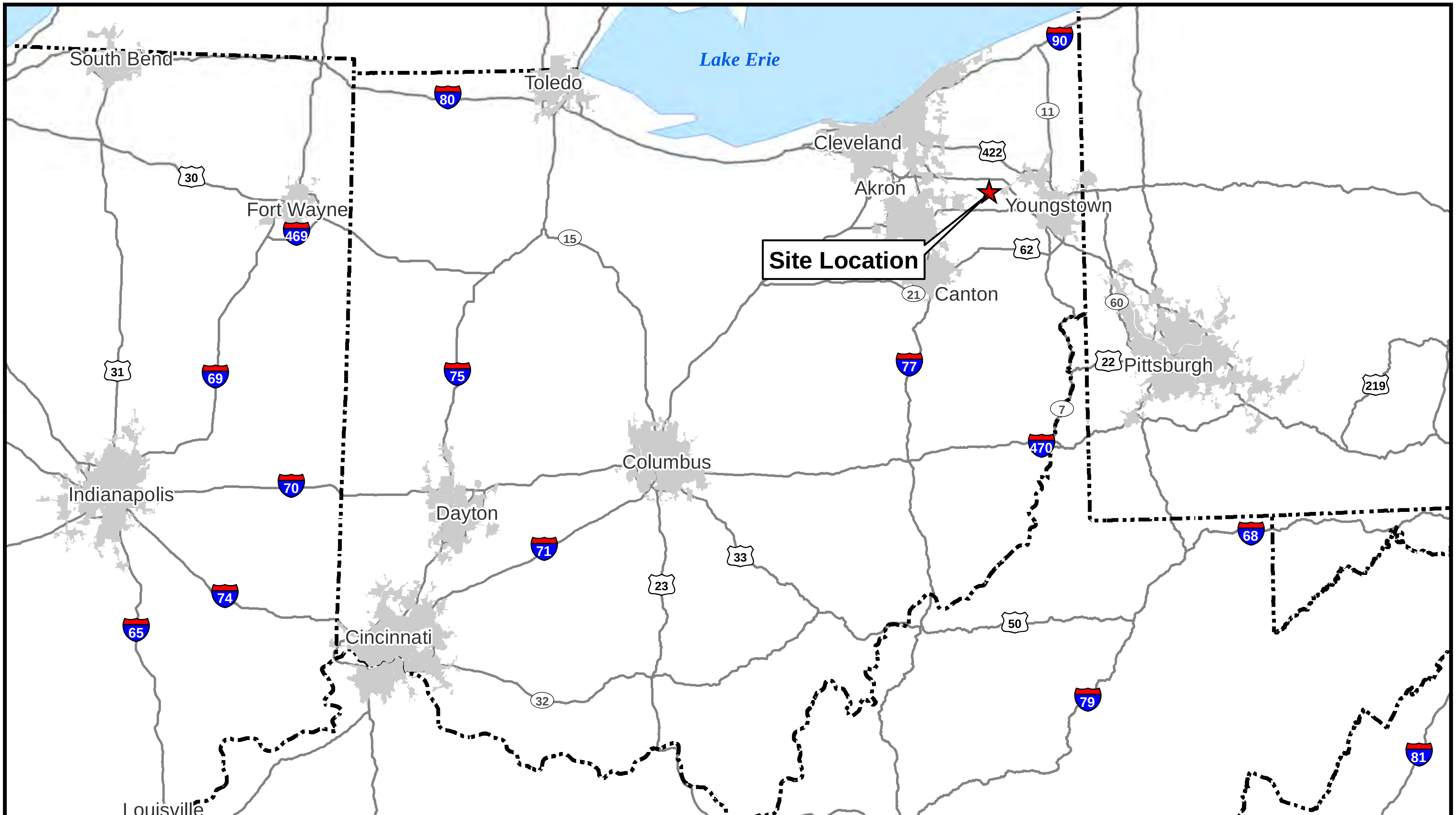
Science Applications International Corporation (SAIC). 2001. Final Phase II Remedial Investigation Report for RVAAP- 05 Winklepeck Burning Grounds at Ravenna Army Ammunition Plant, Ravenna, Ohio. April.

SAIC. 2009. Final Record of Decision for Soil and Dry Sediment for the RVAAP-12 Load Line 12, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. March.

Shaw Environmental, Inc. (Shaw). 2007. Interim Record of Decision for the Remediation of Soils at Load Lines 1 through 4, Former Ravenna Army Ammunitions Plant, Portage and Trumbull Counties, Ohio. Prepared for USACE. January 2007.

U.S. Army Corps of Engineers (USACE). 2004. Phase II Remedial Investigation Report for the Load Line 4 at the Ravenna Army Ammunition Plant, Ravenna, Ohio. September.

Figures



LEGEND:

- Interstate/Highway
- State Boundary
- Urban Areas (Regional)
- Major Lakes (State)

0 130,000 260,000

Scale In Feet

N

BASE MAP SOURCE:
ESRI

Camp James A. Garfield

FIGURE 1
SITE LOCATION MAP
FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900
DATE: 3/26/2020

ch2m.

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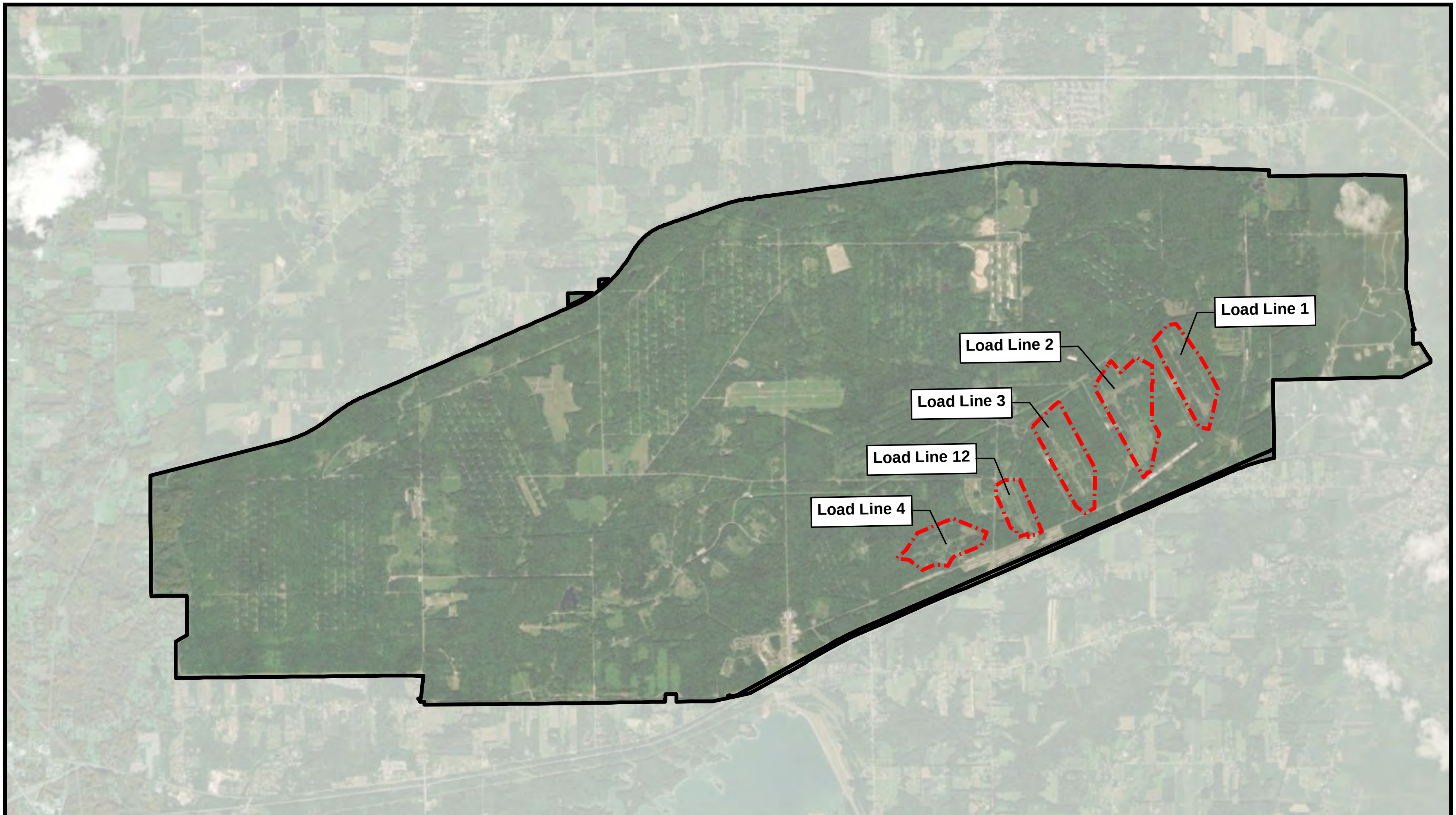

LEGEND:

Camp James A. Garfield Property

Load Line Area

0 3,900 7,800

Scale In Feet

N

BASE MAP SOURCE:
ESRI online map service, DigitalGlobe, 2017/2018.

Camp James A. Garfield

FIGURE 2
LOAD LINE LOCATIONS
FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900

DATE: 3/26/2020

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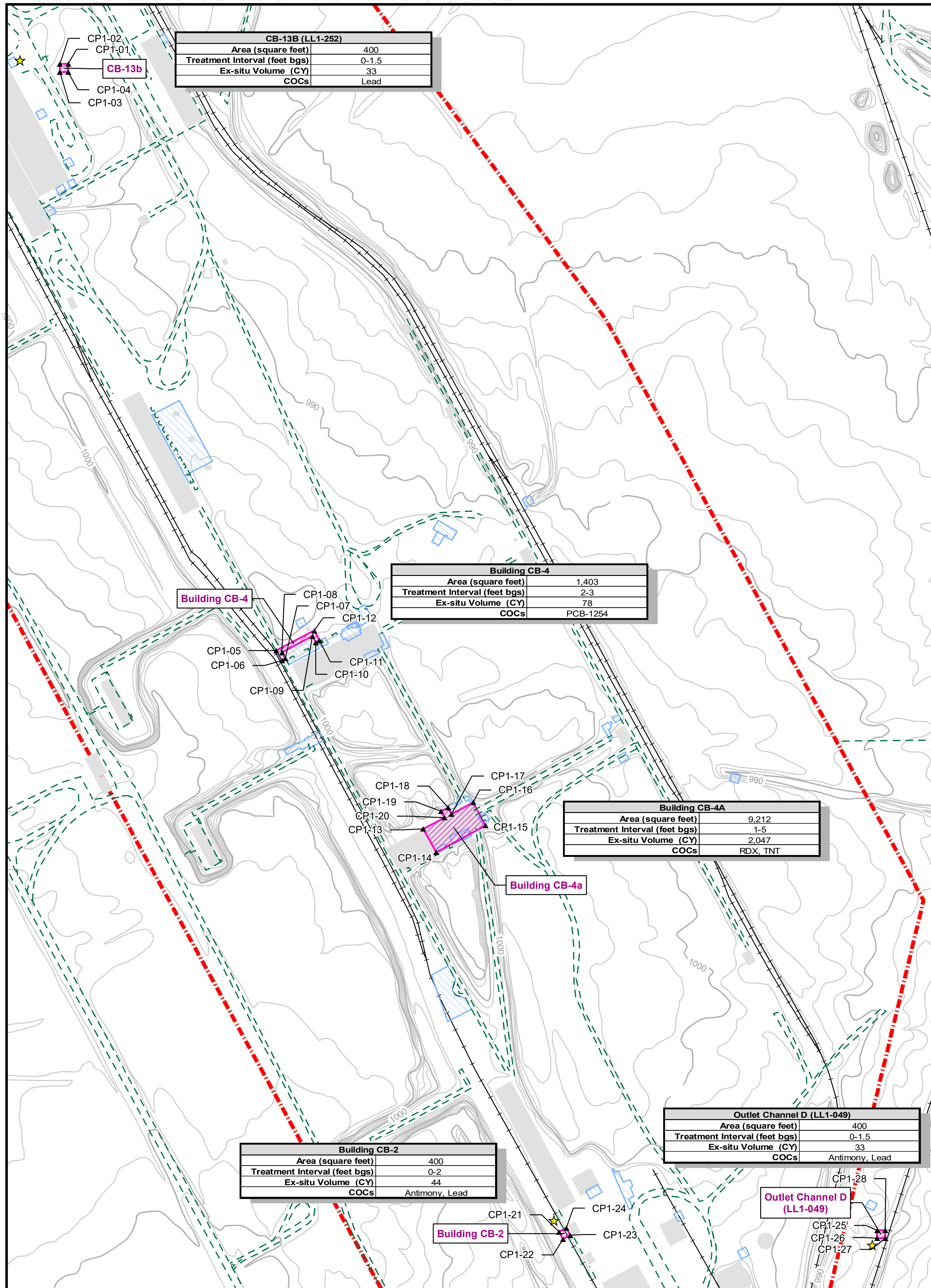

LEGEND:

- Roll Off Area
- Control Point
- Elevated Walkway
- Former Railroad
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Demolished Building
- Area of Concern Boundary
- Elevation Contour (10 ft interval)
- Elevation Contour (2 ft interval)

N

0 180 360
Scale In Feet

Camp James A. Garfield

FIGURE 3
LOAD LINE 1 EXCAVATION PLAN
FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900

DATE: 3/27/2020

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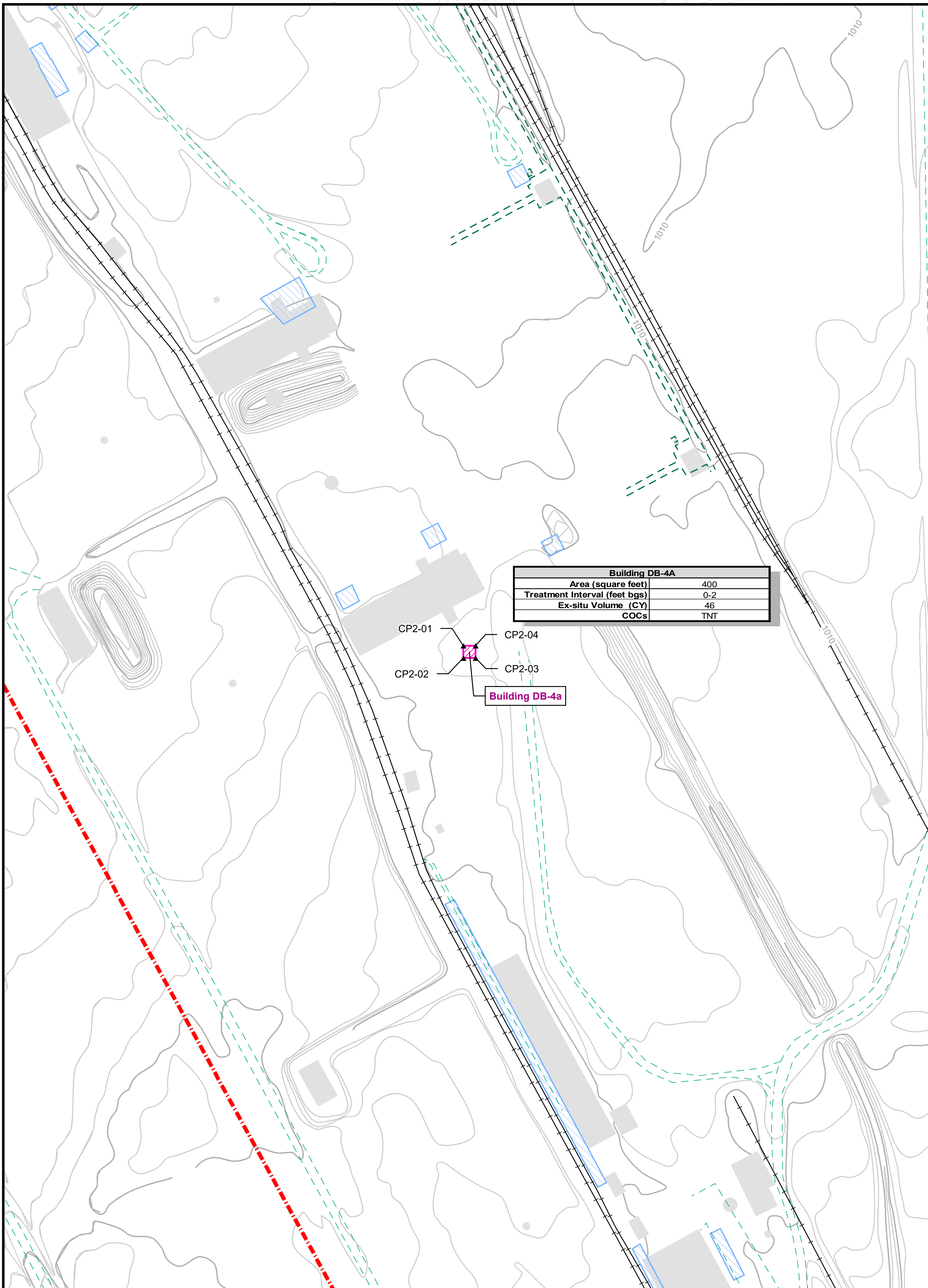

Building DB-4A	
Area (square feet)	400
Treatment Interval (feet bgs)	0-2
Ex-situ Volume (CY)	46
COCs	TNT

LEGEND:

- ▲ Control Point
- Elevated Walkway
- Former Railroad
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Demolished Building
- Area of Concern Boundary
- Elevation Contour (10 ft interval)
- Elevation Contour (2 ft interval)

N

0 125 250

Scale In Feet

Camp James A. Garfield

FIGURE 4

LOAD LINE 2 EXCAVATION PLAN

FORMER RAVENNA ARMY AMMUNITION PLANT

PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900

DATE: 3/27/2020

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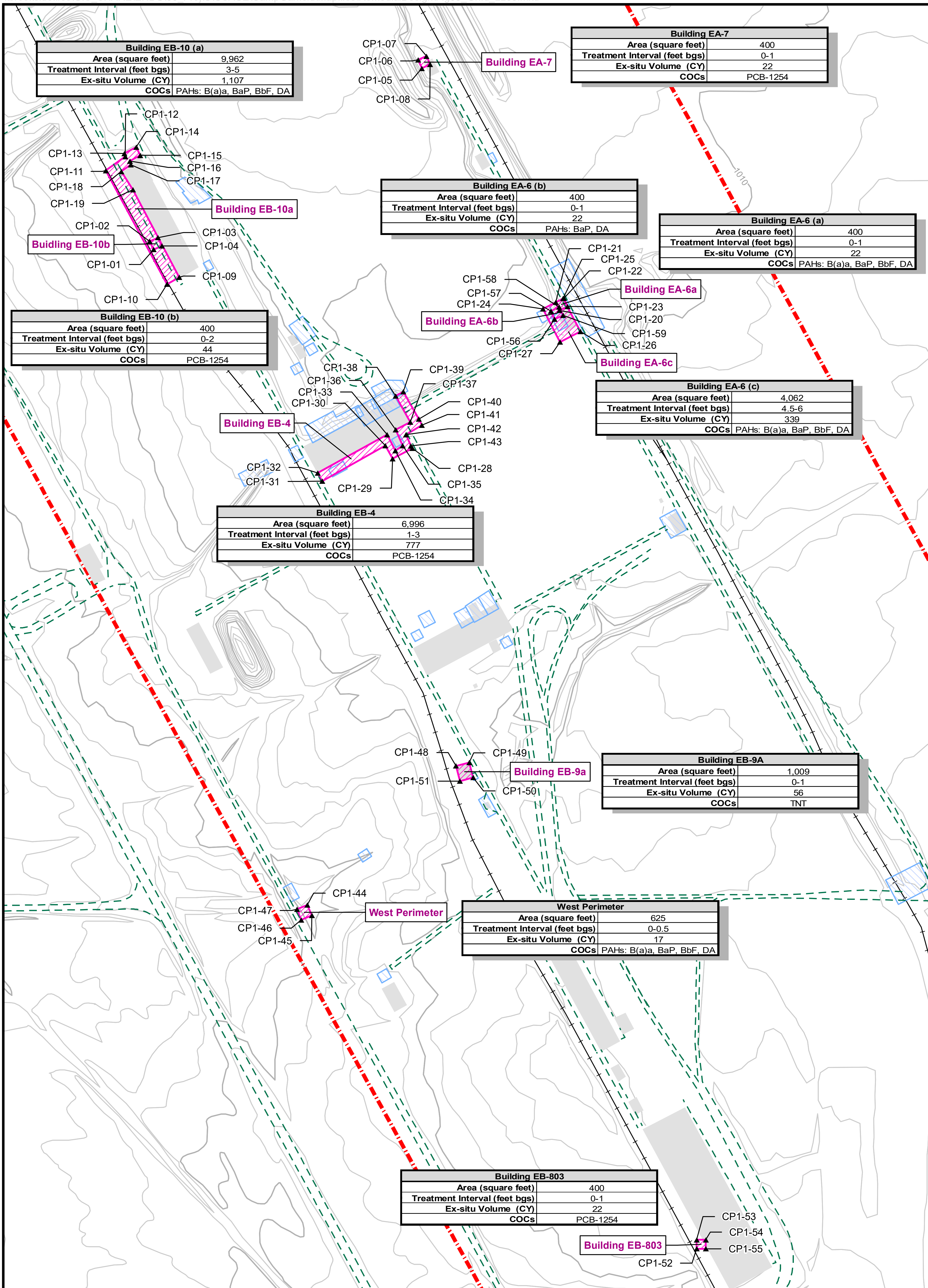

Building EB-10 (a)	
Area (square feet)	9,962
Treatment Interval (feet bgs)	3-5
Ex-situ Volume (CY)	1,107
COCs	PAHs: B(a)a, BaP, BbF, DA

Building EA-7	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PCB-1254

Building EA-6 (b)	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PAHs: BaP, DA

Building EA-6 (a)	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PAHs: B(a)a, BaP, BbF, DA

Building EB-10 (b)	
Area (square feet)	400
Treatment Interval (feet bgs)	0-2
Ex-situ Volume (CY)	44
COCs	PCB-1254

Building EA-6 (c)	
Area (square feet)	4,062
Treatment Interval (feet bgs)	4.5-6
Ex-situ Volume (CY)	339
COCs	PAHs: B(a)a, BaP, BbF, DA

Building EB-4	
Area (square feet)	6,996
Treatment Interval (feet bgs)	1-3
Ex-situ Volume (CY)	777
COCs	PCB-1254

Building EB-9A	
Area (square feet)	1,009
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	56
COCs	TNT

West Perimeter	
Area (square feet)	625
Treatment Interval (feet bgs)	0-0.5
Ex-situ Volume (CY)	17
COCs	PAHs: B(a)a, BaP, BbF, DA

Building EB-803	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PCB-1254

LEGEND:

- ▲ Control Point
- Elevated Walkway
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Former Railroad
- Demolished Building
- Area of Concern Boundary
- Elevation Contour (10 ft interval)
- Elevation Contour (2 ft interval)

N

0 160 320

Scale In Feet

Camp James A. Garfield

FIGURE 5

LOAD LINE 3 EXCAVATION PLAN

FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900

DATE: 3/27/2020

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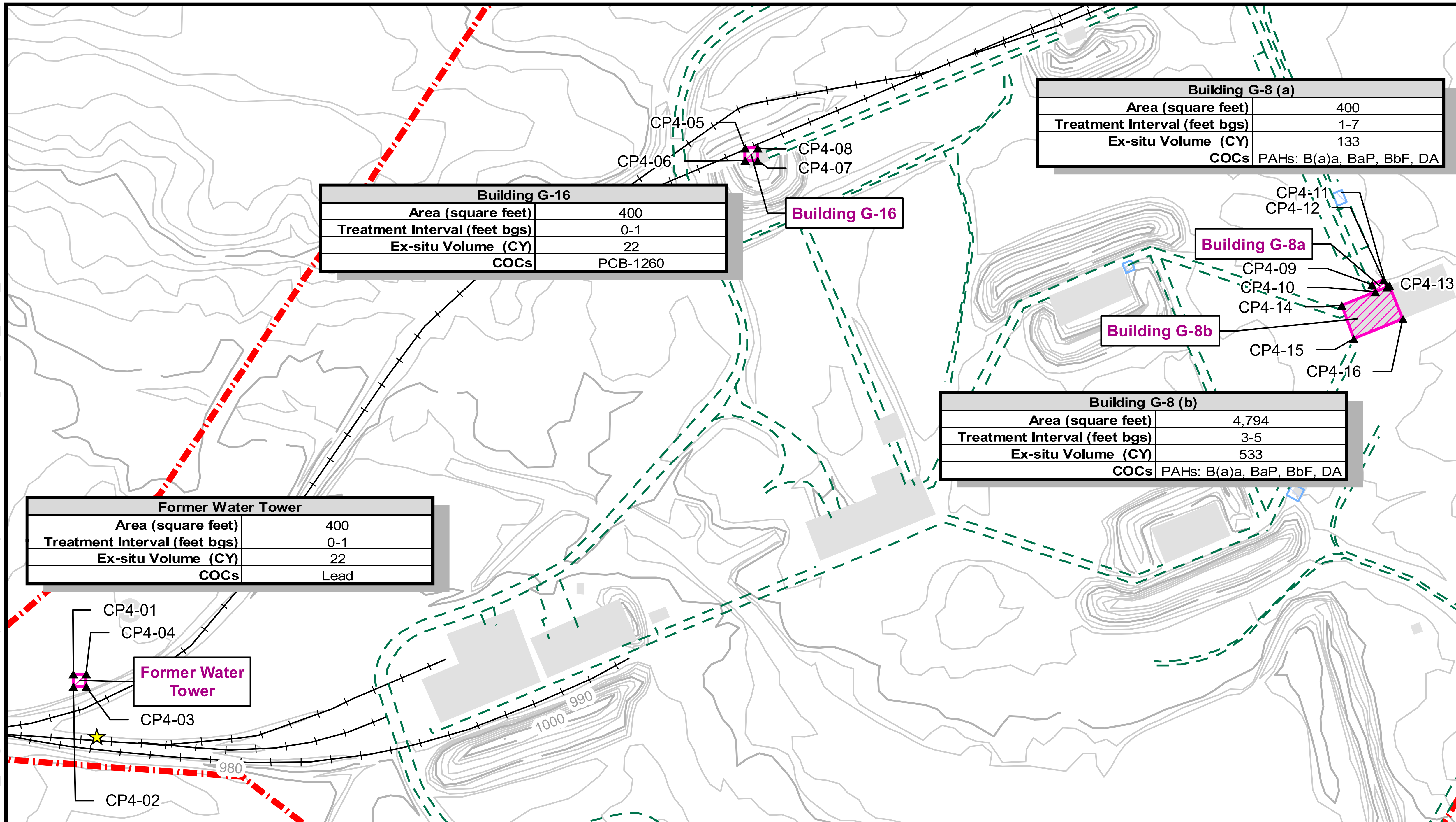

Building G-16	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PCB-1260

Building G-8 (a)	
Area (square feet)	400
Treatment Interval (feet bgs)	1-7
Ex-situ Volume (CY)	133
COCs	PAHs: B(a)a, BaP, BbF, DA

Building G-8 (b)	
Area (square feet)	4,794
Treatment Interval (feet bgs)	3-5
Ex-situ Volume (CY)	533
COCs	PAHs: B(a)a, BaP, BbF, DA

Former Water Tower	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	Lead

LEGEND:

- Roll Off Area
- Control Point
- Elevated Walkway
- Elevation Contour (2 ft interval)
- Elevation Contour (10 ft interval)
- Former Railroad
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Area of Concern Boundary
- Demolished Building

N

0 140 280
Scale In Feet

Camp James A. Garfield

FIGURE 6
LOAD LINE 4 EXCAVATION PLAN
FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900
DATE: 3/27/2020

ch2m

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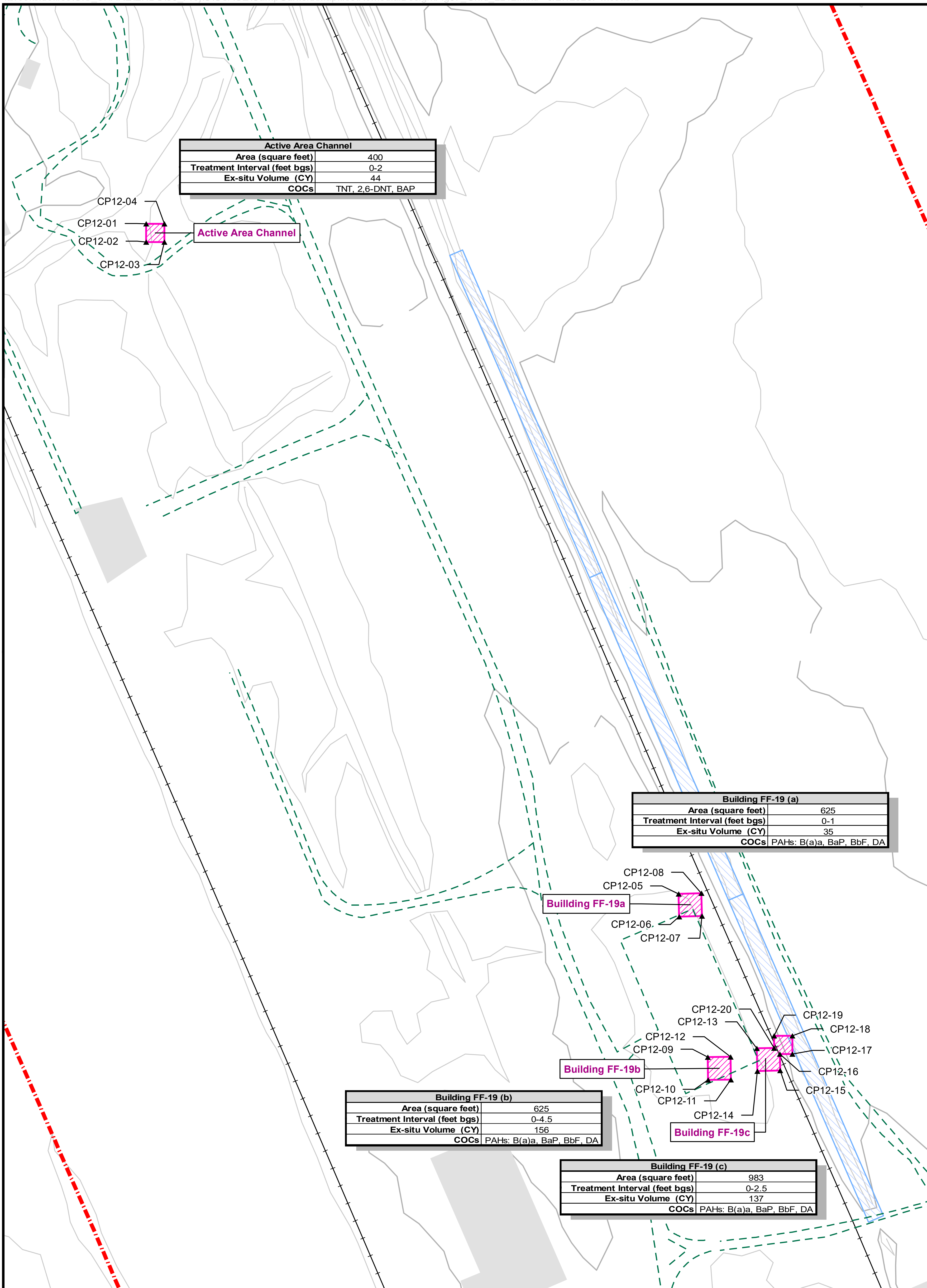


Active Area Channel	
Area (square feet)	400
Treatment Interval (feet bgs)	0-2
Ex-situ Volume (CY)	44
COCs	TNT, 2,6-DNT, BAP

Building FF-19 (a)	
Area (square feet)	625
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	35
COCs	PAHs: B(a)a, BaP, BbF, DA

Building FF-19 (b)	
Area (square feet)	625
Treatment Interval (feet bgs)	0-4.5
Ex-situ Volume (CY)	156
COCs	PAHs: B(a)a, BaP, BbF, DA

Building FF-19 (c)	
Area (square feet)	983
Treatment Interval (feet bgs)	0-2.5
Ex-situ Volume (CY)	137
COCs	PAHs: B(a)a, BaP, BbF, DA

LEGEND:

- Control Point
- Elevated Walkway
- Former Railroad
- Elevation Contour (2 ft interval)
- Elevation Contour (10 ft interval)
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Demolished Building
- Area of Concern Boundary

Camp James A. Garfield

FIGURE 7

LOAD LINE 12 EXCAVATION PLAN

FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

PN: D3294900

DATE: 3/27/2020

ch2m

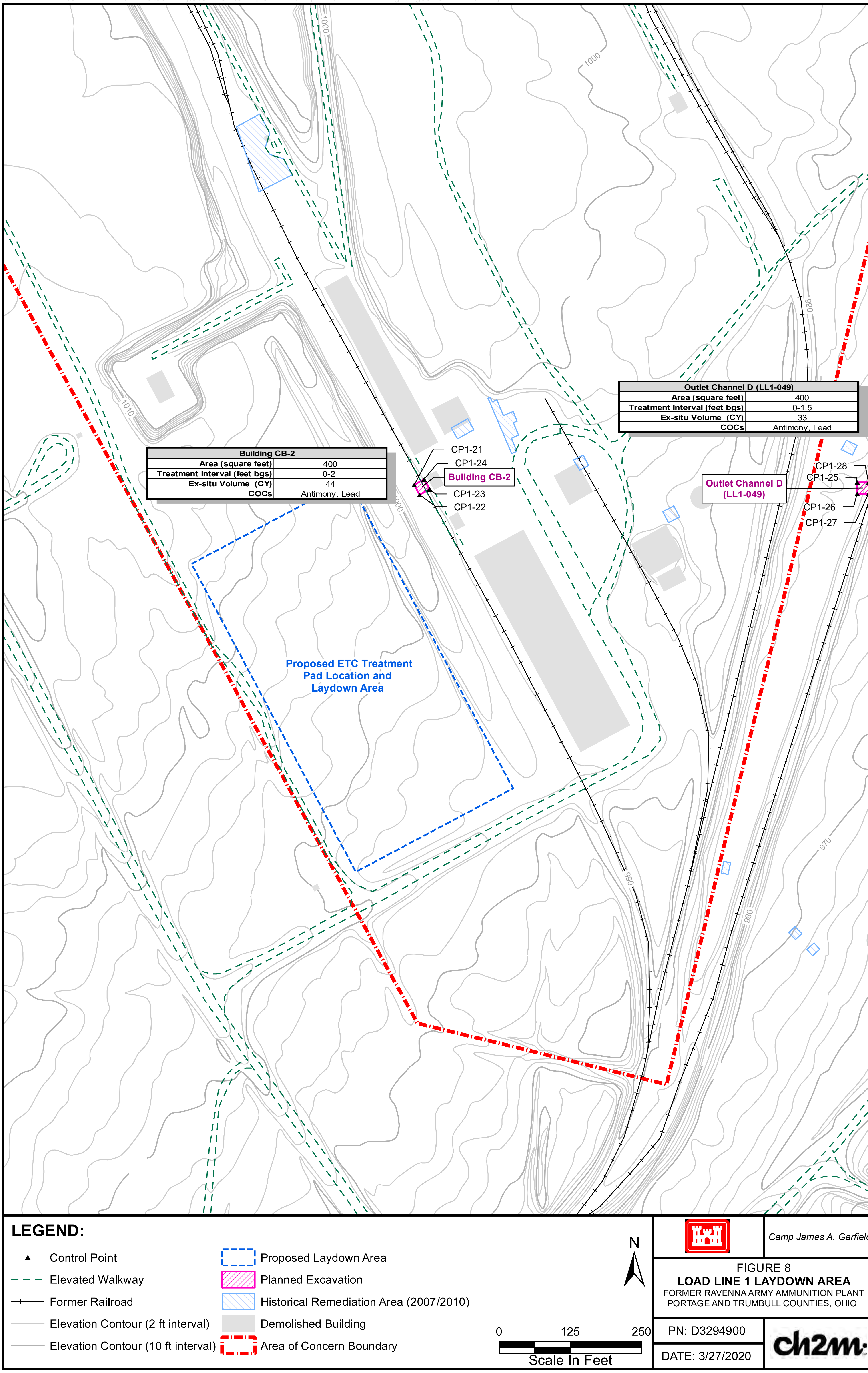
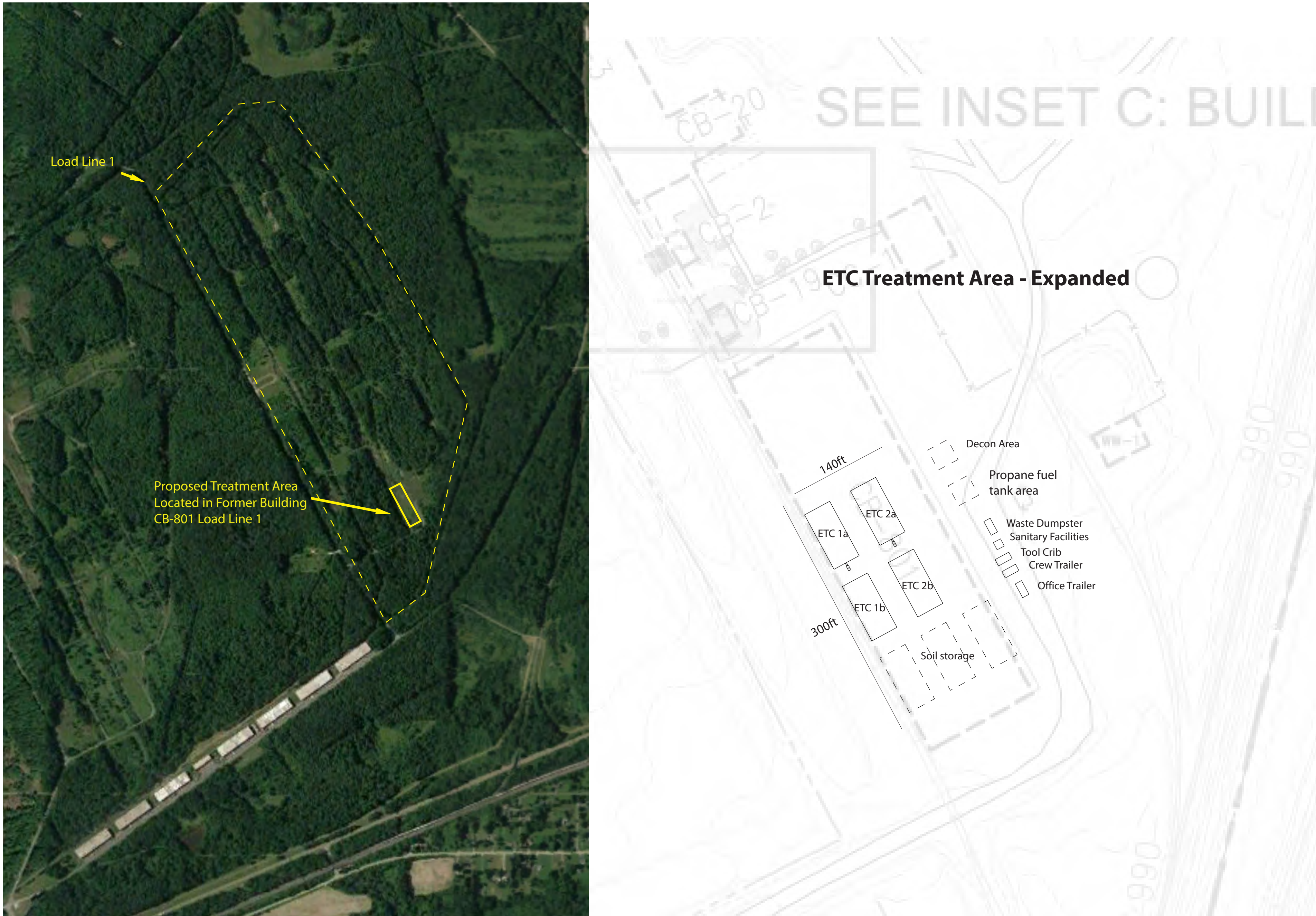


FIGURE 8
LOAD LINE 1 LAYDOWN AREA
FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO



Camp James A. Garfield JMTC - ETC Treatment Location at Load Line 1

IRON CREEK GROUP

Figure 9

LEGEND:

MAIN ACCESS ROUTE

IRON CREEK GROUP

Camp James A. Garfield JMTC - Main Access Route from Building 1036 to Load Line 1

Figure 10

Camp James A. Garfield JMTC - Soil Hauling Route from Load Lines 2-4 & 12 to Load Line 1

LEGEND:

- SOIL HAULING ROUTE
- "TRUCKS ENTERING" (SIGNAGE)

IRON CREEK GROUP

Figure 11

Appendix A
Tree Cutting Plan

February 21, 2020

Mr. David Connolly
Army National Guard Directorate
111 S George Mason Drive
Arlington VA 22204

Attn: Mr. David Connolly

Re: 2020 Remedial Activities - Tree Cutting Plan
Load Lines 1-4, and 12 at Former Ravenna Army Ammunition Plant
Camp James A. Garfield Joint Military Training Facility

Dear Mr. Connolly:

The purpose of this letter Work Plan is to describe the tree cutting Scope Of Work in support of the proposed 2020 Remedial Activities Services at the Former Ravenna Army Ammunition Plant – Camp James A. Garfield (CJAG) Joint Military Training Facility (JMTC).

The proposed remedial activities services that will take place at Load Lines 1-4 and 12 include excavation of contaminated soil, thermal soil remediation, and backfilling of treated soil. Additional activities will include tree cutting and brush clearing, concrete removal (some elevated walkways), and transport of soil to Load Line 1 for thermal remediation.

During the initial site walk that was completed on November 20, 2019, CH2M and Iron Creek personnel identified the approximate boundaries of the excavation areas and marked the trees, which will need to be cut to allow for safe and timely completion of the remedial activities. Due to the protective timelines related to the roosting of the Northern Long Eared Bat, cutting of trees and limbs that are three inches or greater diameter at breast height (dbh) is restricted during the roosting season (1 April to 30 September). Iron Creek is proposing to conduct tree cutting activities during the month of March 2020 in advance of the planned remedial activities scheduled for mid to late 2020. The intent of the March 2020 effort is to fell trees and limbs 3 inches or greater in diameter; further processing of the felled material (e.g., mulching or sectioning into smaller lengths) may be postponed until the larger site preparation effort scheduled for the remedial activities in mid to late 2020.

Tree Cutting

In order to facilitate the remedial action activities, tree removal in and around the excavation limits, the treatment system setup area in Load Line 1, and the associated access routes will be required. The limits of the planned tree cutting align directly with the scheduled remedial activities and the relative boundaries are boldly outlined in red on the attached Load Line figures. These approximate boundaries have been marked in the field for initial review by the Natural Resource Manager in preparation for tree cutting activities. A formal survey of the proposed excavation limits will be completed in conjunction with the actual tree cutting activities and Iron Creek will flag any additional trees/limbs along access routes or near the excavation areas that will be felled so that the Natural Resources Manager can review prior to felling.

It is assumed that only trees and limbs 3 inches or greater in diameter within the highlighted areas on the figures and those posing access issues along the soil transportation route will be targeted during this clearing activity. Trees and limbs will be hand felled by workers using chainsaws or removed using a tracked skid steer fitted with a "Brush Hog" mulching system. The "Brush Hog" is capable of removing trees up to approximately 6" in diameter and these trees are mulched as part of the cutting process. The mulch resulting from this tree clearing will be distributed evenly across the same areas where the trees are removed. Larger trees and limbs that are unsuitable to be mulched, or in areas where the tracked skid steer could create surface disturbance due to wet or unfavorable surface soil conditions, will be hand felled with a chainsaw. The trees that are felled will be cut into eight foot lengths and piled neatly adjacent to the site at the time of the remedial activities, or during the tree cutting activities, as time permits. Trees and limbs will not be bucked into firewood and any mulched wood chips will not be left in stockpiles.

Trees growing in and around excavation areas will be cut flush with the surface. No stump grinding will occur during tree and brush removal activities. Stumps encountered during site prep and excavation activities will be removed and properly disposed using an excavator. Stumps that do not hinder Site activities will be left in place to prevent soil destabilization. Tree cutting will be coordinated with the OHARNG Environmental Office and conducted in accordance with Mobilization and Site Preparation Activities (Section 5.2 of the RD).

Environmental Protection Plan

The Environmental Protection Plan outlined in Section 7 of the RD Work Plan will be followed.

Protection of Natural Resources

Tree and brush cutting restrictions include a prohibition on tree felling and brush cutting of vegetation three inches in diameter and greater between 1 April and 30 September to avoid potential impacts to roosting Northern Long Eared Bats.

There are no formal ground disturbance activities scheduled as part of the tree and brush clearing operations and impacts to streams and wetlands are not anticipated. The tracked skid steer will not be used in areas where it could create surface disturbance due to wet or unfavorable surface soil conditions.

Following the completion of the remedial activities associated with this scope of work, the areas of concern where soil disturbance has been undertaken will be restored using a seed mixture listed in the *OHARNG Approved Grass Seed Mixes For Temporary Cover And Final Site Closures Environmental Procedures dated 2 April 2018.*

We trust this information will meet your requirements. Should you have any questions or wish to discuss this plan in more detail, please contact the undersigned at (403) 269 3501 or via email at chad@ironcreekgroup.com

Kind Regards,

Chad Belenky
President Iron Creek Group Inc.

CC: Nathaniel Peters II, USACE Louisville (1 electronic copy)
Kevin Sedlak, ARNG (1 electronic copy)
Katie Tait, OHARNG (1 electronic copy)
Sarah Meyers, CH2M (1 electronic copy)
Key Rosebrook, CH2M (1 electronic copy)
Roger Richter, Iron Creek (1 electronic copy)

Attachments - Seven (7) Figures

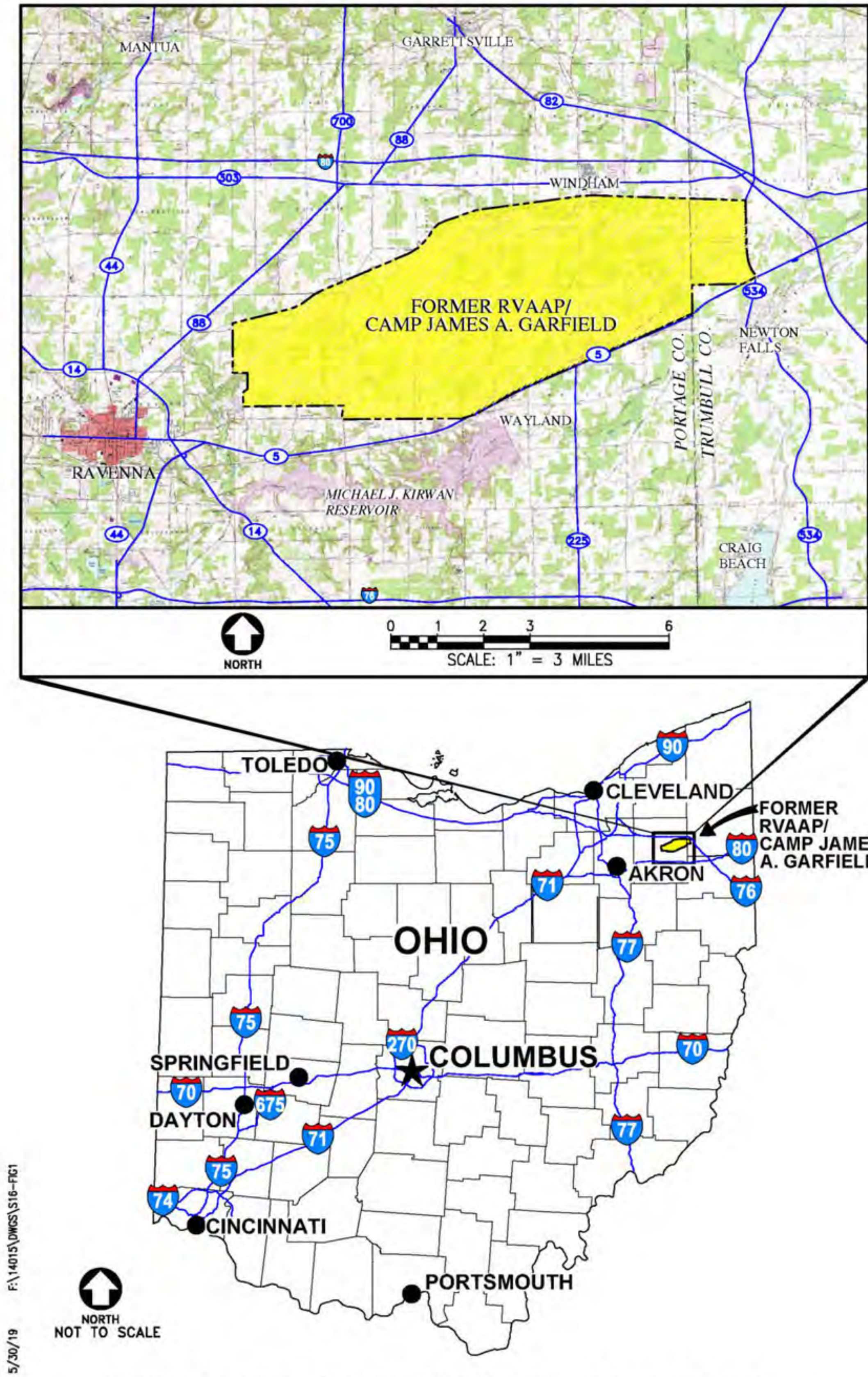


Figure 1. General Location and Orientation of Camp James A. Garfield

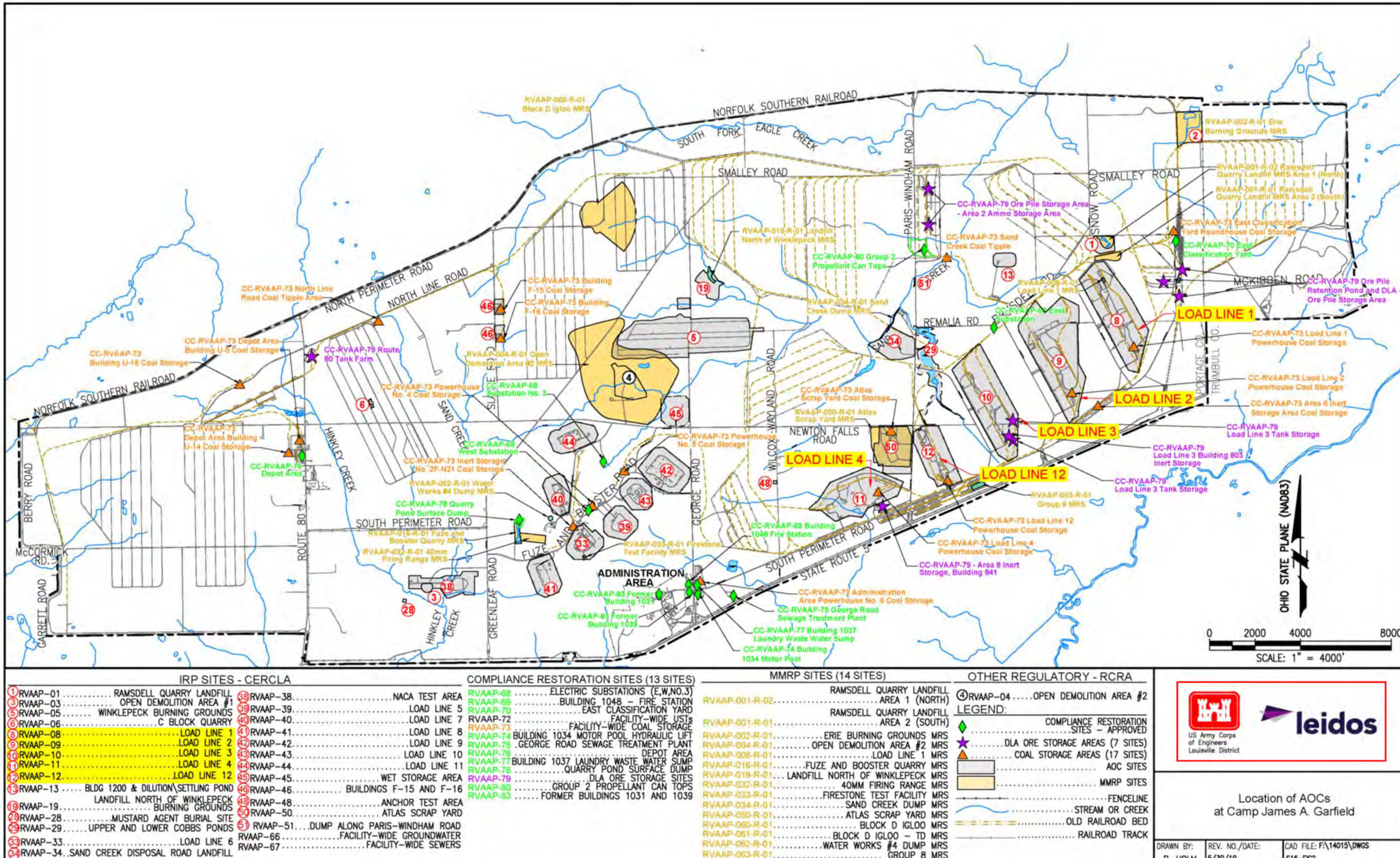
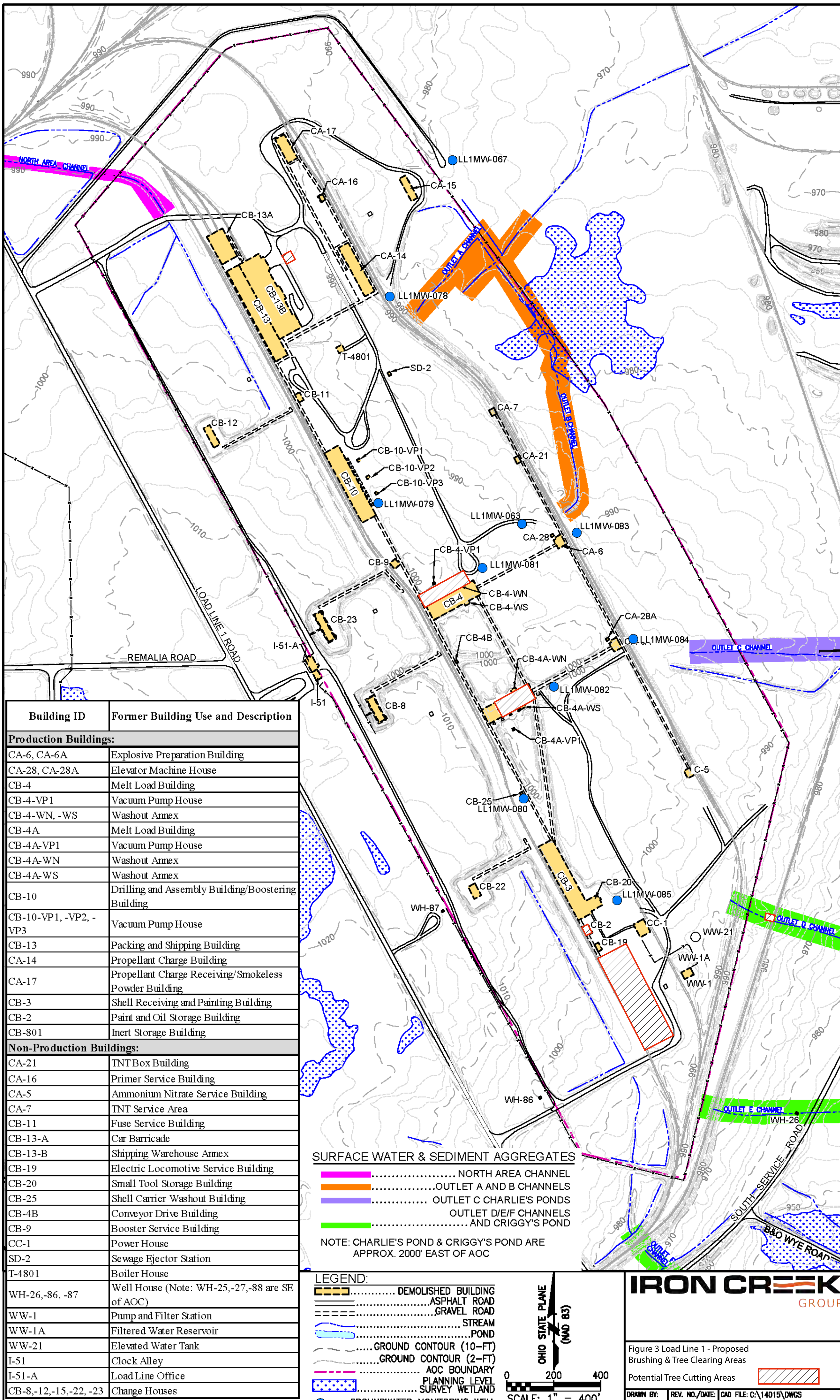
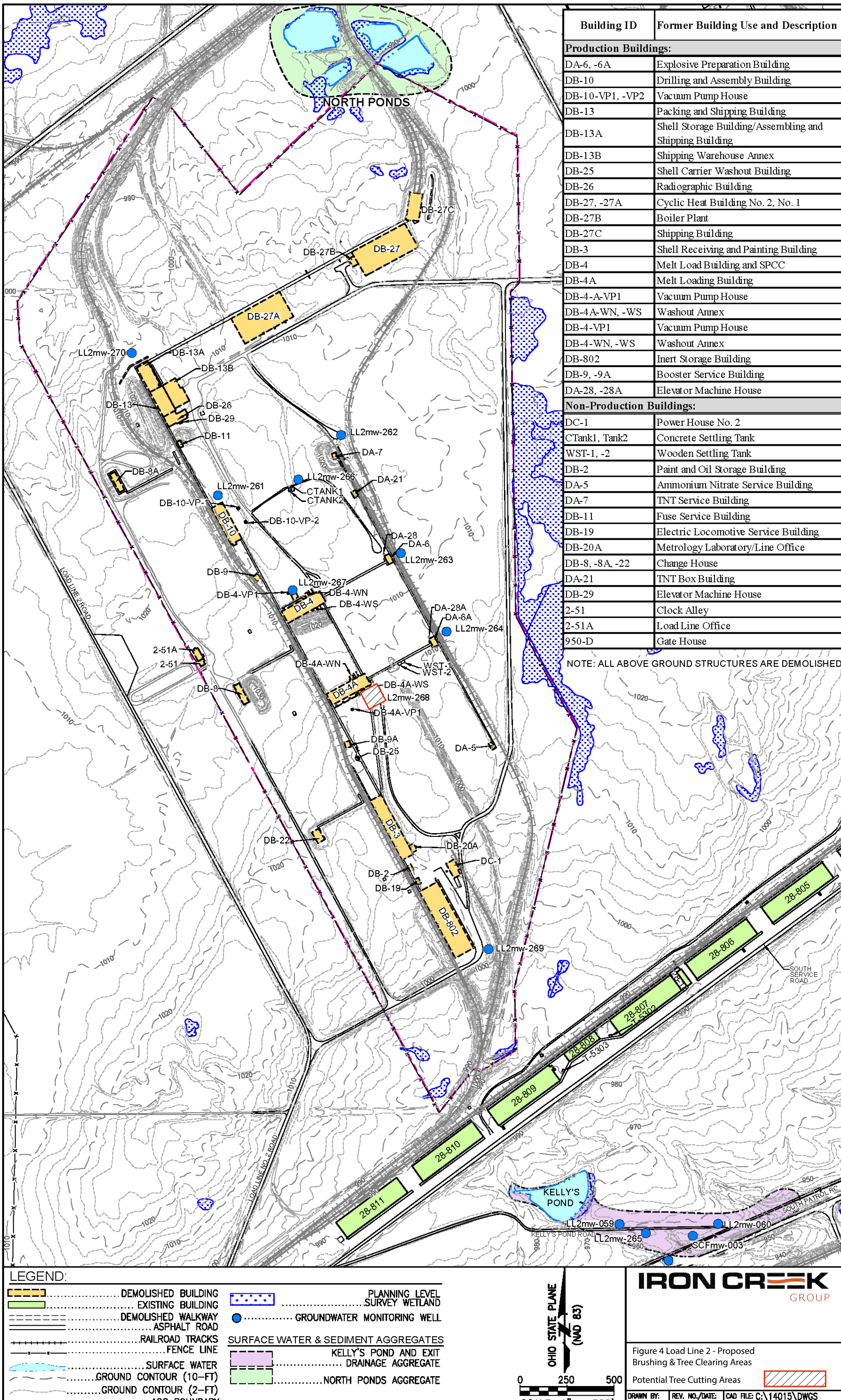


Figure 2. Location of AOCs at Camp James A. Garfield

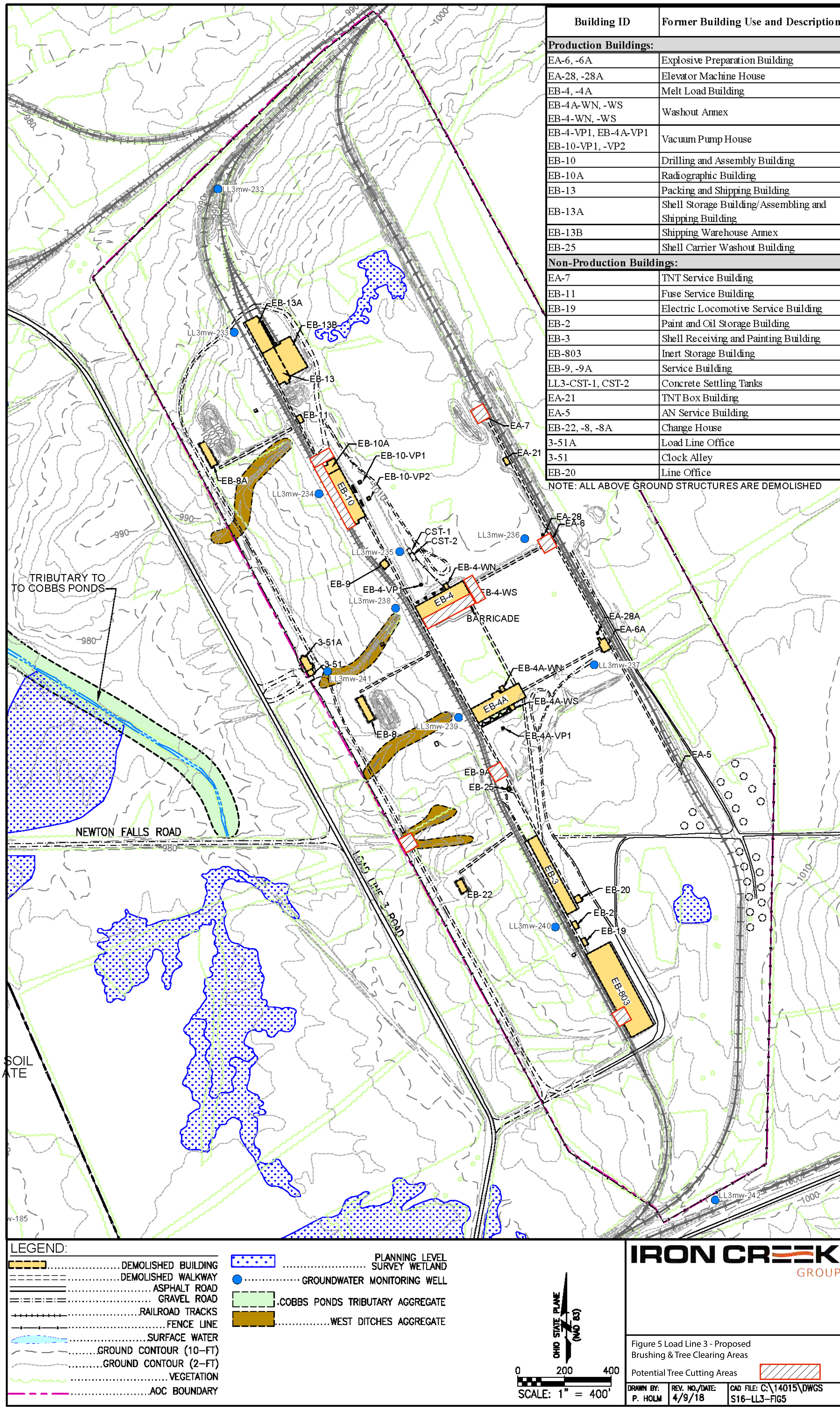


Building ID	Former Building Use and Description
Production Buildings:	
CA-6, CA-6A	Explosive Preparation Building
CA-28, CA-28A	Elevator Machine House
CB-4	Melt Load Building
CB-4-VP1	Vacuum Pump House
CB-4-WN, -WS	Washout Annex
CB-4A	Melt Load Building
CB-4A-VP1	Vacuum Pump House
CB-4A-WN	Washout Annex
CB-4A-WS	Washout Annex
CB-10	Drilling and Assembly Building/Boostering Building
CB-10-VP1, -VP2, -VP3	Vacuum Pump House
CB-13	Packing and Shipping Building
CA-14	Propellant Charge Building
CA-17	Propellant Charge Receiving/Smokeless Powder Building
CB-3	Shell Receiving and Painting Building
CB-2	Paint and Oil Storage Building
CB-801	Inert Storage Building
Non-Production Buildings:	
CA-21	TNT Box Building
CA-16	Primer Service Building
CA-5	Ammonium Nitrate Service Building
CA-7	TNT Service Area
CB-11	Fuse Service Building
CB-13-A	Car Barricade
CB-13-B	Shipping Warehouse Annex
CB-19	Electric Locomotive Service Building
CB-20	Small Tool Storage Building
CB-25	Shell Carrier Washout Building
CB-4B	Conveyor Drive Building
CB-9	Booster Service Building
CC-1	Power House
SD-2	Sewage Ejector Station
T-4801	Boiler House
WH-26,-86, -87	Well House (Note: WH-25,-27,-88 are SE of AOC)
WW-1	Pump and Filter Station
WW-1A	Filtered Water Reservoir
WW-21	Elevated Water Tank
I-51	Clock Alley
I-51-A	Load Line Office
CB-8,-12,-15,-22, -23	Change Houses

NOTE: ALL ABOVE GROUND STRUCTURES ARE DEMOLISHED

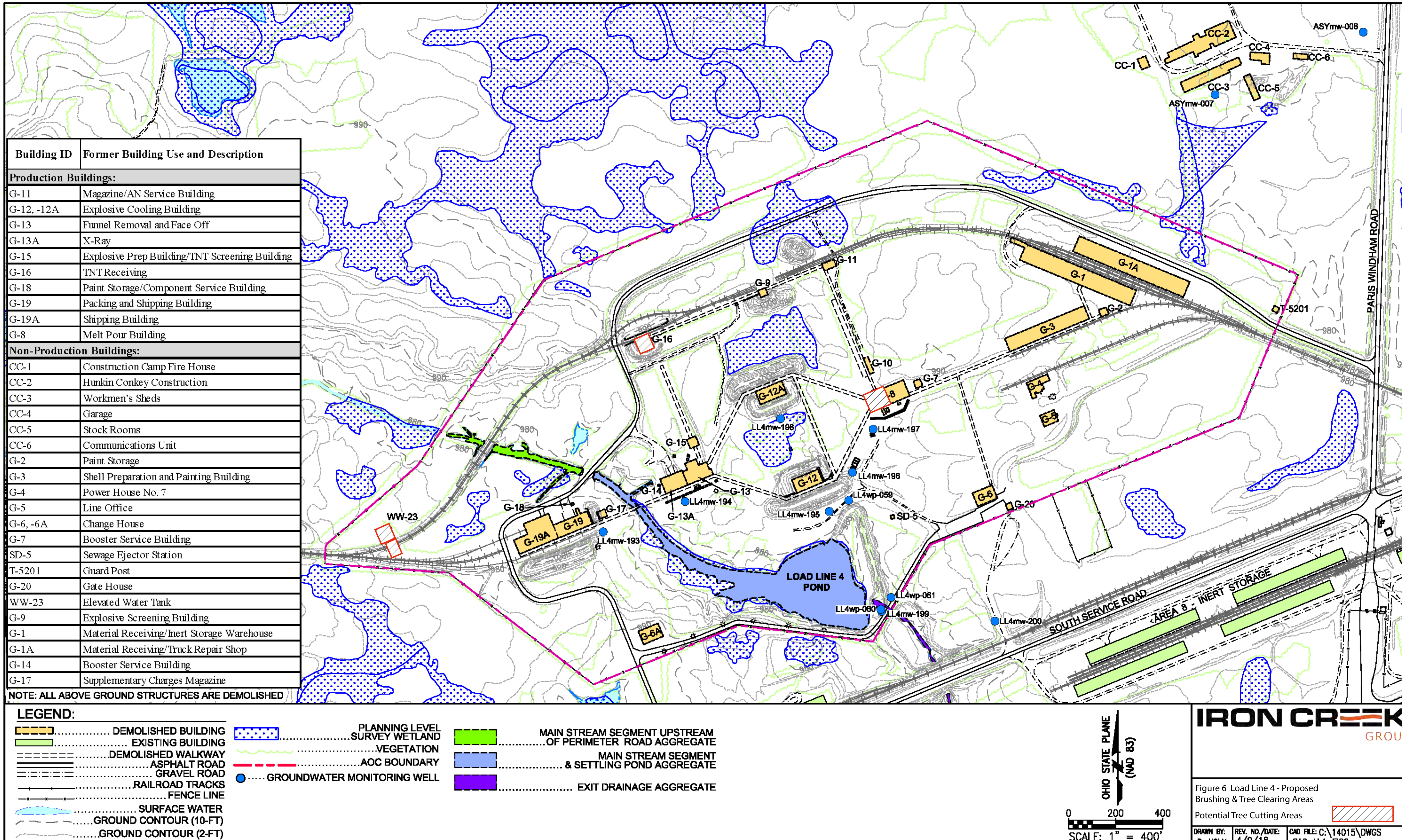


Building ID	Former Building Use and Description
Production Buildings:	
DA-6, -6A	Explosive Preparation Building
DB-10	Drilling and Assembly Building
DB-10-VP1, -VP2	Vacuum Pump House
DB-13	Packing and Shipping Building
DB-13A	Shell Storage Building/Assembling and Shipping Building
DB-13B	Shipping Warehouse Annex
DB-25	Shell Carrier Washout Building
DB-26	Radiographic Building
DB-27, -27A	Cyclic Heat Building No. 2, No. 1
DB-27B	Boiler Plant
DB-27C	Shipping Building
DB-3	Shell Receiving and Painting Building
DB-4	Melt Load Building and SPCC
DB-4A	Melt Loading Building
DB-4-A-VP1	Vacuum Pump House
DB-4A-WN, -WS	Washout Annex
DB-4-VP1	Vacuum Pump House
DB-4-WN, -WS	Washout Annex
DB-802	Inert Storage Building
DB-9, -9A	Booster Service Building
DA-28, -28A	Elevator Machine House
Non-Production Buildings:	
DC-1	Power House No. 2
CTank1, Tank2	Concrete Settling Tank
WST-1, -2	Wooden Settling Tank
DB-2	Paint and Oil Storage Building
DA-5	Ammonium Nitrate Service Building
DA-7	TNT Service Building
DB-11	Fuse Service Building
DB-19	Electric Locomotive Service Building
DB-20A	Metrology Laboratory/Line Office
DB-8, -8A, -22	Change House
DA-21	TNT Box Building
DB-29	Elevator Machine House
2-51	Clock Alley
2-51A	Load Line Office
950-D	Gate House



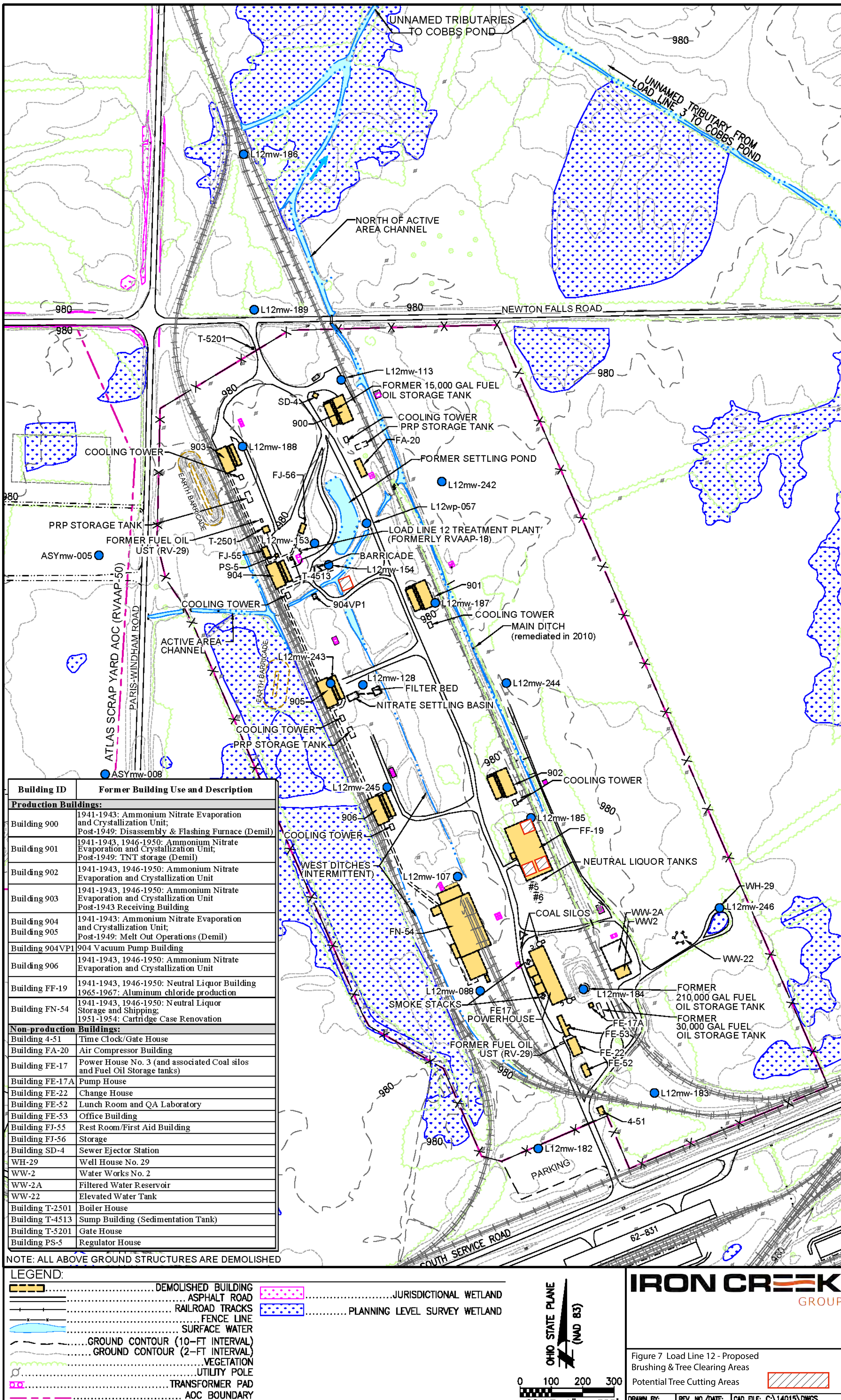
Building ID	Former Building Use and Description
Production Buildings:	
EA-6, -6A	Explosive Preparation Building
EA-28, -28A	Elevator Machine House
EB-4, -4A	Melt Load Building
EB-4A-WN, -WS EB-4-WN, -WS	Washout Annex
EB-4-VP1, EB-4A-VP1 EB-10-VP1, -VP2	Vacuum Pump House
EB-10	Drilling and Assembly Building
EB-10A	Radiographic Building
EB-13	Packing and Shipping Building
EB-13A	Shell Storage Building/Assembling and Shipping Building
EB-13B	Shipping Warehouse Annex
EB-25	Shell Carrier Washout Building
Non-Production Buildings:	
EA-7	TNT Service Building
EB-11	Fuse Service Building
EB-19	Electric Locomotive Service Building
EB-2	Paint and Oil Storage Building
EB-3	Shell Receiving and Painting Building
EB-803	Inert Storage Building
EB-9, -9A	Service Building
LL3-CST-1, CST-2	Concrete Settling Tanks
EA-21	TNT Box Building
EA-5	AN Service Building
EB-22, -8, -8A	Change House
3-51A	Load Line Office
3-51	Clock Alley
EB-20	Line Office

NOTE: ALL ABOVE GROUND STRUCTURES ARE DEMOLISHED



Building ID	Former Building Use and Description
Production Buildings:	
G-11	Magazine/AN Service Building
G-12, -12A	Explosive Cooling Building
G-13	Funnel Removal and Face Off
G-13A	X-Ray
G-15	Explosive Prep Building/TNT Screening Building
G-16	TNT Receiving
G-18	Paint Storage/Component Service Building
G-19	Packing and Shipping Building
G-19A	Shipping Building
G-8	Melt Pour Building
Non-Production Buildings:	
CC-1	Construction Camp Fire House
CC-2	Hunkin Conkey Construction
CC-3	Workmen's Sheds
CC-4	Garage
CC-5	Stock Rooms
CC-6	Communications Unit
G-2	Paint Storage
G-3	Shell Preparation and Painting Building
G-4	Power House No. 7
G-5	Line Office
G-6, -6A	Change House
G-7	Booster Service Building
SD-5	Sewage Ejector Station
T-5201	Guard Post
G-20	Gate House
WW-23	Elevated Water Tank
G-9	Explosive Screening Building
G-1	Material Receiving/Inert Storage Warehouse
G-1A	Material Receiving/Truck Repair Shop
G-14	Booster Service Building
G-17	Supplementary Charges Magazine

NOTE: ALL ABOVE GROUND STRUCTURES ARE DEMOLISHED



Building ID	Former Building Use and Description
Production Buildings:	
Building 900	1941-1943: Ammonium Nitrate Evaporation and Crystallization Unit; Post-1949: Disassembly & Flashing Furnace (Demil)
Building 901	1941-1943, 1946-1950: Ammonium Nitrate Evaporation and Crystallization Unit; Post-1949: TNT storage (Demil)
Building 902	1941-1943, 1946-1950: Ammonium Nitrate Evaporation and Crystallization Unit
Building 903	1941-1943, 1946-1950: Ammonium Nitrate Evaporation and Crystallization Unit Post-1943 Receiving Building
Building 904 Building 905	1941-1943: Ammonium Nitrate Evaporation and Crystallization Unit; Post-1949: Melt Out Operations (Demil)
Building 904VP1	904 Vacuum Pump Building
Building 906	1941-1943, 1946-1950: Ammonium Nitrate Evaporation and Crystallization Unit
Building FF-19	1941-1943, 1946-1950: Neutral Liquor Building 1965-1967: Aluminum chloride production
Building FN-54	1941-1943, 1946-1950: Neutral Liquor Storage and Shipping; 1951-1954: Cartridge Case Renovation
Non-production Buildings:	
Building 4-51	Time Clock/Gate House
Building FA-20	Air Compressor Building
Building FE-17	Power House No. 3 (and associated Coal silos and Fuel Oil Storage tanks)
Building FE-17A	Pump House
Building FE-22	Change House
Building FE-52	Lunch Room and QA Laboratory
Building FE-53	Office Building
Building FJ-55	Rest Room/First Aid Building
Building FJ-56	Storage
Building SD-4	Sewer Ejector Station
WH-29	Well House No. 29
WW-2	Water Works No. 2
WW-2A	Filtered Water Reservoir
WW-22	Elevated Water Tank
Building T-2501	Boiler House
Building T-4513	Sump Building (Sedimentation Tank)
Building T-5201	Gate House
Building PS-5	Regulator House

Appendix B
Propane Tank Inspection Form

Propane Tank Inspection Form
(To Be Conducted Weekly)

X = Okay or fixed **C = Needs to be corrected** **NA = Not applicable**	**DATE**								
INSPECTOR'S INITIALS									
Propane Tank Location ___________________									
Propane ASTs in good condition (i.e. no major rust areas, no dents, no leaks, etc.)									
Contents labeled									
Propane AST is properly secured									
Other combustible materials are located at least 15 feet away from AST									
Proper signage is posted (i.e., No Smoking and Flammable signage)									
Tank valve is clearly tagged, closed properly, and plugged									
Tank structural integrity is inspected at least once per year									

Comments:

____
____
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____
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____

Appendix C
Quality Assurance Project Plan

FINAL

Quality Assurance Project Plan for RVAAP Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12)

Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio

Contract No. W912QR-12-D-0005
Delivery Order No. W912QR19F0952

Prepared for:

U.S. Army Corps of Engineers
Louisville District
600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202

Prepared by:

CH2M HILL CONSTRUCTORS, INC
2411 Dulles Corner Park, Suite 500
Herndon, Virginia 20171

September 2020

Executive Summary

This Quality Assurance Project Plan (QAPP) for the Remedial Design for Load Lines 1, 2, 3, 4, and 12 Using Ex-situ Thermal Treatment Technology, Former Ravenna Army Ammunition Plant Restoration Program, Camp James A. Garfield, Portage and Trumbull Counties, Ohio is intended to be used by CH2M HILL staff and subcontractors who will perform field sampling and provide analytical services. The purpose is to establish requirements to ensure that data are collected, analyzed, and reviewed in a consistent manner so that analytical data of known quality are obtained. This QAPP provides guidance on analytical services and should be used in conjunction with the project-specific documents such as the Project Work Plan and field Standard Operating Procedures (SOPs) that detail the sampling protocols. The format of this QAPP is based on the Uniform Federal Policy-Quality Assurance Project Plan (UFP-QAPP) guidance document where specific UFP Worksheets are provided to define the analytical chemistry and field services program. Worksheets that are not provided are cross referenced back to the project Work Plan. The following table details a cross reference of all UFP-QAPP required Worksheets and where the associate detail they would define can be found.

Worksheet #	Title	Location
#1 and #2	Title and Approval Page	Project Work Plan
#3 and #5	Project Organization and QAPP Distribution	Project Work Plan
#4, #7 and #8	Personnel Qualifications and Signoff Sheet	Project Work Plan
#6	Communication Pathways	Project Work Plan
#9	Project Scoping Session Participants Sheet	Project Work Plan
#10	Conceptual Site Model	Project Work Plan
#11	Project/Data Quality Objectives	Split details, Project Work Plan and the QAPP
#12	Measurement Performance Criteria	QAPP
#13	Secondary Data Criteria and Limitations	Project Work Plan
#14 and #16	Project Tasks and Schedule	Split details, Project Work Plan and the QAPP
#15	Reference Limits and Evaluation	QAPP
#17	Sampling Design and Rationale	Project Work Plan
#18	Sampling Locations and Methods	QAPP
#19 and #30	Sample Containers, Preservation, and Hold Times	QAPP
#20	Field Quality Control Sample Summary	QAPP
#21	Project Sampling Standard Operating Procedure References	QAPP
#22	Field Equipment Calibration, Maintenance, Testing, and Inspection	N/A
#23	Analytical Standard Operating Procedure References	QAPP

Worksheet #	Title	Location
#24	Analytical Instrument Calibration	QAPP
#25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	QAPP
#26 and #27	Sampling Handling, Custody, and Disposal	QAPP
#28	Laboratory Quality Control Sample Summary	QAPP
#29	Project Documents and Records	QAPP
#31, #32 and #33	Assessments and Corrective Actions	QAPP
#34	Data Verification and Validation Inputs	QAPP
#35	Data Verification Procedures	QAPP
#36	Data Verification Procedures	QAPP
#37	Data Usability Assessment	QAPP

Contents

Figures (compiled at the end of the document)

Attachments

Tables

Abbreviations and Acronyms

%	percent
%D	percent difference
%R	percent recovery
<	less than
>	more than
≤	less than or equal to
≥	more than or equal to
A2LA	American Association of Laboratory Accreditation
ADR	automatic data review
APP	Accident Prevention Plan
ASTM	ASTM International (formerly the American Society for Testing and Materials)
BaP	benzo(a)pyrene
BbF	Benzo(b)fluoranthene
CAS	Chemical Abstracts Service
CCB	continuing calibration blank
CC	continuing calibration
CCV	continuing calibration verification
CD	compact disc
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH2M	CH2M HILL, Inc.
Chemtech	Chemtech Laboratory
COC	contaminant of concern
COR	Contracting Officer's Representative
cs	confirmation sample
CT	CT Laboratories LLC
CY	cubic yard(s)
DA	dibenz(a,h)anthracene
DL	detection limit
DNT	dinitrotoluene
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	data quality objective
DU	decision unit
DVD	digital versatile disc
ECD	electron capture detector
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ER	equipment rinsate
ETC	enhanced thermal conduction
FD	field duplicate
FS	Feasibility Study
FSOP	Field Standard Operating Procedure
FTL	Field Team Leader

GC	gas chromatography
GPS	global positioning system
HAZWOPER	hazardous waste operations and emergency response
HCL	hydrochloric acid
HDOH	Hawai'i Department of Health
HPLC	high-performance liquid chromatography
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICS	interference check solution
ICS-A	interference check solution, absolute concentration value for all nonspiked project analyte
ICS-AB	interference check solution, within ± 20 percent of true value
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
ISM	incremental sampling methodology
ITR	Independent Technical Reviewer
ITRC	Interstate Technology Research Council
L	liter
LCL	lower confidence limit
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LDC	Laboratory Data Consultants
LDR	linear dynamic range
LLC	limited liability company
LOD	limit of detection
LOQ	limit of quantitation
LSOP	laboratory standard operating procedure
MD	matrix duplicate
MPC	measurement performance criteria
MS	matrix spike or mass spectrometry or Master of Science
MSD	matrix spike duplicate
N/A	not applicable
NIST	National Institute Standards and Technology
PAH	polycyclic aromatic hydrocarbon
PAL	project action level
PARCCS	precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB	polychlorinated biphenyl
PDF	portable document format
PDS	post-digestion spike
PM	Project Manager
PP	Proposed Plan
PQO	project quality objective
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control

QSM	Quality Systems Manual
RACR	Remedial Action Completion Report
RD	Remedial Design
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	remedial investigation
ROD	Record of Decision
RPD	relative percent difference
RRT	relative retention time
RSD	relative standard deviation
RT	retention time
RVAAP	Former Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SEDD	Stage 2A electronic data deliverable
SO	soil
SOP	standard operating procedure
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STC	Senior Technical Consultant
SVOC	semivolatile organic compound
TAT	turnaround time
TBD	to be determined
TCLP	toxicity characteristic leaching procedure
TNT	trinitrotoluene
UCL	upper confidence limit
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

Worksheet #11—Project and Data Quality Objectives

Project Quality Objectives

Project quality objectives (PQOs) define the type, quantity, and quality of data that are needed to answer project-specific questions and support project-specific decisions.

Who will use the data?

U.S. Army stakeholders (USACE, Army National Guard, and Ohio Army National Guard), Ohio Environmental Protection Agency and CH2M will use the data to support the project-specific decisions to be made, as outlined in this QAPP and the project Work Plan.

What will the data be used for?

The Former Ravenna Army Ammunition Plant (RVAAP) Installation Restoration Program has identified several areas of concern at Camp James A. Garfield which need to have soil remediated for various man-made organic contaminants, with polycyclic aromatic hydrocarbons (PAHs) being the predominant contaminants at several areas of concern. Also, of concern are metals and Polychlorinated biphenyls (PCBs). Industrial operations at the former RVAAP consisted of 12 munitions-assembly facilities referred to as "load lines." All buildings and Load Lines 1, 2, 3, 4, and 12 have been demolished.

Excavation confirmation samples will be collected to confirm the removal of contaminated soil to below the applicable cleanup goals for the Industrial Receptor in the Record of Decision (ROD) Amendment (also see Table 4-1 of the Remedial Design [RD] Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the contaminants of concern (COCs) applicable to each planned excavation).

Treatment verification samples will be collected to confirm that thermal desorption of contaminated soils has removed target contamination to below the applicable Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation).

Disposal characterization samples will be collected to meet disposal requirements for soil from metals-contaminated planned excavations and for liquid investigation derived waste (IDW) if off-site disposal is needed.

What types of data are needed?

Soil samples will be collected and analyzed for specific target compounds, as defined in Worksheet #15 and Worksheet #18. Field sampling will be conducted using the methods included in Worksheet #21. Analytical methods will follow laboratory standard operating procedures (SOPs) defined in Worksheet #23. The sampling design and rationale are presented in the project Work Plan.

How "good" should the data be in order to support the environmental decision?

Laboratory analytical methods are planned to be definitive quality data. Definitive data are defined as data that are suitable for final decision making. The comparison of detected concentrations against project-specific screening levels (see Table 15-1) will be used to support the project-specific decisions. Data are generated using rigorous analytical methods, in this case, approved EPA SW846 reference methods for chemistry parameters (provided in Worksheets #19 and #30. Definitive data are not restricted in their use unless quality problems require data qualification resulting in unusable data. Data of definitive quality are needed to evaluate potential human health and ecological risks. Field analytical results will be considered screening level data quality, qualitative, and less rigorous than definitive data.

How much data are needed? Where, when, and how should the data be collected/generated?

The sampling design and rationale are presented in the project Work Plan. Worksheet #18 summarizes the number of samples and the analytical parameters necessary to assess confirmation sample concentrations. SOPs for field sampling and analytical procedures are discussed in Worksheets #21 and #23. Fieldwork is planned to begin as early as August 2020 and will follow the site-specific safety procedures outlined in the Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP).

Who will collect and generate the data?

CH2M will collect the data on behalf of USACE. Soil samples will be submitted for analysis to CT Laboratories LLC (CT) in Baraboo, Wisconsin where a 7-day turnaround time (TAT) for laboratory analysis fits the scope. For treatment verification samples that require a 48-hour TAT of PCBs and/or PAHs, samples will be sent to Chemtech Laboratory (Chemtech) in Mountainside, New Jersey. Quality assurance (QA) split samples will be collected and sent to a laboratory to be determined (TBD) by USACE. CH2M will collect all samples and ship to both the primary laboratory (CT), as well as the QA split lab (TBD by USACE). Each of these laboratories is certified for each method and analyte through the U.S. Department of Defense (DoD) Environmental Laboratory Analytical Program (ELAP).

Data will be managed by CH2M. The results of QA split samples will not be validated but will be assessed for precision between the primary laboratory data and a technical memorandum developed to describe the results of that evaluation.

How will the data be reported? How will the data be archived?

Analytical data will be reported in both hard copy and electronically. Hard copy analytical data will meet reporting requirements defined in Worksheet #29. The laboratory will verify that the electronic data quality, content, and format comply with the latest Stage 2A electronic data deliverable (SEDD) requirement files A1 and A3. The USACE's Automated Data Review (ADR) software tool will be used to validate the analytical data. In addition, after ADR is complete, an Army Environmental Data Management System compatible file will be exported directly from ADR and provided to load to the Ravenna Environmental Information Management System.

CH2M will store hard copy and electronic data, as well as project records, for 5 years after project completion. Project reports will be archived on CD or DVD media and stored in the project file and will be available from CH2M.

Data Quality Objectives

The structure of the data quality objective (DQO) process provides an effective planning tool that can save resources by making data collection operations more effective and complete to meet overall project objectives.

DQOs are created based on establishing scientifically sound data that will address the overall problem to be solved and include the purpose and media for sample collection, the analytical detection limits (DLs) necessary to support planned data screening or comparisons to appropriate regulatory benchmarks, QA/QC needs, and knowledge of existing data and project data gaps. Complete DQOs will allow for the end result of the project to address the original problem to be solved to reach a previously agreed upon project closure point.

The DQO process consists of seven iterative steps. Each step defines criteria that will be used to establish the final data collection design. The seven steps are as follows:

1. State the problem to be resolved.
2. Identify the decisions to be made.
3. Identify the inputs to the decisions.
4. Define the boundaries of the study.
5. Develop a decision rule.
6. Specify the tolerable limits on decision errors.
7. Optimize the design for obtaining the data.

DQOs for sampling are provided in Tables 11-1 through 11-3.

Table 11-1. DQO #1 – Excavation Delineation

Step 1 – Statement of Problem: The extent of soil exceeding the industrial cleanup goals at the planned excavation locations requires confirmation of COC concentrations after excavation.

Step 2 – Identify the Goals of the Study: Excavate soil at the planned excavation locations until the sidewalls and bottom of the excavation do not exceed the industrial cleanup goals.

Step 3 – Identify Information Inputs: Previous investigations at the Load Lines identified human health risk from COCs in surface and subsurface soil at Load Lines 1, 2, 3, 4 and 12 for likely future land use (for example, commercial/industrial). ROD Amendment (Leidos, 2019) identifies ex situ thermal treatment of soil at the planned excavation locations as part of the selected remedy to reduce the risk and be protective of human health.

Step 4 – Define the Boundaries of the Study: The remedial action will remove soil from 24 planned excavation locations at Load Lines 1, 2, 3, 4 and 12 identified in the ROD Amendment (see RD Work Plan Table 2-1 and Figures 3 to 7). Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation using ISM to confirm that soils exceeding the industrial cleanup goals have been successfully removed. The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.

Step 5 – Develop the Analytical Approach: In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP). An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM **field** primary, duplicate and triplicate data evaluations. An RSD/RPD of less than or equal to 20% will be the goal for ISM **laboratory** subsample replicates (triplicates for explosives, duplicates for PAHs and PCBs; one per laboratory batch of up to 20 samples for each analytical group).

Laboratory results will be compared to applicable industrial receptor cleanup goals in ROD Amendment (see Table 4-1 of RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional excavation will be conducted at locations with exceeding results until cleanup goals are met. Analytical data quality will be evaluated per this QAPP. The analytical methods specified in this QAPP will provide the lowest available detection limits using standard methods that will allow the data to be screened against the cleanup goals.

Step 6 – Specify Performance or Acceptance Criteria: All sample locations are known in accordance with the ROD Amendment and RD Work Plan which define soil removal boundaries for confirmation. Any soil removal beyond planned boundaries will be completed until industrial cleanup goals are met. Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed on known quality to meet project objectives as defined in Worksheet 36.

In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample replicates will be submitted to Ohio EPA for review of the following DQOs:

- For ISM laboratory subsample replicate results greater than the LOQ (triplicates for explosives, duplicates for PAHs and PCBs; one per laboratory batch of up to 20 samples for each analytical group), an RPD or RSD, as applicable, of less than or equal to 20% as a goal. If this DQO is not met, a J-flag will be applied to the associated data.
- For the field ISM triplicates, an RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into sample data evaluations. If this DQO is not met for the ISM field triplicate samples, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 "Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016):

Table 11-1. DQO #1 – Excavation Delineation (continued)

Good Precision (RSD <35%)

- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Data can be used for confirmation purposes without the need for additional sampling, if cleanup goals are met.

Moderate Precision (RSD >35% but <50%)

- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.);
- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Additional confirmation sampling recommended following remediation of decision units (DUs) that exceed cleanup goals, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Poor Precision (RSD >50% but <100%)

- Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report;
- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Compare the 95% UCL (Chebyshev method) for replicate data to 150% of the cleanup goal for decision making;
- Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Very Poor Precision (RSD >100%)

- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;
- Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;
- If one or more of the replicate samples exceeds the cleanup goal then remediation of the DU should be considered, even if the mean concentration is well below the cleanup goal. Remediation of associated DUs where replicate samples were not collected should also be considered;
- If all replicate samples are below the cleanup goal, then compare the 95% UCL (Chebyshev method) for replicate data to the unadjusted cleanup goal for decision making;
- If all replicate samples are below the cleanup goal, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to unadjusted cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the attached SOP, *Incremental Sampling for Surface Soil*. A systematic random sampling scheme will be used in selecting the aliquot sampling locations for each sidewall and the excavation bottom to ensure that the aliquots are spread out relatively equally. This will be accomplished by gridding the bottom and the contaminated interval of each sidewall into approximately equally sized grids, and then collecting an aliquot from the sidewall/bottom surface at the center of each grid. If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). The duplicate and triplicate aliquots will be placed in separate containers to be submitted to the laboratory.

The results will be compared to the Industrial cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP). Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days.

If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6.

Table 11-1. DQO #1 – Excavation Delineation (continued)

Step 7 – Develop the Detailed Plan for Obtaining Data (continued):

If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled.

If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if a field replicate sample exceeds an applicable cleanup goal. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the cleanup goals, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR.

Once an excavation meets the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil excavated/treated.

Table notes:

CH2M =CH2M HILL Constructors, Inc.
COC = contaminant of concern
COR = Contracting Officer's Representative
DoD = U.S. Department of Defense
ISM = incremental sampling methodology
ITRC = Interstate Technology Research Council
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
RSD = relative standard deviation

Table 11-2. DQO #2 – Treatment Verification

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for PCBs, PAHs and/or explosives will be excavated and undergo ex-situ thermal treatment to meet the cleanup goals.

Step 2 – Identify the Goals of the Study: Confirm that treated soil meets the applicable cleanup goals before being placed back in the excavations as backfill.

Step 3 – Identify Information Inputs: Treated soil will be analyzed for the applicable COCs at a rate of approximately one composite sample per 150 cubic yards (CY) of treated soil.

Step 4 – Define the Boundaries of the Study: Treatment verification sampling will be performed for soil excavated from the planned excavations and treated in the ex situ Enhanced Thermal Treatment cell. Individual treatment cells will be segregated by COCs to facilitate treatment verification sampling and material management based on varying analytical TATs. The temporal boundary for the thermal desorption does not apply.

Step 5 – Develop the Analytical Approach: Treatment verification samples will be collected from treated soil at a rate of approximately one sample per 150 CY of treated soil. Treatment verification samples will be analyzed for the COCs associated with a particular batch of treated soil, based on the excavation from which the soil came as shown on Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP.

The laboratory results will be compared to Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional thermal treatment will be conducted until the cleanup goals are met.

Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed to be of known quality to meet project objectives as defined in Worksheet 36.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide Sampling and Analysis Plan (SAP) for Environmental Investigations (Leidos, 2011), the RD Work Plan and this QAPP. One composite treatment verification sample will be collected per 150 CY of treated soil. As each ETC treatment cell contains approximately 500 CY, the cell will be divided into quadrants for sampling and one composite treatment verification sample will be analyzed from each quadrant. After the soil achieves the target treatment temperature and the burners are disconnected, Iron Creek will utilize the excavator bucket to expose the soil in an approximately 4-foot by 6-foot area to a depth of approximately one foot in each quadrant in order to collect the treatment verification sample. While all of the soil will reach the target treatment temperature, the soil in the outer layer of the quadrant is farthest from the heating elements and therefore will reach the target treatment temperature last. Therefore, sampling the outer layer of soil is most conservative for treatment verification. Decontaminated or disposable sampling tools will be used to collect aliquots of approximately equal volume from 10 locations within the 4-foot by 6-foot by 1-foot exposed area. Each aliquot will be placed in a decontaminated stainless steel bowl to allow for further cooling. The aliquots will then be homogenized and placed into laboratory containers for analysis of the applicable COCs (see Table 2-1 of the RD Work Plan).

Treatment verification samples for explosives will be submitted for laboratory analysis with projected turnaround time of 7 days. Treatment verification samples for soil from locations with PAHs and/or PCBs only are planned for laboratory analysis with projected turnaround time of 48 hours.

If a treatment verification sample meets the applicable cleanup goals, then the associated soil will be cleared by CH2M for use as backfill. If a treatment verification sample exceeds an applicable cleanup goal, then the excavator bucket will be used to expose another approximately 4 by 6 by 1-foot area in the outer layer of the quadrant and a second treatment verification sample will be collected for analysis of the COC that exceeded the cleanup goal.

Depending on the magnitude of the exceedance, the second composite treatment verification sample may be collected immediately for analysis of the COC that exceeded the cleanup goal in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected) or the active heating system may be turned on again to further treat the soil prior to collecting the second treatment verification sample. This decision will be based on the professional judgement of the system operator. Should a quadrant not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling. This process will be repeated until the quadrant meets the applicable cleanup goals. The CH2M CM/FQM will review the sampling results and provide approval before the material can be used as backfill.

Table notes:
CH2M = CH2M HILL Constructors, Inc.
COC = contaminant of concern
CY = cubic yard
DoD = U.S. Department of Defense
ETC = enhanced thermal conduction
PAH = polycyclic aromatic hydrocarbon(s)
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB = polychlorinated biphenyl(s)
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RA = remedial action
RD = remedial design
ROD = Record of Decision
TAT = turnaround time

Table 11-3. DQO #3 – Disposal Characterization for Metals-Impacted Soils

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for metals will be excavated for off-site disposal and waste profile information is needed.

Step 2 – Identify the Goals of the Study: Characterize the excavated metals-impacted soils for off-site disposal as IDW.

Step 3 – Identify Information Inputs: The ROD Amendment identified human health risk for commercial/industrial land use due to antimony and lead, or lead only, at four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4). ROD Amendment (Leidos, 2019) identifies off-site disposal of metals-impacted soil as part of the selected remedy to reduce the risk and be protective of human health. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Step 4 – Define the Boundaries of the Study: Metals-impacted soils will be excavated from four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4) as shown on RD Work Plan Table 2-1 and Figures 3 and 6). The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.

Step 5 – Develop the Analytical Approach: One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Laboratory results will be provided to the Transportation and Disposal subcontractor who will coordinate with an appropriate disposal facility to obtain approval of the material prior to transporting the excavated soil off-site. Based on generator knowledge, it is expected that these soils will be characterized as nonhazardous. Analytical data quality will be evaluated per this QAPP.

Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. IDW data will not be validated.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide SAP (Leidos, 2011), the RD Work Plan and this QAPP. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Table notes:

DoD = U.S. Department of Defense
IDW = investigation derived waste
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCBs = polychlorinated biphenyls
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
SVOC = semivolatile organic compound
TCLP= toxicity characteristic leaching procedure
VOC = volatile organic compound

Worksheet #12—Measurement Performance Criteria

Measurement performance criteria (MPC) were established for the analytical parameters of the project. The MPCs relate to data quality indicators consisting of precision, accuracy, representativeness, comparability, completeness, and sensitivity, commonly referred to as precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters. Refer to the following worksheets for the required information in Worksheet #12:

- Worksheet #15 (*Reference Limits and Evaluation*) for analytical detection levels as well as associated screening level objectives.
- Worksheet #24 (*Analytical Instrument Calibration*) and Worksheet #28 (*Analytical Quality Control and Corrective Action*) for the requirements of laboratory QA/QC activities for soil analytical methods
- Worksheet #35 (*Data Verification Procedures*) and Worksheet #36 (*Data Validation Procedures*) for data review and validation process
- Worksheet #37 (*Data Usability Assessment*) for PARCCS parameters

The quality of the data for this project will be verified using appropriate MPCs established for both sampling procedures and analytical methods. The MPCs follow those defined in the DoD Quality System Manual (QSM) Version 5.1.1 (DoD and DOE 2018), and the referenced EPA method and laboratory SOPs for parameters not included in the QSM. The sampling procedures and the quality of the laboratory results will be evaluated for compliance with the project-specific DQOs through a review of overall PARCCS, in accordance with procedures described in Worksheet #37. The results will be summarized in a data quality report, developed to include forms and tables as part of the ADR system.

Worksheets #14 and #16—Project Tasks and Schedule

Worksheets #14 and #16 (combined) provide an overview of project tasks as the outcome of project scoping activities and includes a project schedule. The following project tasks are discussed in the project Work Plan Section 5:

- Pre-mobilization activities
- Mobilization and site preparation
- Excavation
- Treatment cell pile construction
- Thermal treatment operations
- Confirmation sampling
- Material handling and transport
- Backfill and restorations

The following subsections detail project activities not detailed in the project Work Plan.

Decontamination Procedures

Non-dedicated equipment used for field sampling will be decontaminated before and during sampling activities. This includes parts that come in contact with soil, tooling, and soil sampling equipment. Large pieces of equipment and tooling including heavy equipment for soil excavation will be decontaminated within a decontamination pad constructed at an area designated by the field team. Equipment (including undedicated sampling equipment) will be decontaminated in designated wash and rinse containers located adjacent to the sample location. At the end of each day, the decontamination fluids will be transferred to the drum staging area.

Sampling Equipment

Non-dedicated sampling equipment will be decontaminated in the field before sampling and between sampling locations. To the extent possible, dedicated or disposable sampling equipment will be used. The following decontamination steps will be taken for non-dedicated (reusable) equipment:

- Alconox detergent wash
- Distilled water rinse
- Air drying

If the equipment is not to be used soon, it must be stowed in such a manner to minimize potential cross contamination. Decontamination fluids will be handled in accordance with the “Investigation Derived Waste Management” section below.

Investigation-Derived Waste Management

IDW will be managed in accordance with Section 8 of the *Facility-Wide* SAP (Leidos, 2011). Minimal decontamination fluids are expected. Decontamination fluids will be stored in either labeled, U.S. Department of Transportation-approved, 55-gal closed-top drums or in approved polyethylene storage containers as needed. The minimal decontamination fluids from proposed excavations that are being thermally treated can be added to the excavated soil for thermal treatment. The minimal decontamination fluids expected from proposed excavations for metals contamination can be added to metals-contaminated soil for off-site disposal.

Laboratory Analysis

Samples will be analyzed by methods as defined in Worksheet #15.

CT Laboratories is the primary laboratory and will analyze the majority of the soil samples. Chemtech Laboratory will support expedited TAT for some treatment verification sample analyses. As stated previously, the QA Split laboratory is yet to be determined by USACE. The QA laboratory will analyze 10 percent of the samples collected for the same parameters as defined in Worksheet #15. Each laboratory holds a current DoD ELAP certification for the required methods. The laboratory analyses will be performed in accordance with the analytical methods, this UFP-QAPP, and the laboratory SOPs as defined in Worksheet #23.

Laboratory TAT for the analytical data will be planned for 7 calendar days for excavation confirmation samples.

Laboratory TAT for the analytical data will be planned for 7 calendar days for treatment verification samples from planned excavations with explosives contamination; however, because the explosives method SW8330B requires air drying of samples prior to any preparation and analysis, there could be delays in meeting the requested TAT. Therefore, the project planning for excavation will make every effort (if possible) to work the explosives contaminated lines in a way that could allow a longer TAT for data.

To help project planning Chemtech Laboratory has been incorporated to provide 48-hour TAT for treatment verification samples from planned excavations with PAH- and/or PCB-only contamination.

Data Management, Review, and Usability

Data Management

Hard copy and electronic data (field and laboratory) will be tracked, stored, handled, and managed. Field activities will be recorded in project logbooks and on the applicable standard field forms as indicated in Worksheet #21. Site maps will be maintained, and sample locations will be updated on the maps as necessary. Field and analytical data will be consolidated and maintained within an electronic database management system. The database management system will be used to perform sample tracking, storage of electronic data, validation of data, querying data for analysis, and preparation of final data tables.

Documents and Records

Project-related data, including field logs, survey information, field forms, chain-of-custody forms, correspondence, and project reports will be maintained in hard copy and/or electronic format (for example, PDF) at the CH2M office in Herndon, Virginia.

Data Review

A three-step data review process (consisting of verification, validation, and usability assessment) will be employed to examine the collected data so that only scientifically sound data of known and documented quality are used to make environmental decisions. Worksheets #34 through #37 describe the process and criteria in detail. The data process will incorporate the U.S. Army ADR data management system as part of the validation and verification process. Electronic data will be loaded to ADR from a SEDD 5.2, 2A format deliverable. Once loaded, the ADR process and associated CH2M manual validation efforts will be completed. The CH2M manual process will address any method detail of a Stage 2B validation scope that cannot be automated by the ADR tool, such as the review of calibration records.

The analytical data obtained will undergo data validation by a qualified CH2M chemist according to the specifications provided in Worksheet #36. In addition, a minimum of 10 percent of the data will undergo a Stage 4 review by a qualified third-party contractor, Laboratory Data Consultants (LDC). Full documentation of the data validation process and the results will be provided in an appendix to the Remedial Action Completion Report (RACR). All data tables and reports will be those used by default from the ADR system.

Data Usability

The data usability assessment is an evaluation based on the results of data validation in the context of the overall project decisions and objectives. The assessment is used to determine whether the project execution and resulting data meet the project DQOs for sampling and analysis. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data. Worksheet #37 describes the process in detail.

As part of the data usability assessment, field data will be compiled from field logs and presented in the RACR listing the sampling details, field observations, and field parameter measurements.

Before data presentation and evaluation, analytical data will be processed to identify the "best result" for a given sample based on unique location, time, medium, and depth. The best result will then be used to compare to the applicable project action levels (PALs), to evaluate the nature and extent of contamination, and determine achievement of project objectives. Best result processing is needed to produce a single representative value for each sample because of multiple records that may result from field duplicates (FDs).

A protocol has been developed that will be used to identify the best result for each sample in the project database, using the following general logic:

- If all results for a given sample are qualified as detected, then the maximum detected result is selected as best result.
- If some results for a given sample are qualified as detected and some qualified as nondetected, then the maximum detected result is selected as best result.
- If all results for a given sample are qualified as nondetected, then the result with the lowest limit of quantitation (LOQ) is selected as the best result.
- If not rejected, flagged data will be used in the same way as the non-flagged data.

Reporting

Remedial Action Completion Report and Schedule

A RACR will be prepared as defined by the project Work Plan. Project schedule is also presented in the project Work Plan.

Worksheet #15—Reference Limits and Evaluation

One of the primary goals of the project-specific QAPP is to select appropriate analytical methods to achieve DLs, limit of detections (LODs), and/or limits of quantitation (LOQs) that will satisfy the overall project DQOs (as defined in the project Work Plan).

To determine whether the DL, LOD, and LOQ will meet the analytical DQOs, the DLs, LODs, and LOQs are compared to the following PALs:

Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan)

Table 15-1 shows the PALs for soil samples with respect to the current laboratory analytical DL, LOD, and LOQ for each listed target compound. Analytical methods with the lowest possible LOQs have been selected in order to meet the PALs.

Note that sample dilution because of target and or non-target compound concentrations or matrix interference may prevent DLs, LODs, or LOQs from being achieved. The samples must be initially analyzed undiluted when reasonable. If a dilution is necessary, both the original and diluted result must be delivered. Samples that are not analyzed undiluted must be supported by matrix interference documentation such as sample viscosity, color, odor, or results from other analyses of the same sample to show that an undiluted sample is not possible.

Table 15-1. Soil Target Analytes, Detection levels, Control Limits and Screening Level Objectives

Method	Analyte	CAS ID	Unit	Cleanup Goals [a]	Detection Limit	Limit of Detection	Limit of Quantitation	Lower Control Limit [b]	Upper Control Limit [c]	Relative Percent Difference
CT Laboratories										
SW6010C	Antimony	7440-36-0	mg/kg	470	0.13	0.4	0.8	79	114	20
SW6010C	Lead	7439-92-1	mg/kg	800	0.04	0.125	0.25	81	112	20
SW8082	Aroclor-1254	11097-69-1	µg/kg	9,700	9	20	30	40	140	30
SW8082	Aroclor-1260	11096-82-5	µg/kg	9,900	6	20	30	60	130	30
SW8082	Decachlorobiphenyl	2051-24-3	%	--	--	--	--	60	125	--
SW8270D	Benzo (a) anthracene	56-55-3	µg/kg	29,000	25	60	120	54	122	40
SW8270D	Benzo (a) pyrene	50-32-8	µg/kg	2,900	15	60	120	50	125	40
SW8270D	Benzo (b) fluoranthene	205-99-2	µg/kg	29,000	25	60	120	53	128	40
SW8270D	Dibenzo (a,h) anthracene	53-70-3	µg/kg	2,900	13	60	120	50	129	40
SW8270D	2-Fluorobiphenyl	321-60-8	%	--	--	--	--	44	115	--
SW8270D	Nitrobenzene-d5 (Surr)	4165-60-0	%	--	--	--	--	37	122	--
SW8270D	Terphenyl-d14 (Surr)	1718-51-0	%	--	--	--	--	54	127	--
SW8330B	2,6-DNT	606-20-2	mg/kg	15	0.06	0.15	0.3	79	117	20
SW8330B	RDX	121-82-4	mg/kg	280	0.06	0.15	0.3	67	129	20

Table 15-1. Soil Target Analytes, Detection levels, Control Limits and Screening Level Objectives (continued)

Method	Analyte	CAS ID	Unit	Cleanup Goals [a]	Detection Limit	Limit of Detection	Limit of Quantitation	Lower Control Limit [b]	Upper Control Limit [c]	Relative Percent Difference
SW8330B	2,4,6- TNT	118-96-7	mg/kg	510	0.05	0.1	0.2	71	120	20
SW8330B	1,2-Dinitrobenzene	528-29-0	%	--	--	--	--	89	123	--
Chemtech Laboratory										
SW8082	Aroclor-1254	11097-69-1	µg/kg	9,700	6.4	13	17	40	140	30
SW8082	Aroclor-1260	11096-82-5	µg/kg	9,900	4.6	13	17	60	130	30
SW8082	Decachlorobiphenyl	2051-24-3	%	--	--	--	--	60	125	--
SW8270D	Benzo(a)anthracene	56-55-3	µg/kg	29,000	38	170	330	54	122	40
SW8270D	Benzo(a)pyrene	50-32-8	µg/kg	2,900	44	170	330	50	125	40
SW8270D	Benzo(b)fluoranthene	205-99-2	µg/kg	29,000	49	170	330	53	128	40
SW8270D	Dibenzo(a,h)anthracene	53-70-3	µg/kg	2,900	52	170	330	50	129	40
SW8270D	2-Fluorobiphenyl	321-60-8	%	--	--	--	--	44	115	--
SW8270D	Nitrobenzene-d5 (Surr)	4165-60-0	%	--	--	--	--	37	122	--
SW8270D	Terphenyl-d14 (Surr)	1718-51-0	%	--	--	--	--	54	127	--

Table notes:

[a] Industrial receptor cleanup goals from the ROD Amendment (Leidos, 2019)
[b] LCL = lower control limit from the DoD QSM 5.1.1 or lab control limit if no available DoD limit
[c] UCL - upper control limit from the DoD QSM 5.1.1 or lab control limit if no available DoD limit

% = percent
CAS = Chemical Abstracts Service
DNT = dinitrotoluene
ID = identification
LCL = lower confidence limit
mg/kg = milligrams per kilogram
ROD = Record of Decision
RDX = royal demolition explosive
TNT = trinitrotoluene
UCL = upper confidence level
µg/kg = micrograms per kilogram

Worksheet #18—Sampling Locations

Tables 18-1 and 18-2 summarize the sample IDs, matrix, analytical parameters, and locations. QA/QC samples will be collected as defined in Worksheet #20. The sample IDs shown in this Worksheet is designed based on RVAAP sample ID requirements.

Table 18-1. Excavation Confirmation Sample IDs, Analytical Parameters, and Locations

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator[1]	Sample ID Sequential Sample Number for Project[2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL1	CB4	cs	The first sample collected in Load Line 1 will use "736" in this field. The second sample in Load Line 1 will use "737," and so on.	001	SO	PCBs	PCB-1254	Sidewall North
LL1	CB4	cs		001	SO	PCBs	PCB-1254	Sidewall East
LL1	CB4	cs		001	SO	PCBs	PCB-1254	Sidewall South
LL1	CB4	cs		001	SO	PCBs	PCB-1254	Sidewall West
LL1	CB4	cs		001	SO	PCBs	PCB-1254	Bottom
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall North 1
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall North 2
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall North 3
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall East 1
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall East 2
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall South
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall West 1
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Sidewall West 2
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Bottom 1
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Bottom 2
LL1	CB4A	cs		001	SO	Explosives	RDX, TNT	Bottom 3
LL1	CB2	cs		001	SO	Metals	Antimony, Lead	Sidewall North
LL1	CB2	cs		001	SO	Metals	Antimony, Lead	Sidewall East
LL1	CB2	cs		001	SO	Metals	Antimony, Lead	Sidewall South
LL1	CB2	cs		001	SO	Metals	Antimony, Lead	Sidewall West
LL1	CB2	cs		001	SO	Metals	Antimony, Lead	Bottom
LL1	CB13B	cs		001	SO	Metals	Lead	Sidewall North
LL1	CB13B	cs		001	SO	Metals	Lead	Sidewall East
L1	CB13B	cs		001	SO	Metals	Lead	Sidewall South
LL1	CB13B	cs		001	SO	Metals	Lead	Sidewall West
LL1	CB13B	cs		001	SO	Metals	Lead	Bottom
LL1	OCD	cs		001	SO	Metals	Antimony, lead	Sidewall North
LL1	OCD	cs		001	SO	Metals	Antimony, lead	Sidewall East
LL1	OCD	cs		001	SO	Metals	Antimony, lead	Sidewall South
LL1	OCD	cs		001	SO	Metals	Antimony, lead	Sidewall West
LL1	OCD	cs		001	SO	Metals	Antimony, lead	Bottom

Table 18-1. Excavation Confirmation Sample IDs, Analytical Parameters, and Locations (continued)

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator[1]	Sample ID Sequential Sample Number for Project[2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL2	DB4A	cs	The first sample collected in Load Line 2 will use "681" in this field. The second sample in Load Line 2 will use "682," and so on.	001	SO	Explosives	TNT	Sidewall North
LL2	DB4A	cs		001	SO	Explosives	TNT	Sidewall East
LL2	DB4A	cs		001	SO	Explosives	TNT	Sidewall South
LL2	DB4A	cs		001	SO	Explosives	TNT	Sidewall West
LL2	DB4A	cs		001	SO	Explosives	TNT	Bottom
LL3	EB10A	cs	The first sample collected in Load Line 3 will use "555" in this field. The second sample in Load Line 3 will use "556," and so on.	001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL3	EB10A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL3	EB10A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL3	EB10A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL3	EB10A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 1
LL3	EB10A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 2
LL3	EB10B	cs		001	SO	PCBs	PCB-1254	Sidewall North
LL3	EB10B	cs		001	SO	PCBs	PCB-1254	Sidewall East
LL3	EB10B	cs		001	SO	PCBs	PCB-1254	Sidewall South
LL3	EB10B	cs		001	SO	PCBs	PCB-1254	Sidewall West
LL3	EB10B	cs		001	SO	PCBs	PCB-1254	Bottom
LL3	EA7	cs		001	SO	PCBs	PCB-1254	Sidewall North
LL3	EA7	cs		001	SO	PCBs	PCB-1254	Sidewall East
LL3	EA7	cs		001	SO	PCBs	PCB-1254	Sidewall South
LL3	EA7	cs		001	SO	PCBs	PCB-1254	Sidewall West
LL3	EA7	cs		001	SO	PCBs	PCB-1254	Bottom
LL3	EA6A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL3	EA6A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL3	EA6A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL3	EA6A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL3	EA6A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom
LL3	EA6B	cs		001	SO	PAHs	BaP, DA	Sidewall North
LL3	EA6B	cs		001	SO	PAHs	BaP, DA	Sidewall East
LL3	EA6B	cs		001	SO	PAHs	BaP, DA	Sidewall South
LL3	EA6B	cs		001	SO	PAHs	BaP, DA	Sidewall West
LL3	EA6B	cs		001	SO	PAHs	BaP, DA	Bottom
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 1
LL3	EA6C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 2

Table 18-1. Excavation Confirmation Sample IDs, Analytical Parameters, and Locations (continued)

Sample ID Area	**Sample ID Designator**	**Sample ID Location Type**	Sample ID Sequential Sample Location Number by Area Designator[1]	Sample ID Sequential Sample Number for Project[2]	**Sample ID Sample Type**	**Analytical Group**	**Analytes**	**Location**
LL3	EB4	cs	The first sample collected in Load Line 3 will use "555" in this field. The second sample in Load Line 3 will use "556," and so on.	001	SO	PCBs	PCB-1254	Sidewall East 1
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall East 2
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall South 1
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall South 2
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall South 3
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall West 1
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Sidewall West 2
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Bottom 1
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Bottom 2
LL3	EB4	cs		001	SO	PCBs	PCB-1254	Bottom 3
LL3	EB9A	cs		001	SO	Explosives	TNT	Sidewall North
LL3	EB9A	cs		001	SO	Explosives	TNT	Sidewall East
LL3	EB9A	cs		001	SO	Explosives	TNT	Sidewall South
LL3	EB9A	cs		001	SO	Explosives	TNT	Sidewall West
LL3	EB9A	cs		001	SO	Explosives	TNT	Bottom
LL3	WP	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL3	WP	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL3	WP	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL3	WP	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL3	WP	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom
LL3	EB803	cs		001	SO	PCBs	PCB-1254	Sidewall North
LL3	EB803	cs		001	SO	PCBs	PCB-1254	Sidewall East
LL3	EB803	cs		001	SO	PCBs	PCB-1254	Sidewall South
LL3	EB803	cs		001	SO	PCBs	PCB-1254	Sidewall West
LL3	EB803	cs		001	SO	PCBs	PCB-1254	Bottom

Table 18-1. Excavation Confirmation Sample IDs, Analytical Parameters, and Locations (continued)

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator[1]	Sample ID Sequential Sample Number for Project[2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL4	WT	cs	The first sample collected in Load Line 4 will use "521" in this field. Second sample in Load Line 4 will use "522," and so on.	001	SO	Metals	Lead	Sidewall North
LL4	WT	cs		001	SO	Metals	Lead	Sidewall East
LL4	WT	cs		001	SO	Metals	Lead	Sidewall South
LL4	WT	cs		001	SO	Metals	Lead	Sidewall West
LL4	WT	cs		001	SO	Metals	Lead	Bottom
LL4	G16	cs		001	SO	PCB	PCB-1260	Sidewall North
LL4	G16	cs		001	SO	PCB	PCB-1260	Sidewall East
LL4	G16	cs		001	SO	PCB	PCB-1260	Sidewall South
LL4	G16	cs		001	SO	PCB	PCB-1260	Sidewall West
LL4	G16	cs		001	SO	PCB	PCB-1260	Bottom
LL4	G8A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL4	G8A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL4	G8A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL4	G8A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 1
LL4	G8B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 2
LL12	AAC	cs	The first sample collected in Load Line 12 will use "321" in this field. The second sample in Load Line 12 will use "322," and so on.	001	SO	Explosives and PAHs	TNT, 2,6-DNT, BaP	Sidewall North
LL12	AAC	cs		001	SO	Explosives and PAHs	TNT, 2,6-DNT, BaP	Sidewall East
LL12	AAC	cs		001	SO	Explosives and PAHs	TNT, 2,6-DNT, BaP	Sidewall South
LL12	AAC	cs		001	SO	Explosives and PAHs	TNT, 2,6-DNT, BaP	Sidewall West
LL12	AAC	cs		001	SO	Explosives and PAHs	TNT, 2,6-DNT, BaP	Bottom
LL12	FF19A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL12	FF19A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL12	FF19A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL12	FF19A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL12	FF19A	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom

Table 18-1. Excavation Confirmation Sample IDs, Analytical Parameters, and Locations (continued)

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator[1]	Sample ID Sequential Sample Number for Project[2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL12	FF19B	cs	The first sample collected in Load Line 12 will use "321" in this field. The second sample in Load Line 12 will use "322," and so on.	001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North
LL12	FF19B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East
LL12	FF19B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South
LL12	FF19B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West
LL12	FF19B	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North 1
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall North 2
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East 1
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall East 2
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South 1
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall South 2
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West 1
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Sidewall West 2
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 1
LL12	FF19C	cs		001	SO	PAHs	B(a)a, BaP, BbF, DA	Bottom 2

Quality Control Samples

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator [1]	Sample ID Sequential Sample Number for Project [2]	Sample ID Sample Type	Analytical Group	Analytes	Location
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	601	SO	Same as parent	Same as parent	Duplicate and triplicate (10%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	701	SO	Same as parent	Same as parent	MS (5%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	801	SO	Same as parent	Same as parent	MSD (5%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	901	ER	Same as parent	Same as parent	Equipment Blank

Table notes:

[1] The "Sequential Sample Location Number by Area Designation" shown is the next sequential number for a particular Area (Load Line), continuing from samples collected during previous work phases at each Load Line and already loaded in to the RVAAP database. The first location sampled during this effort at Load Line 1 should have "736" in this portion of the Sample ID, the second location sampled during this effort at Load Line 1 should have "737" in this portion of the Sample ID, and so on. The starting number for Load Line 2 will be "681"; Load Line 3 will be "555"; Load Line 4 will be "521"; and Load Line 12 will be "321".

[2] At each sample location, the "Sequential Sample Number for Project" will start with "001" for the first sample collected at that location for this project. If more than one sample is collected at the same location, the second sample will have "002" in this portion of the sample ID, and so on. If QC samples are collected at a particular sample location, this portion of the sample ID will use "601" for a Field Duplicate, "701" for a matrix spike (MS), "801" for a matrix spike duplicate (MSD), and "901" for an equipment rinsate.

B(a)a = Benz(a)anthracene
BaP = Benzo(a)pyrene
BbF = Benzo(b)fluoranthene
cs = confirmation sample
DA = Dibenz(a,h)anthracene
2,6-DNT = 2,6-dinitrotoluene
cs= Confirmation Sample
ER = equipment rinsate
ID = identification
MS = matrix spike
MSD = matrix spike duplicate
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
SO = soil
TNT = 2,4,6-trinitrotoluene
tv= Treatment Verification

Table 18-2. Treatment Verification Sample IDs and Analytical Parameters

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator [1]	Sample ID Sequential Sample Number for Project [2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL	EXSITU	tv	001	001	SO	Based on source of soil (PCBs, PAHs, and/or explosives, as applicable per Table 2-1 of the RD Work Plan)	Based on source of soil (PCB-1254, PCB-1260; B(a)a, BaP, BbF, DA; TNT, RDX, 2,6-DNT, as applicable per Table 2-1 of the RD Work Plan)	TBD
LL	EXSITU	tv	002	001	SO			TBD
LL	EXSITU	tv	003	001	SO			TBD
LL	EXSITU	tv	004	001	SO			TBD
LL	EXSITU	tv	005	001	SO			TBD
LL	EXSITU	tv	006	001	SO			TBD
LL	EXSITU	tv	007	001	SO			TBD
LL	EXSITU	tv	008	001	SO			TBD
LL	EXSITU	tv	009	001	SO			TBD
LL	EXSITU	tv	010	001	SO			TBD
LL	EXSITU	tv	011	001	SO			TBD
LL	EXSITU	tv	012	001	SO			TBD
LL	EXSITU	tv	013	001	SO			TBD
LL	EXSITU	tv	014	001	SO			TBD
LL	EXSITU	tv	015	001	SO			TBD
LL	EXSITU	tv	016	001	SO			TBD
LL	EXSITU	tv	017	001	SO			TBD
LL	EXSITU	tv	018	001	SO			TBD
LL	EXSITU	tv	019	001	SO			TBD
LL	EXSITU	tv	020	001	SO			TBD
LL	EXSITU	tv	021	001	SO			TBD
LL	EXSITU	tv	022	001	SO			TBD
LL	EXSITU	tv	023	001	SO			TBD
LL	EXSITU	tv	024	001	SO			TBD
LL	EXSITU	tv	025	001	SO			TBD
LL	EXSITU	tv	026	001	SO			TBD
LL	EXSITU	tv	027	001	SO			TBD
LL	EXSITU	tv	028	001	SO			TBD
LL	EXSITU	tv	029	001	SO			TBD

Table 18-2. Treatment Verification Sample IDs and Analytical Parameters (continued)

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator [1]	Sample ID Sequential Sample Number for Project [2]	Sample ID Sample Type	Analytical Group	Analytes	Location
LL	EXSITU	tv	030	001	SO	Based on source of soil (PCBs, PAHs, and/or explosives, as applicable per Table 2-1 of the RD Work Plan)	Based on source of soil (PCB-1254, PCB-1260; B(a)a, BaP, BbF, DA; TNT, RDX, 2,6-DNT, as applicable per Table 2-1 of the RD Work Plan)	TBD
LL	EXSITU	tv	031	001	SO			TBD
LL	EXSITU	tv	032	001	SO			TBD
LL	EXSITU	tv	033	001	SO			TBD
LL	EXSITU	tv	034	001	SO			TBD
LL	EXSITU	tv	035	001	SO			TBD
LL	EXSITU	tv	036	001	SO			TBD
LL	EXSITU	tv	037	001	SO			TBD
LL	EXSITU	tv	038	001	SO			TBD

Quality Control Samples

Sample ID Area	Sample ID Designator	Sample ID Location Type	Sample ID Sequential Sample Location Number by Area Designator [1]	Sample ID Sequential Sample Number for Project [2]	Sample ID Sample Type	Analytical Group	Analytes	Location
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	601	SO	Same as parent	Same as parent	Duplicate (10%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	701	SO	Same as parent	Same as parent	MS (5%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	801	SO	Same as parent	Same as parent	MSD (5%)
Same as parent sample	Same as parent sample	Same as parent sample	Same as parent sample	901	ER	Same as parent	Same as parent	Equipment Blank

Tables notes:

[1] The "Sequential Sample Location Number by Area Designation" shown is the next sequential number for a particular Area (Load Line), continuing from samples collected during previous work phases at each Load Line and already loaded in to the RVAAP database. The first location sampled during this effort at Load Line 1 should have "736" in this portion of the Sample ID, the second location sampled during this effort at Load Line 1 should have "737" in this portion of the Sample ID, and so on. The starting number for Load Line 2 will be "681"; Load Line 3 will be "555"; Load Line 4 will be "521"; and Load Line 12 will be "321".

[2] At each sample location, the "Sequential Sample Number for Project" will start with "001" for the first sample collected at that location for this project. If more than one sample is collected at the same location, the second sample will have "002" in this portion of the sample ID, and so on. If QC samples are collected at a particular sample location, this portion of the sample ID will use "601" for a Field Duplicate, "701" for a matrix spike (MS), "801" for a matrix spike duplicate (MSD), and "901" for an equipment rinsate.

B(a)a = Benz(a)anthracene
BaP = Benzo(a)pyrene
BbF = Benzo(b)fluoranthene
DA = Dibenz(a,h)anthracene
2,6-DNT = 2,6-dinitrotoluene
CS= Confirmation Sample
ER = equipment rinsate
ID = identification
MS = matrix spike
MSD = matrix spike duplicate
RDX = hexahydro-1,3,5-trinitro-1,3,5-triazine
SO = soil
TNT = 2,4,6-trinitrotoluene
tv= Treatment Verification

Worksheets #19 and #30—Sample Containers, Preservation, and Hold Times

The analytical methods for each sample matrix, including the required sample volume, containers, preservation, and holding time requirements, are provided in Table 19-1. Additional information on the laboratory analytical SOPs is provided in Worksheet #23.

Table 19-1. Sample Containers, Preservation, and Hold Times

Matrix	Analytical Group	Analytical Method	Containers	Quantity	Preservation Requirements	Maximum Holding Time
Soil	Explosives	SW8330B	1 L amber glass, ISM collected confirmation samples will be collected in 2-gal sealable bags, not to exceed 1 kg, all required methods for the ISM collection can be shared from this volume	2	Cool less than 6° C	14 days to extraction/ 40 days to analysis
Soil	PCBs	SW8082	4-oz glass, ISM collected confirmation samples will be collected in 2-gal sealable bags, not to exceed 1 kg, all required methods for the ISM collection can be shared from this volume	1	Cool less than 6° C	None
Soil	PAHs	SW8270D	4-oz amber glass, ISM collected confirmation samples will be collected in 2-gal sealable bags, not to exceed 1 kg, all required methods for the ISM collection can be shared from this volume	1	Cool less than 6° C	14 days to extraction/ 40 days to analysis
Soil	Metals	SW6010C	4-oz glass, ISM collected confirmation samples will be collected in 2-gal sealable bags, not to exceed 1 kilogram, all required methods for the ISM collection can be shared from this volume	1	Cool less than 6° C	180 days to digestion and analysis
IDW Soil	Ignitability and corrosivity	SW1030/ SW9045	4-oz. glass	1	Cool less than 6° C	N/A
IDW Soil	VOC	SW8260C/ SW1311	8 oz amber glass	3	No headspace; cool less than 6° C	14 days preserved;
IDW Soil	SVOCs	SW8270D /SW1311	8 oz amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW Soil	Pesticides	SW8081B /SW1311	8 oz amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW Soil	Herbicides	SW8151A /SW1311	8 oz amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW Soil	Metals (RCRA list)	SW6010C/ SW7470A /SW1311	8 oz amber glass	1	Cool less than 6° C	180 days/ 28 days for mercury
IDW Soil	PCBs	SW8082	8 oz amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW soil	Ignitability and corrosivity	SW1030/ SW9045	4-oz. glass	1	Cool less than 6° C	N/A
IDW liquid	VOC	SW8260C	40-mL volatile organic analysis	3	No headspace; cool less than 6° C, HCL to pH less than 2	14 days preserved; 7 days unpreserved
IDW liquid	SVOCs	SW8270D	1-L amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW liquid	Pesticides	SW8081B	1-L amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis

Table 19-1. Sample Containers, Preservation, and Hold Times (continued)

IDW liquid	Herbicides	SW8151A	1-L amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW liquid	Metals (RCRA list)	SW6010C/ SW7470A	250-mL poly	1	Field filter for dissolved; cool less than 6° C; HNO_3 to pH less than 2	180 days/ 28 days for mercury
IDW liquid	Explosives	SW8330B	1-L amber glass	2	Cool less than 6° C	7 days to extraction/ 40 days to analysis
IDW liquid	Ignitibility	EPA 1010A	250-mL poly	1	Cool less than 6° C	30 days
IDW liquid	Corrosivity	SW9045D	250-mL poly	1	Cool less than 6° C	As soon as possible

Table notes:

°C = degrees Celsius
gal = gallon(s)
HCL = hydrochloric acid
HNO_3 = nitric acid
IDW = investigation-derived waste
ISM = incremental sampling methodology
kg = kilogram
L = liter
mL = milliliter
N/A = not applicable
oz = ounce(s)
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyls
RCRA = Resource Conservation and Recovery Act
SVOC = semivolatile organic compound
VOC = volatile organic compound

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Certification: DoD ELAP
Accreditation Expiration: April 30, 2020
Sample Delivery Method: FedEx Overnight services
Preliminary Data: 7 days from time of receipt
Data Deliverable: 21 calendar days

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Certification: DoD ELAP
Accreditation Expiration: October 20, 2021
Sample Delivery Method: FedEx Overnight services
Preliminary Data: 48 hours from time of receipt
Data Deliverable: 21 calendar days

Quality Assurance Split Laboratory

To be determined based on Army direction

Worksheet #20—Field Quality Control Sample Summary

Field QC sampling requirements and procedures are specified in the sections below. Table 20-1 provides a summary of the types of samples to be collected and analyzed during the project. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix.

Table 20-1. Field Quality Control Samples

Matrix	Analyte/Analytical Group	Field Samples	FDs or ISM FD and Triplicate/Laboratory Subsample	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total Analyses
Soil (ISM excavation confirmation samples)	PAHs, explosives, PCBs and/or metals (location dependent)	142	14/14	7	7	7	0	191
Soil (treatment verification)	PAHs, explosives, PCBs and/or metals (location dependent)	38	4	2	2	2	0	48
Soil quality assurance split	PAHs, explosives, PCBs and/or metals (location dependent)	18	0	0	0	0	0	18

Table notes:
FD = field duplicate
ISM = incremental sampling methodology
PAH = polycyclic aromatic hydrocarbon(s)
PCB = polychlorinated biphenyls

Field Duplicate and Triplicates

An FD is an additional sample collected at the same time from the same location as the original sample. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. FD samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

FD samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The samples may be either co-located samples or sub samples of a single sample collection. The sample containers are assigned a unique identification number in the field. Specific locations should be designated for collection of FD samples before the beginning of sample collection. The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the incremental sampling methodology (ISM) excavation confirmation samples, the ROD Amendment requires that the ISM samples be collected in duplicate. However, to follow current DoD and Interstate Technology Research Council (ITRC) requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with DoD QSM and ITRC requirements incorporating a field duplicate and triplicate sample collection for one per 10 samples collected. The laboratory will also collect a laboratory subsample duplicate (PAHs and PCBs) and triplicate (explosives and metals) for each batch of up to 20 samples to verify the subsampling precision. A relative standard deviation (RSD) of less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent) will be incorporated into the field primary, duplicate and triplicate data.

Matrix Spike and Matrix Spike Duplicate

A matrix spike (MS)/matrix spike duplicate (MSD) is an aliquot of sample spiked with a known mass and concentration of specific analytes. The spiking occurs before sample preparation and analysis at the laboratory. To allow the analytical laboratory to run MS/MSD analyses, additional sample volumes will be collected in the field to provide sufficient sample volume. One MS and one MSD samples will be analyzed at a rate of approximately one for every 20 field samples per matrix.

Equipment Blanks

An equipment blank is a sample of American Society for Testing and Materials (ASTM) Type II reagent grade water poured into, over, or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. These may also be called rinse blanks or rinsate blanks. Equipment blanks are used to assess the effectiveness of equipment decontamination procedures.

Equipment blanks will be collected immediately after the equipment has been decontaminated and included for each sampling event, as appropriate. At a minimum, equipment blanks will be collected at a frequency of one per 20 samples or one per week (whichever is more frequent) for each decontaminated equipment type. The equipment blank samples will be analyzed for all laboratory analyses requested for the environmental samples collected at the site.

Worksheet #21—Field Standard Operating Procedures

Project sampling activities will be conducted in accordance with the procedures described in the Facility-wide SAP (Leidos, 2011) and this QAPP. The SOP for collecting ISM excavation confirmation samples is provided in Attachment 1 of this QAPP.

Worksheet #23—Analytical Standard Operating Procedure References

The analytical SOP references in Table 23-1 were provided by the laboratories. Only SOPs for sample data being validated are presented. IDW data will not be validated. Note that the laboratory SOPs have not been modified specifically for this project to meet the DQO requirements. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements and UFP-QAPP to technical staff. Laboratory SOPs are provided as Attachment 2 of this QAPP.

Table 23-1. Analytical SOP References

Reference Number	Title, Revision Number, and Date	Definitive/ Screening Data	Matrix/ Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
LSOP-01	SV-004 Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 11. 8/8/19	Definitive	PCBs	GC/ECD	CT	No
LSOP-02	SV-006 Semivolatile Organic Compounds by GC/MS, Method SW8270D. Revision 0. 5/29/19	Definitive	PAHs	GC/MS	CT	No
LSOP-03	MT-009 Method 6010- Inductively Coupled Plasma. Revision 5.3. 4/16/19	Definitive	Metals	ICP	CT	No
LSOP-04	SV-010, Explosives by Modified Method SW8330B. Revision 5.1. 6/13/19	Definitive	Explosives	HPLC	CT	No
LSOP-05	GT002 Processing of Multi-incremental Samples and Subsampling	Definitive	Explosives, PCBs, PAHs and metals	GC/MS. HPLC, ICP, GC/EICD	CT	No
LSOP-06	Determination of Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 3/29/17	Definitive	PCBs	GC/ECD	Chemtech (treatment verification samples with expedited turnaround)	No
LSOP-07	Determination of Extractable Semivolatile Organic Compounds by Method SW8270D. Revision 6/6/19	Definitive	PAHs	GC/MS	Chemtech (treatment verification samples with expedited turnaround)	No

Table notes:
Chemtech = Chemtech Laboratory, Inc.
CT = CT Laboratories, LLC
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer

Worksheet #24—Analytical Instrument Calibration

To confirm that the analytical methods and the selected instrumentation meet the project requirements, each analytical instrument will be calibrated according to the procedures outlined in the tables provided in Worksheet #28. Worksheets #24 and #28 have been combined together for efficiency and ease of use to the CH2M project chemist and the laboratory. The information provides documentation on corrective actions, flagging criteria for laboratory services, and expectations for analytical services. The table meet the requirements of both Worksheet #28 and Worksheet #24. Tables are presented by method and reflect the requirements of the DoD QSM Version 5.1.1 (DoD and DOE 2018) and individual method requirements.

Worksheet #25— Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

To ensure the analytical instrument and equipment are available and in working order when needed, all laboratory analytical equipment will undergo maintenance and testing procedure per the laboratory SOPs. DoD QSM v. 5.1.1 is the basis for specifications in Table 25-1.

Table 25-1 Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Check for leaks, replace gas line filters, replace column, clean injection port/liner	PAHs	Monitor instrument performance via CCV	As needed	No maintenance required if instrument QC meets DoD criteria	Replace connections, clean source, replace gas line filters, replace GC column, clip column, replace injection port liner, clean injection port, replace electron multiplier	Analyst, supervisor	LSOP-02
ICP	Perform leak test, change pump tubing, change torch and window, clean filters	Metals	Monitor instrument performance via CCV and CC blank	As needed	No maintenance required if instrument QC meets DoD criteria	Change pump tubing, change torch and window, clean filters; recalibrate and reanalyze affected data	Analyst, supervisor	LSOP-03
GC/ECD	Check pressure and gas supply daily. Bake out column, change septa, liner, seal as needed, cut column as needed.	PCB	Liner, seal, septum, column	Prior to initial calibration or as necessary	Less than 20% difference	If %D is more than ±20% and samples are less than practical quantitation limit, then narrate. If %D is more than ±20% only on one column, then narrate. If %D is more than ±20% for closing CCV and is likely due to matrix interference, then narrate. Otherwise reanalyze samples back to the last acceptable CCV	Analyst, supervisor	DV-GC-0020; DV-GC-0021; DV-GC-0022
HPLC	Clean, check all lines and frits for clogs, check and maintain flow pressure, change column	Selected explosives	Monitor instrument performance using CCV and retention times	As needed	Calibration and QC criteria met	Clean and replace items as needed; call for service if required	Analyst, supervisor	LSOP-04

Table notes:

CC = continuing calibration
CCV = continuing calibration verification
%D = percent difference
DoD = U.S. Department of Defense
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer
PAH = polycyclic aromatic hydrocarbon(s)
PCB = polychlorinated biphenyls
QC = quality control

Worksheets #26 and #27—Sampling Handling, Custody, and Disposal

To verify sample authenticity and data defensibility, a complete sample handling system will be followed from the time of sample collection to final sample disposal. Table 26-1 outlines the activities and associated responsible parties.

Table 26-1. Summary of Sample Handling, Custody, and Disposal Procedures

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample labeling	FTL, CH2M	Section 6 of the RVAAP Facility-Wide SAP (Leidos, 2011)
Chain-of-custody form completion	FTL, CH2M	Section 6 of the RVAAP Facility-Wide SAP (Leidos, 2011)
Packaging	FTL, CH2M	Section 7 of the RVAAP Facility-Wide SAP (Leidos, 2011)
Shipping coordination	FTL, CH2M	Section 7 of the RVAAP Facility-Wide SAP (Leidos, 2011)
Sample receipt, inspection, log-in, custody, storage and disposal	Sample custodian, supervisor at CT/, Chemtech; and TBD QA laboratory	N/A

Table notes:
CH2M = CH2M HILL Engineers, Inc.
Chemtech = Chemtech Laboratory
CT = CT Laboratories LLC
FTL = field team leader
N/A = not applicable
QA = quality assurance
SOP standard operating procedure
TBD = to be determined

Field Sample Custody Procedures

A sample numbering system will be used to identify each sample, including duplicate samples. The sample number will be a unique identifier. The site-specific identifier is defined in Worksheet #18.

Laboratory Sample Custody Procedures

A designated laboratory representative will accept the shipped samples and verify that the received samples match those on the chain-of-custody record. The condition, temperature, and appropriate preservation of the samples should be checked and documented on the chain-of-custody form. The occurrence of any anomalies in the received samples and their resolution should be documented in the laboratory records. All sample information will then be entered into a tracking system, and unique analytical sample identifiers will be assigned. The laboratory will review this information for accuracy.

The laboratory must supply sample receipt confirmation within 24 hours of sample receipt that includes the following:

- A fully executed copy of the chain-of-custody received with the samples
- Sample acknowledgement letter and log-in report
- Cooler and sample receipt form noting any problems, breakages, holding time issues, temperature exceedances, inconsistencies between the chain of custody, purchase order, and project instructions

Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for analytical methods required for this project are specified in Worksheets #19 and #30. Subcontracted analyses will be documented with the chain-of-custody form. Procedures ensuring internal laboratory chain of custody also will be implemented and documented by the laboratory. Specific instructions concerning the analysis specified for each sample will be communicated to the analysts. Analytical batches will be created, and laboratory QC samples will be introduced into each batch.

Samples will be stored in limited-access, temperature-controlled areas. Refrigerators, coolers, and freezers will be monitored for temperature 7 days a week. Acceptance criterion for the temperatures of the refrigerators and coolers is less than 6° C. Acceptance criterion for the temperatures of the freezers is lower than minus 7° C. All of the cold storage areas will be monitored by thermometers that have been calibrated with a National Institute Standards and Technology (NIST)-traceable thermometer. As indicated by the findings of the calibration, correction factors may be applied to each thermometer. Records regarding acceptance criteria will be maintained.

Samples will be stored for 30 days after analysis and reporting, at which time the samples will be disposed of. The samples will be disposed of in accordance with applicable local, state, and federal regulations. Disposal records will be maintained by the laboratory. SOPs describing sample control and custody will be maintained by the laboratory.

Worksheet #28—Analytical Quality Control and Corrective Action

Worksheet #28 presents analytical QC requirements relevant to analysis of environmental samples that will be followed by laboratories producing definitive data. The purpose of the laboratory QC activities is to produce data of known quality sufficient to meet the project-specific DQOs. Laboratory QC samples will follow method specific requirements of the DoD QSM Version 5.1.1 (DoD and DOE 2018) and/or the analytical method and are presented in Tables 28-1 through 28-4 for the methods requiring validation.

Laboratory QC samples must be included in an analytical batch with the field samples. An analytical batch is a group of samples (not exceeding 20 environmental samples plus associated laboratory QC samples) similar in composition (matrix) that are extracted or digested at the same time and with the same lot of reagents and analyzed together as a group. The analytical batch also extends to cover samples that do not need separate extraction or digestion. The identity of each analytical batch will be unambiguously reported with the analyses so that a reviewer can identify the laboratory QC samples and the associated environmental samples. The type of laboratory QC samples and the frequency of use of these samples are discussed below and in method-specific laboratory standard operating procedures.

Detection Limits

The DLs will be completed for target analytes and matrices in accordance with the DoD QSM Version 5.1.1 (DoD and DOE 2018). The laboratory will establish DLs for each method, matrix, and analyte. The information has been provided in tables of Worksheet #15. The DL is used along with other measurements of sensitivity, such as the LOD and LOQ.

If multiple instruments are used, the DL used for reporting purposes will represent the least sensitive instrument response for each compound or element spiked.

Limit of Detection

The DL will be used to determine the LOD for each analyte and matrix and for preparatory and cleanup methods routinely used on samples, as follows. After each DL determination, the laboratory must immediately establish the LOD by spiking a quality system matrix at approximately two to three times the DL (for a single-analyte standard) or one to four times the DL (for a multi-analyte standard). The spike concentration establishes the LOD; it is specific to each combination of analyte, matrix, method (including sample preparation), and instrument configuration. The LOD must be verified quarterly.

The following requirements apply to the initial DL and LOD determinations and to the quarterly LOD verifications:

- The apparent signal-to-noise ratio at the LOD must be at least 3, and the results must meet method requirements for analyte identification (for example, ion abundance, second-column confirmation, or pattern recognition). For data systems that do not provide a noise measurement, the signal produced by the verification sample must produce a result that is at least three standard deviations greater than the mean method blank concentrations.
- If a laboratory uses multiple instruments for a given method, the LOD must be verified for each instrument.
- If the LOD verification fails, the laboratory must repeat the DL determination and LOD verification at a higher concentration, or perform and pass two consecutive LOD verifications at a higher concentration and set the LOD at the higher concentration.

The laboratory will maintain documentation for DL determinations and LOD verifications.

Limit of Quantitation

The range at which quantitative results may be obtained with a specified degree of confidence for the method is referred to as the LOQ. The laboratory will verify LOQs by including a standard equal to or below the LOQ as the lowest point on the calibration curve. LOQ verification criteria will use laboratory LCS control limit ranges.

If a result is greater than the DL and less than the LOQ, the result will be reported as a detected concentration and flagged "J." If no detected concentration is determined down to the DL, the result will be reported to the LOQ concentration (with the added variables of sample dilution, final volume, and sample mass included), reported as a nondetect result, and flagged "U." A detected result greater than or equal to the LOQ will be reported without a qualifying flag unless a specific QA/QC failure is associated with the data. No results below the DL will be reported.

At a minimum, the LOQ must be verified quarterly. The laboratory procedure for establishing the LOQ must empirically demonstrate precision and bias at the LOQ. The LOQ and associated precision and bias must meet project-specific requirements and must be reported. If the method is modified, precision and bias at the new LOQ must be demonstrated and reported.

DLs, LODs, and LOQs are provided in Worksheet #15. LODs are expected to be two to three times greater than the DL and below the LOQ. The DLs, LODs, LOQs were compared to the project-specific screening criteria to determine whether they will meet the analytical DQOs.

Sample dilution because of target and or non-target compound concentrations or matrix interference could prevent LOQs from being achieved. Samples initially must be analyzed while undiluted when reasonable. If dilution is necessary, both the original and diluted results must be reported. Samples that are not analyzed undiluted must have the express approval of CH2M within extraction and analysis holding time and be supported by matrix interference documentation, such as sample viscosity, color, odor, or results from other analyses of the same sample, to show that undiluted analysis is not possible. Appropriate cleanup procedures must be followed to minimize matrix effects on LOQs.

Calibration

Analytes reported must be present in the initial and continuing calibrations. The calibrations must meet the acceptance criteria specified in the tables provided in this UFP-QAPP. Results reported must be within the calibration range. Samples will be diluted, if necessary, to bring analyte responses within the calibration range. Records of standard preparation and instrument calibration will be maintained. Records must unambiguously trace the standards and their use in calibration and quantitation of sample results.

Instrument calibration will be performed by beginning with the simplest approach first, the linear model through the origin, and then progressing through other options until the acceptance criteria are met. In cases where an analyte has more than one acceptable calibration model, results from the simplest calibration model will be reported. If more than the minimum number of standards is analyzed for the initial calibration (ICAL), all of the standards analyzed will be included in the ICAL. The only exception to this rule is that a standard at either end of the calibration curve can be dropped from the calibration, providing that the requirement for the minimum number of standards is met and the low point of the calibration curve is at or below the LOQ for each analyte.

Calibrations must use the simplest calibration model first. Non-linear calibration will be considered only when a linear approach cannot be applied. It is not acceptable to use an alternate calibration procedure when a compound fails to perform in the usual manner. When this occurs, it is indicative of instrument issues or operator error.

The continuing calibration verification (CCV) cannot be used as the laboratory control sample (LCS), except for methods that do not involve sample preparation. A CCV will be performed daily before sample analysis (unless an ICAL and second-source standard verification is performed immediately before sample analysis) and as required by the applicable method. In accordance with National ELAP requirements, the laboratory will analyze the CCV concentration to vary throughout the calibration range. Finally, the lowest standard used must be at or below the LOQ for each analyte in the method.

Laboratory Control Samples

An LCS is a sample of known composition that is spiked with target analytes. The LCS is used with each analytical batch to determine whether the method is in control. Each analyte in the LCS will be spiked at a level less than or equal to the midpoint of the calibration curve, which is defined as the median point of the curve instead of the middle of the range. The LCS will be carried through the complete sample preparation and analysis procedure. Except for volatile organic compound analysis, the LCS cannot be used as the CCV.

At least one LCS will be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from LCSs will be reported. Failure of an analyte in the LCS will necessitate appropriate corrective action, including qualification of the failed analyte in the samples, as required.

Laboratory Control Sample Control Limits

The LCS limits are specified in the DoD QSM Version 5.1.1 (DoD and DOE 2018). Laboratory historical control limits will be used for methods not listed in the DoD QSM.

The performance of the LCS is evaluated against the QC acceptance limits. When an analyte in the LCS is outside the acceptance limit, corrective action will be performed.

Marginal Exceedance

The laboratory may not use marginal exceedances as part of their data review practice but are encouraged to contact the CH2M project chemist to discuss compound-specific failures as needed.

Matrix Spike and Matrix Spike Duplicate

An MS or MSD is an aliquot of sample collected in the field and spiked with known masses and concentrations of the target analytes in the laboratory. The spiking will occur before sample preparation and analysis. Each analyte in the MS and MSD must be spiked at a level less than or equal to the midpoint of the calibration curve for that analyte. The MS/MSD is used to document potential matrix effects associated with a site and will not be used to control the analytical process. The MS/MSD results and flags will not be associated with or related to samples that are collected from the same site where the MS/MSD set were collected. The field team leader will select the samples for MS/MSDs and the laboratory will use the samples to prepare the appropriate MS/MSDs.

The performance of the MS and MSD will be evaluated against the QC acceptance limits outlined in Worksheet #15. If either the MS or the MSD is outside the QC acceptance limits, the data will be evaluated to determine whether there is a matrix effect or analytical error, and the analytes in the parent sample and associated FD (if applicable) will be qualified according to the data flagging criteria of this QAPP.

If the sample concentration exceeds the spike concentration by a factor of four or more, the data will be reported unflagged. The laboratory should communicate potential matrix difficulties to the CH2M project chemist, so an evaluation can be made with respect to the project-specific DQOs.

Surrogates

Surrogates are compounds similar to the target analytes in chemical composition and behavior in the analytical process, but not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency. Surrogates will be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, the sample will be re-prepared and re-analyzed. If corrective actions are not performed or are ineffective, an appropriate flag will be applied to the sample results. Surrogate spikes that have been diluted out will not be flagged.

Internal Standards

Internal standards are known amounts of standards that are added to a portion of a sample or sample extract and carried through the entire determination procedure. They are used as a reference for calibration and for controlling the precision and bias of the analytical method. Internal standards will be added to environmental samples, controls, and blanks, in accordance with the method requirements.

If the results of the internal standards are outside of the acceptance limits, corrective actions will be performed. After the system problems have been resolved and system control has been reestablished, samples analyzed while the system was malfunctioning will be re-analyzed. If corrective actions are not performed or are ineffective, an appropriate flag will be applied to the sample results.

Retention Time Windows

Retention time (RT) windows are used in gas chromatography (GC), ion chromatography, and high-performance liquid chromatography analysis for qualitative identification of analytes. They are calculated from replicate analyses of a standard on multiple days. The procedure and calculation method are given in SW-846, Method 8000C. The center of the RT window is established for each analyte and surrogate using the RT of the midpoint standard of the ICAL. For non-MS methods, they are updated daily using the absolute RT in the ICAL verification.

If the RT is outside the acceptance limits, corrective action will be performed—this applies to CCV subsequent to the ICAL verification and to LCSs. If corrective actions are not performed or are ineffective, an appropriate flag will be applied to the sample results.

Method Blank

A method blank is an analyte-free matrix to which the reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparation and analytical procedure, and is used to assess potential contamination resulting from the analytical process.

A method blank will be included in every analytical batch. The presence of analytes in a method blank at concentrations greater than the LOD indicates the need for further assessment of the data. The source of contamination will be investigated, and measures will be taken to correct, minimize, or eliminate the problem if the concentration exceeds one-half the LOQ. For common laboratory contaminants (for example, methylene chloride, acetone, or phthalates), the method blank must not exceed the LOQ. No analytical data will be corrected for the presence of analytes in blanks.

If an analyte is detected in the method blank and in the associated samples and corrective actions are not performed or are ineffective, an appropriate flag may be applied to the sample results.

Quality Control Checks

Holding-time Compliance

Sample preparation and analyses will be performed within the method-required holding times, except as noted in Worksheet #19. Some methods have more than one holding-time requirement (for example, Method SW8270D). For methods not requiring sample preparation, holding time is calculated from the time of sample collection to the time of completion of the analytical runs. For methods requiring sample preparation before analysis, holding time is calculated from the time of preparation completion to the time of completion of the analytical runs.

Holding times are determined based on days, hours, and minutes. If the time of sample collection is not provided, the laboratory must assume the most conservative time of day. If holding times are exceeded and the analyses are performed, the results must be flagged according to the procedures described in this worksheet, except as noted in a table within Worksheet #19 and identified in the data-package case narrative.

Standard Materials

Standard materials (including second source materials) used in calibration and sample preparation must be traceable to NIST, EPA, American Association of Laboratory Accreditation (A2LA), or other equivalent approved source, if available. If an NIST, EPA, or A2LA standard material is not available, the standard material proposed for use must be included in an addendum to the project-specific QAPP and approved before use.

The standard materials must be current, and the following expiration policy must be followed:

- Expiration dates for amputated solutions should not exceed the manufacturer's expiration date or one year from the date of receipt, whichever comes first.
- Expiration dates for laboratory-prepared stock and diluted standards must be no later than the expiration date of the stock solution or material or the date calculated from the holding time allowed by the applicable analytical method, whichever comes first.
- Expiration dates for pure chemicals will be established by the laboratory and be based on chemical stability, possibility of contamination, and environmental and storage conditions.
- Expired standard materials will be either re-validated before use or discarded. Re-validation may be performed through assignment of a true value and error window statistically derived from replicate analyses of the material as compared to an unexpired standard. The laboratory will label standard and QC materials with expiration dates.

A second source standard will be used to independently confirm the ICAL. A second source standard is a standard purchased from a vendor different from that supplying the material used in the ICAL. The second source material can be used for the continuing calibration standards and/or for the LCS. Two different lot numbers from the same vendor do not normally constitute a second source. However, when a project requires analyses for which there is not a separate vendor source available, the use of different lot numbers from the same vendor will be acceptable to verify calibration.

Supplies and Consumables

The laboratory will inspect supplies and consumables before their use in analysis. The materials description in the methods of analysis will be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents will be monitored and documented. An inventory and storage system for these materials will assure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS tuning check	Before ICAL and calibration verification, every 12 hours	Refer to criteria listed in method description Use 4-bromofluorobenzene or decafluorotriphenylphosphine	Retune instrument and verify	Not appropriate
Multipoint ICAL for all analytes (minimum five standards)	Before sample analysis	Option 1: Linear—RSD for each analyte is less than 15% Option 2: Linear—linear least squares regression r is more than 0.995. Linear least square regression r^2 is equal to or more than 0.99 (SW8260C) for each analyte Option 3: Nonlinear—coefficient of determination is equal to or more than 0.99 (6 points will be used for second order; 7 points will be used for third order). Nonlinear calibrations models are not a preferred option and must only be used for compounds that typically will not demonstrate a linear model If the specific version of a method requires additional evaluation (for example, response factors or low calibration standard analysis and recovery criteria), then these additional requirements must also be met	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Calibration may not be forced through the origin
Second-source calibration verification	Once per ICAL	All analytes within ±20% of expected value	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical sequence	Position will be set using the midpoint standard of the ICAL curve. On days when an ICAL is not performed, the initial CCV is used	N/A	N/A
RT window verification for each analyte	Each sample	RRT of the analyte within ±0.06 RRT units of ICAL. Laboratories may update the RTs based on the CCV to account for minor performance fluctuations or after routine system maintenance (for example, column clipping. With each sample, the RRT will be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, there has been a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to re-establish the RTs.	Correct problem then reanalyze all samples analyzed since the last RT check	Not appropriate, no target compounds are to be reported when the RRT is out of control

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
CCV	Daily, before sample analysis (unless ICAL performed on same day), after every 12 hours of analysis time and at the end of the analytical batch run.	All analytes within ±20%D of expected value of true value All analytes within ±50%D of expected value of true value for ending CCV	Correct problem, then rerun CCV If that fails, then repeat ICAL	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
Internal standard	Each sample, standard, and QC sample	Retention time within ±10 seconds from retention time of the midpoint standard in the ICAL; extracted ion current profile area within -50% to +100% of area from internal standards in ICAL mid-point standard	Inspect MS and GC for malfunctions and make corrections as appropriate Reanalysis of samples analyzed while the system was malfunctioning is mandatory	Apply Q-flag to all results for analytes associated with failed internal standards
Method blank	One per analytical batch	No analytes detected more than one-half LOQ; or more than one-tenth the amount measured in any sample or one-tenth the regulatory limit, whichever is greater For common laboratory contaminants, no analytes detected more than LOQ See Worksheet #36	Assess data and correct problem If necessary, reprepare and analyze method blank and all samples processed with the contaminated blank	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15	Correct problem, then reanalyze If still out, then reprepare and reanalyze the LCS and all samples in the affected batch	If corrective action fails, then apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error Analyze LCS for failed target analytes Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if any following criteria met: • %R for MS or MSD is more than upper control limit • %R for MS or MSD is less than lower control limit • MS/MSD RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤20 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, then discuss in case narrative	Apply Q-flag to all associated analytes if acceptance criteria are not met
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
D = difference when using response factors or drift when using least square, regression, or nonlinear calibration
DoD = U.S. Department of Defense
GC = gas chromatography
ICAL = initial calibration
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PQO = project quality objective
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RRT = relative retention time
RSD = relative standard deviation
RT = retention time

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICAL	At instrument setup, after ICV or CCV failure, before sample analysis	ICAL must meet one of the three options below: • Option 1: RSD for each analyte equal to or less than 20% • Option 2: linear least squares regression for each analyte: r^2 more than or equal to 0.99 • Option 3: nonlinear least squares regression (quadratic) for each analyte r^2 more than or equal to 0.99	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Quantitation for multicomponent analytes such as chlordane, toxaphene and Aroclors must be performed using a 5-point calibration
ICV	Immediately following ICAL, analysis of second source standard before sample analysis	±20% of expected value All reported analytes within established RT windows	Correct problem and rerun ICV. If that fails, repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment	Once per ICAL and at the beginning of the analytical sequence	Midpoint of ICAL curve when ICAL is performed On days ICAL is not performed, the initial CCV is used	Not applicable	Not applicable
RT window width	At method set up and after major maintenance	RT width is ±3 times standard deviation for each analyte RT from the 72-hour study	Not applicable	Not applicable
CCV	Daily, before sample analysis; after every 10 samples, and at the end of the analysis sequence with the exception of CCVs for pesticides and multicomponent analytes (toxaphene, chlordane), which are only required before sample analysis	Reported analytes within established RT windows All reported analytes and surrogates within ±20% of true value	Recalibrate and reanalyze affected samples since last acceptable CCV Or immediately analyze 2 additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action and recalibrate; then reanalyze affected samples	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to results for the specific analyte(s) in samples since last acceptable CCV
Method blank	One per preparatory batch	No analytes detected greater than one-half LOQ or more than one-tenth amount measured in any sample or one-tenth regulatory limit, whichever is greater Common contaminants must not be detected more than LOQ	Correct problem. If necessary, re-prepare and analyze method blank and samples processed with the contaminated blank	Apply B-flag to associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS	One per preparatory batch	Acceptance criteria: Worksheet #15	Correct the problem and reanalyze the LCS and samples in the preparatory batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082 (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS	One per preparatory batch	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS > upper control limit (2) %R for MS < lower control limit
MSD, matrix duplicate	One per preparatory batch LCSD analyzed if no MS/MSD analyzed	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if any of following criteria are met: • %R for MSD is more than upper control limit • %R for MSD is less than lower control limit • RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤20 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample and batch QC samples	Acceptance criteria: Worksheet #15	Correct the problem. Reprepare and reanalyze the samples with the failed surrogate if sufficient sample material is available If obvious chromatographic interference with the surrogate is present, reanalysis may not be necessary	If corrective action fails, then apply Q-flag to the specific analyte(s) in the samples and explain in case narrative
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as the initial or primary column Results between primary and secondary column RPD less than or equal to 40%	Not applicable	Apply J-flag if RPD is more than 40% and explain in case narrative

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082 (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICV = initial calibration verification
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RSD = relative standard deviation
RT = retention time

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
LDR or high-level check standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ±10% of true value.	Dilute samples within the calibration range, or re-establish/verify the LDR.	Not appropriate.
ICAL (minimum one high standard and a calibration blank)	Daily ICAL prior to sample analysis	If more than one calibration standard is used, r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.
ICV/Second-source calibration verification	Once per ICAL prior to sample analysis	All analytes within ± 10% of expected value.	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. Samples may not be analyzed until the calibration has been verified.
CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% D of expected value of true value.	Recalibrate and reanalyze all affected samples since last acceptable CCV Or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	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
Low-level calibration check standard (low-level ICV)	Daily	All analytes within ± 20%D of expected value of true value.	Correct problem and repeat ICAL	Flagging not appropriate. No samples will be analyzed without a valid low-level calibration check standard.
Method blank	One per analytical batch	No analytes detected > ½ LOQ; or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. For common laboratory contaminants, no analytes detected > LOQ. See Worksheet #36.	Assess data. Correct problem. If necessary, re-prepare and analyze method blank and all samples processed with the contaminated blank.	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate. See Worksheet #36.
ICB/CCB	Before beginning a sample run, after every 10 field samples, and at end of the analysis sequence.	No analytes detected >LOD.	Correct problem and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed.	Flagging is not appropriate.

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICS (also called spectral interference checks)	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all nonspiked project analytes < LOD (unless they are 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 failed ICS.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze. If still out, re-prepare and reanalyze the LCS and all samples in the affected batch.	If corrective action fails, apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch.
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15.	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs.	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if: (1) %R for MS or MSD > upper control limit (2) %R for MS or MSD < lower control limit (3) MS/MSD RPD > control limit
Soil sample triplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest concentration within the quantitation range of the method The RSD for results above the LOQ must not exceed 20%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Dilution test Only applicable for samples with concentrations more than 50 times LOQ (prior to dilution) Use along with MS/MSD or PDS data to confirm matrix effects	Once per preparatory batch if MS or MSD fails	Five-fold dilution must agree within ± 10% of the original measurement.	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
PDS addition Criteria apply for samples with concentrations less than 50 times LOQ prior to dilution	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible)	Recovery within 80 to 120%	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCB = continuing calibration blank
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICB = initial calibration blank
ICS = Interference Check Solutions
ICV = initial calibration verification
LCS = laboratory control sample
LDR Linear Dynamic Range
LOD= limit of detection
LOQ = limit of quantitation
MD = matrix duplicate
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS post digestion spike
PQO = project quality objective
RPD = relative percent difference

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Soil-drying procedure	Each sample, LCS and method blank	Laboratory must have a procedure to determine when the sample is dry to constant mass. Record date, time, and ambient temperature on a daily basis while drying samples	Not applicable	Not appropriate
Soil-sieving procedure	Each sample, LCS and method blank	Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve	Not applicable	Not appropriate
Soil-grinding procedure	Initial demonstration	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 micrometers by passing representative portions of ground sample through a 200 mesh sieve (ASTM E11)	Not applicable	Not appropriate
Soil-grinding blank	At least one grinding blank per batch must be analyzed	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (for example, ground and subsampled) and analyzed in the same manner as a field sample No reported analytes must be detected > 1/2 LOQ	Blank results must be reported, and the affected samples must be flagged accordingly if blank criteria are not met	If any individual grinding blank is found to exceed the acceptance criteria, apply B-flag to the samples following that blank
Soil-subsampling process	Each sample, duplicate, LCS, and Method Blank	Entire ground sample is mixed, spread out on a large flat surface (for example, baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample	Not applicable	Not appropriate
Soil sample triplicate	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method The RSD for results above the LOQ must not exceed 20%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Initial Calibration (ICAL) for all analytes (including surrogates)	At instrument setup and after ICV or CCV failure, prior to sample analysis.	ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Flagging is not appropriate.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analyte(s) and surrogates within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.
Continuing Calibration Verification (CCV)	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 20% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	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.
Internal Standards (IS)	If employed, every field sample, standard and QC sample.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; Internal standard signal (area or height) within -50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	Inspect instrumentation for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the non-compliant IS. Flagging is not appropriate for failed standards.

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Method Blank (MB)	One per preparatory batch.	No analytes detected > 1/2 LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze Method Blank and all QC samples and field 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.
LCS for analytes	One LCS per preparatory batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze If still out, re-prepare and reanalyze the LCS and samples in the affected batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch
MS/MSD or matrix duplicate	One per preparatory batch	Acceptance criteria: Worksheet #15.	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS or MSD greater than upper control limit (2) %R for MS or MSD less than lower control limit (3) MS/MSD RPD greater than control limit
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15.	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, discuss in case narrative	Apply Q-flag to associated analytes if acceptance criteria are not met
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as for initial or primary column analysis Results between primary and secondary column/detector RPD ≤ 40%	N/A	Apply J-flag if RPD > 40% Discuss in the case narrative

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
ASTM = American Society for Testing and Materials
CH2M = CH2M HILL Constructors, Inc.
g = gram(s)
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS = post digestion spike
PQO = project quality objective
QC = quality control
RSD = relative standard deviation

Worksheet #29—Project Documents and Records

The required data package deliverables during every aspect of the project are identified in this worksheet. They include (1) sample collection and field measurement records, (2) analytical records, and (3) data assessment records.

Sample Collection and Field Measurement Records

Sample collection and field measurement records generally include field logbooks, photographic documentation, equipment decontamination records, sampling instrument calibration records, soil boring logs, well development logs, well sampling logs, chain-of-custody forms, and air bills (see Table 29-1).

Table 29-1. Sample Collection and Field Measurement Records

Document	Where Maintained
Field notebooks	Electronic PDF copies in the project file. Hard copy (bound notebook) in the project file. Archived at project closeout.
Chain-of-custody records	Electronic PDF copies in the project file. Hard copy in the project file. Archived at project closeout.
Air bills	Hard copy in the project file. Archived at project closeout.
Telephone logs	Hard copy in the project file. Archived at project closeout.
Corrective action forms	Electronic PDF copies in the project file. Hard copy in the project file. Archived at project closeout.
Electronic field data deliverables	Loaded in the project
Various field measurements	Recorded in field notebook.
All field equipment calibration information	Recorded in field logbook.
Pertinent telephone conversations	Recorded in field logbook.
Field equipment maintenance records	Inspected by Construction Manager or Quality Construction Manager
Sample receipt, custody, and tracking records	Electronic PDF copies in the project file.
Standard traceability logs	Electronic PDF copies in the project file. Archived at project closeout.
Equipment calibration logs	Electronic PDF copies in the project file. Archived at project closeout.
Sample prep logs	Electronic PDF copies in the project file. Archived at project closeout.
Run logs	Electronic PDF copies in the project file. Archived at project closeout.
Equipment maintenance, testing, and inspection logs	Electronic PDF copies in the project file. Archived at project closeout.
Reported field sample results	Electronic PDF copies in the project file. Archived at project closeout.
Reported results for standards, QC checks, and QC samples	Electronic PDF copies in the project file. Archived at project closeout.
Instrument printouts (raw data) for field samples, standards, QC checks, and QC samples	Electronic PDF copies in the project file. Archived at project closeout.
Data package completeness checklists	Electronic PDF copies in the project file. Archived at project closeout.
Sample disposal records	Maintained by the laboratory.
Extraction/cleanup records	Maintained by the laboratory.
Field sampling audit checklists	Electronic PDF copies in the project file. Archived at project closeout.
Data Validation Reports	Electronic PDF copies in the project file. Archived at project closeout.
Electronic data deliverables	Electronic PDF copies in the project file. Archived at project closeout.

Table notes:

PDF = portable document file
QC = quality control

Analytical Records

Analytical Data Deliverables

The laboratory data reports will contain information included in Table 29-2. A PDF version of all hard copy data will be provided as part of the laboratory data deliverable. Supporting raw data information is required and will also be included in the PDF submittal.

The data for this project will be collected and documented in such a manner that will allow the generation of data packages that can be used by an external data auditor to reconstruct the analytical process. The data provided by the laboratory must be legible and properly labeled.

Table 29-2. Information for Laboratory Data Reports

Case Narrative – A detailed case narrative per analytical fraction is required and will include explanation of any non-compliance and/or exceptions and corrective action. Exceptions will be noted for receipt, holding times, methods, preparation, calibration, blanks, spikes, surrogates (if applicable), and sample exceptions.
Sample ID cross reference sheet (laboratory IDs and client IDs)
Completed chain-of-custody and any sample receipt information
Sample preparation (extraction/digestion) logs
Copies of nonconformance memorandums and CAs

Table notes: ID = identification

Table 29-3. Laboratory Data Reports

Form	Item	Description	Level 4
GC/MS Organic Fractions	1	Sample Results	+ raw
	2	Surrogate Recovery Summary (with applicable control limits)	
	3	MS/MSD Accuracy and Precision Summary [b]	+ raw
	3	LCS Accuracy Summary	+ raw
	4	Method Blank Summary	+ raw
	5	Instrument Tuning Summary (including tuning summary for applicable initial calibrations)	
	6	Initial Calibration Summary (including concentration levels of standards)	+ raw
	7	Continuing Calibration Summary	+ raw
	8	Internal Standard Summary (including applicable initial calibrations)	
GC Organic Fractions	1	Sample Results	+ raw
	2	Surrogate Recovery Summary (with applicable control limits)	
	3	MS/MSD Accuracy and Precision Summary [b]	+ raw
	3	LCS Accuracy Summary	+ raw
	4	Method Blank Summary	+ raw
	6	Initial Calibration Summary (including concentration levels of standards)[c]	+ raw
	7	Continuing Calibration Summary[c]	+ raw
	7	Degradation Summary (Pesticides only)[c]	+ raw
	8	Analytical Sequence (including internal standard area performance where applicable) [c]	
	9	Compound Identification Summary (where confirmation required)[c]	

Table 29-3. Laboratory Data Reports (continued)

Form	Item	Description	Level 4
Metals Inorganic Fractions	1	Sample Results	• + raw
	2A	Initial and Continuing Calibration Summary	• + raw
	3	Initial and Continuing Calibration Blanks and Method Blanks Summary	• + raw
	4	Interference Check Standard Summary	• + raw
	5A	Pre-digestion Matrix Spike Recoveries Summary	• + raw
	5B	PDS Recoveries Summary	• + raw
	6	Native Duplicate or MS/MSD Precision Summary [b]	• + raw
	7	LCS Recovery Summary	• + raw
	8	Method of Standard Addition (if necessary)	• + raw
	9	Serial Dilution	• + raw
	10	Instrument or Method Detection Limit Summary	
	11	ICP Interelement Correction Factors	
	12	Linear Range Summary	
	13	Preparation Log Summary	• + raw
	14	Analytical Run Sequence and Graphite Furnace Atomic Absorption Spectrophotometry	• + raw

[a] Contract Laboratory Program form or summary form with equivalent information
[b] With RPD calculated according to DoD method specifications
[c] Including deliverables for primary and confirmation analysis (where applicable)

Data required
+ raw: Raw data should be included in data deliverable

GC = gas chromatography
ICP = inductively coupled plasma
LCS = laboratory control sample
MS = mass spectrometry or matrix spike
MSD = matrix spike duplicate
PDS = post-digestion spike

Worksheet #31, #32, and #33—Assessments and Corrective Actions

Periodic assessments will be performed during the project so that planned project activities are implemented in accordance with this document. Table 31-1 summarizes the type, frequency, and responsible parties of planned assessment activities, and corrective action measures to be performed for the project.

Table 31-1. Assessments and Correction Actions

Assessment Type	Responsible Party and Organization	Frequency	Assessment Deliverable	Timeframe of Notification	Person(s) Responsible for Responding to Assessment Findings	Assessment Response Documentation	Timeframe of Response	Person(s) Responsible for Implementing Corrective Actions	Person(s) Responsible for Monitoring Corrective Action Implementation
Field Procedure Assessment and Work Plan Compliance	On-site QC Manager/ SSHO/CH2M	Weekly	Internal memorandum	1 business day	Varies depending on specific work element	Internal memorandum	1 business day	Varies depending on specific work element	Key Rosebrook/ CH2M
Field Documentation Reviews	On-site QC Manager/ SSHO/CH2M	Daily	Internal memorandum	1 business day	Varies depending on specific work element	Internal memorandum	1 business day	Varies depending on specific work element	Key Rosebrook/ CH2M
Sample Condition Report	Shane Lowe/ CH2M	After samples are received at the laboratory	Internal e-mail	24 hours after sample receipt	Doug Scott/ CH2M	Internal and external email	24 hours after notification	Shane Lowe/CH2M	Doug Scott/ CH2M
Data Validation	Shane Lowe/ CH2M	After receiving data form laboratory and during data validation	Internal and external e-mail	14 business days	Laboratory QA Manager	Internal and external corrective action reports, updated case narratives, and corrected data submissions	7 business days	Laboratory QA Manager	Doug Scott/ CH2M
Data Quality Evaluation Report	Shane Lowe/ CH2M	One after all data are validated	Internal and external report	30 days after completion of validation	Doug Scott/ CH2M	Internal and external responses to comments and applicable report revision	7 to 10 business days	Shane Lowe/ CH2M	Doug Scott/ CH2M
Internal Project Reporting Reviews	Jason Cole/ CH2M	Once per report and/or per report version	Internal report comments	7 to 10 business days	Key Rosebrook/ CH2M	Internal and external responses to comments and applicable report revision	7 to 10 business days	Varies depending on expertise required by the CH2M senior reviewers	Sarah Meyers/ CH2M

Table notes:
CH2M = CH2M HILL Constructors, Inc.
Q = quality assurance
QC = quality control
SSHO = Site Safety and Health Officer

Worksheet #34—Data Verification and Validation Inputs

To confirm that scientifically sound data of known and documented quality are used in making project decisions, Table 34-1 establishes the procedures that will be followed to verify and validate project data including, but are not limited to, sampling documents and analytical data packages.

Table 34-1. Data Verification and Validation Inputs

Report	Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/ Records	1	Approved UFP-QAPP	X	
	2	Contract	X	
	3	Field SOPs	X	
	4	Analytical SOPs	X	
Field Records	5	Field logbooks	X	X
	6	Chain-of-custody forms	X	X
	7	Sampling diagrams/surveys	X	X
	8	Relevant correspondence	X	X
	9	Change orders/deviations	X	X
	10	Field audit reports	X	X
	11	Field corrective action reports	X	X
Analytical Data Package	12	Cover sheet (laboratory identifying information)	X	X
	13	Case narrative	X	X
	14	Internal laboratory chain-of-custody	X	X
	15	Sample receipt records	X	X
	16	Sample chronology (dates and times of receipt, preparation, and analysis)	X	X
	17	Communication records	X	X
	18	DL/LOD/LOQ establishment and verification	X	X
	19	Instrument calibration records	X	X
	20	Definition of laboratory qualifiers	X	X
	21	Results reporting forms	X	X
	22	QC sample results	X	X
	23	Corrective action reports	X	X
	24	EDD	X	X

Table notes:

DL = detection limit
EDD = electronic data deliverable
LOD = limit of detection
LOQ = limit of quantitation LOQ
QAPP = Quality Assurance Project Plan
QC = quality control
SOP = standard operating procedure
UFP = Uniform Federal Policy

Worksheet #35—Data Verification Procedures

Data verification is a completeness check to confirm that all required activities were conducted, all specified records are present, and the contents of the records are complete. It applies to both field and laboratory records.

Table 35-1. Data Verification Procedures

Verification Input	Description	Person(s) Responsible for Verification
Field Notebooks	Field notes will be reviewed internally at the end of each working day and placed in the project file.	QC Manager/SSHO/CH2M
Chain-of-Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper’s signature on the chain-of-custody forms will be initialed by the reviewer, a copy of the chain-of-custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	QC Manager/SSHO/CH2M
Sampling Forms	Sampling forms will be reviewed internally at the end of each working day and placed in the project file.	QC Manager/SSHO/CH2M
Field SOPs	Verify that the sampling SOPs were followed.	QC Manager/SSHO/CH2M
Field Audit Reports and Corrective Actions	Verify that applicable field audits and Health and Safety meetings were completed and that all required corrective action were defined, implemented, and effective.	QC Manager/SSHO/CH2M
Analytical SOPs	Verify that the analytical SOPs were followed.	Laboratory QA Officer/ Shane Lowe/CH2M
Laboratory Data	Laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal. Received data packages will be validated internally by the CH2M project chemist.	Laboratory QA Officer/ Shane Lowe/CH2M
Method QC Results	Verify that the required QC samples were run and met required limits.	Laboratory QA Officer/ Shane Lowe/CH2M
Field QC Sample Results	Verify that the required field QC samples were run and met required limits.	Laboratory QA Officer/ Shane Lowe/CH2M
Quantification Limits	Verify that the sample results met the project quantification limit specified in the QAPP.	Shane Lowe/CH2M
Laboratory Corrective Actions	Verify that applicable laboratory corrective actions were defined, implemented and effective.	Laboratory QA Officer/ Shane Lowe/CH2M
Project Reports	Project reports will undergo a QA review by CH2M senior staff with applicable expertise dependent upon the content of the report.	Various/CH2M

Table notes:

CH2M = CH2M HILL Constructors, Inc.
QA = quality assurance
QC = quality control
SOP = standard operating procedure(s)
SSHO = Site Safety and Health Officer

Worksheet #36—Data Validation Procedures

Definitive data will be verified and validated at the Stage 2b as described in the EPA QA/G-8 (EPA 2002). Validation criteria were designed using the requirements of the DoD QSM Version 5.1.1 (DoD and DOE 2018) as a beginning framework. This section identifies the data review and validation requirements (see Table 36-1).

Table 36-1. Validation Summary

Matrix	Analytical Group	Validation Criteria	Data Validator
Soil	PAHs, PCBs, explosives, or metals (location dependent).	Defined in Worksheet #28, Tables 36-3 through 36-5 and below; 100% of the data undergo Stage 2B validation. Note that QA split samples will not be validated. They will have a precision evaluation only.	Shane Lowe/CH2M

Table notes:
CH2M = CH2M HILL Constructors, Inc.
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl(s)
QA = quality assurance

Data Review Requirements for Definitive Data

Scientifically sound data of known and documented quality that meet the DQOs are essential to the decision-making process. Data will be examined and evaluated to varying levels of detail and specificity by a variety of personnel who have different responsibilities within the data management process. Data assessment includes verification, review, validation, evaluation, and usability assessment. The data review process will be documented to facilitate efficient and accurate assessment of data quality and usability. The overall usability of the data is indicated with appropriate qualifiers.

Laboratory Requirements

The analytical data package must contain adequate information and be presented in a clear and concise manner. The laboratory data package should be organized such that the analytical results are reported on a per analytical batch basis, unless otherwise specified. A reviewer should be able to determine the PARCCS of the data, based on the information contained in the data package. Additional information may be required, depending on the detail of data review performed. A Stage 4 deliverable is required for this project.

A schedule should be established so that data packages (that is, sample delivery groups) are provided in a timely manner to CH2M for data review, validation, assessment, and use. This includes identifying the anticipated number of these data packages to be generated for the project. Preliminary data packages are to be submitted to CH2M within 7 days of the receipt of samples and final packages within 21 days.

Laboratory Data Reporting Requirements

The following requirements should be met for reporting:

- LODs and sample results should be reported to one decimal place more than the corresponding LOQ, unless the appropriate number of significant figures for the measurement dictates otherwise.
- Samples will be analyzed undiluted if possible. Nondetects will be reported to the LODs. LODs and LOQs for minority chemicals in highly-contaminated samples may have to be adjusted because of dilutions.

Manual Integrations

Manual integrations are an integral part of the chromatographic analysis process and will be done only as a corrective action measures. Examples of instances where manual integration would be warranted include, but are not limited to, co-eluting compounds resulting in poor-peak resolution, a misidentified peak, an incorrect RT, or a problematic baseline.

When manual integrations are used, the following procedures will be implemented to document the event and for consistency in performing the manual integration:

- A laboratory SOP will be followed for manual integrations. This SOP will specify the following: (1) when automated integrations by the instrument are likely to be unreliable, (2) what constitutes an unacceptable automated integration, (3) how the problems should be resolved by the analyst, and (4) the procedures for the analyst to follow in documenting any required manual integrations.
- Raw data records will include a complete audit trail for those manipulations, including the following: (1) results of both the automated and manual integrations, (2) notation of the cause and justification for performing the manual integrations, (3) date, and (4) signature or initials of person performing the manual operations.
- All manual integrations must be reviewed and approved by the section supervisor and/or the QA officer.
- All manual integrations must be identified in the case narrative.

Laboratory Data Review Requirements

All definitive data will be reviewed first by the laboratory analyst and then by the laboratory supervisor of the respective analytical section using the same criteria listed below before they are submitted to CH2M. This internal data review process, which is multi-tiered, should include all aspects of data generation, reduction, and QC assessment. Elements for review or verification at each level must include, but are not limited to, the following:

- Sample receipt procedures and conditions
- Sample preparation
- Appropriate laboratory SOPs and methodologies
- Accuracy and completeness of analytical results
- Correct interpretation of all raw data, including all manual integrations
- Appropriate application of QC samples and compliance with established control limits
- Verification of data transfers
- Documentation completeness
- Accuracy and completeness of data deliverables (hard copy and electronic)

Laboratory Data Evaluation

The calibration, QC, corrective actions, and flagging requirements for definitive data are provided in Worksheet #28. Data qualifiers should be applied by the laboratory as part of their internal validation activities. The allowable data qualifiers for definitive data are *Q, M, E, J, B*, *and U.* The definitions of the data qualifiers are provided in the Table 36-2. Flagging criteria apply when acceptance criteria are not met, and corrective actions were not successful or not performed. The data qualifiers must be reviewed by the supervisor of the respective analytical sections.

The laboratory QA section will perform a 100 percent review of 10 percent of the completed data packages. The laboratory project representative will complete a final review on all the completed data packages.

The CH2M project chemist or designee will subsequently evaluate the flags applied by the laboratory as part of their data review and usability assessment activities. The flags may be accepted, modified, or rejected. For all data qualifiers that are changed, clear justification will be provided. All Q-flagged data will be evaluated and either accepted without qualification, accepted with qualification, or rejected.

Table 36-2. Laboratory Data Qualifiers

Qualifier	Description
Q	This indicates that one or more QC criteria fail. Data must be carefully assessed by CH2M (or project team) with respect to the project-specific requirements and evaluated for usability. Subsequent assessment by USACE may result in rejection of data.
M	Manual integration
J	The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria.
B	The analyte was found in an associated blank above one half the LOQ, as well as in the sample.
U	The analyte was analyzed for but not detected.
E	Exceeds calibration range of the instrument.

Table notes:
CH2M = CH2M HILL Constructors, Inc.
LOQ = limit of quantitation
QC = quality control
USACE = U.S. Army Corps of Engineers

CH2M Requirements

CH2M has overall responsibility for data quality and may be assisted in its review by external organizations. Regardless of who performs the data review, the individual(s) should possess the disciplinary expertise, experience, and theoretical knowledge to perform the task, and a complete understanding of the intended use of the data and the relationship of the QC results to the usability of the data.

Data Verification Guidelines

The CH2M project chemist will review the data verification performed by the laboratory for completeness and accuracy. Data verification may be done electronically or manually, or by a combination of both. The verification process includes, but is not limited to the following:

- Sampling documentation (such as the chain-of-custody form)
- Preservation summary and holding times
- Presence of all analyses and analytes requested
- Use of required sample preparation and analysis procedures
- LODs and LOQs
- Correctness of concentration units
- Case narrative

Data Validation Guidelines

Data validation extends data verification and is used to confirm that the requirements for a specific intended use are fulfilled. Data validation is the systematic process of evaluating the compliance of the data with the pre-defined requirements of the project (including method, procedural, or contractual requirements) and compliance of the data against criteria based on the quality objectives documented in this document. The purpose of data validation is to assess the performance associated with the analysis to determine the quality of the data. Data validation includes a determination, to the extent possible, of the reasons for any failure to meet performance requirements, and an evaluation of the impact of such failures on the usability of the data. The project chemist may add or delete data qualifier flags during validation.

Validation will be performed on an analytical batch basis using ADR software on 100 percent of the primary project data by assessing QC samples and associated field sample results. Manual validation will be completed where ADR cannot meet the need such as calibration review. Data validation guidelines have been developed in accordance with the method requirements, professional judgment and general DoD requirements. The following information will be reviewed as part of a Stage 2B type summary data validation:

- Chain-of-custody documentation
- Holding time
- QC sample frequencies
- Method blanks
- LCS
- Surrogate spikes
- MS/MSD
- Initial and continuing calibration information
- Internal standards
- Tuning criteria
- FD precision
- Case narrative review and other method-specific criteria
- Laboratory duplicates
- Serial dilutions
- Post digestion spikes
- Calibration blanks

Raw Data Review

A Stage 4 data review involves an in-depth review of the raw data to verify accuracy followed by analysis and interpretation of the data in the context of the project objectives and end-use as part of the usability assessment. The review includes but is not limited to the following:

- Method-specific instrument calibration and QC parameters
- Raw data and chromatograms
- System performance
- Proper integration (if applicable)
- Spectral matches, and/or RTs to verify analyte identification (where applicable)
- Random check of calculations
- Interference problems or system performance problems
- Estimated results (such as J-qualifiers)
- Resolution by the laboratory of any identified problems, as necessary

Ten percent of all data will be validated as a Stage 4 review by a third-party validation firm, LDC. The firm will be subcontracted directly to CH2M. Results of the third-party data validation will be incorporated into the project results if any differences are noted in the ADR/CH2M process to LDC final reporting.

Data Assessment and Interpretation

This phase of the data validation process (assessment) may include but is not limited to the review of the following:

- All Q-flagged data and final determination of its usability
- All B-flagged data and final determination of its usability
- Laboratory and field blank contamination and parallel contamination in samples
- Duplicate and replicate sample analyses
- Potential LCS failure where marginal exceedances criteria may apply
- Impact of multiple data issues on the final analytical results
- Deficiencies identified during data verification and assessment of their impact on the sample results
- Incorporation of site-specific factors and assessment of their impact on the data
- Assessment of data usability and assignment of final data qualifiers listed in Table 36-3, as necessary

- Discussion of completeness, representativeness, and comparability

Data flags, as well as the reason for each flag, will be entered into an electronic database and made available to the data users. A final flag is applied to the data by the data validator/chemist after evaluating all flags entered into the database and selecting the most conservative flags.

ADR.net will be used to perform the comparisons against the limits for elements of QC that are available in the laboratory electronic deliverables. Calibration, internal standards and tuning criteria will be reviewed manually in the laboratory data packages. The process will include data flagging for issues related to method blanks, equipment blanks, trip blanks, ambient blanks, LCSs, MS/MSD samples, FDs, surrogate recoveries, holding time, and reconciliation of dilutions and re-extractions. All of the elements of QC, their limits, and the logic for applying flags will be incorporated in the electronic database.

A data validation report will be prepared to summarize the findings and their impact on the overall data usability. The report will include a discussion of the QC evaluated (including but not limited to calibration, LCS, MS/MSD, FD, surrogates and internal standards) as well as a summary table of the final validation flags applied to the data and the validation reasons. This may be incorporated into the final usability assessment.

Method Blank Evaluation Guidance

For method blanks, the source of contamination should be investigated. If one-half the LOQ is exceeded, the laboratory should evaluate whether reprocessing of the samples is necessary using the following criteria: (1) the method blank contamination exceeds a concentration greater than one-tenth of the measured concentration of any sample in the associated preparation batch; or (2) there is evidence indicating that the blank contamination otherwise affects the sample results. Except when the sample analysis resulted in a nondetect, all samples associated with method blank contamination and meeting these criteria must be reprocessed in a subsequent preparation batch. If no sample volume remains for reprocessing, the results will be reported with a B-flag, along with any other appropriate data qualifier. If an analyte is found only in the method blank, but not in any batch samples, no flagging is necessary. Method blank contamination must be addressed in the case narrative.

CH2M project chemist will evaluate laboratory B-qualified data such as method blanks, as well as other blank detections based on the concentration of the analyte in the samples in relation to the concentration in the blank. The B-flag may be removed and not used if the analyte concentrations in the samples are much higher (≥ 5 times) than in the blank (≥ 10 times in case of common laboratory contaminants). Any blank contamination that may impact data usability must be discussed in conjunction with project-specific goals. When a dataset contains low-level detects in field samples and has associated field or laboratory blanks that have detects at similar concentrations, this suggests that the low-level detects in these field samples may be artifacts because of either field or laboratory practices. A sample detect that is ≤ 5 times the blank contamination (≤ 10 times for common laboratory contaminants) may be considered a nondetect and flagged "U" at the detected concentration.

Duplicate Evaluation Guidance

QC measures for precision include FDs, field replicates, laboratory duplicates, MSDs, analytical replicates, and surrogates. These measures will be evaluated by the laboratory and qualified according to applicable procedures, with the exception of the FDs.

Specifically, FDs should be sent to the laboratory as blind samples and should be given unique sample identification numbers. These sample results can be used to assess field sampling precision, laboratory precision, and, potentially, the representativeness of the matrix sampled. Flagging of results associated with FDs should be assigned such that the level of uncertainty required, as provided by the project-specific objectives, is taken into account (Table 36-4).

Poor overall precision may be the result of one or more of the following: field instrument variation, analytical measurement variation, poor sampling technique, sample transport problems, or spatial variation (heterogeneous sample matrices). To identify the cause of imprecision, the project team should evaluate the field sampling design rationale and sampling techniques, and review both field and analytical duplicate sample results. If poor precision is indicated in both the field and analytical duplicates, then the laboratory may be the source of error. If poor precision is limited to the FD results, then the sampling technique, field instrument variation, sample transport, and/or spatial variability may be the source of error. If data validation reports indicate that analytical imprecision exists for a particular dataset or sample delivery group, then the impact of that imprecision on usability must be discussed in the report.

Flagging Conventions

The allowable final data qualifiers for definitive data and the hierarchy of data qualifiers, listed in order of the most severe through the least severe, are X, J, UJ, and U. Their definitions are summarized in Table 36-3.

Table 36-3. Usability Assessment Data Qualifiers

Qualifier	Description
X	The data are potentially rejected because of deficiencies in meeting QC criteria and may not be used for decision making.
J	The analyte was positively identified; the quantitation is an estimation because of discrepancies in meeting certain analyte-specific QC criteria or the analyte was positively identified but the associated concentration is an estimation above the DL and below the LOQ.
UJ	The analyte was not detected; however, the result is estimated because of discrepancies in meeting certain analyte-specific QC criteria.
U	The analyte was analyzed for, but not detected or is qualified as nondetect because of blank contamination.

Table notes:
DL = detection limit
LOQ = limit of quantitation
QC = quality control

Table 36-4 presents the specific guidelines for applying these data usability qualifiers and includes additional information that is not included in the table as published by the DoD QSM Version 5.1.1, but can be used to help define additional general flagging criteria applied (in some cases based on professional judgment). Table 36-5 presents the final data reporting flag conventions to be used in compliance with the DoD QSM version 5.1.1.

Table 36-4. General Data Qualifying Conventions

Quality Control Requirement	Criteria	Flag	Flag Applied To
Holding time	Time exceeded for extraction or analysis by a factor of 2 or more	J for the positive results; X or UJ for nondetects [a]	All analytes in the sample
Sample preservation	Sample not preserved (If sample preservation was not done in the field but was performed at the laboratory upon sample receipt, no flagging is required, metals only)	J positive results; X or UJ for nondetects [a]	Sample
	Temperature out of control	J for positive results; UJ for nondetects [a] X based on professional judgment	Sample
Instrument tuning	Mass assignment error or Ion abundance method-specific criteria not met	X for all results, if critical ions involved, use judgment otherwise	All associated samples in analytical batch
Initial calibration	All analytes must be within method-specified criteria	J for positive results; UJ for nondetects, X based on professional judgment	All associated samples in analytical batch

Table 36-4. General Data Qualifying Conventions (continued)

Quality Control Requirement	Criteria	Flag	Flag Applied To
Second source check or continuing calibration	All analytes must be within method-specified criteria	High Bias: J for the positive results, no flag for nondetects Low Bias: J for the positive results, UJ for the nondetects; J for the positive results/X for all nondetects greater than twice the control criteria	All associated samples in analytical batch
Low-level calibration check or interference check sample	All analytes must be within 20% of expected value	High Bias: J for the positive results, no flag for the nondetects Low Bias: J for the positive results, UJ for the nondetects; X for all nondetects greater than twice the control criteria	All associated samples in analysis batch
LCS	%R greater than UCL %R less than LCL and greater than 10% %R less than LCL and less than 10%	J for the positive results; J for the positive results; UJ for the nondetects J for the positive results; X for the nondetects	Specific analyte(s) in all samples in the associated analytical batch
Internal standards	Area greater than UCL Area less than LCL Sample is re-extracted and reanalyzed and recovery outside of criteria is confirmed as a matrix effect	J for the positive results J for the positive results; UJ for the nondetects If area is too low based on professional judgment, UJ or X for the nondetects	Sample
Surrogate spikes	%R greater than UCL %R less than LCL and greater than 10% %R less than 10% Excessive dilution	J for the positive results J for the positive results; UJ for the nondetects J for the positive results; X for the nondetects No flag required	Sample
Blanks (method, equipment, ambient, or trip)	Analyte(s) detected greater than DL (use the blank of the highest concentration)	U for positive sample results ≤ 5 times highest blank concentration (10 times for common laboratory contaminants)	All samples in preparation, field or analytical batch, whichever applies
Field duplicates or laboratory duplicates, ISM duplicates and triplicate sets	Both sample results greater than 5 times LOQ and RPD greater than UCL or	J for the positive results	The specific analyte(s) in all samples collected on the same sampling date
	One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	J for the positive results UJ for the nondetects	Note: No flagging is required for RPDs based on J-flagged results
	For ISM field duplicate/triplicate sets that have first been evaluated as defined above, an RSD will be calculated with a criteria for evaluation of 35%.	J flag any detections and UJ any nondetections greater than 35%	Apply flags to the parent sample, duplicate and triplicate only
	For ISM laboratory subsample duplicate/triplicate sets that have first been evaluated as defined above, an RPD will be calculated with a criteria for evaluation of 35%	J flag any detections and UJ any nondetections greater than 35%	Apply flags to the parent sample, duplicate and triplicate only

Table 36-4. General Data Qualifying Conventions (continued)

Quality Control Requirement	Criteria	Flag	Flag Applied To
MS/MSD	%R greater than UCL %R less than LCL and >10% %R less than 10% or MS/MSD RPD greater than control limit; Sample concentration greater than 4x spike concentration; Excessive dilution [a]	J for the positive results J for the positive results; UJ for the nondetects J for the positive results; X for the nondetects J for the positive results No flag required	The specific analyte(s) in the parent sample
Serial dilutions (applicable to sample concentrations more than 50 times LOQ)	All analytes must be within 10% of expected value	J for the positive results, UJ for the nondetects	The specific analyte(s) in the parent sample
PDS (applicable to sample concentrations less than 50 times LOQ)	Within 80 to 120%	Greater than UCL: J for the positive results Lower than LCL: J for the positive results; UJ for the nondetects	The specific analyte(s) in the parent sample
RT window	Analyte within established window	X for all results	Sample

Table notes:

[a] Based on analyte-specific review

%R = percent recovery
DL = detection limit
ISM =incremental sampling methodology
LCL = lower confidence limit
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike
MSD = matrix spike duplicate
PDS = post-digestion spike
RPD = relative percent difference
RT = retention time
UCL = upper confidence limit

Table 36-5. Data Qualifying Conventions—Quantitation

Criteria	Flag
Less than DL	U, UJ at the LOD
More than or equal to DL less than LOQ	J
More than or equal to LOQ	As needed
More than or equal to high standard/linear range	J

Examples:
DL = 2, LOD = 4, LOQ = 15, sample is undiluted
Example 1: Analytical result: not detected; reported result: les than 4U
Example 2: Analytical result: 3; reported result: 3J
Example 3: Analytical result: 10; reported result: 10J
Sample 4: Analytical result: 15; reported result: 15

Table notes:
DL = detection limit
LOD = limit of detection
LOQ = limit of quantitation

Worksheet #37—Data Usability Assessment

The data usability assessment is an evaluation based on the results of data verification and validation in the context of the overall project decisions or objectives. The assessment is used to determine whether the project execution and resulting data meet the project DQOs. Both the sampling and analytical activities must be considered, with the ultimate goal of assessing whether the final, qualified results support the decisions to be made with the data.

The following sections summarize the processes to determine whether the collected data are of the right type, quality, and quantity to support the environmental decision making for the project, and describe how data quality issues will be addressed and how limitations of the use of the data will be handled.

Summary of Usability Assessment Processes

Data gaps may be present if (1) a sample is not collected, (2) a sample is not analyzed for the requested parameters, or (3) the data are determined to be unusable. The need for further sampling will be determined on a case-by-case basis, depending on whether data can be extrapolated from adjacent sample locations, and whether the data are needed based on the results from adjacent sample locations.

The CH2M project chemist and the laboratory will confirm that the collected data meet the LODs, LOQs, and laboratory QC limits specified in this document. During the data validation assessment, nonconformances will be documented, and data will be qualified accordingly. The CH2M project chemist will determine whether the data are usable based on the requirements specified in this document.

Data as qualified by the CH2M project chemist are considered useable, with the exception of rejected data. Estimated and/or biased results are considered usable. Outliers, if present, can be addressed on a case-by-case basis. There is no generic formula for determining whether a result is an outlier. Potential outliers will be referred to a statistician and/or senior consultant, who will determine which formulas are appropriate for classifying data points in a statistically appropriate and defendable manner.

Evaluative Procedures to Assess Project-Specific Overall Measurement Error

Overall measurement error is normally associated with both sampling design and quality and quantitative measures performed in both the field and laboratory. In-depth assessment will be performed during the data review and validation processes to assess conformance with the field SOPs, laboratory standard operating procedures, and objectives of this document. Qualifiers will be used to indicate overall usability of the data.

Personnel Responsible for Performing Usability Assessment

Doug Scott/CH2M Project Chemist
Shane Lowe/CH2M Project Chemist
Key Rosebrook/CH2M Design Manager
Sarah Meyers/CH2M Project Manager
Jason Cole/CH2M Senior Technical Consultant

Usability Assessment Documentation

The results will be assembled and statistically reported for an overall quality assessment in a data validation report, which will be provided as an appendix to the report. The data validation report will identify precision and accuracy exceedances with respect to the laboratory performance for each batch of samples, as well as comparability of field and laboratory duplicates. Discussion will cover PARCC criteria, as described in the following subsections.

Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Precision is the measurement of the variability associated with the sampling and analytical process. Precision is determined by analysis of duplicate field samples, laboratory/matrix duplicates, LCSDs and/or MSDs. Field duplicate samples and MSD samples should be collected to assess field precision at a frequency as described in Worksheet #20. The required control limits for LCSD, MSD and laboratory/matrix duplicate precision for each method, matrix, and analyte are provided in Table 15-1. A control limit, relative percent difference (RPD) of ± 50 percent for soil will be used for original and field duplicate concentrations greater than five times the LOQ for treatment samples. For ISM laboratory subsample replicates a control limit RSD/RPD of 20 percent will be used. For ISM field triplicate results, the precision is measured using the RSD and the control limit for that will be less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent). The formula for the calculation of RPD and RSD are provided below.

If calculated from duplicate measurements:

$$RPD = 100\% \times \frac{(C_1 - C_2)}{(C_1 + C_2) \times \frac{1}{2}} \quad (1)$$

Where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use RSD rather than RPD:

$$RSD = 100\% \times (s / \bar{y}) \quad (2)$$

Where:

RSD = relative standard deviation
s = standard deviation
$\bar{y}$ = mean of replicate analyses

Standard deviation, σ, is defined as follows:

$$\sigma = \sum_{i=1}^{n} \sqrt{\frac{(y_i - \bar{y})^2}{n-1}} \quad (3)$$

Where:

σ = standard deviation
y_i = measured value of the i^{th} replicate
$\bar{y}$ = mean of replicate analyses
n = number of replicates

Accuracy

Accuracy reflects the total error associated with a measurement. A measurement is considered accurate when the reported value agrees with the true value or known concentration of the spike or standard within acceptable limits. Analytical accuracy is measured by comparing the percent recovery (*%R*) of analytes spiked into an LCS or MS to a control limit. For many methods of organic compound analysis, surrogate compound recoveries also are used to assess accuracy and method performance for each sample analyzed.

Both accuracy and precision are calculated for each analytical batch, and the associated sample results are interpreted by considering these specific measurements. The formula for calculation of accuracy is included below as *%R* from pure and sample matrices. Accuracy requirements are listed for each method, matrix, and analyte in Table 15-1.

For measurements where MSs are used:

$$\%R = 100\% \times \left[\frac{S - U}{C_{sa}} \right] \qquad (4)$$

Where:

%R = percent recovery
S = measured concentration in spiked aliquot
U = measured concentration in unspiked aliquot
C_{sa} = actual concentration of spike added

For situations where a LCS is used instead of or in addition to MSs:

$$\%R = 100\% \times \left[\frac{C_m}{C_{sm}} \right] \qquad (5)$$

Where:

%R = percent recovery
C_m = measured concentration of LCS
C_{sm} = actual concentration of LCS

Representativeness

Representativeness is a qualitative term that refers to the degree in which data accurately and precisely depicts the characteristics of a population, whether referring to the distribution of contaminant within a sample, a sample within a matrix, or the distribution of a contaminant at a site. Representativeness is determined by appropriate program design, with consideration of elements such as sampling locations. Objectives for representativeness are defined for each sampling and analysis task and are a function of the investigative objectives. Assessment of representativeness will be achieved through use of the standard field sampling and analytical procedures. Decisions regarding sample locations process and numbers and the statistical sampling design are documented in the project Work Plan.

Comparability

Comparability is a qualitative indicator of the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms supports the assessment of comparability. Historical comparability can be achieved through consistent use of methods and documentation procedures throughout the project. Assessment of comparability is considered subjective and the results should be interpreted by experienced environmental professionals with a clear knowledge of the PQOs and project decisions.

Completeness

Completeness is a measure of the amount of valid data obtained compared with the amount that was expected to be obtained under correct, normal conditions. It is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples (for example, by site) as set out in the DQOs. Valid data are data that are usable in the context of the project goals. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results and may include an X-flag after a usability assessment has been performed. Completeness should not be determined only based on laboratory data qualifiers. The goal for completeness is 90 percent for the samples.

Completeness is calculated as follows for all measurements:

$$\%C = 100\% \times \left[\frac{V}{T}\right] \qquad (6)$$

Where:

> *%C* = percent completeness
> *V* = number of measurements judged valid
> *T* = total number of measurements

Sensitivity

Sensitivity is the ability of an analytical method or instrument to discriminate between measurement responses representing different concentrations. This capability is established during the planning phase to meet project-specific objectives. It is important to be able to detect the target analytes at the levels of interest. Sensitivity requirements include the establishment of various limits such as calibration requirements, instrument LODs, and LOQs. The project QA/QC on method requirements has been established to be compliant with the DoD QSM Version 5.1.1 (DoD and DOE 2018). Project-specific LOD and LOQs are established in Worksheet #15 based on project-specific action level objectives.

References

Hawai'i Department of Health (HDOH). 2016. Technical Guidance Manual for the Implementation of the Hawai'i State Contingency Plan, Section 4, Decision Unit Characterization. August.

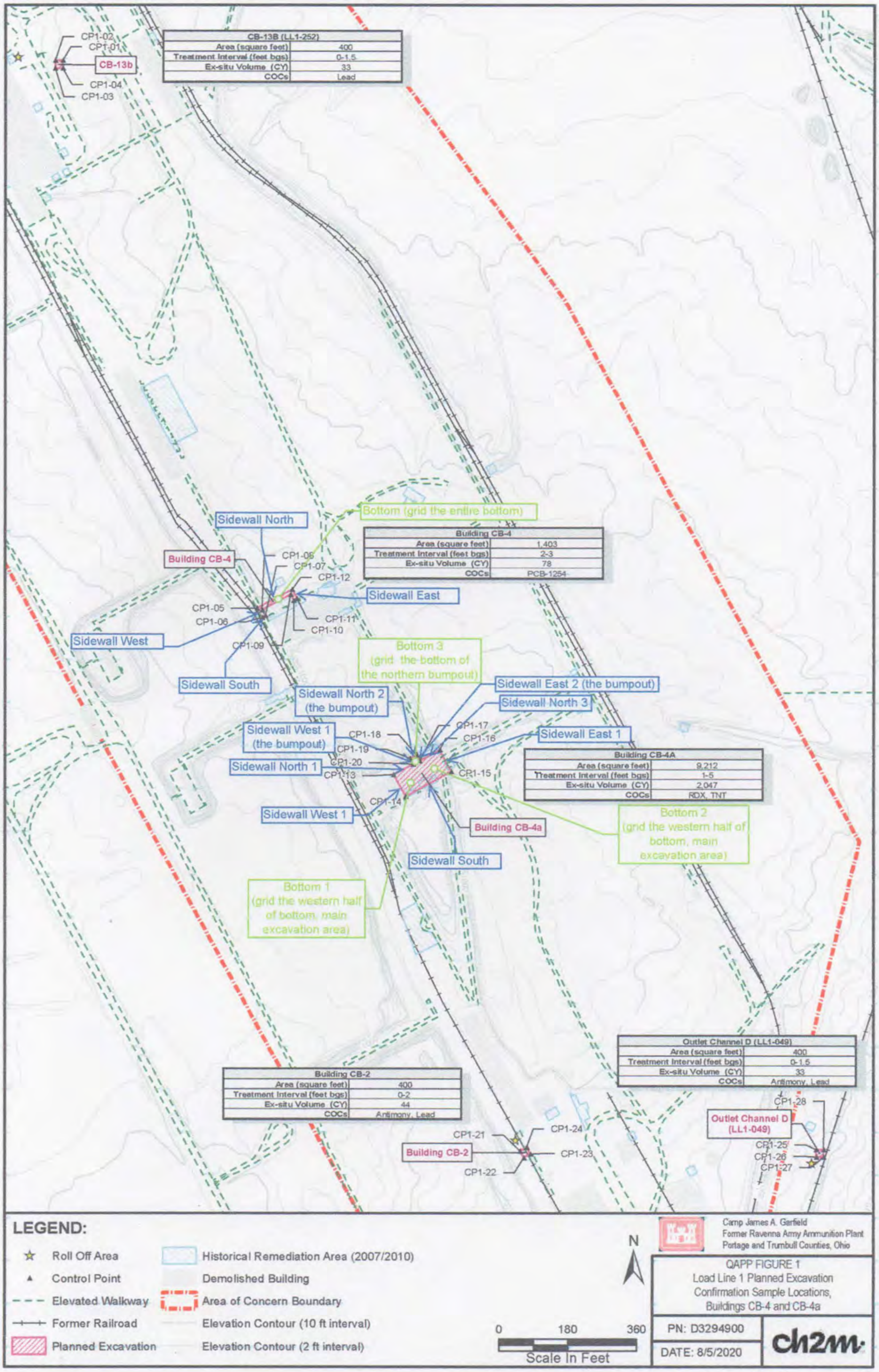
Leidos. 2011. *Facility-Wide Sampling and Analysis Plan for Environmental Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio*. Prepared for USACE. February.

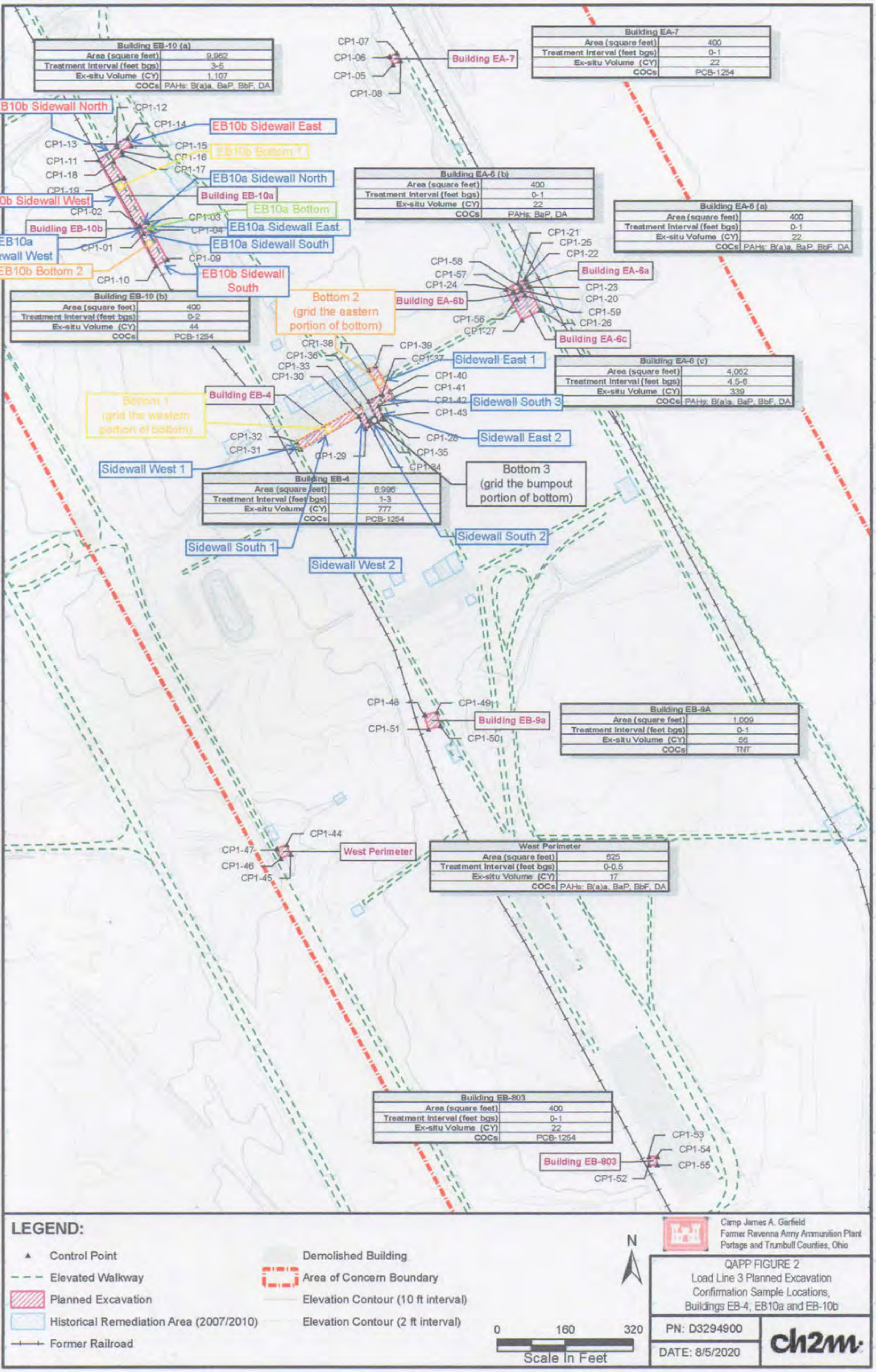
Leidos. 2019. *Final Record of Decision Amendment for Soil, Sediment, and Surface Water at RVAAP Load Lines 1, 2, 3, 4, and 12*. Prepared for USACE. December 2019.

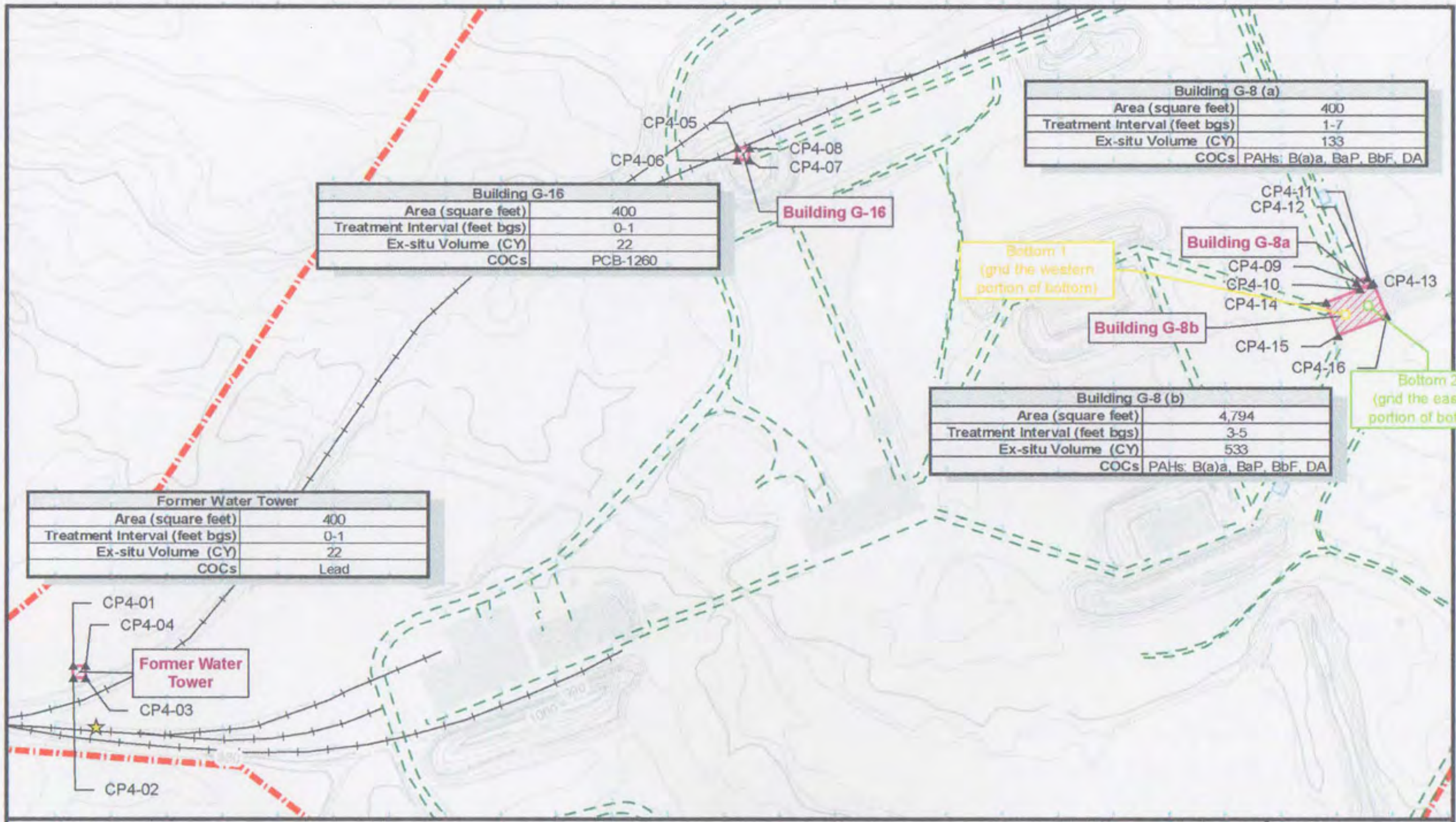
U.S. Department of Defense and U.S. Department of Energy (DoD and DOE). 2018. *Consolidated Quality Systems Manual for Environmental Laboratories. Quality Systems Manual for Environmental Laboratories*, Version 5.1.1

U.S. Environmental Protection Agency (EPA). 2002. *Guidance on Environmental Data Verification and Data Validation*, EPA QA/G-8, November.

Figures


CB-13B (LL1-252)
Area (square feet) 400
Treatment Interval (feet bgs) 0-1.5
Ex-situ Volume (CY) 33
COCs Lead
CP1-02
CP1-01
CB-13b
CP1-04
CP1-03
Bottom (grid the entire bottom)
Sidewall North
Building CB-4
Area (square feet) 1,403
Treatment Interval (feet bgs) 2-3
Ex-situ Volume (CY) 78
COCs PCB-1254
Building CB-4
CP1-08
CP1-07
CP1-12
Sidewall East
CP1-05
CP1-06
CP1-11
CP1-10
Sidewall West
CP1-09
Sidewall South
Bottom 3
(grid the bottom of the northern bumpout)
Sidewall East 2 (the bumpout)
Sidewall North 2 (the bumpout)
Sidewall North 3
Sidewall West 1 (the bumpout)
CP1-17
CP1-18
CP1-16
Sidewall East 1
CP1-19
CP1-20
Sidewall North 1
CP1-13
CP1-15
Building CB-4A
Area (square feet) 9,212
Treatment Interval (feet bgs) 1-5
Ex-situ Volume (CY) 2,047
COCs RDX, TNT
CP1-14
Sidewall West 1
Building CB-4a
Bottom 2
(grid the western half of bottom, main excavation area)
Sidewall South
Bottom 1
(grid the western half of bottom, main excavation area)
Outlet Channel D (LL1-049)
Area (square feet) 400
Treatment Interval (feet bgs) 0-1.5
Ex-situ Volume (CY) 33
COCs Antimony, Lead
Building CB-2
Area (square feet) 400
Treatment Interval (feet bgs) 0-2
Ex-situ Volume (CY) 44
COCs Antimony, Lead
CP1-28
Outlet Channel D (LL1-049)
CP1-21
CP1-24
Building CB-2
CP1-23
CP1-22
CP1-25
CP1-26
CP1-27
LEGEND:
Roll Off Area
Control Point
Elevated Walkway
Former Railroad
Planned Excavation
Historical Remediation Area (2007/2010)
Demolished Building
Area of Concern Boundary
Elevation Contour (10 ft interval)
Elevation Contour (2 ft interval)
N
0 180 360
Scale In Feet
Camp James A. Garfield
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
QAPP FIGURE 1
Load Line 1 Planned Excavation Confirmation Sample Locations, Buildings CB-4 and CB-4a
PN: D3294900
DATE: 8/5/2020
ch2m


Building EB-10 (a)
Area (square feet) 9,962
Treatment Interval (feet bgs) 3-5
Ex-situ Volume (CY) 1,107
COCs PAHs: B(a)a, BaP, BbF, DA
Building EA-7
Area (square feet) 400
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 22
COCs PCB-1254
Building EA-7
EB10b Sidewall North
EB10b Sidewall East
EB10b Bottom 1
EB10a Sidewall North
Building EB-10a
EB10b Sidewall West
EB10a Bottom
Buidling EB-10b
EB10a Sidewall East
EB10a Sidewall West
EB10a Sidewall South
EB10b Bottom 2
EB10b Sidewall South
Building EA-6 (b)
Area (square feet) 400
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 22
COCs PAHs: BaP, DA
Building EA-6 (a)
Area (square feet) 400
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 22
COCs PAHs: B(a)a, BaP, BbF, DA
Building EA-6a
Building EA-6b
Building EA-6c
Building EB-10 (b)
Area (square feet) 400
Treatment Interval (feet bgs) 0-2
Ex-situ Volume (CY) 44
COCs PCB-1254
Bottom 2 (grid the eastern portion of bottom)
Sidewall East 1
Building EA-6 (c)
Area (square feet) 4,062
Treatment Interval (feet bgs) 4.5-6
Ex-situ Volume (CY) 339
COCs PAHs: B(a)a, BaP, BbF, DA
Building EB-4
Sidewall South 3
Bottom 1 (grid the western portion of bottom)
Sidewall East 2
Sidewall West 1
Bottom 3 (grid the bumpout portion of bottom)
Building EB-4
Area (square feet) 6,996
Treatment Interval (feet bgs) 1-3
Ex-situ Volume (CY) 777
COCs PCB-1254
Sidewall South 2
Sidewall South 1
Sidewall West 2
CP1-01 CP1-02 CP1-03 CP1-04 CP1-05 CP1-06 CP1-07 CP1-08 CP1-09 CP1-10 CP1-11 CP1-12 CP1-13 CP1-14 CP1-15 CP1-16 CP1-17 CP1-18 CP1-19 CP1-20 CP1-21 CP1-22 CP1-23 CP1-24 CP1-25 CP1-26 CP1-27 CP1-28 CP1-29 CP1-30 CP1-31 CP1-32 CP1-33 CP1-34 CP1-35 CP1-36 CP1-37 CP1-38 CP1-39 CP1-40 CP1-41 CP1-42 CP1-43 CP1-44 CP1-45 CP1-46 CP1-47 CP1-48 CP1-49 CP1-50 CP1-51 CP1-52 CP1-53 CP1-54 CP1-55 CP1-56 CP1-57 CP1-58 CP1-59
Building EB-9a
Building EB-9A
Area (square feet) 1,009
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 56
COCs TNT
West Perimeter
West Perimeter
Area (square feet) 625
Treatment Interval (feet bgs) 0-0.5
Ex-situ Volume (CY) 17
COCs PAHs: B(a)a, BaP, BbF, DA
Building EB-803
Area (square feet) 400
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 22
COCs PCB-1254
Building EB-803
LEGEND:
Control Point
Elevated Walkway
Planned Excavation
Historical Remediation Area (2007/2010)
Former Railroad
Demolished Building
Area of Concern Boundary
Elevation Contour (10 ft interval)
Elevation Contour (2 ft interval)
N
0 160 320
Scale In Feet
Camp James A. Garfield
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
QAPP FIGURE 2
Load Line 3 Planned Excavation Confirmation Sample Locations, Buildings EB-4, EB10a and EB-10b
PN: D3294900
DATE: 8/5/2020
ch2m



Building G-16	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	PCB-1260

Building G-8 (a)	
Area (square feet)	400
Treatment Interval (feet bgs)	1-7
Ex-situ Volume (CY)	133
COCs	PAHs: B(a)a, BaP, BbF, DA

Building G-8 (b)	
Area (square feet)	4,794
Treatment Interval (feet bgs)	3-5
Ex-situ Volume (CY)	533
COCs	PAHs: B(a)a, BaP, BbF, DA

Former Water Tower	
Area (square feet)	400
Treatment Interval (feet bgs)	0-1
Ex-situ Volume (CY)	22
COCs	Lead

LEGEND:

- ☆ Roll Off Area
- ▲ Control Point
- Elevated Walkway
- Elevation Contour (2 ft interval)
- Elevation Contour (10 ft interval)
- Former Railroad
- Planned Excavation
- Historical Remediation Area (2007/2010)
- Area of Concern Boundary
- Demolished Building

N

0 140 280
Scale In Feet

Camp James A. Garfield
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

QAPP FIGURE 3
Load Line 4 Planned Excavation
Confirmation Sample Locations,
Bottom Samples, Building G-8b

PN: D3294900
DATE: 8/5/2020

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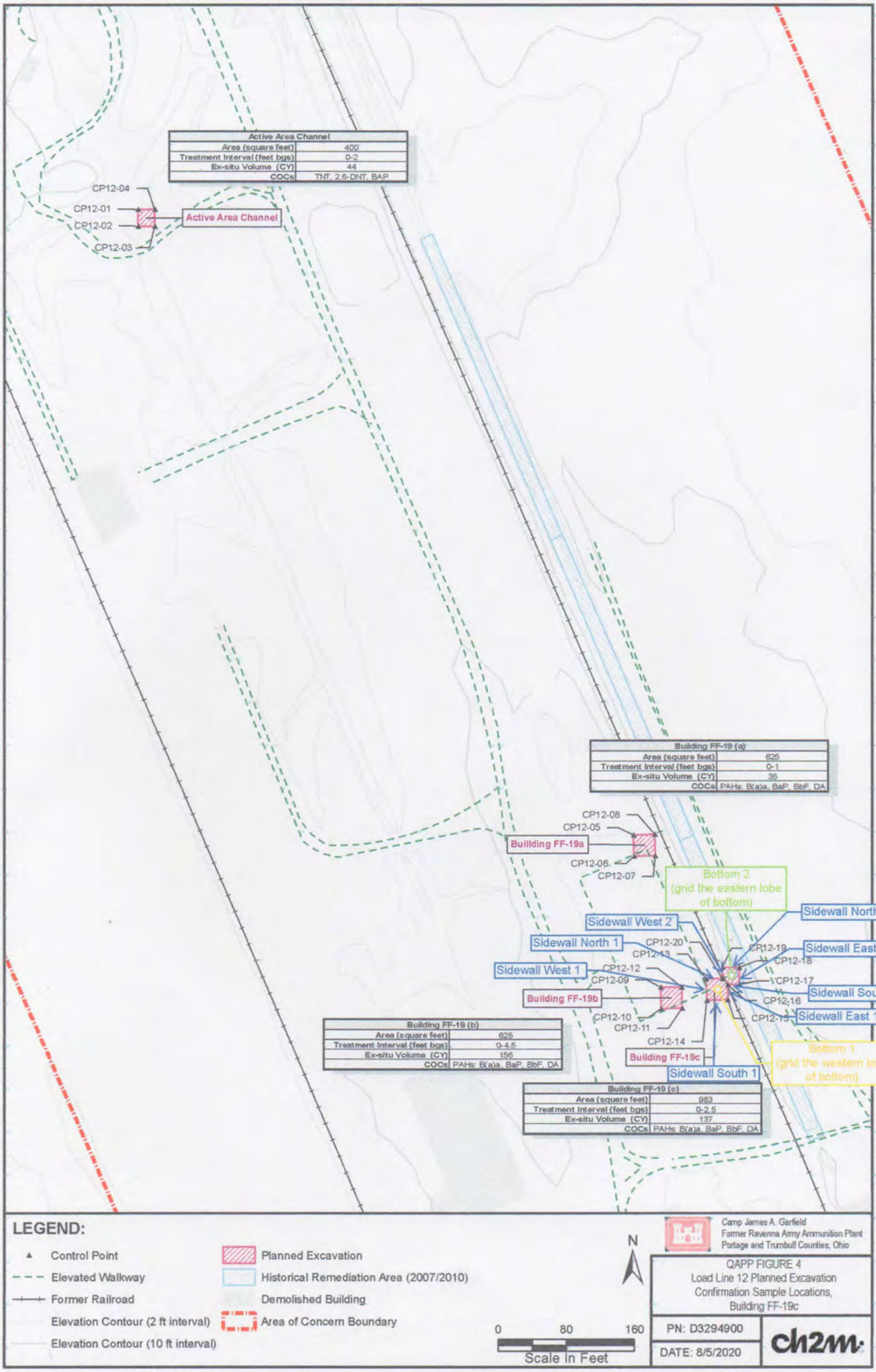

Active Area Channel
Area (square feet) 400
Treatment Interval (feet bgs) 0-2
Ex-situ Volume (CY) 44
COCs TNT, 2,6-DNT, BAP
CP12-04
CP12-01
CP12-02
CP12-03
Active Area Channel
Building FF-19 (a)
Area (square feet) 625
Treatment Interval (feet bgs) 0-1
Ex-situ Volume (CY) 35
COCs PAHs: B(a)a, BaP, BbF, DA
CP12-08
CP12-05
Building FF-19a
CP12-06
CP12-07
Bottom 2
(grid the eastern lobe of bottom)
Sidewall North 2
Sidewall West 2
CP12-20
Sidewall North 1
CP12-13
CP12-19
Sidewall East 2
CP12-18
Sidewall West 1
CP12-12
CP12-09
CP12-17
Sidewall South 2
Building FF-19b
CP12-16
CP12-15
Sidewall East 1
CP12-10
CP12-11
Building FF-19 (b)
Area (square feet) 625
Treatment Interval (feet bgs) 0-4.5
Ex-situ Volume (CY) 156
COCs PAHs: B(a)a, BaP, BbF, DA
CP12-14
Building FF-19c
Bottom 1
(grid the western lobe of bottom)
Sidewall South 1
Building FF-19 (c)
Area (square feet) 983
Treatment Interval (feet bgs) 0-2.5
Ex-situ Volume (CY) 137
COCs PAHs: B(a)a, BaP, BbF, DA
LEGEND:
Control Point
Elevated Walkway
Former Railroad
Elevation Contour (2 ft interval)
Elevation Contour (10 ft interval)
Planned Excavation
Historical Remediation Area (2007/2010)
Demolished Building
Area of Concern Boundary
N
0 80 160
Scale In Feet
Camp James A. Garfield
Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio
QAPP FIGURE 4
Load Line 12 Planned Excavation Confirmation Sample Locations, Building FF-19c
PN: D3294900
DATE: 8/5/2020
ch2m

Attachment 1
Ohio EPA FSOP 2.1.3 Table 1: Summary of Soil Sampling Errors and Control Measures

(excerpted from Ohio EPA FSOP 2.1.3,
Incremental Sampling for Soils and Sediments)

Table 1
Summary of Soil Sampling Errors and Control Measures[1]

Sampling Error	Cause	Description	Control
Fundamental Error (FE)	Compositional heterogeneity	Error caused by particle size and compositional distribution	Increase sample mass and reduce the size of the largest particles sampled
Grouping and Segregation Error (GE)	Distributional heterogeneity	Error caused by heterogeneous particle distribution	Increase sample mass or number of samples, properly homogenize the sample before selecting a subsample for analysis
Long-Range Heterogeneity Fluctuation Error (CE_2)	Large-scale heterogeneity	Error generated by changes in concentration across space or time	Reduce the spatial interval between samples
Periodic Heterogeneity Fluctuation Error (CE_3)	Periodic heterogeneity	Error generated by periodic changes in concentration over time	Change the spatial or temporal intervals between samples
Increment Delimitation Error (DE)	Sample increment geometry	Error resulting from the shape of the sample increment	Select a sampling plan design and equipment that samples a representative portion of the soil unit of interest
Increment Extraction Error (EE) (ME)?	Sampling device shape	Error resulting from the size and shape of the sampling device	Select sampling equipment that does not exclude certain soil particles based on size or shape, use proper sampling protocols
Preparation Error (PE)	Sample handing	Loss or gain of constituents during sample handling and analytical preparation	Use appropriate sample handling, preservation, transport and preparation protocols

[1] Adapted from the February 2012 ITRC *Incremental Sampling Methodology*, Table 2-2, p. 28

Attachment 2
Incremental Sampling for Surface Soil
Standard Operating Procedure

STANDARD OPERATING PROCEDURE

Incremental Sampling Method for Surface Soil

1 Purpose and scope

The purpose of this standard operating procedure (SOP) is to summarize requirements for the effective field implementation of increment sampling method (ISM) for soil undertaken as part of site characterization at contaminated sites. The ISM soil sampling process provides a view of mean contaminant concentrations over the area of a DU.

This SOP applies to all CH2M HILL personnel and subcontractors who perform ISM activities, and is limited to describing methods for obtaining surface soil samples (considered less than 1-foot below ground surface) for non-volatile, semi-volatile and inorganic analyses using ISM techniques. ISM techniques have been developed for volatile organic compounds and subsurface soil, however, they are not included in this SOP. This SOP was developed according to the following reference documents:

- *American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.*
- *Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.*
- *ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.*
- *Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.*
- *Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.*
- *Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.*
- *U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.*

This SOP focuses on the most commonly used ISM soil sampling tasks and applications anticipated at a field site and should be used in conjunction with other applicable project SOPs.

2 General

The objective of ISM is to reduce the variability created by taking discrete samples, and improve the reliability and representativeness of environmental data by obtaining multiple sub-samples (sample increments) over a decision unit (DU) (defined as the area or volume in question). These "increments" are combined into one bulk ISM sample, which is submitted to the laboratory, resulting in a better representation of actual mean concentrations in a DU.

The DU encompasses the area or volume about which a decision is necessary (e.g., deciding whether risks are acceptable or not). Appropriate decision units must be identified for ISM to be valid. Therefore, the identification of decision units is one of the most important factors when using ISM. Identification and delineation of the decision units should be conducted during project planning and identified in a client and regulatory approved Workplan prior to obtaining ISM samples. Since ISM sampling provides an "average" concentration of a DU, agreement on the DU boundaries is extremely important prior to collecting the "bulk increment sample".

The number of increments incorporated into the bulk ISM, and the overall size of the ISM collected are not dependent on the size of the decision unit. The sampling theory is based on an assumption (and empirical observations) that 30 to 100 increments from a given decision unit of any size will result in a sample that is adequately representative of the average contaminant level in the decision unit as a whole. If the decision unit is the size of a small backyard garden, then 30 to 100 increments are collected. If the decision unit is a 10-acre, neighborhood-size area in a former agricultural field, then 30 to 100 increments of a similar mass are likewise collected.

If the contaminant distribution is expected to be very heterogeneous, it may be preferable to increase the number of increments collected to the recommended maximum of 100 for larger DUs. This may help to reduce field sampling error and minimize the variation between replicate samples used to evaluate the precision of the data collected. It has been reported that increasing the number of increments from 30 up to 100 may improve the reproducibility of data collected, and since the ISM sample is submitted as one sample, the number of increments collected does not typically increase analytical costs except that a small fee may be added for the excess sample mass management in the laboratory.

This SOP describes procedures for selecting sampling locations, marking field sampling locations, collecting incremental soil samples, and submitting these samples for laboratory analyses. This SOP assumes that the DU, and method for selecting increment locations within the DU has already been determined in the project work plan or project Quality Assurance Project Plan (QAPP), and that analyses and the laboratory conducting the analyses have been identified in the QAPP.

3 Responsibilities

This section describes the responsibilities of key project personnel including the PM, SM, DM, HSM, FTL, and field sampler.

3.1 Project Manager

The PM provides adequate resources and engages field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The PM will solicit the appropriate technical expertise to adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the PM should be consulted if complications arise in following sample handling and custody procedures.

3.2 Site Manager

The SM coordinates and schedules daily field activities. In addition, the SM trains field staff engaged in this activity and ensures compliance with this SOP.

3.3 Data Manager

The DM maintains and manages the sample tracking and scheduling program used to track field ISM samples. The DM should consult the SM, FTL, and Project Chemist regarding ISM soil sampling field sample processing.

3.4 Health and Safety Manager

The HSM is responsible for site-specific HS&E oversight and overall compliance with project HS&E requirements. The HSM conducts HS&E evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project-specific HSP, and coordinates with the SM to complete and certify the HS&E program.

3.5 Field Team Leader

The FTL maintains compliance with ISM sample techniques and methods, particularly the procedures to be used. The FTL, or their designee, should know the requirements of ISM soil sampling and maintain adequate documentation of sample collection activities. The FTL should take responsibility for collecting ISM samples accurately and correctly and for coordinating with the SM and data manager to successfully conduct any ISM field sample processing before laboratory analysis.

3.6 Field Sampler

The Field Sampler, under the supervision of the FTL (who may be the same person), should confirm that samples are correctly collected, labeled, tracked by chain of custody, and stored until they are delivered to the FTL or data manager. The Field Sampler should maintain custody of the samples until they are relinquished to the FTL or data manager. The Field Sampler informs the FTL and/or data manager of sampling conditions and potential deviations in sample collection.

3.7 Project Chemist

The project chemist is responsible for ensuring that the laboratory selected to analyze the ISM samples is qualified to do the work and meet the project data quality objectives (DQOs).

4 Procedures

ISM samples are prepared by typically collecting 30 to 50 small increments (samples) (up to 100 may be needed if a soil at the DU is determined to be very heterogeneous) of soil from systematic random locations within a specified decision unit and combining these increments into a single sample, referred to as the “bulk ISM sample.” Individual soil increments typically weigh between 30 and 50 grams, with bulk ISM typically weighing between 900 and 2,500 grams. The mass of the final bulk ISM depends on the number of increments collected, the size of the sample collection tool utilized. However a minimum final sample size should not be less than 1 kilogram as a general guideline.

4.1 Reconnaissance, Planning and Field Staging

During the DU planning process (Work Plan stage of project), a historical records search and site walk should be conducted to determine if there are areas that may have elevated levels of contamination as it may be desirable to break these “hotspots” into separate decision units. It is also useful for planning sample collection locations if access to some areas will be difficult. Logistics of sampling around buildings or sampling in areas of heavy vegetation should be considered when setting up the random grid (discussed in the following section).

4.2 Setting up a Stratified or Systematic Random Grid

A systematic random or stratified random sample collection scheme is developed from a random starting point in the DU. Typically a systematic random grid is the preferred sampling method. However, both strategies result in sample collection points spread out approximately equally across the DU. For example, a square-shaped decision unit could be divided into six rows and five columns with six increments collected from each of the five rows in a systematic, random fashion to obtain 30 increments for one bulk ISM.

The following are the definitions for these two sampling collection options:

1. Stratified Random Sampling Mode: DU into representative strata, sample at random within each strata, with number of samples proportional to relationship of each strata to the entire DU. This is used when there is high heterogeneity expected within the DU.

2. Systematic Random Sampling: DU into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

The project planning documents should generate a map, showing the DU(s) and approximate proposed sample locations (increments) within the DU(s). Random locations for incremental sample collection points can be pre-determined in the office using a random number generating program, or in the field. For more rectangular-shaped decision units, a fewer number of rows might be used with more increments per row collected. Row lengths and increments per row may be modified as needed for odd-shaped decision units.

4.3 Field Delineation of DU

Corners of the DU and some other strategic locations should be entered into a Global Positioning Device (GPS) in the office prior to going to the field. Using the GPS device, it is useful to mark the ends of each row with flags to help establish approximate lines for the collection of increments. Flags may also be placed along the edges of the decision unit parallel to the rows to help ensure approximate spacing. Placing flags at every increment collection point is usually not necessary. Often, just the four corners of the DU (or enough points to delineate the DU shape, if irregular) are located via GPS to document the DU location and to create maps for the soil investigation report.

Once the corners and rows of the DU have been marked using the GPS, the increment samples may be collected by pacing the same number of steps within each subunit or row of the DU where the sample increments are to be collected.

4.4 Tools for Collection of ISM

Using the wrong tools, or collecting a sample that contains more soil particles from the top of the sample than the bottom (or vice versa) could lead to biased sample results due to the heterogeneous distribution of contaminated particles in the soil. Care should be taken to collect increments in a manner that produces a cylindrical or core-shaped sample. This can be accomplished using a soil coring sampler (preferred), a trowel (if used to collect a “core-shaped” sample), or even a large drill in some soils. The most appropriate type of sampling device is dependent in part on the hardness of the soil, or how rocky it is. For soft soils, a soil core barrel that can be advanced by hand/foot is quick and efficient. Battery-operated drills with large bits may also be an option. For harder or rocky soils, a coring device with slide hammer, a mattock (large pick), hydraulic, or electric-assisted device, may be needed to advance the core barrel or access the soil column for sampling. Whatever tool(s) is used, the objective should focus on collecting core-shaped sample increments. It is important to understand field conditions and test proposed sampling tools at the site before selecting a particular type or combination of tools. If the site cannot be visited ahead of time, then a mix of sampling tools should be taken to help ensure that adequate soil samples can be collected in as efficient a manner as possible.

4.5 Sample Collection

Once the DU has been delineated with flags in the field collection of sample increments may begin.

Use flags or survey twine to define the edges of each grid cell and complete construction of the ISM sample grid as depicted in Figure 1 below.

Figure 1. Example Completed ISM Sample Grid

Sketch the ISM sample grid design, orientation (compass bearing), overall dimensions, cell dimensions, nearby features, and any other valuable information in the field notebook. Photograph the completed sample grid for future reference. Survey the center and corner stake locations of the DU or record them with a GPS unit.

If using stratified random sampling mode, a grid is set up over the DU making each part of the grid equal size, and one increment is collected at random from each subunit of the grid. If using systematic random sampling mode, select a random starting point in one subunit, then collect an increment sample at this location, and the same location at each subsequent subunit of the DU.

In either mode the following procedures should be followed:

- Sampling tools shall be new or decontaminated prior to use according to the project planning documents.
- Sampling tools need not be decontaminated between each sample increment, but shall be decontaminated or discarded prior to sampling a new DU.
- Test the proposed sampling tool(s), and determine what tool(s) will provide the best sample increments.
- Samples should be collected from the same depth at all incremental sampling locations.
- Larger sized particles (rocks, cobbles, and coral) and roots should be avoided or discarded prior to transferring the sample into the bulk ISM container.
- The laboratory is going to sieve out anything >2 millimeters (mm), so collect enough sample at each increment such that there will still be sample for analysis after the portion > 2mm has been sieved out. This may require collection of multiple aliquots per increment if ISM samples are collected using a small diameter coring device.
- The sample collector will describe and classify soils collected according to Universal Soil Classification System (USCS) nomenclature. At a minimum, this will be done for the final bulk ISM sample after all the increments have been collected. Additionally, during collection of increments, the soil will be described at each significant change in lithology type encountered across the DU. Soil descriptions and classifications will be recorded in the field logbook.

- Individual increments collected are placed into a single sample container to produce the bulk ISM.
- If replicates and triplicates are being collected (strongly recommended), replicate increments may be collected from near the normal sample location by pacing off a few feet from the normal sample collection and obtaining a replicate increment. The triplicate increment may be collected by pacing another few feet from the duplicate increment sampling location (see Section 4.6).
- Store bulk ISM samples as required by the project planning documents.
- Pack and ship samples to the laboratory in accordance with the project planning documents.

4.6 Collection of Field Replicate ISM Samples

To statistically evaluate sampling precision for each DU, replicate ISM samples are collected from selected decision units. Typically two replicate increments are collected from the same depth as the normal sample in different locations. A different random starting location is determined for each replicate collected in the selected DU(s). Replicate sample increments are generally collected along the same approximate directional lines established through the DU for the initial ISM samples, though at different systematic random locations than initially used. This is accomplished by pacing off the replicate increments from a different random starting location on the first line/row of the DU, and continuing to sample at this different random interval throughout the DU.

Replicate samples may be collected by establishing rows for increment collection that run perpendicular to or at a 45 degree angle to the direction used to collect the initial ISM. Another option is to use the same rows but collect increments in between the locations used for the initial sample. Replicate samples should be sent to the laboratory as “blind” samples, meaning the laboratory does not know they represent replicate samples of the initial ISM.

The replicate samples are prepared and analyzed in the same manner as carried out for the initial sample. Triplicate samples (i.e., initial ISM plus two replicates) are preferred and more useful than just duplicates for statistical analysis. If only one DU is being investigated, triplicate samples are recommended. If multiple DUs are being investigated, it may not be necessary to collect triplicates at all DUs.

4.7 Laboratory Processing of ISM Samples

The bulk ISM is submitted to the laboratory for analysis. Careful planning with the laboratory for processing of ISM samples by the Project Chemist prior to sample collection is essential to obtain meaningful results. Details of project requirements will be described in the project planning documents.

It is important to note that, while the laboratory is receiving a bulk sample of up to 2,500g, it will only analyze a subset of this sample. One issue discussed in both the Environmental Protection Agency (EPA) and American Society of Testing Materials (ASTM) guidance documents is the choice of a minimum sub-sample mass for extraction/analysis of soil samples in order to reduce “Fundamental Error” of the lab analyses to approximately 15% or less. The minimum appropriate mass is based on the maximum particle size in the soil samples. For samples with a maximum particle size of <2mm, the minimum analysis mass is 10 grams. If the analytical method to be used typically calls for sample extraction/analysis mass of less than 10 grams, the method should be modified to increase extraction/analysis mass to at least 10 grams for samples with maximum particle sizes of <2mm (larger mass could be beneficial for some analyses). For analyses of fine particulates (e.g., <250 µm), a one-gram sub-sample may be adequate to reduce Fundamental Error below 15%; however a larger mass may be reliably run by the method (e.g., 2-10 grams).

4.8 Investigation Derived Waste

Any IDW generated during sample collection (such as used PPE and soil collection apparatus) should be disposed of properly in accordance with the project planning documents.

5 Records

Record all ISM soil sampling activities, including field bulk sample collection in a field notebook, in accordance with the Work Plan and applicable project SOPs. Chain-of-custody forms, photographs, and any other sampling documentation should comply with the project planning documents.

6 References

American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.

Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.

Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.

HDOH. May 11, 2007. Pesticides in Former Agricultural Lands and Related Areas – Updates on Investigation and Assessment (arsenic, technical chlordane, and dioxin test methodologies and action levels and field sampling strategies). Office of Hazard Evaluation and Emergency Response. 07-241 RB.

ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.

Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.

Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.

U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.

7 Definitions

Bulk ISM Sample: The compilation of all ISM soil sampling increments collected from a DU.

Compositional Heterogeneity: The variability of contaminant concentrations between the particles that make up the population. This type of heterogeneity results in fundamental error (FE).

Decision Unit (DU): The area or volume in which a decision must be made (for example, deciding whether risks are acceptable or not). The DU may be as small as a 55-gallon drum or as large as acres in size.

Distributional Heterogeneity: The non-random distribution across a population due to slight spatial variations. This type of heterogeneity results in grouping and segregation error (GSE).

Fundamental Error (FE): A result of not representing proportional concentrations of all of the particles in a population.

Increment: A group of particles collected from a population with a single operation of the sampling device.

Sieving: Pouring material (for example, the bulk ISM sample) through a sieve.

Stratified Random Sampling: A statistical sampling method that divides the sample population (DU) into representative strata (grid cells), then randomly sampling within each stratum with the number of samples proportional to relationship of each stratum to the entire population.

Systematic Random Sampling: divide population (DU) into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

Sub-sampling: Dividing the sieved bulk ISM sample to create a final laboratory sample.

Attachment 1 - Figures Illustrating Systematic Random Sampling Method

(Source: HDOH *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, 2020)

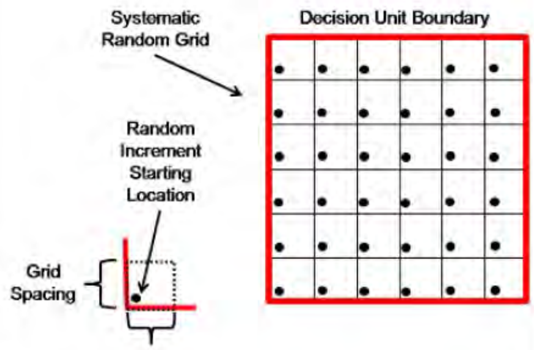

Figure 4-9. Example Increment Collection Locations Based on a Systematic Random Grid Scheme
Grid spacing determined based on DU area and number of desired increments. Initial increment location selected from random location, subsequent increments collected at uniform spacing within DU.

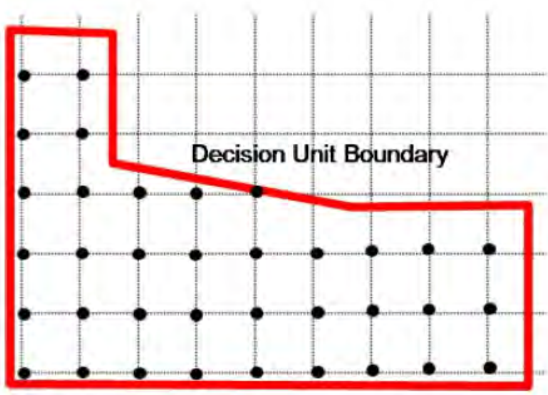

Figure 4-11. Systematic Increment Locations for Odd Shaped DUs (compare to Figure 4-9)
The number of increments collected within grid rows can vary in different areas of the DU.

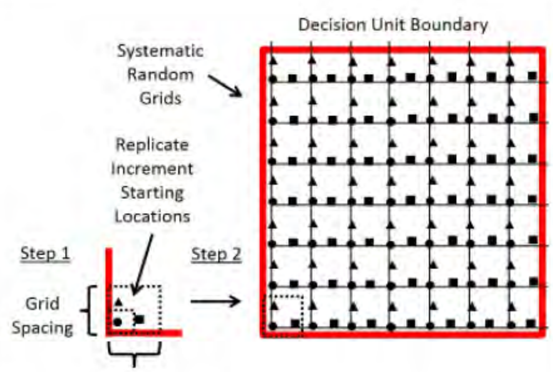

Figure 4-12. Example Collection of Increment Location Points for Triplicate Multi Increment Samples
Increments collected in a systematic random method. Circles, triangles and squares depict increment collection locations for three, respective Multi Increment samples (increments collected halfway between initial increment grid point locations).

Attachment 3
Laboratory Standard Operating Procedures
(provided on CD as a separate file)

Attachment 3 is not tagged for accessibility. For further information please contact the Admin Record.

Appendix D
Stormwater Pollution Prevention Checklist

Stormwater Pollution Prevention
Inspection Checklist & Corrective Action Log

For:

Former Ravenna Army Ammunition Plant - RVAAP Load Lines 1, 2, 3, 4, and 12 Remediation
Camp James A. Garfield JMTC
6499 George Rd
Ravenna, OH 44266

Instructions:

- Keep the following inspection, monitoring, and certification records in the same location that you keep your Stormwater Pollution Prevention Plan:
  - A copy of any correspondence exchanged between you and EPA specific to the Stormwater Pollution Prevention Plan;
  - Descriptions and dates of any incidences of significant spills, leaks, or other releases;
  - Records of employee training;
  - Documentation of maintenance and repairs of control measures;
  - All inspection reports;
  - Description of any deviations from the schedule for visual assessments and/or monitoring;
  - Description of any corrective action taken at your site;
  - Documentation of any benchmark exceedances and how they were responded to;
  - Documentation to support any determination that pollutants of concern are not expected to be present above natural background levels, and that such pollutants were not detected in your discharge or were solely attributable to natural background sources; and
  - Documentation to support your claim that your facility has changed its status from active to inactive and unstaffed.

- Complete this form every seven (7) days and/or after a storm event resulting in ½ inches of rain or more.
- Follow the instructions of this template to keep your records complete.

A. Significant spills, leaks or other releases

Instructions:

- Include the descriptions and dates of any incidences of significant spills, leaks, or other releases that resulted in discharges of pollutants to waters of the State, through stormwater or otherwise; the circumstances leading to the release and actions taken in response to the release; and measures taken to prevent the recurrence of such releases.
- Provide information, as shown below, for each incident, and attach additional documentation (e.g., photos, spill cleanup records) as necessary. Repeat as necessary by copying and pasting the fields below.

Date of incident: Insert Date of Incident
Location of incident: Insert Location of Incident
Description of incident: Insert Description of Incident
Circumstances leading to release: Describe circumstances leading to release
Actions taken in response to release: Describe actions taken in response to release
Measures taken to prevent recurrence: Describe measures taken to prevent recurrence

IRON CREEK GROUP

B. Employee training

Instructions:

- Keep records of employee training, including the date of the training.
- Training should outline the following:
  - The deadlines associated with installation, maintenance, and removal of stormwater controls and with stabilization;
  - The location of all stormwater controls on the site required by this remedial action, and how they are to be maintained;
  - The proper procedures to follow with respect to the pollution prevention requirements; and
  - When and how to conduct inspections, record applicable findings, and take corrective actions.

Training Date: Insert Date of Training	
Training Description: Insert Description of Training	
Trainer: Insert Trainer(s) names	
Employee(s) trained	Employee signature
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	
Insert Name	

C. Maintenance

Instructions:

- Include in your records documentation of maintenance and repairs of control measures and industrial equipment, including:
  - the control measure/equipment maintained,
  - date(s) of regular maintenance,
  - date(s) of discovery of areas in need of repair/replacement, and for repairs,
  - date(s) that the control measure/equipment was returned to full function, and
  - the justification for any extended maintenance/repair schedules.
- Provide information, as shown below, to document your maintenance activities for each control measure and industrial equipment. Repeat as necessary by copying and pasting the information below for additional control measures.

Control Measure Maintenance Records (copy information below for each control measure)

Control Measure: Insert Name of Control Measure
Regular Maintenance Activities: Describe maintenance activities
Regular Maintenance Schedule: Insert Maintenance Schedule

Date of Action: Insert Date of Action
Reason for Action: ☐ Regular Maintenance ☐ Discovery of Problem
If Problem,
- Description of Action Required: Describe actions taken in response to problem
- Date Control Measure Returned to Full Function: Insert Date
- Justification for Extended Schedule, if applicable: Insert Justification (if applicable)

Notes: Insert Notes (if applicable)

Industrial Equipment and Systems Maintenance Records (copy information below for each industrial equipment/system)

Industrial Equipment/Systems: Insert Name of Industrial Equipment/System
Regular Maintenance Activities: Describe maintenance activities
Regular Maintenance Schedule: Insert Maintenance Schedule

Date of Action: Insert Date of Action
Reason for Action: ☐ Regular Maintenance ☐ Discovery of Problem
If Problem,
- Description of Action Required: Describe actions taken in response to problem
- Date Industrial Equipment Returned to Full Function: Insert Date
- Justification for Extended Schedule, if applicable: Insert Justification (if applicable)

Notes: Insert Notes (if applicable)

D. Routine Facility Inspection Reports

Instructions:

- Include in your records copies of all routine facility inspection reports completed for the facility.

Using the Sample Routine Facility Inspection Report

- This inspection report is designed to be customized according to the specific control measures and activities at your facility. For ease of use, you should take a copy of your site plan and number all of the stormwater control measures and areas of industrial activity that will be inspected. A brief description of the control measures and areas that were inspected should then be listed in the site-specific section of the inspection report.
- You can complete the items in the "General Information" section that will remain constant, such as the facility name, and inspector (if you only use one inspector). Print out multiple copies of this customized inspection report to use during your inspections.
- When conducting the inspection, walk the site by following your site map and numbered control measures/areas of industrial activity to be inspected. Also note whether the "Areas of Industrial Materials or Activities exposed to stormwater" have been addressed (customize this list according to the conditions at your facility). Note any required corrective actions and the date and responsible person for the correction.

Stormwater Industrial Routine Facility Inspection Report

General Information			
Facility Name	Insert Name		
Ohio EPA Facility Permit No.	Insert Ohio EPA Facility Permit No.		
Date of Inspection	Insert Date	**Start/End Time**	Insert Start/End Time
Inspector's Name(s)	Insert Name		
Inspector's Title(s)	Insert Title		
Inspector's Contact Information	Insert Contact Info		
Inspector's Qualifications	Insert qualifications or add reference to the SWPPP		

Weather Information
Weather at time of this inspection? ❑ Clear ❑Cloudy ❑ Rain ❑ Sleet ❑ Fog ❑ Snow ❑ High Winds ❑ Other: Temperature:
Weather details since last inspection (including date of last inspection, a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred):
Have any previously unidentified discharges of pollutants occurred since the last inspection? ❑Yes ❑No **If yes, describe:** Describe
Are there any discharges occurring at the time of inspection? ❑Yes ❑No **If yes, describe:** Describe

Control Measures

- *Number the structural stormwater control measures identified in your Stormwater Pollution Prevention Plan on your site map and list them below (add as many control measures as are implemented on-site). Carry a copy of the numbered site map with you during your inspections. This list will ensure that you are inspecting all required control measures at your facility.*
- *Describe corrective actions initiated, date completed, and note the person that completed the work in the Corrective Action Log.*

	Structural Control Measure	**Control Measure is Operating Effectively?**	**If No, In Need of Maintenance, Repair, or Replacement?**	**Corrective Action Needed and Notes** (identify needed maintenance and repairs, or any failed control measures that need replacement)
1	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
2	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
3	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
4	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
5	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
6	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions

	Structural Control Measure	Control Measure is Operating Effectively?	If No, In Need of Maintenance, Repair, or Replacement?	Corrective Action Needed and Notes (identify needed maintenance and repairs, or any failed control measures that need replacement)
7	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
8	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
9	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions
10	Insert Control Measure Name	❑Yes ❑No	❑ Maintenance ❑ Repair ❑ Replacement	Describe Corrective Actions

Areas of Industrial Materials or Activities exposed to stormwater
Below are some general areas that should be assessed during routine inspections. Customize this list as needed for the specific types of industrial materials or activities at your facility.

	Area/Activity	Inspected?	Controls Adequate (appropriate, effective, and operating)?	Corrective Action Needed and Notes
1	**Material loading/unloading and storage areas**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
2	**Equipment operations and maintenance areas**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
3	**Fueling areas**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
4	**Outdoor vehicle and equipment washing areas**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
5	**Waste handling and disposal areas**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
6	**Erodible areas/construction**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
7	**Dust generation and vehicle tracking**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
8	**(Other)**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
9	**(Other)**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions
10	**(Other)**	❑Yes ❑No ❑ N/A	❑Yes ❑No	Describe Corrective Actions

Non-Compliance

Describe any incidents of non-compliance observed and not described above:
Describe Non-compliance

Additional Control Measures

Describe any additional control measures needed to comply with the permit requirements:
Describe Additional Controls Needed

Notes

Use this space for any additional notes or observations from the inspection:
Additional Notes

CERTIFICATION STATEMENT

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Print name and title: ____

Signature:____**Date:**___________________

Appendix E
Construction Quality Control Forms

CH2M DAILY TAILGATE MEETING LOG

Project. ____ Date: ____________________

TOPICS DISCUSSED:

1.
2.
3.
4.
5.
6.

MEETING CONDUCTED BY: SIGNATURE:

MEETING ATTENDEES	
Name/Company	Signature
1.	
2.	
3.	
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5.	
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25.	

PERSONNEL QUALIFICATION and VERIFICATION FORM

CANDIDATE: ______________________________ POSITION/LEVEL: ______________________

CONTRACT: ______________________________

REVIEW ITEMS		CANDIDATE QUALIFICATIONS	VERIFIED BY/DATE
EXPERIENCE	REQUIRED: AREA AND YEARS		
	ACTUAL: AREA AND YEARS		
EDUCATION	REQUIRED		
	ACTUAL		
CERTIFICATIONS & REGISTRATIONS	REQUIRED		
	ACTUAL		
TRAINING	REQUIRED		
	ACTUAL		
OTHER	REQUIRED		
	ACTUAL		

PREPARATORY PHASE INSPECTION CHECKLIST (Part I)

Project : ______________________________ Date: ______________

TITLE AND NO. OF TECHNICAL SECTION: ______________________________

____

____

____

Work Plan Reference : ______________________________

A. Planned Attendants:

	Name	**Position**	Company
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			
9)			
10)			
11)			

B. Submittals required to begin work:

	Item	Submittal No.	Action Code
1)			
2)			
3)			
4)			
5)			
6)			
7)			
8)			

I hereby certify, that to the best of my knowledge and belief, that the above required materials delivered to the job site are the same as those submitted and approved.

____

____

Project QC Manager

(continued):

PREPARATORY PHASE INSPECTION CHECKLIST (Part I)

Project : ______________________________ Date: ____________________

C. Equipment to be used in executing work:

1) ______________________________
2) ______________________________
3) ______________________________
4) ______________________________
5) ______________________________

D. Work areas examined to ascertain that all preliminary work has been completed:

____

____

E. Methods and procedures for performing Quality Control, including specific testing requirements:

____

____

PREPARATORY PHASE INSPECTION CHECKLIST (Part II)

A. Persons in attendance: See Meeting Attendance Sheet (attached)

The above methods and procedures have been identified from the project plans and will be performed as specified for the Definable Feature of Work.

Project QC Manager

INITIAL PHASE INSPECTION CHECKLIST

Project.: ______________________ Date: ______________

Title and No. of WP Section: ______________________

____

____

Description and Location of Work Inspected: ______________________

A. Key Personnel Present:

Name	Position	Company

B. Materials being used are in strict compliance with the contract plans and specifications: ☐Yes ☐No

If not, explain:

____

____

____

C. Procedures and/or work methods witnessed are in strict compliance with the contract specifications: ☐Yes ☐No

If not, explain: ______________________

____

____

____

D. Workmanship is acceptable: ☐Yes ☐No

State where improvement is needed: ______________________

____

____

____

E. Workmanship is free of safety violations: ☐Yes ☐No

If no, corrective action taken: ______________________

____

____

____

____

Project Quality Control Manager

FOLLOW-UP PHASE INSPECTION CHECKLIST

CONTRACTOR QUALITY CONTROL DAILY REPORT CONTINUATION SHEET
(ATTACH ADDITIONAL SHEETS IF NECESSARY)

Date: ______________________________

Contractor: ______________________________

Project: ______________________________

Y=YES; N=NO; SEE REMARKS BLANK=NOT APPLICABLE	
WORK COMPLIES WITH WORK PLAN AS APPROVED IN INITIAL PHASE	

IDENTIFY DEFINABLE FEATURE OF WORK, LOCATION, AND LIST PERSONNEL PRESENT

INSPECTIONS PERFORMED & WHO PERFORMED TEST

Project QC Manager ______________________ Date ______________________

FINAL INSPECTION CHECKLIST (PART I)

Project: ____________________ Date: ____________

Area of Inspection: ____________________

A. Definable Feature Of Work: Status of Inspection:

I hereby certify, that to the best of my knowledge and belief, that the work inspected is complete and all materials and equipment used and work performed were completed in accordance with plans submitted and approved.

____

____
Project QC Manager

(continued):

FINAL INSPECTION CHECKLIST (PART II)

MEETING ATTENDANCE LIST

Meeting:		Date:
Name	Organization	Phone Number

QC Inspections, Testing and Verification Log

RVAAP Load Lines 1, 2, 3, 4, and 12

Reference	Section / page	Test Required	Testing Date	Tested By	Verification Date	Verification By	Inspection Date	Inspected By	Location of Test (on-site/off-site)	Frequency	Remarks
Mobilization and Site Preparation											
Excavation											
Thermal Treatment											
Transportation and Disposal											
Backfill and Site Restoration											

WASTE TRACKING LOG

Site/Task Description	Container Type	Container Desig./No.	Accumula-tion Start Date	Matrix	Waste Profile No. and/or Sample ID	Trans-porter	Date Trans-ported	Disposal Facility	Waste Type (Haz, Nonhaz, TSCA)	Waste Code (RCRA then State)	Disposal Facility Date (found on final manifest)	Manifest Number	Disposal Method (Enter disposal quantity under appropriate method)							Cert. of Disp/ Destruc Date	Comments/Notes
													Incineration	Landfill	Recycle	Onsite	Offsite Water Treatment	Other	Unit		

Note: All waste should be included on the Waste Tracking Log from the moment of generation.

FIELD QC INSPECTION FORM

I **Project:**
Date:
QC Inspection Team Leader:
Inspection Remarks:
1.)
2.)
3.)
4.)
5.)
6.)

Inspected by	Date

QC REPORT

Project. ______________________________ Date: ______________

LOCATION OF WORK: ______________________________

DESCRIPTION OF WORK: ______________________________

WEATHER: ☐(CLEAR) ☐(FOG) ☐(P.CLOUDY) ☐(RAIN) ☐(WINDY)

TEMPERATURE: MIN: _____°F MAX: _____°F

1. Work completed today by subcontractor:

____

2. Work completed today by QC inspection staff :

____

3. All work performed in conformance with Work Plan requirements?

If not, explain:

____

4. Non-conformances/deficiencies reported:

____

5. Comments:

____

CERTIFICATION: I certify that the above report is complete and correct and that I, or my representative, have inspected all work identified on this report and have determined to the best of my knowledge and belief that noted work activities are in compliance with work plans and specifications, except as may be noted above.

____
Project QC Manager

NON-CONFORMANCE REPORT

PART 1 – General Information

Date Submitted:	NCR Number:
Submitted To:	Company/ Title/Position:
Prepared By:	Company/ Title/Position:
Project Name:	Project Number:
PO Number:	Contract Number:

PART 2 – Non-Conformance Report

Description of Non-Conforming Item or Condition				
Contract Requirement or Project Specification/Drawing				
Test/Inspection/Audit Identifying Non-Conformance				
Reportable Release?	Yes ☐		No ☐	
Material Name:			Quantity:	
Disposition:	Repair ☐	Rework ☐	Use-As-Is ☐	Reject ☐

PART 3 – Investigation/Root Cause Determination

Personnel Responsible for Investigative Process:
Investigative Process Findings:
Probable Root and Contributing Cause(s):

PART 4 – Corrective Actions

Proposed Corrective Actions and Completion Dates:		
Personnel Responsible for Implementation of Corrective Actions:		
Resulting Actions and Effectiveness of Those Actions:		
Personnel Responsible for Monitoring Effectiveness of Corrective Actions:		
Corrective actions have been completed and monitored for effectiveness.		
Signature	Company/Title	Date

PART 5 – Response Approval

Responses Accepted By		
Signature	Company/Title	Date
Signature	Company/Title	Date

PART 6 – Quality Control Follow-Up

Comments/Findings of Follow-Up Observation / Inspection / Audit:		
Verification Results	Satisfactory ☐	Unsatisfactory ☐

PART 7 – NCR Closure

NCR Closed		
	Program QA/QC Manager	
Signature	Company/Title	Date

Nonconformance Report Log

Project No.:					
Description of Nonconformance	**No. NCRs for Week Ending**	**Report No.**	**Date Found**	**Date Corrected**	**Responsible Contractor**

CORRECTIVE ACTION REQUEST[1]

(2)CAR #:	(3)PRIORITY: ☐HIGH ☐NORMAL	(4)DATE PREPARED:

PART A: NOTICE OF DEFICIENCY

(5)PROJECT:	
(6)PROJECT MANAGER:	(7)QC MANAGER/STAFF:
(8)CONSTRUCTION MANAGER:	(9)MEC MANAGER:
(10)ISSUED TO (INDIVIDUAL & ORGANIZATION):	
(11)REQUIREMENT & REFERENCE:	
(12)PROBLEM DESCRIPTION & LOCATION: (13)CAP REQUIRED? ☐YES ☐NO	(14)RESPONSE DUE:
(15)ISSUED BY (PRINTED NAME & TITLE): SIGNATURE: DATE:	(16)MANAGEMENT CONCURRENCE:

PART B: CORRECTIVE ACTION

(17)PROPOSED CORRECTIVE ACTION/ACTION TAKEN: NOTE: SUPPORTING DOCUMENTATION MUST BE LISTED ON THE BACK OF THIS FORM AND ATTACHED.	
(18)PART B COMPLETED BY (NAME & TITLE): SIGNATURE: DATE:	(19)QC CONCURRENCE:

PART C: CORRECTIVE ACTION VERIFICATION

(20)CAR VERIFICATION AND CLOSE-OUT: (CHECK ONLY ONE & EXPLAIN STIPULATIONS, IF ANY)

- ☐APPROVED FOR CLOSURE WITHOUT STIPULATIONS
- ☐APPROVED FOR CLOSURE WITH FOLLOWING STIPULATIONS

COMMENTS/STIPULATIONS:

(21)CLOSED BY (PRINTED NAME & TITLE):

SIGNATURE: DATE:

CORRECTIVE ACTION REQUEST (CAR) INSTRUCTION SHEET

(1) QC Manager: Verify that the total number of pages includes all attachments.

(2) QC Manager: Fill in CAR number from CAR log.

(3) CQC System Manager: Fill in appropriate priority category. High priority indicates resolution of deficiency requires expediting corrective action plan and correction of deficient conditions noted in the CAR and extraordinary resources may be required due to the deficiencies impact on continuing operations. Normal priority indicates that the deficiency resolution process may be accomplished without further impacting continuing operations.

(4) CAR Requestor: Fill in date CAR is initiated.

(5) CAR Requestor: Identify project name, number, CTO, and WAD.

(6) CAR Requestor: Identify Project Manager

(7) CAR Requestor: Identify CQC System Manager.

(8) CAR Requestor: Identify project organization, group, or discrete work environment where deficiency was first discovered.

(9) CAR Requestor: Identify line manager responsible for work unit where deficiency was discovered.

(10) QC Manager: Identify responsible manager designated to resolve deficiency (this may not be work unit manager).

(11) CAR Requestor: Identify source of requirement violated in contract, work planning document, procedure, instruction, etc; use exact reference to page and, when applicable, paragraph.

(12) CAR Requestor: Identify problem as it relates to requirement previously stated. Identify location of work activities impacted by deficiency.

(13) QC Manager: Identify if Corrective Action Plan (CAP) is required. CAP is typically required where one or more of the following conditions apply: CAR priority is High; deficiency requires a rigorous corrective action planning process to identify similar work product or activities affected by the deficiency; or deficiency requires extensive resources and planning to correct the deficiency and to prevent future recurrence.

(14) QC Manager: Identify date by which proposed corrective action is due to QC for concurrence.

(15) QC Manager: Sign and date CAR and forward to responsible manager identified in (10) above.

(16) Responsible Manager: Initial to acknowledge receipt of CAR.

(17) Responsible Manager: Complete corrective action plan and identify date of correction. Typical corrective action response will include statement regarding how the condition occurred, what the extent of the problem is (if not readily apparent by the problem description statement in [12]), methods to be used to correct the condition, and actions to be taken to prevent the condition from recurring. If a CAP is required, refer to CAP only in this section.

(18) Responsible Manager: Sign and date corrective action response.

(19) QC Manager: Initial to identify concurrence with corrective action response from responsible manager.

(20) QC Manager: Check appropriate block to identify if corrective action process is complete so that CAR may be closed. Add close-out comments relevant to block checked.

(21) QC Manager: Indicate document closeout by signing and dating.

CORRECTIVE ACTION PLAN

Attach clarifications and additional information as needed. Identify attached material in appropriate section of this form.

PART A: TO BE COMPLETED BY PROJECT MANAGER OR DESIGNEE

(1)PROJECT:		
(2)PROJECT MANAGER:	(3)QC MANAGER:	
(4)CAR NO(S) AND DATE(S) ISSUED:		
(5)DEFICIENCY DESCRIPTION AND LOCATION:		
(6)PLANNED ACTIONS	(7)ASSIGNED RESPONSIBILITY	(8) COMPLETION DUE DATE
(9)PROJECT MANAGER SIGNATURE: DATE:		

PART B: TO BE COMPLETED BY CQC SYSTEM MANAGER OR DESIGNEE

(10)CAP REVIEWED BY: DATE:
(11)REVIEWER COMMENTS:
(12)CAP DISPOSITION: (CHECK ONLY ONE AND EXPLAIN STIPULATIONS, IF ANY) ☐ APPROVED WITHOUT STIPULATIONS ☐ APPROVED WITH STIPULATIONS ☐ APPROVAL DELAYED, FURTHER PLANNING REQUIRED COMMENTS:
(13)QC MANAGER SIGNATURE: DATE:

ROOT CAUSE ANALYSIS FORM

Root Cause Analysis (RCA)

Root Cause Categories (RCC): Select the RCC numbered below that applies for the root cause (RC) and/or contributing factor (CF) in the first column, then describe the specific root cause and corrective actions in each column.

1. **Lack of skill or knowledge**
2. **Lack of or inadequate operational procedures or work standards**
3. **Inadequate communication of expectations regarding procedures or work standards**
4. **Inadequate tools or equipment**
5. **Correct way takes more time and/or requires more effort**
6. **Short-cutting standard procedures is positively reinforced or tolerated**
7. **Person thinks there is no personal benefit to always doing the job according to standards**

RCC #	Root Cause(s)	Corrective Actions	RC[1]	CF[2]	Due Date	Date Completed	Date Verified

[1] RC = Root Cause; [2] CF = Contributing Factors (check which applies)

Investigation Team Members

Name	Job Title	Date

Results of Solution Verification and Validation

Reviewed By

Name	Job Title	Date

Determination of Root Cause(s)

For minor losses or near losses the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, to determine the root cause, and to develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must use the Root Cause Analysis Flow Chart to assist in identifying the root cause(s) of a loss. Any loss may have one or more "root causes" and "contributing factors". The "root cause" is the primary or immediate cause of the incident, while a "contributing factor" is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the *person* involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors". Causes that pertain to the *system* within which the loss or injury occurred should be referred to as "job factors".

<u>Personal Factors</u>

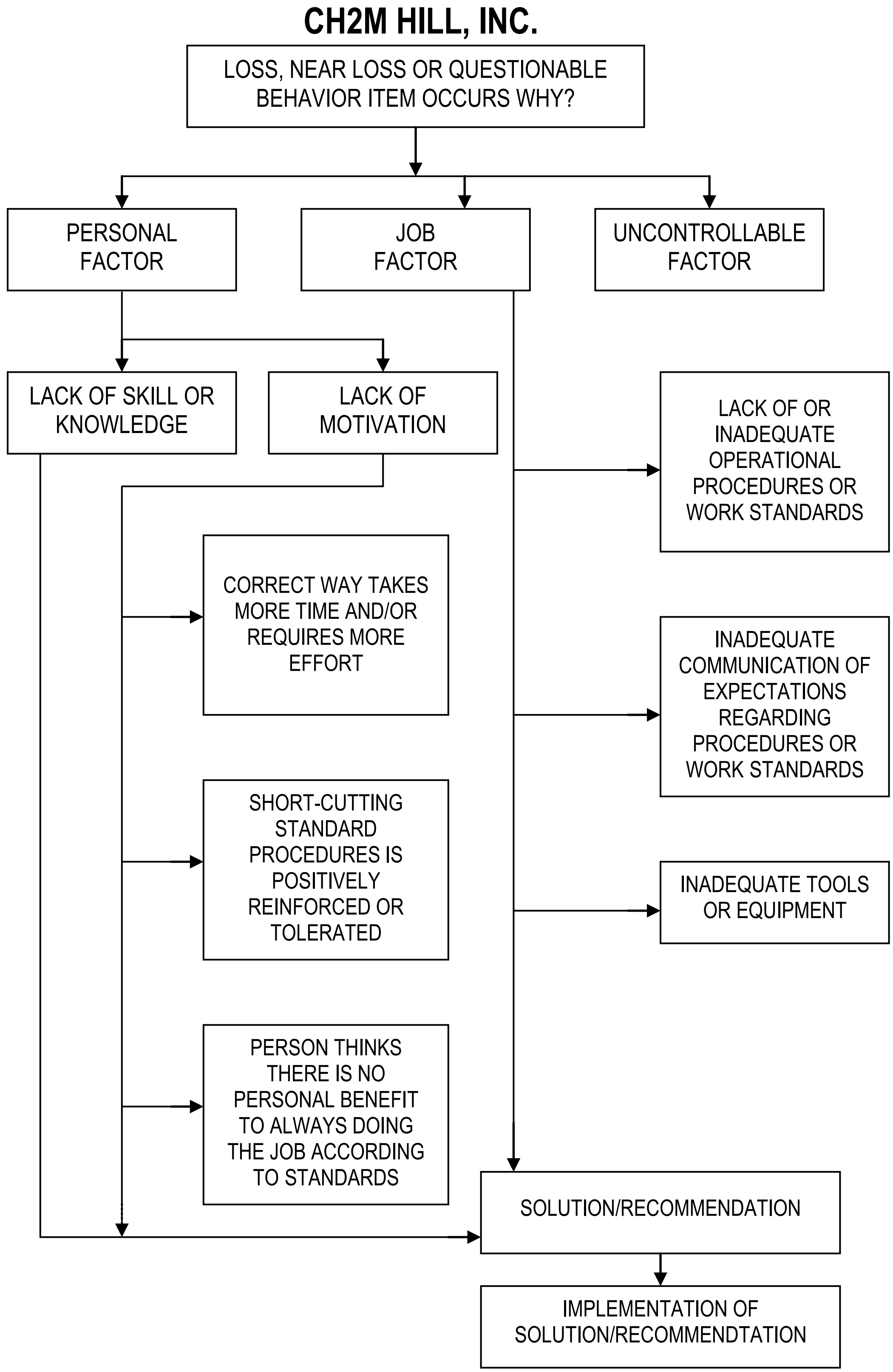
- Lack of skill of knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks that there is no personal benefit to always doing the job according to standards

<u>Job Factors</u>

- Lack of or inadequate operational procedures or work standards.
- Inadequate communication of expectations regarding procedures or standards
- Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other "uncontrollable factor". In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates "all" seven other factors.

Root Cause Analysis
Flow Chart



Appendix F
Comment Response Tables and Correspondence

Appendix F has not been tagged for accessibility. For further information please contact the Admin Record.

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

October 1, 2020

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Army National Guard
Installation and Environment
Clean-up Branch
IPA Designation
1438 State Route 534 SW
Newton Falls, OH 44444

RE: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859263

Subject: Receipt and Review of the "Final Remedial Design Work Plan for RVAAP Load Lines 1 – 4 and 12 (RVAAP-08 through RVAAP-12)," Dated September 23, 2020

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the document entitled, "Final Remedial Design for RVAAP Load Lines 1 – 4 and 12." This document, received by Ohio EPA's NEDO on September 23, 2020, was prepared for the U.S. Army Corps of Engineers (USACE) Louisville District, by CH2M HILL Constructors, Inc., 2411 Dulles Corner Park, Suite 500, Herndon, VA.

Ohio EPA has no further comments and we concur with the Final Remedial Design Work Plan for RVAAP Load Lines 1-4 and 12.

As a precautionary response to COVID-19, Ohio EPA is currently operating with most staff working remotely. During this time, we will not be issuing hard-copy mail. This letter is an official response from Ohio EPA that will be maintained as a public record.

RECEIVED
OCT 02 2020

If you have any questions or concerns, please do not hesitate to contact me at (330) 963-1201, or by email at Susan.Netzly-Watkins@epa.ohio.gov.

Sincerely,

Sue Netzly-Watkins

Sue Netzly-Watkins
Site Coordinator
Division of Environmental Response and Revitalization

SNW/sc

ec: Nat Peters, USACE
Craig Coombs, USACE
Katie Tait, OHARNG RTLS
Sarah Meyers, CH2M
Rebecca Shreffler, Chenega
Natalie Oryshkewych, Ohio EPA, NEDO, DERR
Bob Princic, Ohio EPA, NEDO, DERR
Tom Schneider, Ohio EPA, SWDO, DERR
Brian Tucker, Ohio EPA, CO, DERR
Kelly Kanoza, Akron Regional Air Quality Management District

From: Susan.Netzly-Watkins@epa.ohio.gov
Sent: Monday, September 21, 2020 3:44 PM
To: Sedlak, Kevin M CIV (USA)
Cc: bob.princic@epa.ohio.gov; Brian.Tucker@epa.ohio.gov; Thomas.Schneider@epa.ohio.gov; KATHRYN.S.TAIT.NFG@MAIL.MIL; Nathaniel Peters II Dr CIV USA USACE (Nathaniel.Peters.II@usace.army.mil); Rebecca.Shreffler@chenega.com; Brillinger, Allan; Meyers, Sarah/WDC; Kvaal, Steven LRL; Craig A. Coombs (Craig.A.Coombs@usace.army.mil)
Subject: [EXTERNAL] RE: Response to today's conference call draft RD for LL 1-4 and 12

Kevin,

Thanks for the discuss today and the follow up email.

Ohio EPA is OK with the clarification provided in your email today on our remaining comment we had on the draft RD for LL 1-4 and 12. We have no further comments.

Sincerely,

Sue Netzly-Watkins
Ohio EPA-DERR-NEDO

-----Original Message-----
From: Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>
Sent: Monday, September 21, 2020 3:11 PM
To: Netzly-Watkins, Susan <Susan.Netzly-Watkins@epa.ohio.gov>
Cc: Princic, Bob <bob.princic@epa.ohio.gov>; Tucker, Brian <Brian.Tucker@epa.ohio.gov>; Schneider, Thomas <Thomas.Schneider@epa.ohio.gov>; Tait, Kathryn <KATHRYN.S.TAIT.NFG@MAIL.MIL>; Nathaniel Peters II Dr CIV USA USACE (Nathaniel.Peters.II@usace.army.mil) <Nathaniel.Peters.II@usace.army.mil>; rebecca.shreffler@chenega.com; Brillinger, Allan <Allan.Brillinger@chenega.com>; Meyers, Sarah/WDC <Sarah.Meyers@jacobs.com>; Kvaal, Steven LRL <Steven.Kvaal@usace.army.mil>; Craig A. Coombs (Craig.A.Coombs@usace.army.mil) <Craig.A.Coombs@usace.army.mil>
Subject: Response to today's conference call

Susan: please see the bold third paragraph and the redline table showing the incorporation of the comment. If you have any questions please feel free to contact me. Thank you.

Kevin Sedlak, PG, MS
Restoration Program Manager
IPA Designation
Camp James A. Garfield JTC
1438 State Route 534 SW
Newton Falls, OH 44444
ARNG-ILE Clean Up
Office Phone 614-336-6000 Ex 2053
e-mail to:kevin.m.sedlak.civ@mail.mil
Please note, any communication generated through this correspondence does not coincide with any contract modifications, specifications, clarifications, or corrections unless a formal document is attached designating the like.

From:	Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>
Sent:	Monday, September 21, 2020 3:11 PM
To:	Susan.Netzly-Watkins@epa.ohio.gov
Cc:	bob.princic@epa.ohio.gov; Brian.tucker@epa.ohio.gov; Thomas.Schneider@epa.ohio.gov; Tait, Kathryn S NFG NG OHARNG (USA); Nathaniel Peters II Dr CIV USA USACE (Nathaniel.Peters.II@usace.army.mil); Rebecca M Shreffler (Rebecca.Shreffler@chenega.com); Brillinger, Allan; Meyers, Sarah/WDC; Kvaal, Steven LRL; Craig A. Coombs (Craig.A.Coombs@usace.army.mil)
Subject:	[EXTERNAL] Response to today's conference call
Attachments:	OEPA_comment_response4_rev091720.pdf
Signed By:	kevin.m.sedlak.civ@mail.mil

Susan: please see the bold third paragraph and the redline table showing the incorporation of the comment. If you have any questions please feel free to contact me. Thank you.

Kevin Sedlak, PG, MS
Restoration Program Manager
IPA Designation
Camp James A. Garfield JTC
1438 State Route 534 SW
Newton Falls, OH 44444
ARNG-ILE Clean Up
Office Phone 614-336-6000 Ex 2053
e-mail to:kevin.m.sedlak.civ@mail.mil
Please note, any communication generated through this correspondence does not coincide with any contract modifications, specifications, clarifications, or corrections unless a formal document is attached designating the like.

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated 8/25/2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov) Dated 9/9/2020
Date: 9/10/2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
	QAPP	Thank you for the detailed response to our comments dated August 25, 2020. We have one clarification question. Why are there different RSD goals for laboratory sub-sample results for COCs other than explosives? Beginning on Page 47 of the pdf and elsewhere in the document it is stated in part: "(a)n RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples). An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for PAH, PCB and metals analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples)." It is not clear why the laboratory RSD goal differs by analytical method. The RSD goal for the laboratory sub-samples is a verification of appropriate soil sub-sampling method(s) an execution in the lab and should not be affected by the analytical methods. The RSD laboratory sub-sampling goal for both methods should be 20% unless information is provided that supports using different goals for different analytical methods.	For **laboratory** soil subsample triplicates, the DoD Quality Systems Manual (QSM) Table B-3 specifies an RSD goal of 20% for results above the LOQ for SW8330B explosives analysis. If this is not met, the DoD QSM specifies that a J-flag will be applied to the associated data. There is not an analytical method requirement for laboratory soil subsample replicates for the other analytes. There is also not a QSM requirement for laboratory soil subsample replicates for the other analytes unless the ISM sample is greater than 1 kg; our ISM samples will be 1 kg or less as specified in Worksheet 19, Table 19-1. This is based on laboratory limitations such as space for drying large volume samples. So for laboratory soil subsample replicates analyzed for the other analytes, the 30 to 35% value previously discussed and agreed between the Army and OhioEPA for the ISM field replicates was used. **As discussed on the 9/21/20 teleconference with OhioEPA, USACE, ANG and CH2M, to move the project forward with regard to OhioEPA comments the RSD/RPD goal for laboratory soil subsample replicates for all analytes will be 20%. If the 20% RSD/RPD is not met, then a J-flag will be applied to the associated data. This change has been incorporated into the attached revision of Table 11-1 of the QAPP.**

1 Table 11-1. DQO #1 – Excavation Delineation

Step 1 – Statement of Problem: The extent of soil exceeding the industrial cleanup goals at the planned excavation locations requires confirmation of COC concentrations after excavation.

Step 2 – Identify the Goals of the Study: Excavate soil at the planned excavation locations until the sidewalls and bottom of the excavation do not exceed the industrial cleanup goals.

Step 3 – Identify Information Inputs: Previous investigations at the Load Lines identified human health risk from COCs in surface and subsurface soil at Load Lines 1, 2, 3, 4 and 12 for likely future land use (for example, commercial/industrial). ROD Amendment (Leidos, 2019) identifies ex situ thermal treatment of soil at the planned excavation locations as part of the selected remedy to reduce the risk and be protective of human health.

Step 4 – Define the Boundaries of the Study: The remedial action will remove soil from 24 planned excavation locations at Load Lines 1, 2, 3, 4 and 12 identified in the ROD Amendment (see RD Work Plan Table 2-1 and Figures 3 to 7). Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation using ISM to confirm that soils exceeding the industrial cleanup goals have been successfully removed. The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.

Step 5 – Develop the Analytical Approach: In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP). An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM **field** primary, duplicate and triplicate data evaluations~~ as well as that of the laboratory subsample triplicate for metals and the RPD for laboratory subsample duplicates (ISM analyses for PAHs and PCBs).~~. An RSD/RPD of less than or equal to 20% will be the goal for ISM ~~**SW8330B explosives analysis of**~~ **laboratory** subsample ~~triplicates~~replicates (triplicates for explosives, duplicates for PAHs and PCBs; one per laboratory batch of up to 20 samples for each analytical group).

Laboratory results will be compared to applicable industrial receptor cleanup goals in ROD Amendment (see Table 4-1 of RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional excavation will be conducted at locations with exceeding results until cleanup goals are met. Analytical data quality will be evaluated per this QAPP. The analytical methods specified in this QAPP will provide the lowest available detection limits using standard methods that will allow the data to be screened against the cleanup goals.

Step 6 – Specify Performance or Acceptance Criteria: All sample locations are known in accordance with the ROD Amendment and RD Work Plan which define soil removal boundaries for confirmation. Any soil removal beyond planned boundaries will be completed until industrial cleanup goals are met. Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed on known quality to meet project objectives as defined in Worksheet 36.

In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample ~~triplicate~~replicates ~~samples (ISM metals and SW8330B explosives analyses) and laboratory subsample duplicate samples (PAHs and PCBs)~~ will be submitted to Ohio EPA for ~~concurrence on meeting~~review of the following DQOs~~review~~:

- For ISM laboratory subsample replicate results greater than the LOQ (triplicates for explosives, duplicates for PAHs and PCBs; one per laboratory batch of up to 20 samples for each analytical group), an RPD or RSD, as applicable, of less than or equal to 20% as a goal. If this DQO is not met, a J-flag will be applied to the associated data.
- ~~An RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).~~
- ~~An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for PAH, PCB and metals analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples).~~
- For the field ISM triplicates, an RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into sample data evaluations. If ~~these~~ this DQO~~s~~ ~~are~~is not met for the ISM field triplicate samples~~ or the associated laboratory subsample replicates~~, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 "Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016):

Table 11-1. DQO #1 – Excavation Delineation (continued)

Good Precision (RSD <35%)

- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Data can be used for confirmation purposes without the need for additional sampling, if cleanup goals are met.

Moderate Precision (RSD >35% but <50%)

- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.);
- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Additional confirmation sampling recommended following remediation of decision units (DUs) that exceed cleanup goals, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Poor Precision (RSD >50% but <100%)

- Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report;
- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Compare the 95% UCL (Chebyshev method) for replicate data to 150% of the cleanup goal for decision making;
- Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Very Poor Precision (RSD >100%)

- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;
- Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;
- If one or more of the replicate samples exceeds the cleanup goal then remediation of the DU should be considered, even if the mean concentration is well below the cleanup goal. Remediation of associated DUs where replicate samples were not collected should also be considered;
- If all replicate samples are below the cleanup goal, then compare the 95% UCL (Chebyshev method) for replicate data to the unadjusted cleanup goal for decision making;
- If all replicate samples are below the cleanup goal, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to unadjusted cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the attached SOP, *Incremental Sampling for Surface Soil*. A systematic random sampling scheme will be used in selecting the aliquot sampling locations for each sidewall and the excavation bottom to ensure that the aliquots are spread out relatively equally. This will be accomplished by gridding the bottom and the contaminated interval of each sidewall into approximately equally sized grids, and then collecting an aliquot from the sidewall/bottom surface at the center of each grid. If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). The duplicate and triplicate aliquots will be placed in separate containers to be submitted to the laboratory.

The results will be compared to the Industrial cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP). Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days.

If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6.

Table 11-1. DQO #1 – Excavation Delineation (continued)

Step 7 – Develop the Detailed Plan for Obtaining Data (continued):

If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled.

If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if a field replicate sample exceeds an applicable cleanup goal. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the cleanup goals, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR.

Once an excavation meets the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil excavated/treated.

Table notes:

CH2M =CH2M HILL Constructors, Inc.
COC = contaminant of concern
COR = Contracting Officer’s Representative
DoD = U.S. Department of Defense
ISM = incremental sampling methodology
ITRC = Interstate Technology Research Council
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
RSD = relative standard deviation

Subject: FW: Load lines 1-4 and 12 Thermal remediation RTCs

-----Original Message-----
From: Susan.Netzly-Watkins@epa.ohio.gov <Susan.Netzly-Watkins@epa.ohio.gov>
Sent: Wednesday, September 9, 2020 12:57 PM
To: Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>; Tait, Kathryn S NFG NG OHARNG (USA) <kathryn.s.tait.nfg@mail.mil>; Nathaniel Peters II Dr CIV USA USACE (Nathaniel.Peters.II@usace.army.mil) <Nathaniel.Peters.II@usace.army.mil>
Cc: Brian.Tucker@epa.ohio.gov; bob.princic@epa.ohio.gov; Thomas.Schneider@epa.ohio.gov
Subject: [Non-DoD Source] RE: Load lines 1-4 and 12 Thermal remediation RTCs

Hello Kevin,

Thank you for the detailed response to our comments dated August 25, 2020.

We have one clarification question. Why are there different RSD goals for laboratory sub-sample results for COCs other than explosives?

Beginning on Page 47 of the pdf and elsewhere in the document it is stated in part:

"(a)n RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).

An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for PAH, PCB and metals analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples)."

It is not clear why the laboratory RSD goal differs by analytical method.
The RSD goal for the laboratory sub-samples is a verification of appropriate soil sub-sampling method(s) an execution in the lab and should not be affected by the analytical methods.

The RSD laboratory sub-sampling goal for both methods should be 20% unless information is provided that supports using different goals for different analytical methods.

Thanks !

Sue

-----Original Message-----
From: Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>
Sent: Friday, September 4, 2020 8:52 AM
To: Netzly-Watkins, Susan <Susan.Netzly-Watkins@epa.ohio.gov>
Cc: Tait, Kathryn <KATHRYN.S.TAIT.NFG@MAIL.MIL>; Nathaniel Peters II Dr CIV USA USACE (Nathaniel.Peters.II@usace.army.mil) <Nathaniel.Peters.II@usace.army.mil>

Subject: Load lines 1-4 and 12 Thermal remediation RTCs

Susan: just checking to see if you had a chance to look at the latest round of RTCs for the work plan. If you have any additional questions and/or concerns please feel free to contact me. Thanks and have a great holiday weekend.

Kevin Sedlak, PG, MS
Restoration Program Manager
IPA Designation
Camp James A. Garfield JTC
1438 State Route 534 SW
Newton Falls, OH 44444
ARNG-ILE Clean Up
Office Phone 614-336-6000 Ex 2053
e-mail to:kevin.m.sedlak.civ@mail.mil

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

August 25, 2020

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Ms. Sue Netzly-Watkins, Site Coordinator
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Responses to Ohio EPA comments on the Draft Remedial Design Work Plan for Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12) (Work Activity No. 267-000-859-030)

Dear Ms. Netzly-Watkins:

An electronic version of the consolidated responses to Ohio EPA comments received June 11, August 4, August 11 and August 14, 2020 on the March 2020 *Draft Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12)* will be sent for your review and approval using the Ohio EPA LiquidFile system. The Work Plan was prepared for the Army in support of the RVAAP restoration program.

The consolidated responses reflect Ohio EPA comments SNW 1 through SNW 9 received on June 11 with responses provided on June 29; Ohio EPA's backcheck comments on SNW 2 received on August 4 with responses provided on August 10; Ohio EPA's backcheck comments on SNW 2 received on August 11 which were discussed on a teleconference August 13; and Ohio EPA's backcheck comments on SNW 2 received on August 14 with responses provided with this letter dated August 25.

Please contact the undersigned at 614-336-6000 Ex 2053 or kevin.m.sedlak.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,

SEDLAK.KEVIN.MICHAEL.1254440171
Digitally signed by SEDLAK.KEVIN.MICHAEL.1254440171
Date: 2020.08.25 14:48:40 -04'00'

Mr. Kevin Sedlak
RVAAP Restoration Program Manager
IPA Designation
Camp James A. Garfield JTC

cc: Tom Schneider, Ohio EPA SWDO (Email transmittal letter only)
Bob Princic, Ohio EPA NEDO-DERR (Email transmittal letter only)
Natalie Oryshkewych, Ohio EPA NEDO-DERR (Email transmittal letter only)
Katie Tait, OHARNG, CJAG (pdf via Email or ftp)
Admin Records Manager – Jennifer Tierney, Vista Sciences Corp (pdf via Email or ftp)
Pat Ryan, Leidos-REIMS (Email transmittal letter only)
Craig Coombs, USACE – Louisville District (Email transmittal letter only)
Nathaniel Peters, USACE – Louisville District (pdf via Email or ftp)
John Hearn, USACE – Louisville District - WPAO (pdf via Email or ftp)

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 1		The total number of areas subject to excavation and remedial activities seems to be inconsistently referenced in the April 2020 Draft Remedial Design (RD) Work Plan (draft RD work plan). Several places in the draft RD work plan text indicate a different number of excavation areas than are reflected in the Figures and Tables. Below are several places in the draft RD work plan that should be revised:	
	Section 1.2 Scope	Section 1.2 Scope: Line 23 notes that the remedy includes excavation of soil from 25 locations. This number is not consistent in the draft RD work plan. The number provided in the report narratives is inconsistent with the number provided in figures and in tables.	The following text revisions were performed in Section 1.2 Page 1-1, Lines 18-21 were revised to "The ROD identifies 24 locations at Load Lines 1-4 and 12 which require soil removal in order to achieve the Remedial Action Objective (RAO) to reduce risk from contaminants of concern (COCs) in surface and subsurface soil to acceptable levels (remedial goal options [RGOs]) for likely future use (i.e., Commercial/Industrial Land Use) that are protective of human health." Page 1-1, Lines 22-25 were revised to "The approved remedy includes excavation of soil from 24 locations, ex-situ thermal treatment of the majority of the excavated soil, off-site disposal of the remaining portion of the excavated soil (metals-contaminated), confirmation sampling, backfill and site restoration."

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 1 (cont.)	Section 2.2.3 Load Line 3:	Section 2.2.3 Load Line 3: Line 4 indicates there are eight planned excavations. Figure 5 shows 10. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.3: Page 2-3, Lines 4-5 were revised to "Load Line 3 is located in the southeastern portion of the former RVAAP and contains ten (10) planned excavations (Figure 5: Load Line 3 Excavation Plan)." Page 2-3, Line 5-6 were revised to "All but one of the planned excavations within Load Line 3 are located adjacent to or beneath former buildings."
	Section 2.2.4 Load Line 4:	Line 14 indicates there are three planned excavations. Figure 6 shows 6. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.4: Page 2-3, Lines 14-16 were revised to "Load Line 4 is located in the south central portion of the former RVAAP and contains four (4) planned excavations (Figure 6: Load Line 4 Excavation Plan). Three of the planned excavations within Load Line 4 are located adjacent to or beneath former buildings."
SNW 2 Jun 11	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved.	The draft RD work plan references a 2011 Leidos Standard Operating Procedure (SOP) will be used as guidance for conducting incremental sampling methodology (ISM) sampling activities. Based on our May 27, 2020 call with your team to discuss our preliminary comments on this draft work plan, we learned that the contractor, CH2M, had identified a different ISM sampling approach in a Quality Assurance Project Plan (QAPP). The QAPP in Appendix C, page 4, Step 7 of this draft RD work plan cites the 2011 Leidos SOP. Ohio EPA recommends using the most current Interstate Technology Research Council (ITRC) ISM sampling guidance.	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 2 Jun 11 (cont.)		Worksheet #18 shows the locations for collecting soil within the Load Line remediation area, but it is not clear what data quality objective (DQO) was applied to determine the number of samples needed to be representative of the bottom or side wall was necessary. Is this in the 2011 Leidos SOP?	Worksheet #18 is premised on resolution of DQO#1 (Excavation Delineation) presented on Page 2, Table 11-1 of the QAPP. Text provided in Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)."

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 2 Jun 11 (cont.)	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved. (cont.)	Worksheet #20 Field Quality Control regarding duplicates: The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the ISM excavation confirmation samples, the Record of Decision (ROD) Amendment requires that the ISM samples be collected in duplicate. However, to follow current Department of Defense (DoD) and ITRC requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with the DoD Quality Systems Manual (QSM) and ITRC.	Text provided in Table 11-1 Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)." Worksheet #20 text contained on Page 29, lines 22-30 is consistent with the note revision to Table 11-1 step 5 text above; no changes were made to this worksheet.
		Worksheet #21 states "Field Standard Operating Procedures Project sampling activities will be conducted in accordance with the procedures described in the Facility-wide SAP (Leidos, 2011) and this QAPP". This reviewer did not have the Field SOP from Leidos. Please clarify if the ISM sample will be processed in the field or in the lab?	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 2 Aug 4	Revised Worksheet 11.1	Step 5. An RSD of 35% as a goal is too high. Ohio EPA recommends an RSD between 5 - 10%.	An RSD of 5 to 10% is not practical or necessary and is not supported by the guidance. The ITRC does not define an "acceptable" RSD for multi-incremental sampling (MIS) but does state that an RSD exceeding 30%–35% from field replicates would be considered "high". However, the Hawaii Department of Health, a leader in the field of MIS and significant contributor to the ITRC, provides the following in the attached Section 4.2.7.3 "Evaluation of Data Representativeness" as part of the discussion on the use of multi increment samples to characterize DUs within their Technical Guidance Manual http://hawaiidoh.org/tgm-pdfs/TGM.pdf: "An RSD less than 35% is considered to reflect good precision for estimates of the average. Good precision implies that the sampling method used, including the number, spacing, and size/shape of increments collected was adequate to capture and reflect small-scale heterogeneity of contaminant distribution within the DU and that error in the laboratory processing and analysis methods was low." And **"RSD ≤35%** .Direct comparison of unadjusted DU data, or the arithmetic mean of replicate data to target action levels, is acceptable when the RSD of the representative replicate data set for the contaminant of concern is less than 35%. Adjustment of the data with respect to the RSD (or calculation of a 95% Upper Confidence Level) is not considered warranted given the overall acceptable sample precision. This assumes, of course, that the samples were collected, processed, and tested in an unbiased manner and are reasonably representative of the targeted DU. **If soil remediation is carried out then unadjusted DU data can be used for confirmation samples.**"

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);
Comments received June 11, August 4, August 11 and August 14, 2020
Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 2 Aug 4 (cont.)	Revised Worksheet 11.1 (cont.)		Ohio EPA's comment for an RSD between 5 and 10% may be referring to the following from the Ohio EPA Technical Guidance Compendium VA30007.19.002 "Use of Multi-Increment (MI) Sampling in the VAP", effective March 2009, Updated August 2019 https://www.epa.ohio.gov/portals/30/vap/tgc/VA30007-19-002.pdf, which is not referring to an RSD but rather says the results of replicates should not vary from one another by more than 5 to 10%. **This is not the same as the RSD.** "Three replicate MI samples are to be collected within each decision unit. Replicate samples verify that field sampling and laboratory subsampling are being conducted properly. Results from replicate samples also will confirm that enough aliquots have been collected to account for the heterogeneity of the contaminated soil and the size of the decision unit. As a general guideline, replicate concentration values should not vary more than 5-10% from each other. ITRC recommends calculating a 95% UCL of the three replicates to be used as the representative value. Ohio EPA will also accept the maximum value of the three replicate samples per decision unit."

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);

Comments received June 11, August 4, August 11 and August 14, 2020

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SNW 2 Aug 4	Worksheet 18	In Section 2 of the SOP it notes the "appropriate decision units must be identified for ISM to be valid". This SOP doesn't provide specific information on how the decision units (DUs) are determined for the AOCs. Clarify what is the representative area of an ISM sample. In our July 31 call, it was noted that a separate ISM sample will be collected for each side wall and a separate ISM sample for the bottom of the excavation. Some excavation areas are subdivided. Clarify the process to determine if additional remedial action would be undertaken at an excavation/OU if the ISM sample is above the CUGs. What parties are informed or involved in the decision making on the additional soil removal activity. Following additional removal is another ISM verification sample collected in the same manner as it had been the first time?	The number of ISM samples for each excavation as shown in Worksheet 18 is based on the shape of the excavation, with the intent being that the sample results will be used to determine if additional soil needs to be removed in a particular direction. The area gridded for each ISM sample is being considered the decision unit. The longest sidewall is for excavation EB10A at Load Line 3; at 285 feet and the contaminated interval at 3 to 5 feet, the east sidewall sample for this excavation will represent a 570 square foot area (0.013 acres). EB10A also has the largest square footage for the bottom (0.23 acres) and will have 3 ISM samples, each representing a DU of less than 0.1 acres. These decision units are small in terms of typical decision units/exposure areas (i.e., the decision units do not need to be this small in order to represent exposure for any receptor), with the DU sizes for this effort being driven by the logistics of excavating, since an exceedance requires additional excavation. Note that sidewall samples are not planned for sidewalls that abut building foundations, or areas excavated during previous remedial actions since the adjacent material is clean backfill. Worksheet 18 has been revised to include directional descriptors in the location column for irregularly shaped excavations (i.e., instead of Sidewall 1, Sidewall 2 etc. the location column has been revised to Sidewall North 1, Sidewall North 2, etc.), and the Load Line figures from the Work Plan have been added to the QAPP with labels added for irregularly shaped excavations to indicate the planned confirmation sample locations.

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SNW 2 Aug 4 (cont.)	Worksheet 18 (cont.)		If a sidewall or bottom sample exceeds the applicable cleanup goals, CH2M will inform the USACE COR (Nat Peters) to discuss removal of additional soil at that location. The USACE COR may consult with additional parties, such as the Katie Tait (OHARNG Restoration Representative) and Kevin Sedlak (ARNG Restoration Representative) Once authorized by the USACE COR, additional soil will be removed in the direction of the exceedance, typically in one-foot increments (if the exceedance is more than one order of magnitude above the applicable cleanup goal, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, another ISM excavation confirmation sample will be collected in the same manner as the first and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. For a sidewall exceedance, an additional sample will be collected from the corresponding sidewall of the extension and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR. Once all sidewall and bottom samples for an excavation meet the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil treated.
SNW 2 Aug 4	General	QAPP Worksheet Table Notes: ITRC = Interstate Technology & **Regulatory** Council	ITRC corrected to Interstate Technology & Regulatory Council

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SNW 2 Aug 11	Revised Worksheet 11.1	We had a chance to look over the RTC for the RSD comment [SNW 2, Aug 4, Revised Worksheet 11.1] and have some feedback that we can discuss further during Thursday's call. Response stated "The RSD is not the same as the 5-10% difference goal" in Ohio EAP FSOP. We can accept the <35 RSD with the addition of Ohio EPA's recommendation of < 10% difference between replicate sample concentrations as a goal. That would mean we have two goals to use in the evaluation of triplicate confirmation samples. Ohio EPA recommends that if the values are above either criterion, then Ohio EPA reviews the data prior to any decision on the removal meeting performance standards at the AOC/DU. The other option could be a blanket failure and you would excavate more and resample.	On August 13, a teleconference with representatives from the Ohio EPA (Sue Netzly-Watkins, Tom Schnieder, Bob Princic, Brian Tucker), ARNG (Katie Tait, Kevin Sedlak), USACE (Nat Peters) and CH2M (Sarah Meyers, Doug Scott) focused on the RSD and percent difference requirement for ISM triplicates. The ARNG and USACE are not aware of a requirement this low being applied on projects elsewhere and has not been applied for ISM at other RVAAP projects. Ohio EPA stated that the responses to the other comments were fine. For the ISM triplicates, CH2M asked about the basis for Ohio EPA's request of a 10% difference between replicates, if it had been applied on other sites and how did it work out. Sue Netzly-Watkins is not aware of it being applied elsewhere. Brian Tucker stated that the question really comes down to how much oversight the Ohio EPA would have for this project, so they wanted to tighten up the percent difference such that they would be consulted/provided with the sample results before the excavations are backfilled. Kevin Sedlak stated that they have never had Ohio EPA involved in the decision of when to backfill, that they have done a lot of digging remediation without Ohio EPA raising this issue, and that delays in making that decision are costly due to the amount of equipment and personnel on site as well as extended management of the open excavations and backfill material. So the Ohio EPA review of analytical data would need to be done in real time, not over the course of a week or several weeks. When asked who at Ohio EPA would be doing the review, Ms. Netzly-Watkins stated that they would talk internally about it and that she assumes this would apply to all the RVAAP sites with thermal treatment. It was discussed that triplicates are not planned for every sidewall and bottom ISM sample, but rather would be collected

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SNW 2 Aug 11 (cont.)	Revised Worksheet 11.1 (cont.)		at a rate of 1 in 10 at random locations. Nat Peters suggested that the triplicates could be collected at the beginning of the excavation confirmation sampling effort instead of randomly so that the RSD and percent difference could be evaluated sooner. Ms. Netzly-Watkins stated that if the triplicates all meet the cleanup goal then the RSD and percent difference don't matter. Kevin Sedlak stated that if any of the three replicates is above the cleanup goal then the highest replicate value would be used and additional soil would be excavated. Mr. Tucker stated that it is not that cut and dry since meeting the cleanup goals is not the only thing. Mr. Sedlak asked for concrete direction from Ohio EPA and that Ohio EPA is welcome to have a representative on-site, but specifics are needed from Ohio EPA. Ms. Netzly-Watkins stated that she appreciated the upfront delivery of responses to comments and the discussion, and that they are looking at this as precedent (i.e., not just for this site). Ohio EPA will get back to the Army on August 14 with path forward.
SNW 2 Aug 14	Revised Worksheet 11.1	Thanks again for meeting with us to discuss the RTC - QA/QC step for the LL 1-4 and 12 RD. Ohio EPA has been taking a closer look at DQOs being applied at remedial projects across the state to ensure consistent application of ISM. In the attachment, we outlined the points discussed yesterday: **"GOAL:** Meet the remediation goal at the RVAAP Areas of Concern (AOCs) with a high level of confidence that field sampling errors and laboratory analysis errors have been minimized. Clear direction is requested so RVAAP team can detect issues with field sampling or laboratory sample preparation. Keeping Ohio EPA in the loop on the quality control checks will increase our confidence of the results.	

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)	**ACTION**: Revise Step 5 to include update data quality (DQ) steps to ensure appropriate use of incremental sampling methodology (ISM). Develop an "if…then" decision tree. This is a two-part quality assurance/quality control (QA/QC) where both the field team's performance and the laboratory's performance need to be within the limit deemed necessary to show the remediation goal was met. Ohio EPA recommends front loading the triplicate sampling QA/QC. The first three confirmation ISM samples should be taken with field triplicates and laboratory duplicates and the results submitted to Ohio EPA for concurrence on meeting data quality objectives (DQOs). Following the initial sampling and data review, the listed 1 triplicate per 10 samples is recommended. If necessary, Ohio EPA will notify RVAAP when the tightness of the data quality is an issue. The goal will be to meet the ITRC guidance of a relative standard deviation (RSD) of 30-35% of the field samples, laboratory samples should be lower. In addition, Ohio EPA will also review the data with above RSD and their FSOP internal guidance and note if there are any concerns with data quality and if our FSOP should be revised. Note: If sample personnel are significantly changed following the initial quality check then, another three ISM sample evaluation may be needed.	QAPP Table 11-1, Step 5, Develop the Analytical Approach, has been revised to state "An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample triplicate for metals and the RPD for laboratory subsample duplicates (ISM analyses for PAHs and PCBs). An RSD of less than or equal to 20% will be the goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples)." QAPP Table 11-1, Step 6, *Specify Performance or Acceptance Criteria*, has been revised to state that "In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample triplicate samples (ISM metals and SW8330B explosives analyses) and laboratory subsample duplicate samples (PAHs and PCBs) will be submitted to Ohio EPA for concurrence on meeting the following DQOs: • An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the field ISM triplicate sample data evaluations. • An RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)		• An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for metals, PAH, and PCB analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples). If these DQOs are not met for the ISM triplicates samples or the associated laboratory subsample replicates, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see QAPP Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016)." Throughout the QAPP, the RSD requirement for ISM field triplicates has been revised from "35%" to "less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%)". See WS20, WS23, WS28-1, WS28-2, WS28-3, WS28-4, and WS37. A Quality Control check has been added to Work Plan Table 9-1, *QC Inspections*, to check that ISM field triplicates and associated laboratory ISM subsamples duplicates/triplicates meet the DQOs specified in QAPP Table 11-1 and that the results have been provided to Ohio EPA for concurrence. **Pages revised in response to this comment are provided as an attachment to support this comment response.**

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)	• As noted in the Hawaii guidance provided for review (http://www.hawaiidoh.org/tgm-Content/0402a.aspx?f=T): "(t)riplicate samples (*i.e.*, original sample plus two replicates) should be collected to evaluate the precision of field sampling methods used. Each set of replicate increments must be collected from completely independent (systematic random) locations. Collection of increments around a single grid point is not appropriate for replicate samples, since this might not adequately test small-scale variability within the decision unit (DU)." Revise step seven (7) to be consistent with the method provided above.	QAPP Table 11-1, Step 7, *Develop the Detailed Plan for Obtaining Data*, has been revised to state "If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). **Pages revised in response to this comment are provided as an attachment to support this comment response.**
		• Ohio EPA concurs that if any of a triplicate ISM samples exceeds a cleanup goal (CUG), then additional excavation and confirmation sampling would be required."	QAPP Table 11-1, Step 7, *Develop the Detailed Plan for Obtaining Data*, has been revised to state "If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6. If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled. If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if a field replicate sample exceeds an applicable cleanup goal." **Pages revised in response to this comment are provided as an attachment to support this comment response.**

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SNW 3	Section 5.4 Thermal Treatment	Provide further clarification in the text of on the design of the thermal treatment system: Are the laterals sealed on the ends or does heated air flow entirely through them?	The laterals are not sealed on the ends, they are perforated – allowing the hot air to flow through and conductively transfer heat to the soil. Text describing the treatment system in Section in 5.3.5 has been edited as follows: Page 5-7, Lines 10-11 were revised to "Perforated lateral steel pipes (3.5-inch x 16-feet) will be attached to each side of the manifold using tees placed along the cell length." Page 5-7, Lines 12-16 were revised to "A second layer of pipes composed of 12-foot perforated laterals and a 12-inch diameter manifold will be placed on top of the second layer of contaminated soil. A third layer of contaminated soil will be placed upon the pipes and manifolds. Followed by installation of a third layer of perforated lateral pipes (9-foot laterals) and 12-inch diameter manifolds."
		Where does the hot air stream from the manifolds go at the end of the dirt pile?	Supplemental text describing hot air was provided in Section 5.3.5. Page 5-7, After line 18, the following text was inserted: "During operation of the ETC treatment cell, hot air is injected into each manifold where it flows into each lateral. As the heated air exits each perforated lateral, it is forced through the soil providing treatment. Air and contaminant vapor pushed through the soil is subsequently captured by the Quonset hut cover (described below). Vapor extracted from the Quonset hut cover is destroyed using a standalone Thermal Oxidizer described in section 5.4.2."

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SNW 3 (cont.)	Section 5.4 Thermal Treatment (cont.)	Section 5.3.5 Soil Stacking indicates that the total height of the typical soil cell will be approximately 9.5 feet at the top; however, in Section 5.4.2 Thermal Oxidizer it indicates that the insulated steel chamber is only five feet high. So, roof height differs in the thermal oxidizer unit and the soil cells?	The ETC treatment cell and thermal oxidizer are different pieces of equipment. The ETC cell is 9.5 feet high as described in Section 5.3.5; the thermal oxidizer is approximately 5 feet high as detailed in Section 5.4.2. Supplemental text in Section 5.3.5 was provided as noted previously to differentiate treatment system components and function.
		It is not clear if the Thermal Oxidizer unit described in this draft RD work plan is the same as the VEG Technology used in the pilot study. Please provide comparison information on these two treatment systems that show this proposed thermal treatment system is as effective as the previously used VEG Technology. It is unclear why the VEG Technology is proposed in the draft RD work plan for Load Line 9 and is not being used at Load Lines 1-4 and 12. Please provide a brief explanation of the rationale for this difference.	The thermal treatment described in the Work Plan is not the VEG technology used in the pilot study. The federal government is not permitted to specify a treatment technology in Request for Proposals (RFP). The RFP requested thermal treatment for the soil remediation at the sites. The VEG contractor was on one of the teams but due to a death of their president shortly after the site visit, they removed themselves from the bidding process. Additionally, the VEG process is a proprietary technology. Therefore, the contractor for the RA is not privy to the technical details to provide a comparison. The ETC technology has been used to successfully treat a broad range of petroleum hydrocarbon impacts including diesel range organics, crude oil, coal tars, heavy hydrocarbons and PAHs. This design has been deployed around the world to effectively remediate hundreds of thousands of tons of hydrocarbon and organic contaminant impacted soils since the mid 1990s and several of these projects have been remote in nature. To date, projects have been successfully completed for many organizations including Progress Energy, Chevron Corporation, U.S. Navy, U.S. Department of Defense, U.S. Department of Energy, Department of Transportation, Department of Corrections, NOAA, and Thiess Services.

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SNW 4	Section 5.6.2 Treatment Verification Samples.	A flow chart or decision tree showing the decision process would be helpful to clarify the following: the use of the second verification sample, what action will be taken if the first sample exceeds cleanup standards, what happens if the second sample is below cleanup standards, how will the next decision for backfilling or additional treatment be made?	Once a sample from the treated soil meets the applicable RGOs, the soil will be considered suitable for backfill. The CH2M Construction Manager/Field Quality Manager will confirm that the soil has been sampled and has met the applicable RGOs before approving its use as backfill. Text has been added to Section 5.6.2 to clarify as follows: Page 5-14, Lines 20-23 was revised to "If the magnitude of the exceedance is small, a second composite treatment verification sample will be collected immediately for analysis of the COC that exceeded the RGO in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected)." Page 5-14, Lines 24-25 was revised to "If the magnitude of the exceedance is large, the active heating system will be restarted to provide additional treatment prior to collecting the second treatment verification sample." Page 5-14, Lines 26-27 was revised to "The decision to restart the heating system will be based on laboratory analytical measurements and the professional judgement of the team members including the system operator."
SNW 5	Section 5.8 Backfill and Site Restoration.	Are there any calculations as to the volume of the projected estimate for treated soil and estimated volume of clean fill to restore the site to its original contours?	The ex situ soil treatment process does not impact the volume of the soil; therefore, it is expected that off-site backfill material will only be required to make up for the volume of excavated soil that is transported and disposed off-site. As detailed in Table 2-1, approximately 160 yards of soil contaminated by metals will be excavated and disposed off-site. Remaining soil with organic contaminants (roughly 5,700 cubic yards) will be treated to meet remedial goals and reused in backfilling operations.

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SNW 6	Section 7 Environmental Management	Line 8 indicates that, "a separate vegetation removal plan will be submitted under separate cover to describe this activity." Ohio EPA did not receive this plan prior to performing the tree felling activities which we understand occurred prior to March 31, 2020. Is this the February 21, 2020 Iron Creek Group letter included in this submittal?	Yes, the referenced submittal constitutes the vegetation removal plan developed by Iron Creek. Page 7-1, Lines 5-10 were revised to “Text in the introduction to Section 7 has been revised to read: “Felling of trees larger than 3 inches in diameter at breast height in areas of excavation was performed prior to March 31, 2020 to prevent wildlife (including the Northern Long Eared Bat) from nesting within the areas of excavation. Because this activity occurred prior to completion of this RD Work Plan, a separate vegetation removal plan (Appendix A) was submitted under separate cover to describe this activity and approved by the Army.”
		The CERCLA exemption does not apply to the existing facility roadways. In our discussion with representatives of the Akron Regional Air Quality Management District (ARAQMD), they requested to be provided a roadway installation date to determine if the particulate emission (PE) limit applies to this project. If you will be adding new roadways this would be considered a modification, assuming the roadway remains after this remedial activity is completed.	No additional roadways will be constructed for this project. Page 7-2, Following Line 4, the following text was added “No additional roadways will be constructed for this project. The existing roads in the load lines and south service road were built in the early 1940s as the facility was constructed. Many of the existing load line roads are old railroad beds that were used for area access following removal of the rails that formerly served facility operations. Access to the excavation and treatment areas will be gained using existing travel paths within the various load lines (primarily the former rail beds) which will remain unimproved. External travel between the load lines will be via existing road infrastructure at the facility.”

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SNW 6 (cont.)	Line 30 Section 7.2 Air Permitting	Include more in the draft RD work plan on how you will address fugitive dust to address the substantive requirements of the regulation. The draft RD work plan Table 7-2 "Review of Rule Applicability" identifies broadly the federal or state air regulation that applies to the proposed activities. The table notes that the facility will submit required reports and conduct monitoring if required by Ohio EPA under Ohio Revised Code 3745-15.	Additional text has been added to Section 8.2, Dust Controls Page 8-2, Lines 18-21 the following text was added: "In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust. During instances of high winds resulting in excessive dust, additional dust control measures or work stoppage may be implemented.
		Table 7-2 indicates that Chapter 17 - Particulate Matter Standards apply. The "Comments" column on the table notes that emissions of fugitive dust from roadways and construction activities will be minimized by the use of water or other suitable dust suppression chemicals. Provide additional information in the RD work plan to address fugitive dust. In addition to water, decreasing vehicle speed, truck tarping, and reducing the drop height of materials can also help mitigate fugitive dust. Clarify under what conditions may work be stopped to address fugitive dust issues and who and at what frequency will you monitor fugitive dust at roadways, parking areas, soil piles and at the thermal treatment area.	Additional text has been added to Section 8.2, Dust Controls as noted below: Page 8-2, Line 15, the following text was added "Iron Creek personnel, including the Site Supervisor, will monitor working conditions and fugitive dust throughout daily operations. During operations, the crew will be working along the active haul routes, excavation area(s) and at the treatment pad itself. Real time conditions will be communicated to the Iron Creek Site Supervisor and work stoppage related to mitigating fugitive dust will be at the Site Supervisor's discretion." Page 8-2, Lines 23-24 the following text was added "In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust."

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	Confirm any soil piles created as a result of the remedial action described in this work plan are temporary and are associated to this remedial action. The draft RD work plan noted that topsoil will be placed near the excavation area. Clarification is needed if this would include just sod or if loose soil will be piled at these locations. Please describe work practices to be implemented to mitigate against fugitive dust releases at all stages/locations of the remedy, and controlling waterborne runoff, etc.	Based on field reconnaissance of the proposed excavation areas at the facility, it appears that the majority of the surface material to be removed prior to excavating is composed of sod and duff. This material, along with any surface growing media will be removed and placed adjacent to the excavation for storage while soil treatment operations for the impacted soil is underway. Table 7-2 the following text was added in the comments column for OAC 3745, Chapter 17: "Erosion control measures, as outlined in the Section 8 of the Work Plan, will be implemented as needed to prevent runoff and/or fugitive dust emissions at all work areas and during all stages of the RA. This includes regular inspection of excavation areas and soil piles, implementation of non-structural BMPs (minimizing disturbance, quick turnaround of backfilling and vegetation reestablishment, etc.), installation of structural BMPs (berms, silt fence, etc.), and application of dust suppressant, as required."
		It is our understanding from our May 27, 2020 call with RVAAP and USACE personnel that the backup generator is propane-fueled. Revise the draft RD work plan to clearly state what fuel type is used to power the 125-kw generator noted in the draft RD work plan under section 5.2.4. Confirm it is exempt as a non-road engine under Ohio Administrative Code (OAC) 3745-31-03(B)(1)(qq).	Text was added to specify generator fuel source as noted below: Page 5-1, Line 34 "propane-fired" was inserted before 125 (kw) generator. Page 7-2, Lines 32-34 the following text was added "The portable engine is propane fired and meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)." Table 7-2 2 the following text was added in the comments column for OAC 3745, Chapter 31: "The propane-fired 125 kw generator meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)."

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

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Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);

Comments received June 11, August 4, August 11 and August 14, 2020

Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	The substantive requirements for the thermal oxidizer will need to be met. OAC 3745-17-07 (A)(1)(a) indicates that visible particulate emissions for any stack shall not exceed 20% opacity, as a six-minute average. Please include the OEM documentation on volatile organic compound (VOC) destruction efficiency at the 950° F operating temperature.	Attached is the Thermal Desorption Applications Manual that provides the destruction efficiency for thermal oxidizers operated on multiple projects. As highlighted in table C-5, DRE numbers exceeding 99% are achieved at operating temperatures in the 1,400 to 1,600°F range, which is more in line with operational conditions that we expect for this project. The minimum operating temperature of 950°F is included in the RD text as it is a common Code of Practice baseline for the bottom end of operational temperatures for this type of equipment, while the higher temperatures in the 1,400 to 1,600°F range are more indicative of what we expect to see at Ravenna. In terms of opacity, we would not expect to see stack exhaust opacity near the 20% range for this project for any oxidizer temperature >950 °F, however, the higher temperatures referenced will demonstrate the VOC removal efficiency, as outlined in the manual. Page 5-11, lines 11- 12 the following was text was added "The minimum operating temperature of the thermal oxidizer is 950 degrees Fahrenheit (°F); the typical operating range for this type of waste is 1,400 to 1,600°F."
SNW 7	Section 8 Storm Water Pollution Prevention	Appendix D - Iron Creek Stormwater Pollution Prevention Inspection Checklist & Corrective Action Log: Will this be implemented at the ETC area, roll-off box storage areas and excavation areas? By whom?	This will be implemented at all areas of the site involved in the remedial action including the ETC treatment area, excavation areas, and storage areas; and will be coordinated by the onsite Iron Creek Supervisor. The metals-impacted soils in roll-off boxes will be transported off-site as soon as possible pending the disposal characterization analytical results and completed waste profile/shipping manifests.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8	Table 11-2 DOO#2 Treatment Verification	Process clarification is needed: Steps 1 and 2 Because confirmation sampling includes analysis for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and explosives, what management steps are taken at soil excavation areas when the soil from the excavation is not heading to ETC, but will be disposed offsite due to metals?	Text has been added to Work Plan Section 5.3.1 for clarity regarding soil management steps for metals-impacted soils. Page 5-4, Lines 14-22: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. The total estimated volume of metals impacted soil scheduled for disposal is +/- 160 CY. Stormwater Pollution Prevention best management practices (BMPs) outlined in Section 8 will be integrated into the excavation operations, as required." Table 11-3 has been added to the QAPP to describe the DQO for sampling the metals-impacted soils for disposal characterization. The table is also provided as an attachment to support this comment response.

Comment Resolution Table

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	More detail is needed on how the soil excavation areas are managed: Will soil go directly into roll-off box containers? QAPP Section 5.3.2 indicates that impacted soils will be excavated ant then transported to the ETC pad. Confirm if at any time, will the impacted soils be stockpiled on the ground prior to treatment and verification?	Text has been added to Section 5.3.2 (Soil for Ex Situ Thermal Treatment) for clarity. Page 5-4, Lines 24 -33, the following text was added "For each planned excavation area with soil that will be thermally treated, the overlying uncontaminated surface soil, if applicable (see Table 2-1), will be removed and stockpiled nearby; erosion/runoff mitigation for the stockpiled uncontaminated surface soil will be implemented per Section 8. The impacted soils will then be excavated to the boundaries of the surveyed area as shown on Figures 3 through 7 and placed into a truck to be transported immediately to the ETC pad shown on Figure 8. Once the material arrives at the ETC pad wheel loaders will be used to place it directly into one of the ETC cells for thermal treatment. Each ETC cell will contain a soil volume of +/-525 CY. Stockpiling of the impacted pre-treatment soil is generally not required at either the excavation area or at the ETC treatment pad. Stormwater Pollution Prevention BMPs outlined in Section 8 will be integrated into the excavation operations, as required."
		Once a roll-off box is full, will it be stored at the excavation site for some time prior to being transported under tarp to the ETC or at another area at RVAAP, or will it go directly offsite if it is one of the four metal contamination area or waste not slated for ETC?	For metals-impacted soils, the soil will be placed in roll-off boxes pending the results of disposal characterization analytical results and waste profile/shipping documentation. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal.

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	Will soils treated from a particular excavation area be placed back in the same excavation area where it originated?	Not necessarily. Soil handling logistics will drive where the treated soil is used as backfill.
		Are roll-off boxes transporting the untreated soil decontaminated if they will be used to transport treated soil?	Roll-off boxes will be used to contain soil excavated from metals-impacted locations pending the results of disposal characterization sampling. The roll-off boxes are not involved in the ex situ thermal treatment of soils. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. In addition, details regarding decontamination procedures were added to section 5.7 as follows: Page 5-15, Lines 31-35: "Trucks used for transporting soil material will be decontaminated when shifting from hauling impacted soil to clean treated soil. The equipment will be decontaminated utilizing a pressure washer at the proposed lined, decon area located within the treatment pad and waste water collected from the process will be added to the treatment cells for processing with the impacted soil material."
		Will treated soil be transported under tarp?	Trucks transporting soil to and from the ETC process within RVAAP do not require tarps.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	Step 3 notes that treated soil will be analyzed for chemicals of concern (COCs) at a rate of one sample per 150 cubic yards of treated soil. Clarify that the ISM sample(s) are collected while the soil is in the ETC. It is unclear how the treated soils in quadrants with verification samples below standards will be managed while a failing quadrant is subject to further treatment. Clarify if the entire load in the ETC unit goes through additional treatment or, will quadrants that pass be removed and stockpiled? Would new untreated soil go in? What sampling technique will be used for the ETC soil; ISM (ITRC guidance or 2011 Leidos), discrete?	The treatment verification samples will be collected as composite samples as described in Table 11-2 (not incremental samples) while the soil is in the ETC. Supplemental text provided below was added to Section 5.6.2 of the Work Plan. In addition, this text was also added to Table 11-2 which is provided as an attachment to this comment response table. Page 5-14, Lines 28-30, the following text was added "If a quadrant does not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling."

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 9	QAPP-Appendix A	Confirm that the lab receiving the sample can achieve the necessary detection limits necessary. The QAPP Table 15 shows the cleanup goals, reporting limits, detection limits, etc. and Worksheet #23 lists the labs that will be used for specific parameters: CT will be conducting PCB, PAH, metal and explosive work. Chemtech is doing just PCB and PAH work. It is not clear how work is divided between these two labs when the work involves PCBs and PAH analysis.	Laboratories identified for project use have confirmed capacity to achieve required analytical detection limits. There was not one lab that could do all of the analyses at the desired expedited turnaround times. Chemtech Laboratory (CT) was added to allow us to get rush data on PCBs and PAHs for the treatment verification samples. Page 12, Lines 3-4, the following text was added to the QAPP "CT Laboratories is the primary laboratory and will analyze the majority of the soil samples. Chemtech Laboratory will support expedited TAT for some treatment verification sample analyses." With identification of CT as the primary project laboratory, Analytical SOP references presented in Table 23-1 on Worksheet #23 were updated to include "LSOP-05, GT002 Processing of Multi-increment Samples and Subsampling". Table 23-1 is provided as an attachment to this comment response table.

Attachment 1
Incremental Sampling of Surface Soil
Standard Operating Procedure (per comment SNW2, June 11)

STANDARD OPERATING PROCEDURE

Incremental Sampling Method for Surface Soil

1 Purpose and scope

The purpose of this standard operating procedure (SOP) is to summarize requirements for the effective field implementation of increment sampling method (ISM) for soil undertaken as part of site characterization at contaminated sites. The ISM soil sampling process provides a view of mean contaminant concentrations over the area of a DU.

This SOP applies to all CH2M HILL personnel and subcontractors who perform ISM activities, and is limited to describing methods for obtaining surface soil samples (considered less than 1-foot below ground surface) for non-volatile, semi-volatile and inorganic analyses using ISM techniques. ISM techniques have been developed for volatile organic compounds and subsurface soil, however, they are not included in this SOP. This SOP was developed according to the following reference documents:

- *American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.*
- *Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.*
- *ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.*
- *Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.*
- *Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.*
- *Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.*
- *U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.*

This SOP focuses on the most commonly used ISM soil sampling tasks and applications anticipated at a field site and should be used in conjunction with other applicable project SOPs.

2 General

The objective of ISM is to reduce the variability created by taking discrete samples, and improve the reliability and representativeness of environmental data by obtaining multiple sub-samples (sample increments) over a decision unit (DU) (defined as the area or volume in question). These "increments" are combined into one bulk ISM sample, which is submitted to the laboratory, resulting in a better representation of actual mean concentrations in a DU.

The DU encompasses the area or volume about which a decision is necessary (e.g., deciding whether risks are acceptable or not). Appropriate decision units must be identified for ISM to be valid. Therefore, the identification of decision units is one of the most important factors when using ISM. Identification and delineation of the decision units should be conducted during project planning and identified in a client and regulatory approved Workplan prior to obtaining ISM samples. Since ISM sampling provides an “average” concentration of a DU, agreement on the DU boundaries is extremely important prior to collecting the “bulk increment sample”.

The number of increments incorporated into the bulk ISM, and the overall size of the ISM collected are not dependent on the size of the decision unit. The sampling theory is based on an assumption (and empirical observations) that 30 to 100 increments from a given decision unit of any size will result in a sample that is adequately representative of the average contaminant level in the decision unit as a whole. If the decision unit is the size of a small backyard garden, then 30 to 100 increments are collected. If the decision unit is a 10-acre, neighborhood-size area in a former agricultural field, then 30 to 100 increments of a similar mass are likewise collected.

If the contaminant distribution is expected to be very heterogeneous, it may be preferable to increase the number of increments collected to the recommended maximum of 100 for larger DUs. This may help to reduce field sampling error and minimize the variation between replicate samples used to evaluate the precision of the data collected. It has been reported that increasing the number of increments from 30 up to 100 may improve the reproducibility of data collected, and since the ISM sample is submitted as one sample, the number of increments collected does not typically increase analytical costs except that a small fee may be added for the excess sample mass management in the laboratory.

This SOP describes procedures for selecting sampling locations, marking field sampling locations, collecting incremental soil samples, and submitting these samples for laboratory analyses. This SOP assumes that the DU, and method for selecting increment locations within the DU has already been determined in the project work plan or project Quality Assurance Project Plan (QAPP), and that analyses and the laboratory conducting the analyses have been identified in the QAPP.

3 Responsibilities

This section describes the responsibilities of key project personnel including the PM, SM, DM, HSM, FTL, and field sampler.

3.1 Project Manager

The PM provides adequate resources and engages field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The PM will solicit the appropriate technical expertise to adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the PM should be consulted if complications arise in following sample handling and custody procedures.

3.2 Site Manager

The SM coordinates and schedules daily field activities. In addition, the SM trains field staff engaged in this activity and ensures compliance with this SOP.

3.3 Data Manager

The DM maintains and manages the sample tracking and scheduling program used to track field ISM samples. The DM should consult the SM, FTL, and Project Chemist regarding ISM soil sampling field sample processing.

3.4 Health and Safety Manager

The HSM is responsible for site-specific HS&E oversight and overall compliance with project HS&E requirements. The HSM conducts HS&E evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project-specific HSP, and coordinates with the SM to complete and certify the HS&E program.

3.5 Field Team Leader

The FTL maintains compliance with ISM sample techniques and methods, particularly the procedures to be used. The FTL, or their designee, should know the requirements of ISM soil sampling and maintain adequate documentation of sample collection activities. The FTL should take responsibility for collecting ISM samples accurately and correctly and for coordinating with the SM and data manager to successfully conduct any ISM field sample processing before laboratory analysis.

3.6 Field Sampler

The Field Sampler, under the supervision of the FTL (who may be the same person), should confirm that samples are correctly collected, labeled, tracked by chain of custody, and stored until they are delivered to the FTL or data manager. The Field Sampler should maintain custody of the samples until they are relinquished to the FTL or data manager. The Field Sampler informs the FTL and/or data manager of sampling conditions and potential deviations in sample collection.

3.7 Project Chemist

The project chemist is responsible for ensuring that the laboratory selected to analyze the ISM samples is qualified to do the work and meet the project data quality objectives (DQOs).

4 Procedures

ISM samples are prepared by typically collecting 30 to 50 small increments (samples) (up to 100 may be needed if a soil at the DU is determined to be very heterogeneous) of soil from systematic random locations within a specified decision unit and combining these increments into a single sample, referred to as the “bulk ISM sample.” Individual soil increments typically weigh between 30 and 50 grams, with bulk ISM typically weighing between 900 and 2,500 grams. The mass of the final bulk ISM depends on the number of increments collected, the size of the sample collection tool utilized. However a minimum final sample size should not be less than 1 kilogram as a general guideline.

4.1 Reconnaissance, Planning and Field Staging

During the DU planning process (Work Plan stage of project), a historical records search and site walk should be conducted to determine if there are areas that may have elevated levels of contamination as it may be desirable to break these “hotspots” into separate decision units. It is also useful for planning sample collection locations if access to some areas will be difficult. Logistics of sampling around buildings or sampling in areas of heavy vegetation should be considered when setting up the random grid (discussed in the following section).

4.2 Setting up a Stratified or Systematic Random Grid

A systematic random or stratified random sample collection scheme is developed from a random starting point in the DU. Typically a systematic random grid is the preferred sampling method. However, both strategies result in sample collection points spread out approximately equally across the DU. For example, a square-shaped decision unit could be divided into six rows and five columns with six increments collected from each of the five rows in a systematic, random fashion to obtain 30 increments for one bulk ISM.

The following are the definitions for these two sampling collection options:

1. Stratified Random Sampling Mode: DU into representative strata, sample at random within each strata, with number of samples proportional to relationship of each strata to the entire DU. This is used when there is high heterogeneity expected within the DU.

2. Systematic Random Sampling: DU into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

The project planning documents should generate a map, showing the DU(s) and approximate proposed sample locations (increments) within the DU(s). Random locations for incremental sample collection points can be pre-determined in the office using a random number generating program, or in the field. For more rectangular-shaped decision units, a fewer number of rows might be used with more increments per row collected. Row lengths and increments per row may be modified as needed for odd-shaped decision units.

4.3 Field Delineation of DU

Corners of the DU and some other strategic locations should be entered into a Global Positioning Device (GPS) in the office prior to going to the field. Using the GPS device, it is useful to mark the ends of each row with flags to help establish approximate lines for the collection of increments. Flags may also be placed along the edges of the decision unit parallel to the rows to help ensure approximate spacing. Placing flags at every increment collection point is usually not necessary. Often, just the four corners of the DU (or enough points to delineate the DU shape, if irregular) are located via GPS to document the DU location and to create maps for the soil investigation report.

Once the corners and rows of the DU have been marked using the GPS, the increment samples may be collected by pacing the same number of steps within each subunit or row of the DU where the sample increments are to be collected.

4.4 Tools for Collection of ISM

Using the wrong tools, or collecting a sample that contains more soil particles from the top of the sample than the bottom (or vice versa) could lead to biased sample results due to the heterogeneous distribution of contaminated particles in the soil. Care should be taken to collect increments in a manner that produces a cylindrical or core-shaped sample. This can be accomplished using a soil coring sampler (preferred), a trowel (if used to collect a “core-shaped” sample), or even a large drill in some soils. The most appropriate type of sampling device is dependent in part on the hardness of the soil, or how rocky it is. For soft soils, a soil core barrel that can be advanced by hand/foot is quick and efficient. Battery-operated drills with large bits may also be an option. For harder or rocky soils, a coring device with slide hammer, a mattock (large pick), hydraulic, or electric-assisted device, may be needed to advance the core barrel or access the soil column for sampling. Whatever tool(s) is used, the objective should focus on collecting core-shaped sample increments. It is important to understand field conditions and test proposed sampling tools at the site before selecting a particular type or combination of tools. If the site cannot be visited ahead of time, then a mix of sampling tools should be taken to help ensure that adequate soil samples can be collected in as efficient a manner as possible.

4.5 Sample Collection

Once the DU has been delineated with flags in the field collection of sample increments may begin.

Use flags or survey twine to define the edges of each grid cell and complete construction of the ISM sample grid as depicted in Figure 1 below.

Figure 1. Example Completed ISM Sample Grid

Sketch the ISM sample grid design, orientation (compass bearing), overall dimensions, cell dimensions, nearby features, and any other valuable information in the field notebook. Photograph the completed sample grid for future reference. Survey the center and corner stake locations of the DU or record them with a GPS unit.

If using stratified random sampling mode, a grid is set up over the DU making each part of the grid equal size, and one increment is collected at random from each subunit of the grid. If using systematic random sampling mode, select a random starting point in one subunit, then collect an increment sample at this location, and the same location at each subsequent subunit of the DU.

In either mode the following procedures should be followed:

- Sampling tools shall be new or decontaminated prior to use according to the project planning documents.
- Sampling tools need not be decontaminated between each sample increment, but shall be decontaminated or discarded prior to sampling a new DU.
- Test the proposed sampling tool(s), and determine what tool(s) will provide the best sample increments.
- Samples should be collected from the same depth at all incremental sampling locations.
- Larger sized particles (rocks, cobbles, and coral) and roots should be avoided or discarded prior to transferring the sample into the bulk ISM container.
- The laboratory is going to sieve out anything >2 millimeters (mm), so collect enough sample at each increment such that there will still be sample for analysis after the portion > 2mm has been sieved out. This may require collection of multiple aliquots per increment if ISM samples are collected using a small diameter coring device.
- The sample collector will describe and classify soils collected according to Universal Soil Classification System (USCS) nomenclature. At a minimum, this will be done for the final bulk ISM sample after all the increments have been collected. Additionally, during collection of increments, the soil will be described at each significant change in lithology type encountered across the DU. Soil descriptions and classifications will be recorded in the field logbook.

- Individual increments collected are placed into a single sample container to produce the bulk ISM.
- If replicates and triplicates are being collected (strongly recommended), replicate increments may be collected from near the normal sample location by pacing off a few feet from the normal sample collection and obtaining a replicate increment. The triplicate increment may be collected by pacing another few feet from the duplicate increment sampling location (see Section 4.6).
- Store bulk ISM samples as required by the project planning documents.
- Pack and ship samples to the laboratory in accordance with the project planning documents.

4.6 Collection of Field Replicate ISM Samples

To statistically evaluate sampling precision for each DU, replicate ISM samples are collected from selected decision units. Typically two replicate increments are collected from the same depth as the normal sample in different locations. A different random starting location is determined for each replicate collected in the selected DU(s). Replicate sample increments are generally collected along the same approximate directional lines established through the DU for the initial ISM samples, though at different systematic random locations than initially used. This is accomplished by pacing off the replicate increments from a different random starting location on the first line/row of the DU, and continuing to sample at this different random interval throughout the DU.

Replicate samples may be collected by establishing rows for increment collection that run perpendicular to or at a 45 degree angle to the direction used to collect the initial ISM. Another option is to use the same rows but collect increments in between the locations used for the initial sample. Replicate samples should be sent to the laboratory as "blind" samples, meaning the laboratory does not know they represent replicate samples of the initial ISM.

The replicate samples are prepared and analyzed in the same manner as carried out for the initial sample. Triplicate samples (i.e., initial ISM plus two replicates) are preferred and more useful than just duplicates for statistical analysis. If only one DU is being investigated, triplicate samples are recommended. If multiple DUs are being investigated, it may not be necessary to collect triplicates at all DUs.

4.7 Laboratory Processing of ISM Samples

The bulk ISM is submitted to the laboratory for analysis. Careful planning with the laboratory for processing of ISM samples by the Project Chemist prior to sample collection is essential to obtain meaningful results. Details of project requirements will be described in the project planning documents.

It is important to note that, while the laboratory is receiving a bulk sample of up to 2,500g, it will only analyze a subset of this sample. One issue discussed in both the Environmental Protection Agency (EPA) and American Society of Testing Materials (ASTM) guidance documents is the choice of a minimum sub-sample mass for extraction/analysis of soil samples in order to reduce "Fundamental Error" of the lab analyses to approximately 15% or less. The minimum appropriate mass is based on the maximum particle size in the soil samples. For samples with a maximum particle size of <2mm, the minimum analysis mass is 10 grams. If the analytical method to be used typically calls for sample extraction/analysis mass of less than 10 grams, the method should be modified to increase extraction/analysis mass to at least 10 grams for samples with maximum particle sizes of <2mm (larger mass could be beneficial for some analyses). For analyses of fine particulates (e.g., <250 µm), a one-gram sub-sample may be adequate to reduce Fundamental Error below 15%; however a larger mass may be reliably run by the method (e.g., 2-10 grams).

4.8 Investigation Derived Waste

Any IDW generated during sample collection (such as used PPE and soil collection apparatus) should be disposed of properly in accordance with the project planning documents.

5 Records

Record all ISM soil sampling activities, including field bulk sample collection in a field notebook, in accordance with the Work Plan and applicable project SOPs. Chain-of-custody forms, photographs, and any other sampling documentation should comply with the project planning documents.

6 References

American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.

Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.

Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.

HDOH. May 11, 2007. Pesticides in Former Agricultural Lands and Related Areas – Updates on Investigation and Assessment (arsenic, technical chlordane, and dioxin test methodologies and action levels and field sampling strategies). Office of Hazard Evaluation and Emergency Response. 07-241 RB.

ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.

Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.

Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.

U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.

7 Definitions

Bulk ISM Sample: The compilation of all ISM soil sampling increments collected from a DU.

Compositional Heterogeneity: The variability of contaminant concentrations between the particles that make up the population. This type of heterogeneity results in fundamental error (FE).

Decision Unit (DU): The area or volume in which a decision must be made (for example, deciding whether risks are acceptable or not). The DU may be as small as a 55-gallon drum or as large as acres in size.

Distributional Heterogeneity: The non-random distribution across a population due to slight spatial variations. This type of heterogeneity results in grouping and segregation error (GSE).

Fundamental Error (FE): A result of not representing proportional concentrations of all of the particles in a population.

Increment: A group of particles collected from a population with a single operation of the sampling device.

Sieving: Pouring material (for example, the bulk ISM sample) through a sieve.

Stratified Random Sampling: A statistical sampling method that divides the sample population (DU) into representative strata (grid cells), then randomly sampling within each stratum with the number of samples proportional to relationship of each stratum to the entire population.

Systematic Random Sampling: divide population (DU) into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

Sub-sampling: Dividing the sieved bulk ISM sample to create a final laboratory sample.

Attachment 1 - Figures Illustrating Systematic Random Sampling Method

(Source: HDOH *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, 2020)

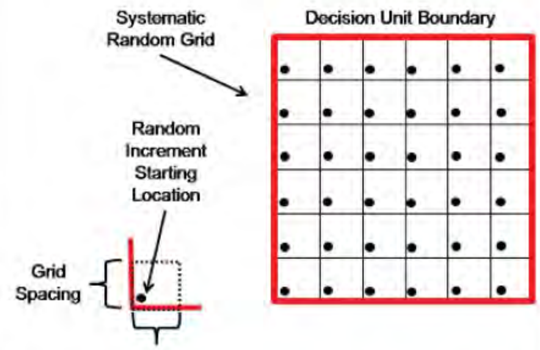

Figure 4-9. Example Increment Collection Locations Based on a Systematic Random Grid Scheme
Grid spacing determined based on DU area and number of desired increments. Initial increment location selected from random location, subsequent increments collected at uniform spacing within DU.

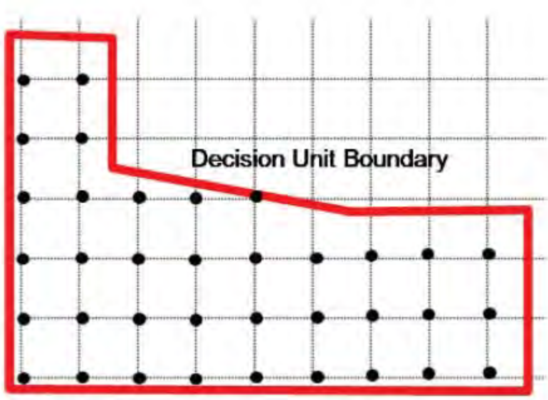

Figure 4-11. Systematic Increment Locations for Odd Shaped DUs (compare to Figure 4-9)
The number of increments collected within grid rows can vary in different areas of the DU.

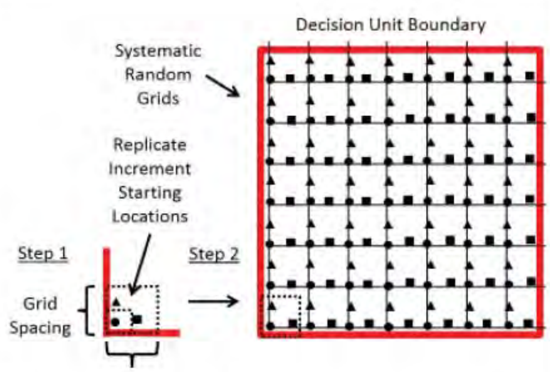

Figure 4-12. Example Collection of Increment Location Points for Triplicate Multi Increment Samples
Increments collected in a systematic random method. Circles, triangles and squares depict increment collection locations for three, respective Multi Increment samples (increments collected halfway between initial increment grid point locations).

Attachment 2

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf

(per comment SNW, August 4 and 14)

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

4.2.7.3 EVALUATION OF DATA REPRESENTATIVENESS

Statistical methods to evaluate the representativeness of Multi Increment sample data have been included in the HEER Office TGM since 2008. A refined approach for use in Hawai‘i based on experience at sites over the past seven years, as well as consideration of statistical methods discussed in the ITRC document Incremental Sampling Methodology (ITRC 2012), is provided below. The discussion applies to evaluation of both field and laboratory replicate data.

Acceptance criteria for the statistical evaluation of the MIS data are established as part of the DQO process for the site investigation. A two-step process is presented. The Relative Standard Deviation (RSD) of the contaminant concentration reported for each replicate sample is first calculated. This provides a measure of the precision of the Multi Increment sampling method used to estimate the mean contaminant concentration for the DU in terms of combined field and laboratory error. The lower the RSD the more precise the sampling approach used, and the more reproducible the data. As discussed below, an RSD of 35% is considered to indicate good reproducibility and reliable data for decision making. An RSD of >100% is considered to be very poor, and not typically appropriate for final decision making (see discussion below).

A 95% Upper Confidence Level (UCL) of the mean contaminant concentration can be calculated for the DU if necessary. This can be used to assist in decision making regarding the potential risks posed by the contamination and the need for remedial actions. Under some circumstances, the RSD can also be used to evaluate MIS data for DUs with similar characteristics in the absence of separate replicate data for those DUs. These topics are discussed in more detail below.

Data Precision

Data precision is evaluated by comparing data for replicate samples collected from the same DU. Replicate Multi Increment samples are intended to provide estimates of the mean concentration of a contaminant in a DU that approximate a statistically normal distribution. This allows statistical evaluation of data with as few as three replicate samples. The precision of the data for a given DU can be evaluated in terms of the Standard Deviation (SD) or more specifically the Relative Standard Deviation (RSD) of replicates. The SD and RSD reflect the total sum of field and laboratory error in the data (i.e., field sampling error + lab processing/subsampling error + lab analysis error).

Standard deviation is a well-known measure of the variation from the mean among a group of samples (USEPA 2006g,b). The lower the standard deviation (i.e., the closer the replicate data are to the mean) the more precise the site data are as an estimate of average contaminant concentration in the DU under investigation. When the mean concentration of a contaminant reported for a set of MIS replicate samples is close to the HDOH EAL, a lower standard deviation for the replicates provides stronger evidence that the true DU mean is indeed below the action level. A low standard deviation for soil sample data is achieved by minimizing error in sample collection, processing and analysis to the extent feasible.

The RSD represents the ratio of the standard deviation of the replicate set over the mean of the replicate set, expressed as a percentage:

$$RSD\ (\%) = \frac{Replicate\ Standard\ Deviation}{Replicate\ Mean} \times 100\% \quad \text{Eq. 2)}$$

An RSD less than 35% is considered to reflect good precision for estimates of the average (see ITRC 2012). Good precision implies that the sampling method used, including the number, spacing, and size/shape of increments collected was adequate to capture and reflect small-scale heterogeneity of contaminant distribution within the DU and that error in the laboratory processing and analysis methods was low.

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

For example, assume that concentrations of 9 mg/kg, 10 mg/kg and 11 mg/kg are reported for a target contaminant in triplicate Multi Increment samples collected from a DU. The mean concentration is 10 mg/kg. The SD is 1 and the RSD is 10%, indicating good precision of the data. Now consider concentrations of 5 mg/kg, 10 mg/kg and 15 mg/kg for a set of triplicate samples. The mean is again 10 mg/kg. The SD is now 5 mg/kg and the RSD is 50%, indicating lower precision and confidence in the replicate data.

The higher the RSD, the less confidence there is that the mean contaminant concentration estimated for any individual DU (i.e. the mean of a replicate set of samples for a DU) is representative of the true mean for the DU. A higher RSD (e.g., >35%) could be due to error in the field and/or laboratory. Field sampling error is the most likely source of data variability. Inadequate sample processing and subsampling is the main source of error at the laboratory, rather than analytical error. This can be evaluated by a review of sample collection, processing and subsampling procedures, as well as testing of replicate samples. The field replicate RSDs are used to estimate the total error for the sample data. The lab subsampling and analysis RSDs are use to estimate the lab subsampling and analysis error for the sample data. The lab subsampling and analysis error can then be subtracted from the total error to compare errors attributable to 1) field sampling, and 2) to lab subsampling and analysis. This analysis should be routinely carried out to evaluate sample data and help identify errors that may be corrected. In limited instances, grinding of samples in the laboratory might be required to reduce the grain size and allow the collection of more representative subsamples, since the ability to increase the mass of soil extracted and tested is limited (see Subsection 4.2.6).

If the RSD for field replicate samples (total error) is high, and RSD(s) for the lab subsampling and analysis replicates are reasonably low, then field error is the indicated source. A high RSD typically indicates the presence of small nuggets of the contaminant in soil or the presence of small, randomly scattered areas of high contamination within the DU. This problem is not insurmountable. One of the strong points of the Multi Increment sampling approach is that field precision and sample representativeness can be evaluated in an efficient manner. The field precision of replicate samples for a DU can be improved by increasing the number of increments and total sample mass to provide better coverage and sample support. The original DU can also be subdivided into smaller DUs for characterization.

The latter may or may not be beneficial, depending on the nature of contaminant distribution. The use of smaller DUs in the absence of increasing the number of increments collected will improve MIS data precision if the contaminant is concentrated within one area of the original DU. The use smaller DUs might not improve data precision, however, if the contaminant is evenly dispersed throughout the DU but highly heterogeneous at the scale of an individual increment. In this case, an increase in the number of increments collected and the mass of sample collected will be necessary to obtain representative and reproducible data.

As the RSD exceeds 35% and replicate contaminant concentrations approach a target action level, there is increasing uncertainty that the data are adequately representative of the true mean of the DU. This calls for an assessment of the sample collection approach employed as well as increasing reliance on other statistical measures to determine the need for further action. As discussed in the next section, this includes use of the 95% Upper Confidence Level (UCL) of the mean for comparison to action levels and for final decision making. This will necessarily be a site-specific decision and is part of the iterative, DQO process described in Section 3 of the TGM.

Adjustment of Data for Decision Making

Table 4-2 presents a recommended approach for evaluation of DU data based on a review of replicate sample data, either collected directly from the DU in question or based from replicate data from similar DUs. Although somewhat subjective, the approach helps to minimize the need to re-sample DUs when proper field and laboratory protocols are followed, while balancing the need to ensure that significant risks to human health and the environment are not inadvertently missed.

RSD ≤35%

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

Direct comparison of unadjusted DU data, or the arithmetic mean of replicate data to target action levels, is acceptable when the RSD of the representative replicate data set for the contaminant of concern is less than 35%. Adjustment of the data with respect to the RSD (or calculation of a 95% Upper Confidence Level) is not considered warranted given the overall acceptable sample precision. This assumes, of course, that the samples were collected, processed, and tested in an unbiased manner and are reasonably representative of the targeted DU. If soil remediation is carried out then unadjusted DU data can be used for confirmation samples.

RSD >35% but ≤50%

A thorough review of field and laboratory procedures should be included in the site investigation report to determine the adequacy of DU-MIS methods used for cases where the RSD for replicate samples exceeds 35%. This review can help identify the need for improvements in field or laboratory methods for future investigations. If recommended field and laboratory procedures were properly followed, and the RSD is greater than 35% but less than or equal to 50%, then unadjusted DU data can be used for initial screening of DUs and determination of the need for remedial actions.

The collection of additional Multi Increment samples is recommended for confirmation of remediation of DUs that exceeded action levels, even if Perimeter DU data collected during the initial investigation were below action levels. The confirmation sampling should include the use of a greater number of increments per DU and/or division of the area into smaller DUs for characterization.

RSD >50% but ≤100%

If the replicate RSD(s) fall between 50% and 100%, the adequacy of field sampling methods and laboratory processing and analysis methods used in the investigation is (again) important to review, and a discussion of potential sources of error should be included in the investigation report.

If analysis of the field sampling error vs the laboratory subsampling and analytical error reveals that a large majority of the error may be attributable to laboratory subsampling and analysis error rather than field sampling error, then the laboratory should be contacted regarding the need to subsample and reanalyze the selected (lab replicate) MI sample again (which should still be stored at the laboratory), as well as potentially subsample and re-analyze any associated DU samples analyzed in that same "batch" of samples.

A 95% UCL concentration should be calculated in cases where the RSD exceeds 50%, using the Chebyshev method. A 95% UCL should also be estimated for related DUs from which replicates were not collected, as described. Use the highest RSD calculated if replicate samples were collected from multiple DUs. Data for associated DUs should likewise be adjusted for comparison to action levels. Note that the RSD will differ between targeted chemicals.

The 95% UCL should be compared to 150% of the target action level (see Use of 95% UCL subsection below). This helps to ensure that potentially significant risk to human health and the environment is not inadvertently overlooked under a worst-case scenario when the true mean does in fact exceed the action level (e.g., non-cancer Hazard Quotient not significantly greater than 1 and within target 10^{-4} to 10^{-6} excess cancer risk range; see USEPA 2006g and HDOH, 2016).

Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes. This can, for example, include knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process, and analyze samples, and the approximation of the data to action levels.

Additional confirmation sampling should be carried out following removal or *in situ* treatment of contaminated soil. This should include the use of smaller DUs and/or a larger number of increments in order to improve field precision of the data. Replicate samples should also be collected and evaluated in the same manner described above (e.g., minimum 10% of DUs).

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

RSD >100%

Contaminants present in soil primarily as small nuggets rather than disseminated throughout the soil matrix can result in replicate RSDs above 100% even when strict collection protocols are followed in the field. High RSDs are often generated for soils contaminated with chips of lead-based paint, lead pellets at shooting ranges or even PCBs (see HDOH, 2015), Re-sampling of such sites might not be feasible due to cost or access limitations. This requires especially careful designation of DUs (e.g., multiple small DUs vs single large DU; see Subsection 3.4.3) as well as the collection of a greater sample mass from a large number of increment locations (see Subsection 4.2.2). Grinding of samples may also be required to manage laboratory subsampling error (see Subsection 4.2.6.3).

Data should be considered especially suspect when the RSD for replicate samples exceeds 100%. Field sample collection and laboratory processing methodologies should again be evaluated and potential sources of error in the data discussed. If analysis of the sampling data reveals that a large majority of the error is attributable to laboratory subsampling and analysis error rather than field sampling error, then the laboratory should be contacted regarding the need to subsample and reanalyze the selected (lab replicate) MI sample again, as well as potentially subsample and re-analyze any associated DU samples analyzed in that same "batch" of samples.

If one or more of the replicate samples exceeds the target action level then remediation of the DU should be considered, even if the mean concentration is well below the target action level. In the absence of other information, remediation of associated DUs where replicate samples were not collected should also be considered, regardless of the concentration of the contaminant reported. Re-sampling of the DU using a greater number of increments and/or smaller DUs is otherwise recommended.

If all replicate samples are below the action level then the approach described above for cases where the RSD falls between 50% and 100% can be followed, provided that confirmation samples are collected for DUs where remediation is ultimately carried out. Data for associated DUs should likewise be adjusted for comparison to action levels.

Additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes should be provided. This approach recognizes cases where two of three replicate samples might be significantly lower than the action level, but the variance between the data yields a high RSD. Consider for example a case where a DU tested for lead yields replicate data of 20 mg/kg, 30 mg/kg and 205 mg/kg with a target action level of 200 mg/kg. The mean of the replicate samples is 85 mg/kg, but the RSD is a very high 122%, indicating poor data precision. It is unlikely that the HEER office would recommend re-sampling or remediation of this DU, however. Compare this to a scenario where the variance between triplicate samples is very low but are just under the target action level, for example 175 mg/kg, 190 mg/kg and 205 mg/kg lead, with a mean of 190 mg/kg lead. The RSD of 8% implies very good data precision. The second DU is clearly more contaminated than the previous example, however, and would be considered a higher priority for remediation if it were to be required.

Table 4-2. Recommended Adjustment of Multi Increment Data for Decision Making Based on Relative Standard Deviation (RSD) of Replicate Samples.

RSD Data	Decision Unit Data Adjustment
Good Precision (RSD ≤35%)	• DU-MIS samples should be collected, processed, and tested in an unbiased manner; • Compare unadjusted MI data directly to target action level for decision making (use arithmetic mean for replicate sample sets);

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

	• Data can be used for confirmation purposes without the need for additional sampling, if action levels are met.
Moderate Precision (RSD >35% but ≤50%)	• Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.); • Compare unadjusted MI data directly to target action level for decision making (use the arithmetic mean for the replicate sample sets); • *Additional confirmation sampling recommended following remediation of DUs that exceed action levels*, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.
Poor Precision (RSD >50% but ≤100%)	• Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report; • If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates; • *Compare the 95% UCL* (Chebyshev method) *for replicate data to 150% of the target action level for decision making* ; • Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the target action level; • Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to action levels; • Additional confirmation sampling *recommended following remediation of DUs that exceed action level* , including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.
Very Poor Precision (RSD ≥100%)	• *Data should be considered suspect;* • If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates; • Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

	• *Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;* • If one or more of the replicate samples exceeds the target action level then remediation of the DU should be considered, even if the mean concentration is well below the target action level. Remediation of associated DUs where replicate samples were not collected should also be considered; • If all replicate samples are below the Action Level, *then compare the 95% UCL* (Chebyshev method) *for replicate data to the* unadjusted *target action level for decision making* ; • If all replicate samples are below the Action Level, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to *unadjusted* target action levels; • Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to action levels; • Additional confirmation sampling *recommended following remediation of DUs that exceed action levels* , including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Use of 95% UCL

Multiple approaches are available for calculation of UCL values, based in part on the variance between individual replicate sample data. An increase in variance between replicate samples will cause a similar increase in confidence intervals and a less precise estimate of the mean. Two equations can be used to bracket the range of UCL values that might be calculated from a set of multi increment replicate samples, the Student's-t UCL and the Chebyshev UCL (ITRC, 2012).

Calculation of a 95% Upper Confidence Limit (UCL) of the mean contaminant concentration for a DU is not required if the RSD for replicate data is equal to or less than 35% (see Table 4-2). If use of a 95% UCL is required for risk assessment or other purposes outside of the HEER Office (and RSD is equal to or less than 35%), then use of the Student's-t method is recommended (see ITRC 2012). This method assumes a normal distribution of replicate data with a UCL calculated as follows:

$$95\%\,UCL = mean + t_{(1-\alpha)(r-1)} \times \frac{SD}{\sqrt{r}} \qquad \text{Eq. 3)}$$

where
mean = arithmetic mean of replicate samples;
SD = standard deviation of replicate samples;
r = number of replicate samples; and
α = acceptable level of potential decision error (e.g., 0.05 or 5% for a 95% UCL);

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

t = (1-α)th quantile of the Student's-*t* distribution with (r-1) degrees of freedom.

The Chebyshev method is considered to be most appropriate for estimation of a 95% UCL when the variance between replicate samples is high (e.g., >35%; after ITRC 2012). This method assumes a non-normal or skewed, nonparametric distribution of data and is calculated as follows:

$$95\%\ UCL = mean + \left(\sqrt{\frac{1}{\alpha} - 1} \times \frac{SD}{\sqrt{r}}\right) \quad \text{Eq. 4)}$$

where the symbol α is again the acceptable level of potential = decision error.

The need for replicate data and calculation of a 95% UCL should be evaluated as part of the systematic planning process described in Section 3. A 95% UCL should ideally be calculated based on replicate sample data specific to the DU in question. If replicate data are not available for a DU, then the a 95% UCL value should be estimated based on replicate data collected for a similar DU at the site. This is done by multiplying the contaminant concentration reported for that DU by the ratio of the 95% UCL and the mean for the replicate data set:

$$Estimated\ 95\%\ UCL = Conc. + \left(Conc. \times \frac{95\%\ UCL}{X}\right) \quad \text{Eq. 5)}$$

where "Conc." is the concentration of the targeted contaminant reported for the subject DU and "X" is mean concentration of the replicate data set used to calculate the initial 95% UCL.

As discussed in Subsection 4.2.4, this approach should only be applied for DUs that can reasonably be assumed to have a similar history and distribution of contamination (see also Subsection 3.4, DU designation). Note that approaches for calculation of a 95% UCL may differ for different chemicals, depending on the calculated RSD for each targeted chemical. Additional, DU-specific replicate samples may be warranted for more direct assessment of mean contaminant concentrations in DUs that could pose a potentially high risk. Examples include a playground area where contaminant concentrations approach an action level and replicate samples from related DUs suggest poor precision of the data.

As discussed in the previous section, direct comparison of a UCL value to a published action level is not required, since the probability that this value is representative of the true mean concentration for the DU is by intent assumed to be very low (i.e., 0.05 or 5%). The 95% UCL should instead be compared to a concentration of the chemical in the soil that could pose an especially heightened risk of adverse health effects in the unlikely event that this concentration represented the true mean for the DU (refer to USEPA 2006g). As a default, an alternative screening level equal to 150% of the original screening level is considered appropriate. This reflects only a marginal increase in overall health risk for screening levels based on a target cancer risk of 10^{-6} and a non-cancer hazard of 1. Alternative approaches should be discussed with the HEER office on a case-by-case basis.

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

In some cases, the DQO/SAP may specify use of an alternate approach to measure and evaluate variation from the mean in replicate sample data. These alternatives should be clearly identified and discussed with a HEER Office project manager for use in the site investigation. Calculated 95% UCL values can also be used in a forward risk assessment to quantify excess cancer risk and non-cancer hazard.

Attachment 3
Pages Revised in response to comment SNW 2, August 14

Table 11-1. DQO #1 – Excavation Delineation

Step 1 – Statement of Problem: The extent of soil exceeding the industrial cleanup goals at the planned excavation locations requires confirmation of COC concentrations after excavation.

Step 2 – Identify the Goals of the Study: Excavate soil at the planned excavation locations until the sidewalls and bottom of the excavation do not exceed the industrial cleanup goals.

Step 3 – Identify Information Inputs: Previous investigations at the Load Lines identified human health risk from COCs in surface and subsurface soil at Load Lines 1, 2, 3, 4 and 12 for likely future land use (for example, commercial/industrial). ROD Amendment (Leidos, 2019) identifies ex situ thermal treatment of soil at the planned excavation locations as part of the selected remedy to reduce the risk and be protective of human health.

Step 4 – Define the Boundaries of the Study: The remedial action will remove soil from 24 planned excavation locations at Load Lines 1, 2, 3, 4 and 12 identified in the ROD Amendment (see RD Work Plan Table 2-1 and Figures 3 to 7). Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation using ISM to confirm that soils exceeding the industrial cleanup goals have been successfully removed. The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.

Step 5 – Develop the Analytical Approach: In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP). An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample triplicate for metals and the RPD for laboratory subsample duplicates (ISM analyses for PAHs and PCBs). An RSD of less than or equal to 20% will be the goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).

Laboratory results will be compared to applicable industrial receptor cleanup goals in ROD Amendment (see Table 4-1 of RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional excavation will be conducted at locations with exceeding results until cleanup goals are met. Analytical data quality will be evaluated per this QAPP. The analytical methods specified in this QAPP will provide the lowest available detection limits using standard methods that will allow the data to be screened against the cleanup goals.

Step 6 – Specify Performance or Acceptance Criteria: All sample locations are known in accordance with the ROD Amendment and RD Work Plan which define soil removal boundaries for confirmation. Any soil removal beyond planned boundaries will be completed until industrial cleanup goals are met. Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed on known quality to meet project objectives as defined in Worksheet 36.

In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample triplicate samples (ISM metals and SW8330B explosives analyses) and laboratory subsample duplicate samples (PAHs and PCBs) will be submitted to Ohio EPA for concurrence on meeting the following DQOs:

- An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the field ISM triplicate sample data evaluations.
- An RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).
- An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for PAH, PCB and metals analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples).

If these DQOs are not met for the ISM triplicates samples or the associated laboratory subsample replicates, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 "Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016).

Good Precision (RSD <35%)

- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Data can be used for confirmation purposes without the need for additional sampling, if cleanup goals are met.

Table 11-1. DQO #1 – Excavation Delineation (continued)

Moderate Precision (RSD >35% but <50%)

- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.);
- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Additional confirmation sampling recommended following remediation of decision units (DUs) that exceed cleanup goals, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Poor Precision (RSD >50% but <100%)

- Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report;
- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Compare the 95% UCL (Chebyshev method) for replicate data to 150% of the cleanup goal for decision making;
- Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Very Poor Precision (RSD >100%)

- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;
- Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;
- If one or more of the replicate samples exceeds the cleanup goal then remediation of the DU should be considered, even if the mean concentration is well below the cleanup goal. Remediation of associated DUs where replicate samples were not collected should also be considered;
- If all replicate samples are below the cleanup goal, then compare the 95% UCL (Chebyshev method) for replicate data to the unadjusted cleanup goal for decision making;
- If all replicate samples are below the cleanup goal, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to unadjusted cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the attached SOP, *Incremental Sampling for Surface Soil*. A systematic random sampling scheme will be used in selecting the aliquot sampling locations for each sidewall and the excavation bottom to ensure that the aliquots are spread out relatively equally. This will be accomplished by gridding the bottom and the contaminated interval of each sidewall into approximately equally sized grids, and then collecting an aliquot from the sidewall/bottom surface at the center of each grid. If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). The duplicate and triplicate aliquots will be placed in separate containers to be submitted to the laboratory).

The results will be compared to the Industrial cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP). Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days.

If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6.

If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled.

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Table 11-1. DQO #1 – Excavation Delineation (continued)

Step 7 – Develop the Detailed Plan for Obtaining Data (continued):

If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if ~~any of the~~a field replicate sample~~s~~ exceeds an applicable cleanup goal. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the cleanup goals, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR.

Once an excavation meets the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil excavated/treated.

Table notes:

CH2M =CH2M HILL Constructors, Inc.
COC = contaminant of concern
COR = Contracting Officer's Representative
DoD = U.S. Department of Defense
ISM = incremental sampling methodology
ITRC = Interstate Technology Research Council
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
RSD = relative standard deviation

Worksheet #20—Field Quality Control Sample Summary

Field QC sampling requirements and procedures are specified in the sections below. Table 20-1 provides a summary of the types of samples to be collected and analyzed during the project. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix.

Table 20-1. Field Quality Control Samples

Matrix	Analyte/Analytical Group	Field Samples	FDs or ISM FD and Triplicate/Laboratory Subsample	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total Analyses
Soil (ISM excavation confirmation samples)	PAHs, explosives, PCBs and/or metals (location dependent)	142	14/14	7	7	7	0	191
Soil (treatment verification)	PAHs, explosives, PCBs and/or metals (location dependent)	38	4	2	2	2	0	48
Soil quality assurance split	PAHs, explosives, PCBs and/or metals (location dependent)	18	0	0	0	0	0	18

Table notes:
FD = field duplicate
ISM = incremental sampling methodology
PAH = polycyclic aromatic hydrocarbon(s)
PCB = polychlorinated biphenyls

Field Duplicate and Triplicates

An FD is an additional sample collected at the same time from the same location as the original sample. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. FD samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

FD samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The samples may be either co-located samples or sub samples of a single sample collection. The sample containers are assigned a unique identification number in the field. Specific locations should be designated for collection of FD samples before the beginning of sample collection. The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the incremental sampling methodology (ISM) excavation confirmation samples, the ROD Amendment requires that the ISM samples be collected in duplicate. However, to follow current DoD and Interstate Technology Research Council (ITRC) requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with DoD QSM and ITRC requirements incorporating a field duplicate and triplicate sample collection for one per 10 samples collected. The laboratory will also collect a laboratory subsample duplicate (PAHs and PCBs) and triplicate (explosives and metals) for each batch of up to 20 samples ~~field sample,~~ ~~along with one laboratory duplicate~~ to verify the subsampling precision. A relative standard deviation (RSD) of less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent) will be incorporated into the field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicates/triplicates for analytes other than explosives (for explosives analysis of laboratory subsample triplicates, the RSD goal is 20 percent).

Worksheet #23—Analytical Standard Operating Procedure References

The analytical SOP references in Table 23-1 were provided by the laboratories. Only SOPs for sample data being validated are presented. IDW data will not be validated. Note that the laboratory SOPs have not been modified specifically for this project to meet the DQO requirements. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements and UFP-QAPP to technical staff. Laboratory SOPs are provided as Attachment 2 of this QAPP.

Table 23-1. Analytical SOP References

Reference Number	Title, Revision Number, and Date	Definitive/ Screening Data	Matrix/ Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
LSOP-01	SV-004 Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 11. 8/8/19	Definitive	PCBs	GC/ECD	CT	No
LSOP-02	SV-006 Semivolatile Organic Compounds by GC/MS, Method SW8270D. Revision 0. 5/29/19	Definitive	PAHs	GC/MS	CT	No
LSOP-03	MT-009 Method 6010- Inductively Coupled Plasma. Revision 5.3. 4/16/19	Definitive	Metals	ICP	CT	No
LSOP-04	SV-010, Explosives by Modified Method SW8330B. Revision 5.1. 6/13/19	Definitive	Explosives	HPLC	CT	No
LSOP-05	GT002 Processing of Multi-incremental Samples and Subsampling	Definitive	Explosives, PCBs, PAHs and metals	GC/MS. HPLC, ICP, GC/EICD	CT	No
LSOP-06	Determination of Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 3/29/17	Definitive	PCBs	GC/ECD	Chemtech (treatment verification samples with expedited turnaround)	No
LSOP-07	Determination of Extractable Semivolatile Organic Compounds by Method SW8270D. Revision 6/6/19	Definitive	PAHs	GC/MS	Chemtech (treatment verification samples with expedited turnaround)	No

Table notes:
Chemtech = Chemtech Laboratory, Inc.
CT = CT Laboratories, LLC
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS tuning check	Before ICAL and calibration verification, every 12 hours	Refer to criteria listed in method description Use 4-bromofluorobenzene or decafluorotriphenylphosphine	Retune instrument and verify	Not appropriate
Multipoint ICAL for all analytes (minimum five standards)	Before sample analysis	Option 1: Linear—RSD for each analyte is less than 15% Option 2: Linear—linear least squares regression r is more than 0.995. Linear least square regression r^2 is equal to or more than 0.99 (SW8260C) for each analyte Option 3: Nonlinear—coefficient of determination is equal to or more than 0.99 (6 points will be used for second order; 7 points will be used for third order). Nonlinear calibrations models are not a preferred option and must only be used for compounds that typically will not demonstrate a linear model If the specific version of a method requires additional evaluation (for example, response factors or low calibration standard analysis and recovery criteria), then these additional requirements must also be met	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Calibration may not be forced through the origin
Second-source calibration verification	Once per ICAL	All analytes within ±20% of expected value	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical sequence	Position will be set using the midpoint standard of the ICAL curve. On days when an ICAL is not performed, the initial CCV is used	N/A	N/A
RT window verification for each analyte	Each sample	RRT of the analyte within ±0.06 RRT units of ICAL. Laboratories may update the RTs based on the CCV to account for minor performance fluctuations or after routine system maintenance (for example, column clipping. With each sample, the RRT will be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, there has been a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to re-establish the RTs.	Correct problem then reanalyze all samples analyzed since the last RT check	Not appropriate, no target compounds are to be reported when the RRT is out of control

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
CCV	Daily, before sample analysis (unless ICAL performed on same day), after every 12 hours of analysis time and at the end of the analytical batch run.	All analytes within ±20%D of expected value of true value All analytes within ±50%D of expected value of true value for ending CCV	Correct problem, then rerun CCV If that fails, then repeat ICAL	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
Internal standard	Each sample, standard, and QC sample	Retention time within ±10 seconds from retention time of the midpoint standard in the ICAL; extracted ion current profile area within -50% to +100% of area from internal standards in ICAL mid-point standard	Inspect MS and GC for malfunctions and make corrections as appropriate Reanalysis of samples analyzed while the system was malfunctioning is mandatory	Apply Q-flag to all results for analytes associated with failed internal standards
Method blank	One per analytical batch	No analytes detected more than one-half LOQ; or more than one-tenth the amount measured in any sample or one-tenth the regulatory limit, whichever is greater For common laboratory contaminants, no analytes detected more than LOQ See Worksheet #36	Assess data and correct problem If necessary, reprepare and analyze method blank and all samples processed with the contaminated blank	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15	Correct problem, then reanalyze If still out, then reprepare and reanalyze the LCS and all samples in the affected batch	If corrective action fails, then apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error Analyze LCS for failed target analytes Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if any following criteria met: • %R for MS or MSD is more than upper control limit • %R for MS or MSD is less than lower control limit • MS/MSD RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤35 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, then discuss in case narrative	Apply Q-flag to all associated analytes if acceptance criteria are not met
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
D = difference when using response factors or drift when using least square, regression, or nonlinear calibration
DoD = U.S. Department of Defense
GC = gas chromatography
ICAL = initial calibration
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PQO = project quality objective
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RRT = relative retention time
RSD = relative standard deviation
RT = retention time

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICAL	At instrument setup, after ICV or CCV failure, before sample analysis	ICAL must meet one of the three options below: • Option 1: RSD for each analyte equal to or less than 20% • Option 2: linear least squares regression for each analyte: r^2 more than or equal to 0.99 • Option 3: nonlinear least squares regression (quadratic) for each analyte r^2 more than or equal to 0.99	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Quantitation for multicomponent analytes such as chlordane, toxaphene and Aroclors must be performed using a 5-point calibration
ICV	Immediately following ICAL, analysis of second source standard before sample analysis	±20% of expected value All reported analytes within established RT windows	Correct problem and rerun ICV. If that fails, repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment	Once per ICAL and at the beginning of the analytical sequence	Midpoint of ICAL curve when ICAL is performed On days ICAL is not performed, the initial CCV is used	Not applicable	Not applicable
RT window width	At method set up and after major maintenance	RT width is ±3 times standard deviation for each analyte RT from the 72-hour study	Not applicable	Not applicable
CCV	Daily, before sample analysis; after every 10 samples, and at the end of the analysis sequence with the exception of CCVs for pesticides and multicomponent analytes (toxaphene, chlordane), which are only required before sample analysis	Reported analytes within established RT windows All reported analytes and surrogates within ±20% of true value	Recalibrate and reanalyze affected samples since last acceptable CCV Or immediately analyze 2 additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action and recalibrate; then reanalyze affected samples	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to results for the specific analyte(s) in samples since last acceptable CCV
Method blank	One per preparatory batch	No analytes detected greater than one-half LOQ or more than one-tenth amount measured in any sample or one-tenth regulatory limit, whichever is greater Common contaminants must not be detected more than LOQ	Correct problem. If necessary, re-prepare and analyze method blank and samples processed with the contaminated blank	Apply B-flag to associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS	One per preparatory batch	Acceptance criteria: Worksheet #15	Correct the problem and reanalyze the LCS and samples in the preparatory batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082 (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS	One per preparatory batch	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS > upper control limit (2) %R for MS < lower control limit
MSD, matrix duplicate	One per preparatory batch LCSD analyzed if no MS/MSD analyzed	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if any of following criteria are met: • %R for MSD is more than upper control limit • %R for MSD is less than lower control limit • RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤35 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample and batch QC samples	Acceptance criteria: Worksheet #15	Correct the problem. Reprepare and reanalyze the samples with the failed surrogate if sufficient sample material is available If obvious chromatographic interference with the surrogate is present, reanalysis may not be necessary	If corrective action fails, then apply Q-flag to the specific analyte(s) in the samples and explain in case narrative
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as the initial or primary column Results between primary and secondary column RPD less than or equal to 40%	Not applicable	Apply J-flag if RPD is more than 40% and explain in case narrative
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICV = initial calibration verification
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RSD = relative standard deviation
RT = retention time

1 Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
LDR or high-level check standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ±10% of true value.	Dilute samples within the calibration range, or re-establish/verify the LDR.	Not appropriate.
ICAL (minimum one high standard and a calibration blank)	Daily ICAL prior to sample analysis	If more than one calibration standard is used, r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.
ICV/Second-source calibration verification	Once per ICAL prior to sample analysis	All analytes within ± 10% of expected value.	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. Samples may not be analyzed until the calibration has been verified.
CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% D of expected value of true value.	Recalibrate and reanalyze all affected samples since last acceptable CCV Or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	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
Low-level calibration check standard (low-level ICV)	Daily	All analytes within ± 20%D of expected value of true value.	Correct problem and repeat ICAL	Flagging not appropriate. No samples will be analyzed without a valid low-level calibration check standard.
Method blank	One per analytical batch	No analytes detected > ½ LOQ; or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. For common laboratory contaminants, no analytes detected > LOQ. See Worksheet #36.	Assess data. Correct problem. If necessary, re-prepare and analyze method blank and all samples processed with the contaminated blank.	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate. See Worksheet #36.
ICB/CCB	Before beginning a sample run, after every 10 field samples, and at end of the analysis sequence.	No analytes detected >LOD.	Correct problem and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed.	Flagging is not appropriate.

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICS (also called spectral interference checks)	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all nonspiked project analytes < LOD (unless they are 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 failed ICS.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze. If still out, re-prepare and reanalyze the LCS and all samples in the affected batch.	If corrective action fails, apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch.
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15. ~~RPD ≤ 20% between MS/MSD or sample and MD.~~	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs.	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if: (1) %R for MS or MSD > upper control limit (2) %R for MS or MSD < lower control limit (3) MS/MSD RPD > control limit
Soil sample triplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest concentration within the quantitation range of the method The RSD for results above the LOQ must not exceed 35%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Dilution test Only applicable for samples with concentrations more than 50 times LOQ (prior to dilution) Use along with MS/MSD or PDS data to confirm matrix effects	Once per preparatory batch if MS or MSD fails	Five-fold dilution must agree within ± 10% of the original measurement.	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met
PDS addition Criteria apply for samples with concentrations less than 50 times LOQ prior to dilution	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible)	Recovery within 80 to 120%	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCB = continuing calibration blank
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICB = initial calibration blank
ICS = Interference Check Solutions
ICV = initial calibration verification
LCS = laboratory control sample
LDR Linear Dynamic Range
LOD= limit of detection
LOQ = limit of quantitation
MD = matrix duplicate
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS post digestion spike
PQO = project quality objective
RPD = relative percent difference

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Soil-drying procedure	Each sample, LCS and method blank	Laboratory must have a procedure to determine when the sample is dry to constant mass. Record date, time, and ambient temperature on a daily basis while drying samples	Not applicable	Not appropriate
Soil-sieving procedure	Each sample, LCS and method blank	Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve	Not applicable	Not appropriate
Soil-grinding procedure	Initial demonstration	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 micrometers by passing representative portions of ground sample through a 200 mesh sieve (ASTM E11)	Not applicable	Not appropriate
Soil-grinding blank	At least one grinding blank per batch must be analyzed	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (for example, ground and subsampled) and analyzed in the same manner as a field sample No reported analytes must be detected > 1/2 LOQ	Blank results must be reported, and the affected samples must be flagged accordingly if blank criteria are not met	If any individual grinding blank is found to exceed the acceptance criteria, apply B-flag to the samples following that blank
Soil-subsampling process	Each sample, duplicate, LCS, and Method Blank	Entire ground sample is mixed, spread out on a large flat surface (for example, baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample	Not applicable	Not appropriate
Soil sample triplicate	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method The RSD for results above the LOQ must not exceed 20%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Initial Calibration (ICAL) for all analytes (including surrogates)	At instrument setup and after ICV or CCV failure, prior to sample analysis.	ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Flagging is not appropriate.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analyte(s) and surrogates within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.
Continuing Calibration Verification (CCV)	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 20% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	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.
Internal Standards (IS)	If employed, every field sample, standard and QC sample.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; Internal standard signal (area or height) within -50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	Inspect instrumentation for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the non-compliant IS. Flagging is not appropriate for failed standards.

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Method Blank (MB)	One per preparatory batch.	No analytes detected > 1/2 LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze Method Blank and all QC samples and field 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.
LCS for analytes	One LCS per preparatory batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze If still out, re-prepare and reanalyze the LCS and samples in the affected batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch
MS/MSD or matrix duplicate	One per preparatory batch	Acceptance criteria: Worksheet #15. ~~MS/MSD RPD of analytes ≤ 20 percent (between MS and MSD or sample and matrix duplicate)~~	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS or MSD greater than upper control limit (2) %R for MS or MSD less than lower control limit (3) MS/MSD RPD greater than control limit
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15.	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, discuss in case narrative	Apply Q-flag to associated analytes if acceptance criteria are not met
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as for initial or primary column analysis Results between primary and secondary column/detector RPD ≤ 40%	N/A	Apply J-flag if RPD > 40%Discuss in the case narrative

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
ASTM = American Society for Testing and Materials
CH2M = CH2M HILL Constructors, Inc.
g = gram(s)
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS = post digestion spike
PQO = project quality objective
QC = quality control
RSD = relative standard deviation

comparability of field and laboratory duplicates. Discussion will cover PARCC criteria, as described in the following subsections.

Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Precision is the measurement of the variability associated with the sampling and analytical process. Precision is determined by analysis of duplicate field samples, laboratory/matrix duplicates, LCSDs and/or MSDs. Field duplicate samples and MSD samples should be collected to assess field precision at a frequency as described in Worksheet #20. The required control limits for LCSD, MSD and laboratory/matrix duplicate precision for each method, matrix, and analyte are provided in Table 15-1. A control limit, relative percent difference (RPD) of ± 50 percent for soil will be used for original and field duplicate concentrations greater than five times the LOQ for treatment samples. For ISM laboratory subsample duplicates a control limit RPD of 35 percent will be used. For ISM ~~duplicate and~~ triplicate results, the precision is measured using the RSD and the control limit for that will be less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent). The formula for the calculation of RPD and RSD are provided below.

If calculated from duplicate measurements:

$$RPD \quad 100\% \times \frac{(C_1 - C_2)}{(C_1 + C_2) \times \frac{1}{2}} \quad (1)$$

Where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use RSD rather than RPD:

$$RSD \quad 100\,\% \times (s / \bar{y}) \quad (2)$$

Where:

RSD = relative standard deviation
s = standard deviation
$\bar{y}$ = mean of replicate analyses

Standard deviation, σ, is defined as follows:

$$\sigma \quad \sum_{i\ 1}^{n} \sqrt{\frac{(y_i - \bar{y})^2}{n-1}} \quad (3)$$

Where:

σ = standard deviation
y_i = measured value of the i^{th} replicate
$\bar{y}$ = mean of replicate analyses
n = number of replicates

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Excavation							
Erosion and sedimentation Controls	CM/FQM	Verify that erosion and sedimentation controls are installed, maintained and inspected.	IP/FP	D	Erosion and sedimentation controls are installed, maintained and inspected.	ICG install, maintain and inspect erosion and sedimentation controls per Work Plan.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)
Initial excavation at each excavation location	CM/FQM	Initial excavation: Verify soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1	FP	O	Soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1.	Excavate to the marked boundaries.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM	Verify initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	FP	O	Initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	Collect sample.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	FP	O	Initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	Analyze for the applicable COCs.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify each COC concentration in the initial ISM samples is less than or equal to the RGO (see table 5-1).	FP	E	Each COC concentration in the initial ISM samples is less than or equal to the RGO.	Discuss with USACE removal of additional soil in the direction of the exceedance. Once approved by USACE COR, excavate additional soil (typically in one-foot increments but may be more depending on magnitude of the exceedance; do not excavate past groundwater or 10 feet bgs, whichever is encountered first).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates meet the DQOs specified in QAPP Table 11-1; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	FP	E	The DQO goals in QAPP Table 11-1 have been met for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	Provide the data for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates to Ohio EPA for concurrence. If the DQO goals are not met, the Ohio EPA will work with the Army to determine whether there are concerns with the data quality (see QAPP Table 11-1).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM and Project Chemist	Verify follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	FP	E	Follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	Collect and analyze for the failed COC.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Final: Verify each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1).	FP	E	Each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC.	Excavation is not complete, return to steps above for sampling and excavation.	FP Form; Daily Reports; QC Log and Report
Excavation dewatering	CM/FQM	Verify analytical results of excavation sidewall and bottom samples meet RGOs AND that Ohio EPA and OHARNG approval has been obtained prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	FP	E	Analytical results of excavation sidewall and bottom samples meet RGOs AND approval obtained from Ohio EPA and OHARNG approval prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	Do not discharge the water onsite. Obtain Ohio EPA and OHARNG approval prior to onsite discharge for water from excavations that meet the RGOs. If the excavation does not meet the RGOs, treat the water in the ETC.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Equipment Inspection	CM/FQM	Verify heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	FP	D	Heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	ICG operators check heavy equipment for leaks, general equipment condition, fluid levels, etc.	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Backfill and Site Restoration							
Backfill of Excavations	CM/FQM	Verify sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP	E	Sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	Do not backfill. Obtain sidewall and bottom excavation confirmation sample results that are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND perform a post-excavation topographic survey of the open excavation to calculate excavated volume AND obtain Ohio EPA concurrence on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP Forms; Daily Reports; QC Log and Report
Off-site backfill material	CM/FQM	Verify off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP	E	Off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	Do not bring the off-site backfill material to the site. ICG obtain samples of backfill material and analyze for the parameters in Table 12-1, and obtain approval from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP Forms; Daily Reports; QC Log and Report
Treated Soil	CM/FQM	Verify treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	IP/FP	E	Treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	Do not use the treated soil as backfill until all applicable COCs are less than or equal to the applicable RGOs.	IP/FP Forms; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify excavations backfilled in lifts approximately 8 inches thick (+/- 25%).	FP	E	Backfill placed in lifts approximately 8-inches thick (+/- 25%).	Add or remove backfill to meet lifts of approximately 8 inches thick (+/- 25%).	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify each lift track packed/wheel packed	FP	E	Each lift track packed/wheel packed.	Track pack/wheel pack each lift before placement of the next lift.	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify backfilled excavation matches surrounding grade.	FP	E	Backfilled excavation matches surrounding grade.	Add/remove backfill, grade etc. until backfilled excavation matches surrounding grade.	FP Form; Daily Reports; QC Log and Report
Seeding	CM/FQM	Verify that excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	FP	E	Excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	Obtain the approved seed mixture and apply, followed by mulching such as straw, woodchips or similar.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Erosion and sedimentation Controls	CM/FQM	Until 70% vegetative cover is established, verify that erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	FP	W	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly by ICG after backfill and restoration (as well as after a ½-inch rain event).	FP Form; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)

Table notes:#
[a] The responsible person (if other than the CM/QCM) is the individual with whom the CM/QCM will coordinate to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.
[c] Quality control phase: PP = preparatory phase, IP = initial phase, and FP = follow-up phase
[d] Frequency: O = once, D = daily, W = weekly, E = each occurrence

% = percent
APP = Accident Prevention Plan
ARNG = Army National Guard
bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CH2M = CH@M HILL Constructors, Inc.
CJAG = Camp James A. Garfield
CM = construction manager
COC = contaminant of concern
COR = Contracting Officer's Representative
CY = cubic yard(s)
ETC = enhanced thermal conduction
FQM = Field Quality Manager
HSM = Health and Safety Manager
ICG = Iron Creek Group
ISM = incremental sampling methodology
NA = not applicable
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
OSR = Off-Site Rule
PCB = polychlorinated biphenyl
PM = Project Manager
QC = quality control
QCM = Quality Control Manager
RCRA = Resource Conservation and Recovery Act
RD = remedial design
RGO = remedial goal option
SCADA = supervisory control and data acquisition
SSHP = Site Safety and Health Plan
SVOC = semivolatile organic compound
TCLP = toxicity characteristic leaching procedure
USACE = U.S. Army Corps of Engineers
VFD = variable frequency drive
VOC = volatile organic compound

Attachment 4
Excerpt from EPA Thermal Desorption Applications Manual (per comment SNW 6)

THERMAL DESORPTION APPLICATIONS MANUAL FOR TREATING NONHAZARDOUS PETROLEUM CONTAMINATED SOILS

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APPENDIX C

CONTRACTOR DIRECTORY, EQUIPMENT, AND PERFORMANCE DATA

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FIGURES

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APPENDIX C

CONTRACTOR DIRECTORY, EQUIPMENT, AND PERFORMANCE DATA

1.0 INTRODUCTION

The purpose of Appendix C is to present technical and performance information on commercially available thermal desorption systems that have been used for remediating nonhazardous petroleum contaminated soils. The survey includes data on both stationary and mobile thermal desorption systems. The data in Appendix C was primarily gathered by Focus Environmental, Inc. by conducting a survey of remediation contractors during September, 1992. Other data resources included the technical literature, industry trade associations, equipment vendor's brochures, remediation contractor's brochures, other EPA reports, and telephone interviews with selected state regulatory agency personnel.

The survey was conducted to develop a directory of remediation contractors, collect information on system configurations and typical operating parameters, and summarize existing soil treatment and air emissions performance data. The survey results are organized into five parts:

- Contractor directory (Table C-1)
- Equipment components of thermal desorption systems (Table C-2)
- Operating parameters for thermal desorption systems (Table C-3)
- Soil treatment data (Table C-4)
- Stack emissions data (Table C-5).

2.0 DIRECTORY OF CONTRACTORS

Table C-1 contains a list of all identified remediation contractors, facility locations, and contact information. For stationary facilities, the facility location of the plant is identified. For mobile systems, "facility location" indicates all states the contractor is willing to operate within. Listing of a specific state under "facility location" for a mobile thermal desorption system does not indicate that the system has obtained operating permits in that state.

3.0 EQUIPMENT TYPES

Table C-2 summarizes the types of thermal desorption and offgas treatment equipment being used to remediate petroleum contaminated soils. The four major types of thermal desorption systems being used for treating petroleum contaminated soils include rotary dryers, asphalt plant aggregate dryers, thermal screws, and a conveyor furnace. Table C-2 also indicates the capacity of each system and the soil disposal methods reported by each contractor.

4.0 THERMAL DESORPTION SYSTEM OPERATING PARAMETERS

Information on thermal desorption system operating parameters is summarized in Table C-3. The parameters listed in Table C-3 represent actual operating data rather than maximum design parameters. Data in this table includes soil feed rates, soil feed sizes, soil discharge temperatures, soil residence times, thermal desorber exit gas temperatures, thermal desorber maximum thermal duties, afterburner temperatures, and afterburner gas residence times.

5.0 SOIL TREATMENT PERFORMANCE RESULTS

Table C-4 summarizes case history information on typical site sizes, types of contaminants treated, soil indicator compounds, concentrations of contaminants in the feed material, and concentrations of contaminants in the treated soil. Thermal desorption soil residual concentration data can only be compared when the results are generated using the same analytical methods. Information on the specific analytical tests which were used to determine soil petroleum hydrocarbon residuals are generally not described in the references cited. Therefore, the data presented in Table C-4 should be used as an approximate performance guide but should not be used to compare performance results from various contractors.

TPH treatment data in Table C-4 was analyzed to determine a distribution of values for contaminated soil concentration, treated soil concentration, and removal efficiency. The results of these analyses are presented in Figures C-1, C-2, and C-3 respectively.

6.0 STACK EMISSIONS PERFORMANCE RESULTS

A summary of stack gas composition data is presented in Table C-5. There are no Federal requirements for conducting stack gas performance tests during the thermal treatment of petroleum contaminated soils, therefore test parameters and protocols vary from site to site. Individual states may require stack testing for particulates, volatile organic compounds (VOC), total hydrocarbons (THC), carbon monoxide (CO), nitrogen oxides (NO_x), metals (primarily lead), sulfur dioxide (SO_2), opacity, or other parameters. Most states have not established standards for hydrocarbon or VOC destruction and removal efficiencies (DREs).

The data in Table C-5 indicate that thermal desorption systems with afterburners and conventional gas cleaning equipment (cyclones, baghouses, afterburners, wet scrubbers) typically attain emissions within the following ranges:

- Particulates — 0.01 to 0.05 gr/dscf
- Lead — 0.001 to 0.006 grams/ton of soil feed
- Carbon monoxide — 2 to 20 ppm_v
- Nitrogen oxides — 5 to 60 ppm_v
- VOC — 10 to 100 ppm_v
- VOC destruction and removal efficiency — 95 to 99.9%.

Limited air emissions data were available for systems that do not use afterburners. No air emissions data were reported for systems using condensation and carbon adsorption systems.

Table C–1. Directory of Contractors

Contractor	Facility Location(s)	Contact	Telephone No.
Advanced Soil Technologies, Inc. 2966 White Bear Ave. Maplewood, MN 55109	Mobile (California, Illinois, Michigan, Minnesota, Wisconsin)	Frank Kellogg	(612) 773–9095
Aggregate Recycling 100 Middle St. Portland, ME 04101	Norridgewock, ME	Bill Mitchell	(207) 634–3652
Alaska Interstate Construction 649 West 54th Avenue Anchorage, AK 99518	Anchorage, AK	Dave Thomas	(907) 562–2792
Allied Environmental Services 2163 Merrick Avenue Merrick, NY 11566	Mobile (35 states)	Stuart Berry	(800) 969–3478
American Asphalt of Wisconsin P. O. Box 1726 Wausau, WI 54402	Winona, MN Stevens Point, WI Amery, WI Lacrosse, WI Wisconsin Dells, WI Tomah, WI Mosinee, WI Fenimore, WI New Richmond, WI Eau Claire, WI Dubuque, IA Lake Delton, WI Wausau, WI Mobile (Iowa, Michigan, Minnesota, Wisconsin)	Jim Tryba	(715) 693–5200
American Soil Processing, Inc. P.O.Box 160, Corporate Center Marion, IA 52303	Marion, IA	Tad Cooper	(319) 377–3333
Anchorage Sand & Gravel 1040 O'Malley Road Anchorage, AK 99515	Mobile (Alaska)	Newton Bingham	(907) 349–3333
Anderson–Columbia Environmental P. O. Box 1386 Lake City, FL 32056–1386	Mobile (Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina)	Mike McRae	(904) 752–7585
Atlantic ESI 274 Delaware Avenue Suite 2D Delmar, NY 12054	Mobile (all 50 states)	Mike Dommermuth	(518) 475–0023
Banks Construction P.O. Box 71505 Charleston Heights, SC 29415	Summerville, SC	Reid Banks	(803) 744–8261

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Advanced Soil Technologies, Inc. 2966 White Bear Ave. Maplewood, MN 55109	Mobile (California, Illinois, Michigan, Minnesota, Wisconsin)	Frank Kellogg	(612) 773-9095
Aggregate Recycling 100 Middle St. Portland, ME 04101	Norridgewock, ME	Bill Mitchell	(207) 634-3652
Alaska Interstate Construction 649 West 54th Avenue Anchorage, AK 99518	Anchorage, AK	Dave Thomas	(907) 562-2792
Allied Environmental Services 2163 Merrick Avenue Merrick, NY 11566	Mobile (35 states)	Stuart Berry	(800) 969-3478
American Asphalt of Wisconsin P. O. Box 1726 Wausau, WI 54402	Winona, MN Stevens Point, WI Amery, WI Lacrosse, WI Wisconsin Dells, WI Tomah, WI Mosinee, WI Fenimore, WI New Richmond, WI Eau Claire, WI Dubuque, IA Lake Delton, WI Wausau, WI Mobile (Iowa, Michigan, Minnesota, Wisconsin)	Jim Tryba	(715) 693-5200
American Soil Processing, Inc. P.O.Box 160, Corporate Center Marion, IA 52303	Marion, IA	Tad Cooper	(319) 377-3333
Anchorage Sand & Gravel 1040 O'Malley Road Anchorage, AK 99515	Mobile (Alaska)	Newton Bingham	(907) 349-3333
Anderson-Columbia Environmental P. O. Box 1386 Lake City, FL 32056-1386	Mobile (Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina)	Mike McRae	(904) 752-7585
Atlantic ESI 274 Delaware Avenue Suite 2D Delmar, NY 12054	Mobile (all 50 states)	Mike Dommermuth	(518) 475-0023
Banks Construction P.O. Box 71505 Charleston Heights, SC 29415	Summerville, SC	Reid Banks	(803) 744-8261

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Bardon Trimount 70 Blanchard Road Burlington, MA 01894	Shrewsbury, MA Stoughton, MA	David Peter	(617) 221-8400
Beede Waste Oil P. O. Box 127 Plaistow, NH 03865	Plaistow, NH	Bob LaFlanne	(603) 382-5761
Brox Industries 85 Greely St. Hudson, NH 03051	Dracut, MA Hudson, NH Marlboro, MA	George Hall George Brox	(603) 856-8077 (617) 454-9105
Cardi Construction Corporation 400 Lincoln Avenue Warwick, RI 02888	Warwick, RI Mobile (Massachusetts, Connecticut, New York)	Steve Cardi, Jr.	(401) 739-8300
Carlo Environmental Technologies 44907 Trinity Drive Clinton Township, MI 48038	Mobile (Michigan)	Mike Carlo	(313) 468-9589
Clean Berkshires 86 S. Main St. Lanesboro, MA 01237	North Adams, MA Mobile (Northeastern U.S.)	John Anthony	(413) 499-9862
Clean Earth of New Castle P. O. Box 1049 New Castle, DE 19720	New Castle, DE Mobile (Continential U.S.)	George Dalphon	(302) 427-6633
Clean Soils 84 2nd Ave, Southeast New Brighton, MN 55112	St. Paul, MN Milwaukee, WI Bakersfield, CA Anchorage, AK Kenai, AK Mobile (Illinois, Michigan, Ohio, Pennsylvania)	Kirk Shellum	(612) 639-8811
Columbia-Anderson Asphalt P.O. Box 1386 Lake City, FL 32056-1386	California Lousiana Ohio New Jersey Texas Mobile (New Jersey)	Bill Sheehan	(714) 261-8860
ConTeck Environmental Services 22460 Hwy 169 NW Elk River, MN 55440	Mobile (Iowa, Minnesota, New Mexico, North Dakota, South Dakota, Texas)	Larry Hicks	(612) 338-6669
Continental Paving 1 Continental Drive Londonderry, NH 03063	Londonderry, NH	Mark Charbonneau	(603) 437-5387

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
C. A. Meyer Paving 4978 McLeod Road Orlando, FL 32805	Orlando, FL	Frank Cox	(407) 849–0770
D'Ambra Construction 800 Jefferson Blvd. Warwick, RI 02887	Warwick, RI	Jenny Parker	(401) 737–1300
DeCato Sand and Gravel RFD15 Box 52 Concord, NH 03301	Loudon, NH	Roger DeCato	(603) 798–5452
Delaware Container Company West 11th Ave & Valley Rd Coatesville, PA 19320	Coatesville, PA	Al Miller	(215) 383–6600
Diversified Contractors, Inc. 1701 West Linden Phoenix, AZ 85007	Phoenix, AZ Mobile (Arizona)	Steve Evers	(602) 274–0787
Domermuth Environmental Services P.O. Box 62 Clarksville, NY 12041–0062	Clarksville, NY	Jim Domermuth	(518) 768–2214
Domermuth Environmental Services 7828 Rutledge Pike Knoxville, TN 37924	Mobile (Alabama, Georgia, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, Virginia)	Glenn Palmer	(615) 637–5781
DRE Environmental, Inc. P.O. Box 1386 Lake City, FL 32056–1386	Mobile (Alabama, Louisiana, Texas, Virginia)	Chris Sleeper	(904) 758–3164
Dustcoating 695 D'Chene Lane Maple Plain, MN 55359	Maple Plain, NY	Larry Johnson	(612) 479–1593
Earle Asphalt Corporation P. O. Box 757 Farmingdale, NJ 07727	Jackson, NJ Farmingdale, NJ	Walter Earle, Jr.	(908) 657–8551 (908) 323–0053
Eau Claire Asphalt Corporation P. O. Box 326 Eau Claire, WI 54702	Eau Claire, WI	Louis Thune	(715) 835–4858
Enviro–Klean Soils, Inc. Box 2003 Snoqualmie, WA 98065	Mobile (Washington)	Richard Obendorf	(206) 888–9388
EnviroTech Mid–Atlantic 1861 Pratt Drive Blackburg, VA 24060	Danville, VA Chesapeake Bay, VA Fredricksburg, VA Mobile (Alabama, Virginia)	Doug Goldsmith	(703) 231–3983

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
EnviroTech Systems 6363 Woodway, Suite 300 Houston, TX 77057	Houston, TX	Bennett Blocker	(713) 789-0400
Falcon Energy Associates P.O. Box 1257 Stockton, CA 95201	Mobile (Arizona, California, Nevada, Oregon, Washington)	Larry Gooden	(209) 463-7108
FERtech Enviro Systems, Inc. 630 N. Morley, Suite 107 Moberly, MO 65270	Mobile (Arkansas, Missouri, Texas)	Shadi Nikfarjam	(800) 362-8808
Four Seasons Industrial Services 3107 South Elm-Eugene Street Greensboro, NC 27406	Mobile (Continental U.S.)	Mike McClung	(919) 273-2718
Gennaro Pavers 1721 Pine St. Warren, OH 44483	Lowellville, OH	David Gennaro	(216) 394-5557
Giant Resources Recovery P. O. Box 352 Harleyville, SC 29448	Harleyville, SC	Al Asaro Luther Rebel	(803) 496-7676 (803) 496-5033
Harry Crooker & Sons, Inc. Old Bath Road RFD4 Box 4079	Brunswick, ME	Dick Morgan	(207) 729-3331
HY-COR-TECH 7828 Old Seward Highway Anchorage, AK 99502	Mobile (all 50 states)	Bob Harding	(907) 522-3728
Industrial Waste, Inc. Ellyson Industrial Park Box 34 Pensacola, FL 32514	Pensacola, FL Mobile (Florida)	Richard Singer	(904) 479-1788
Johnson Blacktop 2320 14th Avenue, NW Rochester, MN 55901	Rochester, MN	Royal Johnson	(507) 254-1854
Kary Asphalt, Inc. Eden Road Eden, MD 21822	Eden, MD	Steve Lambrose	(301) 543-0200
Keystone Block Transport P. O. Box 9 Temple, PA 19560	Sinking Springs, PA	Laura Lubahn	(215) 926-6915
Kleen-Soil International, Inc. 13838 Harlee Road Palmetto, FL 34221	Palmetto, FL	Tony L. Tripi	(904) 471-8628
Lakehead Backtop & Materials 6327 Tower Avenue Superior, WI 54880	Superior, WI	Joe Kimmes	(715) 392-3844

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Marriners, Inc. P. O. Box 600 Rockport, ME 04856	Washington, ME	David Andrus	(207) 236–4317
McCrossan 7855 Jefferson Highway Maple Grove, MN 55369	Maple Grove, MN	Bob Dongoske	(612) 425–4167
Merrimack Timber Services P. O. Box 359 Epsom, NH 03234	Chichester, NH Littleton, NH Hartland, VT	Jim Langille	(603) 798–4557
METCO Environmental, Inc. P. O. Box 368 Cumberland, MD 21502	Cumberland, MD Mobile (West Virginia)	Doug Reineke	(301) 729–6922
Midwest Soil Remediation 27010 St. Charles Rd. Wheaton, IL 60188	Wheaton, IL Mobile (Arkansas, Indiana, Kansas, Mississippi, Michigan, Wisconsin)	John Sweeney	(708) 231–5115
M.L. Chartier, Inc. 9195 Marine City Highway Fair Haven, MI 48023–0069	Mobile (Michigan)	Dennis Heine	(313) 725–8373
M.L. Fuhrman Company, Inc. P.O. Box 1054 Fond du Lac, WI 54935	Mobile (all 50 states)	Mick Fuhrman	(414) 923–2580
Mobile Reclaim, Inc. 4131 NW 13th St., #105 Gainesville, FL 32609	Gainesville, FL	Jeff Borneman	(904) 373–4614
National Soils Inc. No. 8 Towpath Road Fort Edward, NY 12828	Loudon, NH Fort Edward, NY Tuscaloosa, AL	George Bower	(603) 647–6996
Nevada Hydrocarbon 2650 East Mustang Sparks, NV 89431	Sparks, NV	Charles Chisholm	(702) 342–0200
OBG Technical Services 5000 Brittonfield Parkway, Suite 200 Syacuse, NY 13220	Mobile (Connecticut)	Jim Fox	(315) 437–6400
OHM Corporation 16406 U.S. Route 224 East Findlay, OH 45839–0551	Mobile (Continental U.S.)	Greg McCartney	(800) 537–9540
Oregon Hydrocarbon 9333 North Harborgate Portland, OR 97283	Portland, OR	Lex Johnson	(503) 735–9525

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Pacific Industrial Services 925 West Esther Street Long Beach, CA 90813	Mobile (California, Montana, Utah, Washington, Wyoming)	John Van Kooy	(800) 359-6397 (310) 590-8626
Pacific Environmental Group, Inc. 1601 Civic Center Drive, Suite 202 Santa Clara, CA 95050	Mobile (California)	Erin Garner	(408) 441-7500
Payne & Dolan P. O. Box 781 Waukasha, WI 53187	Green Bay, WI Madison, WI Sussex, WI	Kurt Bechthold	(414) 524-1769
Peak Oilfield Service 4300 B Street Suite 603 Anchorage, AK	Mobile (all 50 states)	Roger Mechon	(907) 561-3200
Pet-Con Soil Remediation, Inc. P.O. Box 205 Spring Green, WI 53588	Spring Green, WI	Thomas LaBudde	(608) 588-7365
PETREO International, Inc. 13036 Sarah's Lane Houston, TX 77015	Houston, TX Mobile (Texas)	John Sullivan	(713) 453-4000
Phoenix Soils, Inc. P.O. Box 1750 Waterbury, CT 06723-1750	Waterbury, CT	Dave Green	(203) 755-2283
Progressive Development International, Inc. P.O. Box 465 Hartland, WI 53029	Mobile (all 50 states)	Corvin Frank	(414) 367-5044
Purgo, Inc. 5020 Monument Ave.#1 Richmond, VA 23230	Ashland, VA	Robert Carroll	(800) 446-2614 (804) 353-7400
Quantum Soil Remediation, Inc. 1327 South Westgate Avenue, Suite 306 Los Angeles, CA 90025	Mobile (California, Illinois, Michigan, North Carolina, New York, South Carolina, Texas)	Mark Randall	(310) 477-1189
Recovery Specialists, Inc. 201 North Park Yipsilanti, MI 48198	Mobile (California, Louisiana, Texas)	Fred Feitel	(313) 483-9600
Recycling Alternatives, Inc. P. O. Box 1896 Salisbury, MD 21802	Fort Worth, TX Adel, GA Nassawadox, VA New Bern, NC Birmingham, AL Chestertown, MD Richmond, VA	Don Mitchell	(410) 860-0268

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Resource Recovery of America, Inc 2300 Highway, 60 West Mulberry, FL 33860	Mulberry, FL	David Dye	(813) 425–1084
Ryan–Murphy, Inc. 8774 Yates Drive, Suite 100 Westminster, CO 80030	Beaumont, TX Mobile (California, New Jersey, Texas)	Steven Sarada	(303) 427–4567
Separation & Recovery Systems, Inc. 1762 McGaw Avenue Irvine, CA 92714	Mobile (New Jersey, Texas, California)	William Sheehan	(714) 261–8860
SFM Corporation P.O. Box 5504 Midland, TX 79704	Mobile (all 50 states)	Rusty Buckingham	(915) 694–7791
Shewey Environmental P.O. Box 5219 Hemet, CA 92544	Mobile (California)	Buzz Nelson	(714) 765–2780
Site Reclamation Systems, Inc. P.O. Box 11 Howey–in–the–Hills, FL 34747	Mobile (Alaska, Alabama, California, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia, Washington, Wisconsin, West Virginia)	Larry Woods	(904) 324–3651
Soil Cleansers, Inc. 2803 Dede Road Finksburg, MD 21048	Mobile (Maryland)	Paul Miller	(410) 833–3780
Soil Purification, Inc. P.O. Box 72515 Chattanooga, TN 37407	Chattanooga, TN	Wendell Feltman	(706) 861–0069
Soil Recycling Technologies, Inc. 1200 17th St., Suite 1930 Denver, CO 80202	Wichita, KS Greeley, CO Denver, CO Grand Junction, CO Atlanta, GA Oklahoma City, OK Fargo, ND Casper, WY Billings, MT Phoenix, AZ East St. Louis, IL Kansas City, KS	Joseph Connor	(303) 573–8300

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Soil Remediation Company 1325 S. Colorado Blvd, Suite 503 Denver, CO 80206	Greenville, SC Columbia, SC Mobile (North Carolina, South Carolina, Virginia)	George Chedsey	(800) 441–1968
Soil Remediation Services 2409 North Kerby St. Portland, OR 97227	Mobile (all 50 states)	George Coats	(503) 288–5816
Soil Remediation Service, Inc. 4820 N. 125th St. Butler, WI 53007	Port Washington, WI Mobile (All 50 states)	Tim Crowley	(414) 781–3545
Soil Safe, Inc. 4600 East Fayette Baltimore, MD 21224	Baltimore, MD	Walter Kennell	(301) 327–5753
Soil Services of Texas 950 1/2 East Port Corpus Christi, Texas	Mobile (Texas)	Sam J. Susser	(512) 883–6321
Sonas Systems of Florida P. O. Box 7387 Tallahassee, FL 32314	Tallahassee, FL	George Atkins	(904) 575–8102
Southeastern Soil Recovery, Inc. P. O. Box 70253 Charleston, SC 29415	Charleston Heights, SC	Bob Williams	(803) 566–7065
Southern Soil Services, Inc. 3505 Pugmill Rd Kissimmee, FL 34741–6462	Kissimmee, FL	Vanessa Burgess	(407) 933–8414
Sterling Asphalt 6431 NE 175th Kenmore, WA 98028	Kenmore, WA	Sam Johnson	(206) 485–5667
Stoneco, Inc. P.O. Box 29A Maumee, OH 43537	Toledo, OH	Don Weber	(419) 893–8731
Sunbelt Resources 715 Skyland Blvd. E Tuscaloosa, AL 35405	Tuscaloosa, AL Mobile (Tennessee)	Bob Jamison	(205) 758–3657
Susser Environmental Services P.O. Box 9036 Corpus Christi, TX 78469	Corpus Christi, TX Mobile (Texas)	Jeff Turner	(512) 883–6321
Testco 40 Stonecastle Road Rock Tavern, NY 12575	Mobile (all 50 states)	Perry Songer	(914) 567–1058

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Texas Soil Recycling 5900 Haynesworth Houston, TX 77034	Houston, TX	Patty Mireles	(713) 922–7155
Thermal–Clean Services P. O. Box 1210 Washington, PA 15301–7210	Washington, PA	Bill Spencer	(412) 228–1111
Tilcon Maine, Inc. P. O. Box 209 Fairfield, ME 04937	Fairfield, ME Midway, ME Portland, ME	Dave Bess	(207) 746–5636
TPS Technologies, Inc. 2070 S.Orange Blossom Trail Apopka, FL 32703	Adelanto, CA Palm Beach, FL Sumter, SC Chester, VA	Jim Lousararian	(617) 622–1000
True Enviromental Remediating Company P.O. Drawer 2360 Casper, WY 82602	Mobile (Wyoming)	Renee Taylor	(307) 237–9301
Tyree Environmental Services 208 Rt. 109 Farmingdale, NY 11735	Mobile (New York)	William Tyree, Jr.	(516) 249–3150
USPCI 5665 Flatiron Parkway Boulder, CO 80301	Mobile (Nevada)	Glenn Sprenger	(303) 938–5549
U.S. Waste Thermal Processing 11090 Rose Avenue Fontana, CA 92335	Mobile (California)	Bob Ruppert	(714) 509–7783
Vanguard–Welltech Environmental 13937 Luther Road Houston, TX 77039	Polestine, TX Mobile (All 50 states)	T. L. McDaniel	(713) 987–3800
Vernor Materials & Equipment Company P.O. Box 967 Clute, TX 77531	Freeport, TX	Michael Baker	(409) 233–3366
Western Thermal Soils Company 2950 Terminal Annex Los Angles, CA 90051	Tucson, AZ Mobile (California, Arizona)	George Cosby	(213) 258–2777
Williams Environmental Services 2076 W. Park Pl. Stone Mountain, GA 30087	Mobile (Alabama, Georgia, South Carolina)	Tom McDowell	(404) 498–2020
Woodworth & Company 1200 East D. Street Tacoma, WA 98421	Mobile (Washington)	Mike Tollkuehn	(206) 383–3585

Table C–2. Equipment Components of Thermal Desorption Systems

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
Advanced Soil Technologies	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	21
Advanced Soil Technologies	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Alaska Interstate Construction	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Soil Processing, Inc.	Rotary dryer	25–40 tons/hour	Mobile	Baghouse, afterburner	B, L, O	(b)
Banks Construction	Rotary dryer	–	–	Baghouse, afterburner	–	7
Brox Industries	Rotary dryer	10–20 tons/hour	Stationary	Baghouse	I	(b)
Brox Industries	Rotary dryer	10–20 tons/hour	Stationary	Baghouse	I	(b)
Cardi Construction Corporation	Rotary dryer	25–50 tons/hour	Mobile	Cyclone, baghouse, afterburner	B, L, R, I	(b)
Clean Berkshires	Rotary dryer	100 tons/hour	Mobile/stationary	Baghouse, afterburner	B, R, L, I	17,(b)

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
Clean Earth of New Castle	Rotary dryer	70 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R, L	11, (b)
Clean Earth of New Castle	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B, R, L	11, (b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile	Baghouse, afterburner, other	B	(b)
Clean Soils	Rotary dryer	90 tons/hour	Stationary	Baghouse, afterburner, other	R	(b)
Clean Soils	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner, other	B	(b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Delaware Container Company	Thermal screw	–	Stationary	–	–	41
Domermuth Environmental Services	Rotary dryer	–	Mobile	Baghouse, afterburner	–	6
DRE Environmental, Inc.	Rotary dryer	35 tons/hour	Mobile	Cyclone, baghouse, afterburner	B	(b)
Dustcoating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
Dustcoating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
D'Ambra Construction	Asphalt agg. dryer	75 tons/hour	Mobile/stationary	Baghouse, afterburner	–	33
Earth Purification Engineering	Rotary dryer	–	Mobile	Cyclone, cooler, baghouse	–	37
Enviro-Klean Soils	Thermal processor	3.5-15 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Enviro-Klean Soils	Thermal processor	10 tons/hour	Mobile	Baghouse, afterburner	B	(b)
EnviroTech Mid-Atlantic	Rotary dryer	–	Mobile/stationary	Baghouse, afterburner	–	7
EnviroTech Southeast	Rotary dryer	–	Mobile/stationary	Baghouse, afterburner	–	7
Falcon Energy Associates	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
Falcon Energy Associates	Rotary dryer	25-40 tons/hour		Baghouse, afterburner	B	(b)
Falcon Energy Associates	Rotary dryer	25-40 tons/hour	Mobile	Baghouse, afterburner	B	(b)
FERtech Enviro Systems	Rotary dryer	15-70 tons/hour	Mobile	Cyclone, BH, AB, heat exchanger	–	(b)
Four Seasons Industrial Services	Rotary dryer	–	Mobile	Baghouse, catalytic afterburner	–	16
Four Seasons Industrial Services	Rotary dryer	10-20 tons/hour	Mobile	Catalytic afterburner	B	(b)
Four Seasons Industrial Services	Rotary dryer	10-20 tons/hour	Mobile	Catalytic afterburner	B	(b)
Gennaro Pavers	Rotary dryer	25 tons/hour	Stationary	Baghouse, afterburner	–	21

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
KleenSoil International	Tile tunnel kiln	60 tons/hour	Stationary	Baghouse, afterburner	L,R	(b)
Midwest Soil Remediation	Rotary dryer	10–20 ton/hour	Mobile	Baghouse	B	(b)
Mobile Reclaim, Inc.	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B, L	(b)
Nevada Hydrocarbon	Rotary dryer	–	Stationary	Baghouse, afterburner	–	7
OHM Corporation	Rotary dryer	–	Mobile	Venturi scrubber	–	53
OHM Corporation	Rotary dryer	–	Mobile	Cyclone, venturi scrubber	–	53
Oregon Hydrocarbon	Rotary Dryer	40–50 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, L, R	(b)
Purgo, Inc.	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recovery Specialists, Inc.	Calciner	–	Mobile	Venturi scrubber, afterburner	–	39
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recycling Alternatives, Inc.	Asphalt agg. dryer	80 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, wet scrubber	R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, afterburner, wet scrubber	R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, baghouse	R, I	(b)
Ryan–Murphy, Inc.	Rotary dryer	15 tons/hour	Mobile	Catalytic afterburner, baghouse	–	14
Ryan–Murphy, Inc.	Rotary dryer	10–20 tons/hour	Stationary	Baghouse with catalytic afterburner	B	(b)
Ryan–Murphy, Inc.	Rotary dryer	10–20 tons/hour	Mobile	Baghouse with catalytic afterburner	B	(b)
Separation & Recovery Systems, Inc.	Thermal screw	4 tons/hour	Mobile	Condensation, activated carbon	B	(b)
Site Reclamation Systems	Rotary dryer	–	Mobile	Baghouse, afterburner	–	12, 53
Soil Cleansers	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
Soil Remediation Company	Rotary dryer	15–30 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R	(b)
Soil Remediation Company	Rotary dryer	15–30 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R	(b)
Soil Remediation Company	Rotary dryer	–	Mobile	–	B, R	(b)
Soil Remediation Services, Inc.	Rotary dryer	25 tons/hour	Mobile	Afterburner, baghouse	B	(b)
South Coast Asphalt Products	Asphalt agg. dryer	120 tons/hour	Stationary	Cyclone, baghouse	–	36, (b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30 tons/hour	Stationary	Baghouse	–	38
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30 tons/hour	Stationary	Cyclone	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	100 tons/hour	Mobile/stationary	Wet scrubber	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Wet scrubber	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50 tons/hour	Mobile/stationary	–	B, R, I, O	(b)

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method [a]	References
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90 tons/hour	Stationary	Baghouse, afterburner	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Wet scrubber	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90 tons/hour	Mobile/stationary	Wet scrubber	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Mobile/stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Stoneco	Rotary dryer	25 tons/hour	Mobile/stationary	Baghouse, afterburner	B, O	21
Thermal–Clean Services	Rotary dryer	30–180 tons/hour	Stationary	Baghouse, afterburner	B, L, R	(b)
TPS Technologies, Inc.	Rotary dryer	25 tons/hour	Stationary	Baghouse, afterburner	–	15
True Environmental Remediating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner, wet scrub.	B, L, R	(b)
Tyree Brothers	Rotary dryer	–	Mobile	Baghouse, afterburner	–	13
U.S. Waste Thermal Processing	Conveyor furnace	5–10 tons/hour	Mobile	Afterburner, wet scrubber	–	43, 53
Vanguard–Welltech Environmental	Thermal screw	4–15 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Western Thermal Soils Company	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Williams Environmental Services	Rotary dryer	30 tons/hour	Mobile	Baghouse, afterburner	–	22
Williams Environmental Services	Rotary dryer	15 tons/hour	Mobile	Baghouse, afterburner	–	22

Notes:

(–) Indicates no data is available.

(a) Soil disposal methods include:
- B – Backfill
- I – Incorporate into asphalt
- L – Landfill cover
- O – Other
- R – Road base

(b) Survey conducted by Focus Environmental, Inc., September 1992.

Table C-3. Operating Parameters for Thermal Desorption Systems

Contractor	Desorber Type	Soil Feed Rate (tons/hr)	Maximum Feed Size (inches)	Soil Discharge Temperature (°F)	Soil Residence Time (minutes)	Desorber Exit Gas Temperature (°F)	Maximum (a) Thermal Duty (MM Btu/hr)	Afterburner Temperature (°F)	Afterburner Gas Residence Time (sec)	References
Advanced Soil Technologies	Rotary dryer	35	2	600–800	3–5	350–400	50	1,400–1,600	1.8	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300	1.5	325	2–3	300	–	–	–	(b)
American Soil Processing, Inc.	Rotary dryer	25–40	2	400–500	–	300	–	1,400–1,600	1.0	(b)
Banks Construction	Rotary dryer	25	–	440	5–7	–	–	–	–	7
Cardi Construction Corporation	Rotary dryer	25	2	850	5–8	350	60	1,600	1.5	(b)
Clean Earth	Rotary dryer	70	2	1,000	8	400	60	1,500	1.75	(b)
Clean Earth	Rotary dryer	25	2	650	5	350	40	1,500	1.5	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	20–50	–	300–600	–	–	–	1,400	–	10
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	25	2	750	4–12	1,000	35	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Confidential No. 1	Rotary dryer	82	–	580	–	–	–	–	–	21
Confidential No. 2	Rotary dryer	29–35	–	530–612	–	–	–	–	–	21
Confidential No. 3	Rotary dryer	22–36	–	580–640	–	–	–	–	–	21
Confidential No. 4	Rotary dryer	22–27	–	650–855	–	–	–	–	–	21
Domermuth Environmental Services	Rotary dryer	20–40	–	400–600	3–4	–	–	1,400–1,600	–	6
DRE Environmental, Inc.	Rotary dryer	35	2	500–1,000	10	400	50	1,600	1.0	(b)
Earth Purification Engineering	Rotary dryer	8	–	500–700	–	710–1,000	3.3	–	–	37
Envirotech Mid-Atlantic	Rotary dryer	30–50	–	750	4.5	–	84	–	–	7, 53
Envirotech Southeast	Rotary dryer	20	–	725	3–5	–	72	1,400–1,600	–	7, 53
Enviro-Klean Soils	Thermal processor	3.5	2	500–750	–	350	5	–	5.0	(b)
Falcon Energy Associates	Rotary dryer	25–40	2	850	5–10	350	42	1,650	1.5	(b)
Falcon Energy Associates	Rotary dryer	25–40	2	850	5–10	350	42	1,650	1.5	(b)
FERtech Enviro Systems, Inc.	Rotary dryer	15–20	2–3	500–800	5–7	700–900	70	1,400–1,800	1.0–2.0	(b)
Four Seasons Industrial Services	Rotary dryer	10–20	2	500–650	8	300	12	1,200	1.0	(b)
Four Seasons Industrial Services	Rotary dryer	10–20	2	500–650	8	300	12	1,200	1.0	(b)
Midwest Soil Remediation	Rotary dryer	10–20	3	600–800	7–8	450	11	1,100	0.075	(b)

(Continued)

Table C-3. (Continued)

Contractor	Desorber Type	Soil Feed Rate (tons/hr)	Maximum Feed Size (inches)	Soil Discharge Temperature (°F)	Soil Residence Time (minutes)	Desorber Exit Gas Temperature (°F)	Maximum (a) Thermal Duty (MM Btu/hr)	Afterburner Temperature (°F)	Afterburner Gas Residence Time (sec)	References
Recovery Specialists, Inc.	Thermal screw	3–5	–	400–575	–	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	7–12	–	400–575	–	–	–	–	–	39
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	3	400	5	400	95	–	–	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	5	450	115	–	–	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	7	450	140	1,400	0.5	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	80	6	500	6	500	175	1,400	1.0	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	5	450	115	–	–	(b)
Ryan–Murphy, Inc.	Rotary dryer	10–20	2.5	400–700	4–8	< 450	10	800–1,250	0.17	(b)
Soil Remediation Company	Rotary dryer	15–30	0.5–6	400–700	5–9	700–900	47	1,400–1,800	2.0	(b)
Soil Remediation Company	Rotary dryer	15–30	0.5–6	400–700	5–9	700–900	47	1,400–1,800	2.0	(b)
Soil Remediation Services	Rotary dryer	25	2	200	–	–	–	1,400–1,600	–	(b)
South Coast Asphalt Products	Asphalt agg. dryer	120	–	350–400	–	350–400	–	–	–	34
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30	0.75	500	3–5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	–	–	–	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50	2	450–550	3–5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50	2	500–600	5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30–40	2	500–600	3–5	–	–	1,500–1,600	0.5	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90	1	500–700	3–5	–	–	–	–	(b)
Stoneco	Rotary dryer	25	2	650	5–8	350	42	1,500	1.5	(b)
Thermal–Clean Services	Rotary dryer	30–180	2	600–1,472	0.3–2	350–1,275	160–220	1,600–2,192	1.0	(b)
True Environmental Remediating	Rotary dryer	25	2	1,000	–	600	70	1,600	1.0	(b)
U.S. Waste Thermal Processing	Conveyor furnace	5–8	1.5	300–650	–	–	10	1,800	0.5	43, 53
Vanguard–Welltech Environmental	Thermal Screw	4–15	4	500	20–45	525	8	1,500	1.0	(b)
Western Thermal Soils Company	Rotary dryer	25	2	850	–	350	28.7	1,400–1,600	1.0	(b)
Williams Environmental Services	Rotary dryer	10–15	3	250–1,000	5–20	450	34	1,400–1,600	2.0	22
Williams Environmental Services	Rotary dryer	25–30	4	250–1,000	5–20	450	87	1,400–1,800	2.0	22

Notes:

(–) Indicates no data available.

(a) Includes afterburner duty if system uses an afterburner.

(b) Survey conducted by Focus Environmental Inc., September 1992.

Table C–4. Thermal Desorption System Soil Treatment Data

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
American Soil Processing, Inc.	Rotary dryer	Marion, IA	–	Gasoline, diesel	Varies	<10	>99.9	Varies	<10	–	(a)
Banks Construction	Rotary dryer	Summerville, SC	–	No. 2 fuel oil	34,300	<25	>99.9	–	<25	–	7
Cardi Construction Corporation	Rotary dryer	Warwick, RI	3,000	No. 2 fuel oil	3,000	<50	98	10	1	90	(a)
Clean Berkshires	Rotary dryer	North Adams, MA	–	Gasoline, diesel, No. 2	3,000	<10	>95	>10	0.1	99	(a)
Clean Earth	Rotary dryer	–	–	–	3,950	<50	>98	23	0.005	99	(a)
Clean Earth	Rotary dryer	Trenton, NJ	–	Hydraulic oil	8,020	<10	>99	35	0.005	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Anchorage, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Kenai, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Kenai, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Multiple sites in PA	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Confidential # 1	Rotary dryer	Confidential	–	Petroleum hydrocarbons	1,300	<48	>96.31	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	No. 2 fuel oil	1,708	<1	>99.94	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	Unleaded gasoline	429	<1	>99.97	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	Gasoline	600	<1	>99.83	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Fuel oil	2,200	7	99.68	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Gasoline, diesel	150	22	85.3	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	No. 2 fuel oil	2,600	<2	>99.92	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Gasoline	1,300	6	99.54	–	–	–	21
Confidential # 4	Rotary dryer	Confidential	–	Crude oil	3,403	219	93.56	–	–	–	21
Dormermuth Environmental Services	Rotary dryer	Knoxville, TN	1,000	Gasoline	–	<100	–	–	<10	–	6
DRE Environmental, Inc.	Rotary dryer	Mobile, AL	6,000	Waste oil	10,000	<25	99	>100	0.001	99	(a)
Earth Purification Engineering	Rotary dryer	Reno, NV	1,000	Gasoline, diesel, JP–4	5,000	<10	>99.80	–	–	–	37
Earth Purification Engineering	Rotary dryer	San Diego, CA	700	Diesel	67,000	<1,000	>98.51	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	1,085	<1	>99.91	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	5,200	<1	>99.98	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	2,400	<1	>99.96	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	1,875	<1	>99.95	–	–	–	37
Envirotech Mid–Atlantic	Rotary dryer	Danville, VA	Fixed	No. 6 fuel oil	8,500	<50	>99.41	–	–	–	7
Envirotech Southeast	Rotary dryer	Munson, FL	–	Motor oil, No. 6 fuel oil	30,000	<40	>99.87	–	–	–	7
Enviro–Klean Soils, Inc.	Thermal processor	Gig Harbor, WA	525	Gasoline	2,100	ND	–	89.5	ND	–	(a)
Enviro–Klean Soils, Inc.	Thermal processor	Auburn, WA	150	Hydraulic, waste oils	580	<52	91	–	–	–	(a)
Falcon Energy Associates	Rotary dryer	Rio Vista, CA	1,000	Stoddard solvent	240	ND	100	0.05	ND	100	(a)

(Continued)

Table C-4. (Continued)

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
Falcon Energy Associates	Rotary dryer	West Sacramento, CA	2,000	Gasoline, diesel	46,000	ND	100	2,790	ND	100	(a)
Four Seasons Industrial Services	Rotary dryer	Conway, SC	1,000	Diesel fuel	3,350	<10	>99.8	35	<0.01	>99.9	(a)
Four Seasons Industrial Services	Rotary dryer	Appomattox, VA	3,000	Petroleum hydrocarbons	3,000	<10	>99.8	10	<0.005	>99.9	(a)
Midwest Soil Remediation	Rotary dryer	Chicago, IL	7,000	JP-4	3,500	10	>98	25	1	98	(a)
Mobile Reclaim, Inc.	Rotary dryer	Orlando, FL	1,045	Diesel	7,660	5	99.9	–	–	–	(a)
Nevada Hydrocarbon	Rotary dryer	Sparks, NV	–	Petroleum hydrocarbons	35,000	<10	>99.97	–	–	–	57
OHM Corporation	Rotary dryer	Cocoa, FL	1,000	Gasoline	–	–	–	–	<0.1	–	53
OHM Corporation	Rotary dryer	Cleveland, OH	1,500	Diesel	–	<50	–	–	–	–	53
OHM Corporation	Rotary dryer	Pennsylvania	1,300	Diesel	–	<100	–	–	–	–	53
OHM Corporation	Rotary dryer	Pennsylvania	1,500	Diesel	–	<100	–	–	–	–	53
Oregon Hydrocarbon	Rotary dryer	Portland, OR	–	Various hydrocarbons	Varies	ND	99	Varies	ND	99	(a)
Recovery Specialists	Thermal screw	–	–	Gasoline	60	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	550	20	96.36	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	560	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	15,000	5,500	63.33	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	17,000	2,100	87.65	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	350	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	390	34	91.28	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	1,340	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	13,000	330	97.46	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	210	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	210	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Jet fuel A	550	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	43,000	1,400	96.74	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Kerosene	550	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	50,000	820	98.36	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	2,100	50	97.62	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Stoddard solvent	1,800	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Stoddard solvent	1,500	ND	–	–	–	–	39
Ryan-Murphy, Inc.	Rotary dryer	Riverside, CA	14,000	JP-4	1,200	<20	99	2	0.05	98	(a)
Site Reclamation Systems, Inc.	Rotary dryer	Florida	–	Petroleum hydrocarbons	–	–	–	–	<0.1	–	53, 12
Soil Remediation Company	Rotary dryer	Greenville, SC	–	–	2,000	<100	>95.00	–	–	–	(a)
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	800	<45	>94.38	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Crude oil	2,000	<70	>96.50	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	3,400	<39	>98.85	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	2,450	<76	>96.90	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Crude oil	6,000	<240	>96.00	–	–	–	19

(Continued)

Table C-4. (Continued)

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
Stoneco	Rotary dryer	Toledo, OH	10,000	All types	3,000	<40	99	0.442	ND	100	(a)
Thermal-Clean Services	Rotary dryer	Washington, PA	–	–	–	10	–	–	0.12	–	(a)
True Environmental Remediating	Rotary dryer	Casper, WY	–	Fuels, crude oil	25,000	<50	>98	–	10	98	(a)
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	300	Gasoline	5,000	ND	–	–	–	–	(a)
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	300	Diesel fuel	5,000	ND	–	–	–	–	53
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	1,000	Petroleum hydrocarbons	–	<10	–	–	–	–	53
U.S. Waste Thermal Processing	Conveyor furnace	California	540	Petroleum hydrocarbons	–	<10	–	–	–	–	53
Vanguard-Weltech Environmental	Thermal Screw	Pouestine, TX	10,000	Diesel	20,000	80	>99.6	25	ND	100	(a)
Western Thermal Soils Company	Rotary dryer	Tucson, AZ	7,000	Diesel	5,000	<10	99.8	–	–	–	(a)
Williams Environmental Services	Rotary dryer	Arburn, AL	600	Gasoline	–	<100	–	–	–	–	53
Williams Environmental Services	Rotary dryer	Alabama	6,000	Gasoline, diesel	5,000	<100	>98.00	–	–	–	22
Williams Environmental Services	Rotary dryer	Alabama	7,000	Diesel	3,000	<10	>99.67	–	–	–	22
Williams Environmental Services	Rotary dryer	South Carolina	3,500	Gasoline, diesel	3,000	<10	>99.67	–	–	–	22

(–) Indicates no data available.

(a) Survey conducted by Focus Environmental, Inc., September 1992.

Table C–5. Stack Emissions Data

Contractor	Desorber Type	Contaminants	Lead in Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Stack Emissions: Particulate (gr/dscf)	Stack Emissions: Volatile Organic Compounds (ppmv dry)	Stack Emissions: Carbon Monoxide (ppmv dry)	Stack Emissions: Nitrogen Oxides (ppmv dry)	Stack Emissions: Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Asphalt Plant	Asphalt agg. dryer	Baseline (a)	–	(b)	Wet scrubber	0.055	–	–	–	0.003	61–65	35
Asphalt Plant	Asphalt agg. dryer	Gasoline	12	(b)	Wet scrubber	0.20	–	–	–	0.0028	–	35
Asphalt Plant	Asphalt agg. dryer	Diesel	17	(b)	Wet scrubber	0.20	–	–	–	0.0045	–	35
American Soil Processing, Inc.	Rotary dryer	Gasoline, diesel fuel	–	1,400–1,600	Cyclone, baghouse, afterburner	0.03	–	–	–	–	–	(c)
Cardi Construction Corporation	Rotary dryer	No. 2 fuel oil	–	1,600	Cyclone, baghouse, afterburner	0.01	–	10	–	0.001	98	(c)
Clean Berkshires	Rotary dryer	Gasoline, diesel fuel, No. 2 fuel oil	–	1,400	Cyclone, baghouse, afterburner	<0.025	<82	–	–	–	>95	(c)
Clean Earth of New Castle	Rotary dryer	–	–	1,500	Baghouse, afterburner	<0.04	–	–	–	–	98	(c)
Clean Soils	Rotary dryer	Gasoline, crude oil	–	1,600	Baghouse, afterburner	0.02	<20	<20	<50	–	>99	(c)
DRE Environmental, Inc.	Rotary dryer	Waste oil	–	1,600	Cyclone, baghouse, afterburner	0.03	<2	2	–	–	99.9	(c)
Enviro–Klean Soils, Inc.	Thermal processor	Hydraulic oils, waste oils	–	1,400	Baghouse, afterburner	0.04	–	<5	<5	–	98	(c)
Enviro–Klean Soils, Inc.	Thermal processor	Gasoline	–	1,400	Baghouse, afterburner	0.04	–	<5	<5	–	98	(c)
Earth Purification Engineering	Rotary dryer	Diesel fuel	–	(b)	Baghouse	0.13	268 (d)	1,373	–	–	89	(c)

(Continued)

Table C–5. (Continued)

Contractor	Desorber Type	Contaminants	Lead in Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Stack Emissions: Particulate (gr/dscf)	Stack Emissions: Volatile Organic Compounds (ppmv dry)	Stack Emissions: Carbon Monoxide (ppmv dry)	Stack Emissions: Nitrogen Oxides (ppmv dry)	Stack Emissions: Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Falcon Energy Associates	Rotary dryer	Stoddard solvent	–	1,650	Baghouse, afterburner	0.04	1 (e)	11.3	58	–	99.6	(c)
Falcon Energy Associates	Rotary dryer	Gasoline, diesel fuel	–	1,650	Baghouse, afterburner	0.04	1 (e)	11.3	58	–	99.6	(c)
Four Seasons Industrial Services	Rotary dryer	Diesel fuel	–	1,200	Catalytic afterburner, baghouse	0.026	14	2.1	120	–	>99.8	(c)
Four Seasons Industrial Services	Rotary dryer	Petroleum hydrocarbons	–	1,200	Catalytic afterburner, baghouse	0.023	351	2.1	120	–	>99.8	(c)
Midwest Soil Remediation	Rotary dryer	JP–4	–	1,100	Baghouse, afterburner	0.04	<50	<10	<50	0.002	99.8	(c)
Mobile Reclaim, Inc.	Rotary dryer	Diesel fuel	–	1,400	Baghouse, afterburner	0.04	–	–	–	–	–	(c)
Oregon Hydrocarbon	Rotary dryer	Various hydrocarbons	–	1,400–1,600	Cyclone baghouse, afterburner	0.025	1.1	–	–	–	98.4	(c)
Ryan–Murphy, Inc.	Rotary dryer	JP–4	–	800–1,250	Catalytic afterburner, baghouse	0.039	0.42	<1	60	–	98.5	(c)
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,500	Baghouse, afterburner	0.002	40	4.5	–	–	99.9	19
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,600	Baghouse, afterburner	0.002	<40	3	–	–	99.9	19
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,400–1,800	Cyclone baghouse, afterburner	0.002	<40	–	–	–	99.9	(c)
South Coast Asphalt Products	Asphalt agg. dryer	Gasoline	–	(b)	Baghouse	–	175–242 (f)	–	–	0.002	47–64	36

(Continued)

Table C-5. (Continued)

Contractor	Desorber Type	Contaminants	Lead In Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Stack Emissions: Particulate (gr/dscf)	Stack Emissions: Volatile Organic Compounds (ppmv dry)	Stack Emissions: Carbon Monoxide (ppmv dry)	Stack Emissions: Nitrogen Oxides (ppmv dry)	Stack Emissions: Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Stoneco	Rotary dryer	All types	–	1,500	Baghouse, afterburner	0.017	–	–	–	–	>99.68	(c)
Thermal-Clean Services	Rotary dryer	–	–	1,600–2,192	Baghouse, afterburner	0.02	10	–	–	–	99.99	(c)
True Environmental Remediating	Rotary dryer	Fuels and crude oil	–	1,600	Baghouse, wet scrubber	0.04	–	–	–	–	97	(c)
Vanguard-Welltech Environmental	Thermal screw	Diesel fuel	–	1,500	Baghouse, afterburner	–	–	–	–	–	–	(c)
Western Thermal Soils Company	Rotary dryer	Diesel fuel	–	1,400–1,600	Baghouse, afterburner	0.012	<80	–	–	–	>99	(c)
U.S. Waste Thermal Processing	Conveyor furnace	Gasoline	–	1,825	Afterburner, wet scrubber	0.008	23 (d)	2.5	–	0.006	–	43
U.S. Waste Thermal Processing	Conveyor furnace	Diesel fuel	–	1,825	Afterburner, wet scrubber	0.006	16 (d)	1.8	–	0.0023	–	43

(a) Baseline asphalt production, no contaminated soil feed.
(b) No afterburner
(c) Survey conducted by Focus Environmental, Inc., September, 1992
(d) Non-methane VOC's (hydrocarbon basis not identified)
(e) Volatile non-methane organic expressed as carbon.
(f) Total hydrocarbons by flame ionization detector

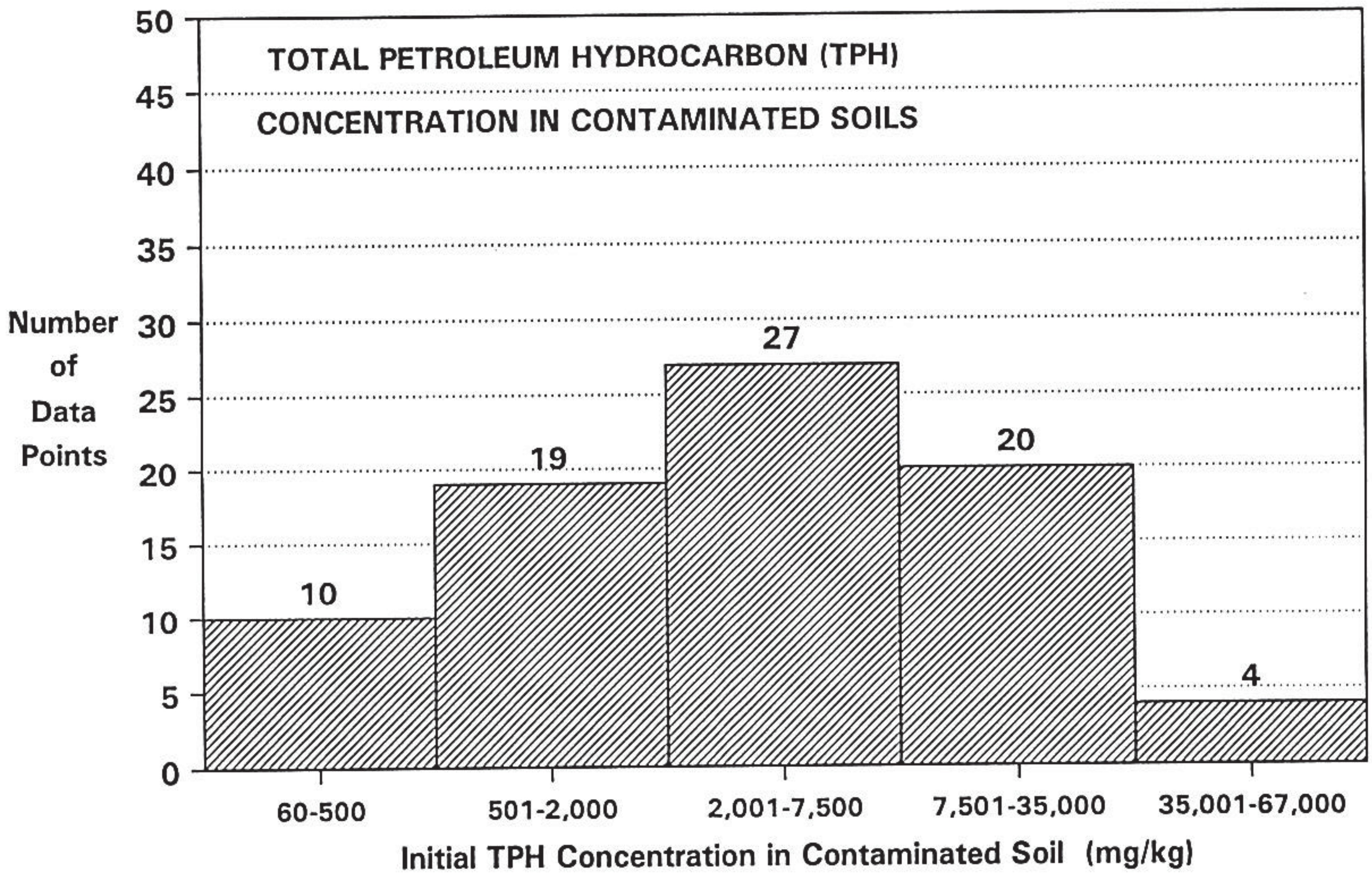

Figure C-1. TPH Concentration Data - Contaminated Soils

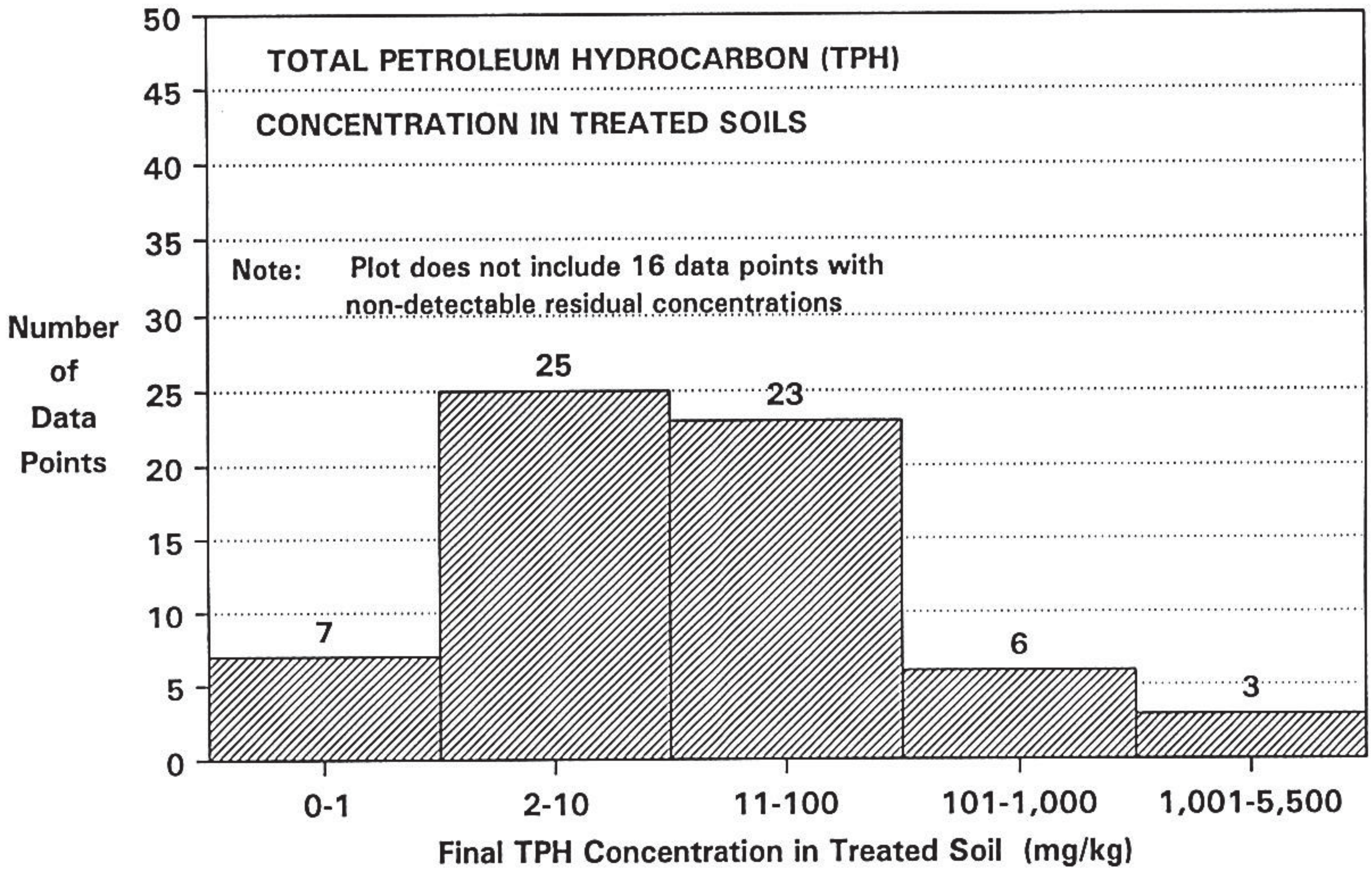

Figure C-2. TPH Concentration Data - Treated Soils

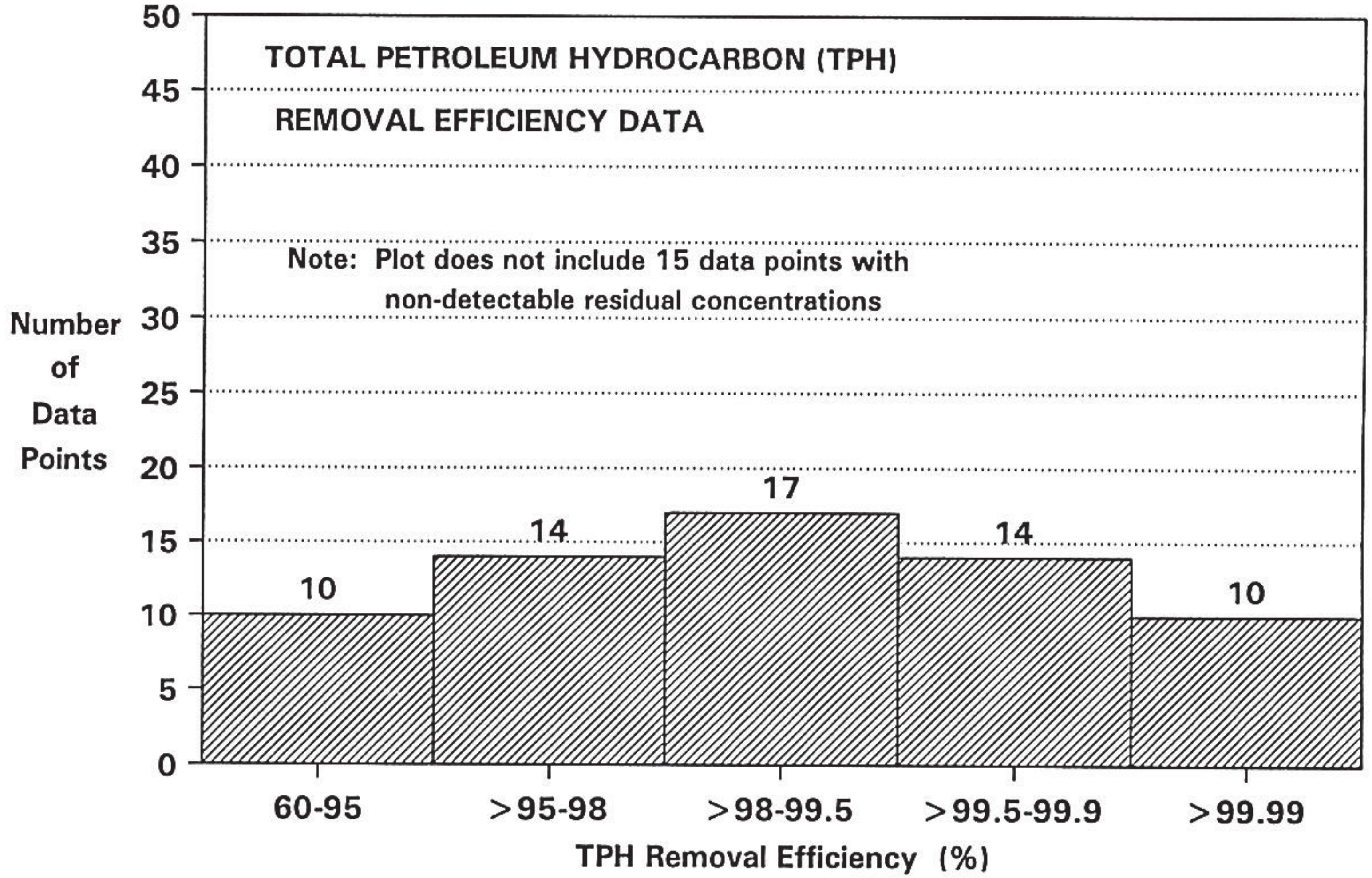

Figure C-3. TPH Removal Efficiency Data

Attachment 5
Revised QAPP Worksheet 11, Table 11-3
(per comment SNW 8)

Table 11-3. DQO #3 – Disposal Characterization for Metals-Impacted Soils

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for metals will be excavated for off-site disposal and waste profile information is needed.
Step 2 – Identify the Goals of the Study: Characterize the excavated metals-impacted soils for off-site disposal as IDW.
Step 3 – Identify Information Inputs: The ROD Amendment identified human health risk for commercial/industrial land use due to antimony and lead, or lead only, at four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4). ROD Amendment (Leidos, 2019) identifies off-site disposal of metals-impacted soil as part of the selected remedy to reduce the risk and be protective of human health. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.
Step 4 – Define the Boundaries of the Study: Metals-impacted soils will be excavated from four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4) as shown on RD Work Plan Table 2-1 and Figures 3 and 6). The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.
Step 5 – Develop the Analytical Approach: One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity. Laboratory results will be provided to the Transportation and Disposal subcontractor who will coordinate with an appropriate disposal facility to obtain approval of the material prior to transporting the excavated soil off-site. Based on generator knowledge, it is expected that these soils will be characterized as nonhazardous. Analytical data quality will be evaluated per this QAPP.
Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. IDW data will not be validated.
Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide SAP (Leidos, 2011), the RD Work Plan and this QAPP. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Table notes:

DoD = U.S. Department of Defense
IDW = investigation derived waste
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCBs = polychlorinated biphenyls
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
SVOC = semivolatile organic compound
TCLP= toxicity characteristic leaching procedure
VOC = volatile organic compound

Attachment 6
Revised QAPP Worksheet 11, Table 11-2
(per comment SNW 8)

Table 11-2. DQO #2 – Treatment Verification

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for PCBs, PAHs and/or explosives will be excavated and undergo ex-situ thermal treatment to meet the cleanup goals.

Step 2 – Identify the Goals of the Study: Confirm that treated soil meets the applicable cleanup goals before being placed back in the excavations as backfill.

Step 3 – Identify Information Inputs: Treated soil will be analyzed for the applicable COCs at a rate of approximately one composite sample per 150 cubic yards (CY) of treated soil.

Step 4 – Define the Boundaries of the Study: Treatment verification sampling will be performed for soil excavated from the planned excavations and treated in the ex situ Enhanced Thermal Treatment cell. Individual treatment cells will be segregated by COCs to facilitate treatment verification sampling and material management based on varying analytical TATs. The temporal boundary for the thermal desorption does not apply.

Step 5 – Develop the Analytical Approach: Treatment verification samples will be collected from treated soil at a rate of approximately one sample per 150 CY of treated soil. Treatment verification samples will be analyzed for the COCs associated with a particular batch of treated soil, based on the excavation from which the soil came as shown on Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP.

The laboratory results will be compared to Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional thermal treatment will be conducted until the cleanup goals are met.

Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed to be of known quality to meet project objectives as defined in Worksheet 36.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide Sampling and Analysis Plan (SAP) for Environmental Investigations (Leidos, 2011), the RD Work Plan and this QAPP. One composite treatment verification sample will be collected per 150 CY of treated soil. As each ETC treatment cell contains approximately 500 CY, the cell will be divided into quadrants for sampling and one composite treatment verification sample will be analyzed from each quadrant. After the soil achieves the target treatment temperature and the burners are disconnected, Iron Creek will utilize the excavator bucket to expose the soil in an approximately 4-foot by 6-foot area to a depth of approximately one foot in each quadrant in order to collect the treatment verification sample. While all of the soil will reach the target treatment temperature, the soil in the outer layer of the quadrant is farthest from the heating elements and therefore will reach the target treatment temperature last. Therefore, sampling the outer layer of soil is most conservative for treatment verification. Decontaminated or disposable sampling tools will be used to collect aliquots of approximately equal volume from 10 locations within the 4-foot by 6-foot by 1-foot exposed area. Each aliquot will be placed in a decontaminated stainless steel bowl to allow for further cooling. The aliquots will then be homogenized and placed into laboratory containers for analysis of the applicable COCs (see Table 2-1 of the RD Work Plan).

Treatment verification samples for explosives will be submitted for laboratory analysis with projected turnaround time of 7 days. Treatment verification samples for soil from locations with PAHs and/or PCBs only are planned for laboratory analysis with projected turnaround time of 48 hours.

If a treatment verification sample meets the applicable cleanup goals, then the associated soil will be cleared by CH2M for use as backfill. If a treatment verification sample exceeds an applicable cleanup goal, then the excavator bucket will be used to expose another approximately 4 by 6 by 1-foot area in the outer layer of the quadrant and a second treatment verification sample will be collected for analysis of the COC that exceeded the cleanup goal.

Depending on the magnitude of the exceedance, the second composite treatment verification sample may be collected immediately for analysis of the COC that exceeded the cleanup goal in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected) or the active heating system may be turned on again to further treat the soil prior to collecting the second treatment verification sample. This decision will be based on the professional judgement of the system operator. Should a quadrant not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling. This process will be repeated until the quadrant meets the applicable cleanup goals. The CH2M CM/FQM will review the sampling results and provide approval before the material can be used as backfill.

Table notes:

CH2M = CH2M HILL Constructors, Inc.
COC = contaminant of concern
CY = cubic yard
DoD = U.S. Department of Defense
ETC = enhanced thermal conduction
PAH = polycyclic aromatic hydrocarbon(s)
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB = polychlorinated biphenyl(s)
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RA = remedial action
RD = remedial design
ROD = Record of Decision
TAT = turnaround time

Attachment 7
Revised QAPP Worksheet 23-1
(per comment SNW 9)

Worksheet #23—Analytical Standard Operating Procedure References

The analytical SOP references in Table 23-1 were provided by the laboratories. Only SOPs for sample data being validated are presented. IDW data will not be validated. Note that the laboratory SOPs have not been modified specifically for this project to meet the DQO requirements. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements and UFP-QAPP to technical staff. Laboratory SOPs are provided as Attachment 2 of this QAPP.

Table 23-1. Analytical SOP References

Reference Number	Title, Revision Number, and Date	Definitive/ Screening Data	Matrix/ Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
LSOP-01	SV-004 Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 11. 8/8/19	Definitive	PCBs	GC/ECD	CT	No
LSOP-02	SV-006 Semivolatile Organic Compounds by GC/MS, Method SW8270D. Revision 0. 5/29/19	Definitive	PAHs	GC/MS	CT	No
LSOP-03	MT-009 Method 6010- Inductively Coupled Plasma. Revision 5.3. 4/16/19	Definitive	Metals	ICP	CT	No
LSOP-04	SV-010, Explosives by Modified Method SW8330B. Revision 5.1. 6/13/19	Definitive	Explosives	HPLC	CT	No
LSOP-05	GT002 Processing of Multi-incremental Samples and Subsampling	Definitive	Explosives, PCBs, PAHs and metals	GC/MS. HPLC, ICP, GC/EICD	CT	No
LSOP-06	Determination of Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 3/29/17	Definitive	PCBs	GC/ECD	Chemtech (treatment verification samples with expedited turnaround)	No
LSOP-07	Determination of Extractable Semivolatile Organic Compounds by Method SW8270D. Revision 6/6/19	Definitive	PAHs	GC/MS	Chemtech (treatment verification samples with expedited turnaround)	No

Table notes:
Chemtech = Chemtech Laboratory, Inc.
CT = CT Laboratories, LLC
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);

Comments received June 11, August 4, August 11 and August 14, 2020

Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 1		The total number of areas subject to excavation and remedial activities seems to be inconsistently referenced in the April 2020 Draft Remedial Design (RD) Work Plan (draft RD work plan). Several places in the draft RD work plan text indicate a different number of excavation areas than are reflected in the Figures and Tables. Below are several places in the draft RD work plan that should be revised:	
	Section 1.2 Scope	Section 1.2 Scope: Line 23 notes that the remedy includes excavation of soil from 25 locations. This number is not consistent in the draft RD work plan. The number provided in the report narratives is inconsistent with the number provided in figures and in tables.	The following text revisions were performed in Section 1.2 Page 1-1, Lines 18-21 were revised to "The ROD identifies 24 locations at Load Lines 1-4 and 12 which require soil removal in order to achieve the Remedial Action Objective (RAO) to reduce risk from contaminants of concern (COCs) in surface and subsurface soil to acceptable levels (remedial goal options [RGOs]) for likely future use (i.e., Commercial/Industrial Land Use) that are protective of human health." Page 1-1, Lines 22-25 were revised to "The approved remedy includes excavation of soil from 24 locations, ex-situ thermal treatment of the majority of the excavated soil, off-site disposal of the remaining portion of the excavated soil (metals-contaminated), confirmation sampling, backfill and site restoration."

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SNW 1 (cont.)	Section 2.2.3 Load Line 3:	Section 2.2.3 Load Line 3: Line 4 indicates there are eight planned excavations. Figure 5 shows 10. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.3: Page 2-3, Lines 4-5 were revised to "Load Line 3 is located in the southeastern portion of the former RVAAP and contains ten (10) planned excavations (Figure 5: Load Line 3 Excavation Plan)." Page 2-3, Line 5-6 were revised to "All but one of the planned excavations within Load Line 3 are located adjacent to or beneath former buildings."
	Section 2.2.4 Load Line 4:	Line 14 indicates there are three planned excavations. Figure 6 shows 6. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.4: Page 2-3, Lines 14-16 were revised to "Load Line 4 is located in the south central portion of the former RVAAP and contains four (4) planned excavations (Figure 6: Load Line 4 Excavation Plan). Three of the planned excavations within Load Line 4 are located adjacent to or beneath former buildings."
SNW 2 Jun 11	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved.	The draft RD work plan references a 2011 Leidos Standard Operating Procedure (SOP) will be used as guidance for conducting incremental sampling methodology (ISM) sampling activities. Based on our May 27, 2020 call with your team to discuss our preliminary comments on this draft work plan, we learned that the contractor, CH2M, had identified a different ISM sampling approach in a Quality Assurance Project Plan (QAPP). The QAPP in Appendix C, page 4, Step 7 of this draft RD work plan cites the 2011 Leidos SOP. Ohio EPA recommends using the most current Interstate Technology Research Council (ITRC) ISM sampling guidance.	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

Comment Resolution Table

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SNW 2 Jun 11 (cont.)		Worksheet #18 shows the locations for collecting soil within the Load Line remediation area, but it is not clear what data quality objective (DQO) was applied to determine the number of samples needed to be representative of the bottom or side wall was necessary. Is this in the 2011 Leidos SOP?	Worksheet #18 is premised on resolution of DQO#1 (Excavation Delineation) presented on Page 2, Table 11-1 of the QAPP. Text provided in Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)."

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SNW 2 Jun 11 (cont.)	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved. (cont.)	Worksheet #20 Field Quality Control regarding duplicates: The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the ISM excavation confirmation samples, the Record of Decision (ROD) Amendment requires that the ISM samples be collected in duplicate. However, to follow current Department of Defense (DoD) and ITRC requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with the DoD Quality Systems Manual (QSM) and ITRC.	Text provided in Table 11-1 Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)." Worksheet #20 text contained on Page 29, lines 22-30 is consistent with the note revision to Table 11-1 step 5 text above; no changes were made to this worksheet.
		Worksheet #21 states "Field Standard Operating Procedures Project sampling activities will be conducted in accordance with the procedures described in the Facility-wide SAP (Leidos, 2011) and this QAPP". This reviewer did not have the Field SOP from Leidos. Please clarify if the ISM sample will be processed in the field or in the lab?	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

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SNW 2 Aug 4	Revised Worksheet 11.1	Step 5. An RSD of 35% as a goal is too high. Ohio EPA recommends an RSD between 5 - 10%.	An RSD of 5 to 10% is not practical or necessary and is not supported by the guidance. The ITRC does not define an "acceptable" RSD for multi-incremental sampling (MIS) but does state that an RSD exceeding 30%–35% from field replicates would be considered "high". However, the Hawaii Department of Health, a leader in the field of MIS and significant contributor to the ITRC, provides the following in the attached Section 4.2.7.3 "Evaluation of Data Representativeness" as part of the discussion on the use of multi increment samples to characterize DUs within their Technical Guidance Manual http://hawaiidoh.org/tgm-pdfs/TGM.pdf: "An RSD less than 35% is considered to reflect good precision for estimates of the average. Good precision implies that the sampling method used, including the number, spacing, and size/shape of increments collected was adequate to capture and reflect small-scale heterogeneity of contaminant distribution within the DU and that error in the laboratory processing and analysis methods was low." And **"RSD ≤35%** .Direct comparison of unadjusted DU data, or the arithmetic mean of replicate data to target action levels, is acceptable when the RSD of the representative replicate data set for the contaminant of concern is less than 35%. Adjustment of the data with respect to the RSD (or calculation of a 95% Upper Confidence Level) is not considered warranted given the overall acceptable sample precision. This assumes, of course, that the samples were collected, processed, and tested in an unbiased manner and are reasonably representative of the targeted DU. **If soil remediation is carried out then unadjusted DU data can be used for confirmation samples.**"

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 2 Aug 4 (cont.)	Revised Worksheet 11.1 (cont.)		Ohio EPA's comment for an RSD between 5 and 10% may be referring to the following from the Ohio EPA Technical Guidance Compendium VA30007.19.002 "Use of Multi-Increment (MI) Sampling in the VAP", effective March 2009, Updated August 2019 https://www.epa.ohio.gov/portals/30/vap/tgc/VA30007-19-002.pdf, which is not referring to an RSD but rather says the results of replicates should not vary from one another by more than 5 to 10%. **This is not the same as the RSD.** "Three replicate MI samples are to be collected within each decision unit. Replicate samples verify that field sampling and laboratory subsampling are being conducted properly. Results from replicate samples also will confirm that enough aliquots have been collected to account for the heterogeneity of the contaminated soil and the size of the decision unit. As a general guideline, replicate concentration values should not vary more than 5-10% from each other. ITRC recommends calculating a 95% UCL of the three replicates to be used as the representative value. Ohio EPA will also accept the maximum value of the three replicate samples per decision unit."

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SNW 2 Aug 4	Worksheet 18	In Section 2 of the SOP it notes the "appropriate decision units must be identified for ISM to be valid". This SOP doesn't provide specific information on how the decision units (DUs) are determined for the AOCs. Clarify what is the representative area of an ISM sample. In our July 31 call, it was noted that a separate ISM sample will be collected for each side wall and a separate ISM sample for the bottom of the excavation. Some excavation areas are subdivided. Clarify the process to determine if additional remedial action would be undertaken at an excavation/OU if the ISM sample is above the CUGs. What parties are informed or involved in the decision making on the additional soil removal activity. Following additional removal is another ISM verification sample collected in the same manner as it had been the first time?	The number of ISM samples for each excavation as shown in Worksheet 18 is based on the shape of the excavation, with the intent being that the sample results will be used to determine if additional soil needs to be removed in a particular direction. The area gridded for each ISM sample is being considered the decision unit. The longest sidewall is for excavation EB10A at Load Line 3; at 285 feet and the contaminated interval at 3 to 5 feet, the east sidewall sample for this excavation will represent a 570 square foot area (0.013 acres). EB10A also has the largest square footage for the bottom (0.23 acres) and will have 3 ISM samples, each representing a DU of less than 0.1 acres. These decision units are small in terms of typical decision units/exposure areas (i.e., the decision units do not need to be this small in order to represent exposure for any receptor), with the DU sizes for this effort being driven by the logistics of excavating, since an exceedance requires additional excavation. Note that sidewall samples are not planned for sidewalls that abut building foundations, or areas excavated during previous remedial actions since the adjacent material is clean backfill. Worksheet 18 has been revised to include directional descriptors in the location column for irregularly shaped excavations (i.e., instead of Sidewall 1, Sidewall 2 etc. the location column has been revised to Sidewall North 1, Sidewall North 2, etc.), and the Load Line figures from the Work Plan have been added to the QAPP with labels added for irregularly shaped excavations to indicate the planned confirmation sample locations.

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SNW 2 Aug 4 (cont.)	Worksheet 18 (cont.)		If a sidewall or bottom sample exceeds the applicable cleanup goals, CH2M will inform the USACE COR (Nat Peters) to discuss removal of additional soil at that location. The USACE COR may consult with additional parties, such as the Katie Tait (OHARNG Restoration Representative) and Kevin Sedlak (ARNG Restoration Representative) Once authorized by the USACE COR, additional soil will be removed in the direction of the exceedance, typically in one-foot increments (if the exceedance is more than one order of magnitude above the applicable cleanup goal, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, another ISM excavation confirmation sample will be collected in the same manner as the first and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. For a sidewall exceedance, an additional sample will be collected from the corresponding sidewall of the extension and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR. Once all sidewall and bottom samples for an excavation meet the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil treated.
SNW 2 Aug 4	General	QAPP Worksheet Table Notes: ITRC = Interstate Technology & **Regulatory** Council	ITRC corrected to Interstate Technology & Regulatory Council

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SNW 2 Aug 11	Revised Worksheet 11.1	We had a chance to look over the RTC for the RSD comment [SNW 2, Aug 4, Revised Worksheet 11.1] and have some feedback that we can discuss further during Thursday's call. Response stated "The RSD is not the same as the 5-10% difference goal" in Ohio EAP FSOP. We can accept the <35 RSD with the addition of Ohio EPA's recommendation of < 10% difference between replicate sample concentrations as a goal. That would mean we have two goals to use in the evaluation of triplicate confirmation samples. Ohio EPA recommends that if the values are above either criterion, then Ohio EPA reviews the data prior to any decision on the removal meeting performance standards at the AOC/DU. The other option could be a blanket failure and you would excavate more and resample.	On August 13, a teleconference with representatives from the Ohio EPA (Sue Netzly-Watkins, Tom Schnieder, Bob Princic, Brian Tucker), ARNG (Katie Tait, Kevin Sedlak), USACE (Nat Peters) and CH2M (Sarah Meyers, Doug Scott) focused on the RSD and percent difference requirement for ISM triplicates. The ARNG and USACE are not aware of a requirement this low being applied on projects elsewhere and has not been applied for ISM at other RVAAP projects. Ohio EPA stated that the responses to the other comments were fine. For the ISM triplicates, CH2M asked about the basis for Ohio EPA's request of a 10% difference between replicates, if it had been applied on other sites and how did it work out. Sue Netzly-Watkins is not aware of it being applied elsewhere. Brian Tucker stated that the question really comes down to how much oversight the Ohio EPA would have for this project, so they wanted to tighten up the percent difference such that they would be consulted/provided with the sample results before the excavations are backfilled. Kevin Sedlak stated that they have never had Ohio EPA involved in the decision of when to backfill, that they have done a lot of digging remediation without Ohio EPA raising this issue, and that delays in making that decision are costly due to the amount of equipment and personnel on site as well as extended management of the open excavations and backfill material. So the Ohio EPA review of analytical data would need to be done in real time, not over the course of a week or several weeks. When asked who at Ohio EPA would be doing the review, Ms. Netzly-Watkins stated that they would talk internally about it and that she assumes this would apply to all the RVAAP sites with thermal treatment. It was discussed that triplicates are not planned for every sidewall and bottom ISM sample, but rather would be collected

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SNW 2 Aug 11 (cont.)	Revised Worksheet 11.1 (cont.)		at a rate of 1 in 10 at random locations. Nat Peters suggested that the triplicates could be collected at the beginning of the excavation confirmation sampling effort instead of randomly so that the RSD and percent difference could be evaluated sooner. Ms. Netzly-Watkins stated that if the triplicates all meet the cleanup goal then the RSD and percent difference don't matter. Kevin Sedlak stated that if any of the three replicates is above the cleanup goal then the highest replicate value would be used and additional soil would be excavated. Mr. Tucker stated that it is not that cut and dry since meeting the cleanup goals is not the only thing. Mr. Sedlak asked for concrete direction from Ohio EPA and that Ohio EPA is welcome to have a representative on-site, but specifics are needed from Ohio EPA. Ms. Netzly-Watkins stated that she appreciated the upfront delivery of responses to comments and the discussion, and that they are looking at this as precedent (i.e., not just for this site). Ohio EPA will get back to the Army on August 14 with path forward.
SNW 2 Aug 14	Revised Worksheet 11.1	Thanks again for meeting with us to discuss the RTC - QA/QC step for the LL 1-4 and 12 RD. Ohio EPA has been taking a closer look at DQOs being applied at remedial projects across the state to ensure consistent application of ISM. In the attachment, we outlined the points discussed yesterday: **"GOAL:** Meet the remediation goal at the RVAAP Areas of Concern (AOCs) with a high level of confidence that field sampling errors and laboratory analysis errors have been minimized. Clear direction is requested so RVAAP team can detect issues with field sampling or laboratory sample preparation. Keeping Ohio EPA in the loop on the quality control checks will increase our confidence of the results.	

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)	**ACTION**: Revise Step 5 to include update data quality (DQ) steps to ensure appropriate use of incremental sampling methodology (ISM). Develop an "if…then" decision tree. This is a two-part quality assurance/quality control (QA/QC) where both the field team's performance and the laboratory's performance need to be within the limit deemed necessary to show the remediation goal was met. Ohio EPA recommends front loading the triplicate sampling QA/QC. The first three confirmation ISM samples should be taken with field triplicates and laboratory duplicates and the results submitted to Ohio EPA for concurrence on meeting data quality objectives (DQOs). Following the initial sampling and data review, the listed 1 triplicate per 10 samples is recommended. If necessary, Ohio EPA will notify RVAAP when the tightness of the data quality is an issue. The goal will be to meet the ITRC guidance of a relative standard deviation (RSD) of 30-35% of the field samples, laboratory samples should be lower. In addition, Ohio EPA will also review the data with above RSD and their FSOP internal guidance and note if there are any concerns with data quality and if our FSOP should be revised. Note: If sample personnel are significantly changed following the initial quality check then, another three ISM sample evaluation may be needed.	QAPP Table 11-1, Step 5, Develop the Analytical Approach, has been revised to state "An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample triplicate for metals and the RPD for laboratory subsample duplicates (ISM analyses for PAHs and PCBs). An RSD of less than or equal to 20% will be the goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples)." QAPP Table 11-1, Step 6, *Specify Performance or Acceptance Criteria*, has been revised to state that "In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample triplicate samples (ISM metals and SW8330B explosives analyses) and laboratory subsample duplicate samples (PAHs and PCBs) will be submitted to Ohio EPA for concurrence on meeting the following DQOs: • An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the field ISM triplicate sample data evaluations. • An RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)		• An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for metals, PAH, and PCB analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples). If these DQOs are not met for the ISM triplicates samples or the associated laboratory subsample replicates, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see QAPP Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016)." Throughout the QAPP, the RSD requirement for ISM field triplicates has been revised from "35%" to "less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%)". See WS20, WS23, WS28-1, WS28-2, WS28-3, WS28-4, and WS37. A Quality Control check has been added to Work Plan Table 9-1, *QC Inspections*, to check that ISM field triplicates and associated laboratory ISM subsamples duplicates/triplicates meet the DQOs specified in QAPP Table 11-1 and that the results have been provided to Ohio EPA for concurrence. **Pages revised in response to this comment are provided as an attachment to support this comment response.**

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SNW 2 Aug 14 (cont.)	Revised Worksheet 11.1 (cont.)	• As noted in the Hawaii guidance provided for review (http://www.hawaiidoh.org/tgm-Content/0402a.aspx?f=T): "(t)riplicate samples (*i.e.*, original sample plus two replicates) should be collected to evaluate the precision of field sampling methods used. Each set of replicate increments must be collected from completely independent (systematic random) locations. Collection of increments around a single grid point is not appropriate for replicate samples, since this might not adequately test small-scale variability within the decision unit (DU)." Revise step seven (7) to be consistent with the method provided above.	QAPP Table 11-1, Step 7, *Develop the Detailed Plan for Obtaining Data*, has been revised to state "If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). **Pages revised in response to this comment are provided as an attachment to support this comment response.**
		• Ohio EPA concurs that if any of a triplicate ISM samples exceeds a cleanup goal (CUG), then additional excavation and confirmation sampling would be required."	QAPP Table 11-1, Step 7, *Develop the Detailed Plan for Obtaining Data*, has been revised to state "If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6. If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled. If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if a field replicate sample exceeds an applicable cleanup goal." **Pages revised in response to this comment are provided as an attachment to support this comment response.**

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SNW 3	Section 5.4 Thermal Treatment	Provide further clarification in the text of on the design of the thermal treatment system: Are the laterals sealed on the ends or does heated air flow entirely through them?	The laterals are not sealed on the ends, they are perforated – allowing the hot air to flow through and conductively transfer heat to the soil. Text describing the treatment system in Section in 5.3.5 has been edited as follows: Page 5-7, Lines 10-11 were revised to "Perforated lateral steel pipes (3.5-inch x 16-feet) will be attached to each side of the manifold using tees placed along the cell length." Page 5-7, Lines 12-16 were revised to "A second layer of pipes composed of 12-foot perforated laterals and a 12-inch diameter manifold will be placed on top of the second layer of contaminated soil. A third layer of contaminated soil will be placed upon the pipes and manifolds. Followed by installation of a third layer of perforated lateral pipes (9-foot laterals) and 12-inch diameter manifolds."
		Where does the hot air stream from the manifolds go at the end of the dirt pile?	Supplemental text describing hot air was provided in Section 5.3.5. Page 5-7, After line 18, the following text was inserted: "During operation of the ETC treatment cell, hot air is injected into each manifold where it flows into each lateral. As the heated air exits each perforated lateral, it is forced through the soil providing treatment. Air and contaminant vapor pushed through the soil is subsequently captured by the Quonset hut cover (described below). Vapor extracted from the Quonset hut cover is destroyed using a standalone Thermal Oxidizer described in section 5.4.2."

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SNW 3 (cont.)	Section 5.4 Thermal Treatment (cont.)	Section 5.3.5 Soil Stacking indicates that the total height of the typical soil cell will be approximately 9.5 feet at the top; however, in Section 5.4.2 Thermal Oxidizer it indicates that the insulated steel chamber is only five feet high. So, roof height differs in the thermal oxidizer unit and the soil cells?	The ETC treatment cell and thermal oxidizer are different pieces of equipment. The ETC cell is 9.5 feet high as described in Section 5.3.5; the thermal oxidizer is approximately 5 feet high as detailed in Section 5.4.2. Supplemental text in Section 5.3.5 was provided as noted previously to differentiate treatment system components and function.
		It is not clear if the Thermal Oxidizer unit described in this draft RD work plan is the same as the VEG Technology used in the pilot study. Please provide comparison information on these two treatment systems that show this proposed thermal treatment system is as effective as the previously used VEG Technology. It is unclear why the VEG Technology is proposed in the draft RD work plan for Load Line 9 and is not being used at Load Lines 1-4 and 12. Please provide a brief explanation of the rationale for this difference.	The thermal treatment described in the Work Plan is not the VEG technology used in the pilot study. The federal government is not permitted to specify a treatment technology in Request for Proposals (RFP). The RFP requested thermal treatment for the soil remediation at the sites. The VEG contractor was on one of the teams but due to a death of their president shortly after the site visit, they removed themselves from the bidding process. Additionally, the VEG process is a proprietary technology. Therefore, the contractor for the RA is not privy to the technical details to provide a comparison. The ETC technology has been used to successfully treat a broad range of petroleum hydrocarbon impacts including diesel range organics, crude oil, coal tars, heavy hydrocarbons and PAHs. This design has been deployed around the world to effectively remediate hundreds of thousands of tons of hydrocarbon and organic contaminant impacted soils since the mid 1990s and several of these projects have been remote in nature. To date, projects have been successfully completed for many organizations including Progress Energy, Chevron Corporation, U.S. Navy, U.S. Department of Defense, U.S. Department of Energy, Department of Transportation, Department of Corrections, NOAA, and Thiess Services.

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SNW 4	Section 5.6.2 Treatment Verification Samples.	A flow chart or decision tree showing the decision process would be helpful to clarify the following: the use of the second verification sample, what action will be taken if the first sample exceeds cleanup standards, what happens if the second sample is below cleanup standards, how will the next decision for backfilling or additional treatment be made?	Once a sample from the treated soil meets the applicable RGOs, the soil will be considered suitable for backfill. The CH2M Construction Manager/Field Quality Manager will confirm that the soil has been sampled and has met the applicable RGOs before approving its use as backfill. Text has been added to Section 5.6.2 to clarify as follows: Page 5-14, Lines 20-23 was revised to "If the magnitude of the exceedance is small, a second composite treatment verification sample will be collected immediately for analysis of the COC that exceeded the RGO in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected)." Page 5-14, Lines 24-25 was revised to "If the magnitude of the exceedance is large, the active heating system will be restarted to provide additional treatment prior to collecting the second treatment verification sample." Page 5-14, Lines 26-27 was revised to "The decision to restart the heating system will be based on laboratory analytical measurements and the professional judgement of the team members including the system operator."
SNW 5	Section 5.8 Backfill and Site Restoration.	Are there any calculations as to the volume of the projected estimate for treated soil and estimated volume of clean fill to restore the site to its original contours?	The ex situ soil treatment process does not impact the volume of the soil; therefore, it is expected that off-site backfill material will only be required to make up for the volume of excavated soil that is transported and disposed off-site. As detailed in Table 2-1, approximately 160 yards of soil contaminated by metals will be excavated and disposed off-site. Remaining soil with organic contaminants (roughly 5,700 cubic yards) will be treated to meet remedial goals and reused in backfilling operations.

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SNW 6	Section 7 Environmental Management	Line 8 indicates that, "a separate vegetation removal plan will be submitted under separate cover to describe this activity." Ohio EPA did not receive this plan prior to performing the tree felling activities which we understand occurred prior to March 31, 2020. Is this the February 21, 2020 Iron Creek Group letter included in this submittal?	Yes, the referenced submittal constitutes the vegetation removal plan developed by Iron Creek. Page 7-1, Lines 5-10 were revised to "Text in the introduction to Section 7 has been revised to read: "Felling of trees larger than 3 inches in diameter at breast height in areas of excavation was performed prior to March 31, 2020 to prevent wildlife (including the Northern Long Eared Bat) from nesting within the areas of excavation. Because this activity occurred prior to completion of this RD Work Plan, a separate vegetation removal plan (Appendix A) was submitted under separate cover to describe this activity and approved by the Army."
		The CERCLA exemption does not apply to the existing facility roadways. In our discussion with representatives of the Akron Regional Air Quality Management District (ARAQMD), they requested to be provided a roadway installation date to determine if the particulate emission (PE) limit applies to this project. If you will be adding new roadways this would be considered a modification, assuming the roadway remains after this remedial activity is completed.	No additional roadways will be constructed for this project. Page 7-2, Following Line 4, the following text was added "No additional roadways will be constructed for this project. The existing roads in the load lines and south service road were built in the early 1940s as the facility was constructed. Many of the existing load line roads are old railroad beds that were used for area access following removal of the rails that formerly served facility operations. Access to the excavation and treatment areas will be gained using existing travel paths within the various load lines (primarily the former rail beds) which will remain unimproved. External travel between the load lines will be via existing road infrastructure at the facility."

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SNW 6 (cont.)	Line 30 Section 7.2 Air Permitting	Include more in the draft RD work plan on how you will address fugitive dust to address the substantive requirements of the regulation. The draft RD work plan Table 7-2 "Review of Rule Applicability" identifies broadly the federal or state air regulation that applies to the proposed activities. The table notes that the facility will submit required reports and conduct monitoring if required by Ohio EPA under Ohio Revised Code 3745-15.	Additional text has been added to Section 8.2, Dust Controls Page 8-2, Lines 18-21 the following text was added: "In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust. During instances of high winds resulting in excessive dust, additional dust control measures or work stoppage may be implemented.
		Table 7-2 indicates that Chapter 17 - Particulate Matter Standards apply. The "Comments" column on the table notes that emissions of fugitive dust from roadways and construction activities will be minimized by the use of water or other suitable dust suppression chemicals. Provide additional information in the RD work plan to address fugitive dust. In addition to water, decreasing vehicle speed, truck tarping, and reducing the drop height of materials can also help mitigate fugitive dust. Clarify under what conditions may work be stopped to address fugitive dust issues and who and at what frequency will you monitor fugitive dust at roadways, parking areas, soil piles and at the thermal treatment area.	Additional text has been added to Section 8.2, Dust Controls as noted below: Page 8-2, Line 15, the following text was added "Iron Creek personnel, including the Site Supervisor, will monitor working conditions and fugitive dust throughout daily operations. During operations, the crew will be working along the active haul routes, excavation area(s) and at the treatment pad itself. Real time conditions will be communicated to the Iron Creek Site Supervisor and work stoppage related to mitigating fugitive dust will be at the Site Supervisor's discretion." Page 8-2, Lines 23-24 the following text was added "In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust."

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	Confirm any soil piles created as a result of the remedial action described in this work plan are temporary and are associated to this remedial action. The draft RD work plan noted that topsoil will be placed near the excavation area. Clarification is needed if this would include just sod or if loose soil will be piled at these locations. Please describe work practices to be implemented to mitigate against fugitive dust releases at all stages/locations of the remedy, and controlling waterborne runoff, etc.	Based on field reconnaissance of the proposed excavation areas at the facility, it appears that the majority of the surface material to be removed prior to excavating is composed of sod and duff. This material, along with any surface growing media will be removed and placed adjacent to the excavation for storage while soil treatment operations for the impacted soil is underway. Table 7-2 the following text was added in the comments column for OAC 3745, Chapter 17: "Erosion control measures, as outlined in the Section 8 of the Work Plan, will be implemented as needed to prevent runoff and/or fugitive dust emissions at all work areas and during all stages of the RA. This includes regular inspection of excavation areas and soil piles, implementation of non-structural BMPs (minimizing disturbance, quick turnaround of backfilling and vegetation reestablishment, etc.), installation of structural BMPs (berms, silt fence, etc.), and application of dust suppressant, as required."
		It is our understanding from our May 27, 2020 call with RVAAP and USACE personnel that the backup generator is propane-fueled. Revise the draft RD work plan to clearly state what fuel type is used to power the 125-kw generator noted in the draft RD work plan under section 5.2.4. Confirm it is exempt as a non-road engine under Ohio Administrative Code (OAC) 3745-31-03(B)(1)(qq).	Text was added to specify generator fuel source as noted below: Page 5-1, Line 34 "propane-fired" was inserted before 125 (kw) generator. Page 7-2, Lines 32-34 the following text was added "The portable engine is propane fired and meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)." Table 7-2 2 the following text was added in the comments column for OAC 3745, Chapter 31: "The propane-fired 125 kw generator meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)."

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov);

Comments received June 11, August 4, August 11 and August 14, 2020

Date: Responses provided June 29, August 10, August 13 (teleconference) and August 25, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	The substantive requirements for the thermal oxidizer will need to be met. OAC 3745-17-07 (A)(1)(a) indicates that visible particulate emissions for any stack shall not exceed 20% opacity, as a six-minute average. Please include the OEM documentation on volatile organic compound (VOC) destruction efficiency at the 950° F operating temperature.	Attached is the Thermal Desorption Applications Manual that provides the destruction efficiency for thermal oxidizers operated on multiple projects. As highlighted in table C-5, DRE numbers exceeding 99% are achieved at operating temperatures in the 1,400 to 1,600°F range, which is more in line with operational conditions that we expect for this project. The minimum operating temperature of 950°F is included in the RD text as it is a common Code of Practice baseline for the bottom end of operational temperatures for this type of equipment, while the higher temperatures in the 1,400 to 1,600°F range are more indicative of what we expect to see at Ravenna. In terms of opacity, we would not expect to see stack exhaust opacity near the 20% range for this project for any oxidizer temperature >950 °F, however, the higher temperatures referenced will demonstrate the VOC removal efficiency, as outlined in the manual. Page 5-11, lines 11- 12 the following was text was added "The minimum operating temperature of the thermal oxidizer is 950 degrees Fahrenheit (°F); the typical operating range for this type of waste is 1,400 to 1,600°F."
SNW 7	Section 8 Storm Water Pollution Prevention	Appendix D - Iron Creek Stormwater Pollution Prevention Inspection Checklist & Corrective Action Log: Will this be implemented at the ETC area, roll-off box storage areas and excavation areas? By whom?	This will be implemented at all areas of the site involved in the remedial action including the ETC treatment area, excavation areas, and storage areas; and will be coordinated by the onsite Iron Creek Supervisor. The metals-impacted soils in roll-off boxes will be transported off-site as soon as possible pending the disposal characterization analytical results and completed waste profile/shipping manifests.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8	Table 11-2 DOO#2 Treatment Verification	Process clarification is needed: Steps 1 and 2 Because confirmation sampling includes analysis for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and explosives, what management steps are taken at soil excavation areas when the soil from the excavation is not heading to ETC, but will be disposed offsite due to metals?	Text has been added to Work Plan Section 5.3.1 for clarity regarding soil management steps for metals-impacted soils. Page 5-4, Lines 14-22: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. The total estimated volume of metals impacted soil scheduled for disposal is +/- 160 CY. Stormwater Pollution Prevention best management practices (BMPs) outlined in Section 8 will be integrated into the excavation operations, as required." Table 11-3 has been added to the QAPP to describe the DQO for sampling the metals-impacted soils for disposal characterization. The table is also provided as an attachment to support this comment response.

Comment Resolution Table

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	More detail is needed on how the soil excavation areas are managed: Will soil go directly into roll-off box containers? QAPP Section 5.3.2 indicates that impacted soils will be excavated ant then transported to the ETC pad. Confirm if at any time, will the impacted soils be stockpiled on the ground prior to treatment and verification?	Text has been added to Section 5.3.2 (Soil for Ex Situ Thermal Treatment) for clarity. Page 5-4, Lines 24 -33, the following text was added "For each planned excavation area with soil that will be thermally treated, the overlying uncontaminated surface soil, if applicable (see Table 2-1), will be removed and stockpiled nearby; erosion/runoff mitigation for the stockpiled uncontaminated surface soil will be implemented per Section 8. The impacted soils will then be excavated to the boundaries of the surveyed area as shown on Figures 3 through 7 and placed into a truck to be transported immediately to the ETC pad shown on Figure 8. Once the material arrives at the ETC pad wheel loaders will be used to place it directly into one of the ETC cells for thermal treatment. Each ETC cell will contain a soil volume of +/-525 CY. Stockpiling of the impacted pre-treatment soil is generally not required at either the excavation area or at the ETC treatment pad. Stormwater Pollution Prevention BMPs outlined in Section 8 will be integrated into the excavation operations, as required."
		Once a roll-off box is full, will it be stored at the excavation site for some time prior to being transported under tarp to the ETC or at another area at RVAAP, or will it go directly offsite if it is one of the four metal contamination area or waste not slated for ETC?	For metals-impacted soils, the soil will be placed in roll-off boxes pending the results of disposal characterization analytical results and waste profile/shipping documentation. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	Will soils treated from a particular excavation area be placed back in the same excavation area where it originated?	Not necessarily. Soil handling logistics will drive where the treated soil is used as backfill.
		Are roll-off boxes transporting the untreated soil decontaminated if they will be used to transport treated soil?	Roll-off boxes will be used to contain soil excavated from metals-impacted locations pending the results of disposal characterization sampling. The roll-off boxes are not involved in the ex situ thermal treatment of soils. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. In addition, details regarding decontamination procedures were added to section 5.7 as follows: Page 5-15, Lines 31-35: "Trucks used for transporting soil material will be decontaminated when shifting from hauling impacted soil to clean treated soil. The equipment will be decontaminated utilizing a pressure washer at the proposed lined, decon area located within the treatment pad and waste water collected from the process will be added to the treatment cells for processing with the impacted soil material."
		Will treated soil be transported under tarp?	Trucks transporting soil to and from the ETC process within RVAAP do not require tarps.

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	Step 3 notes that treated soil will be analyzed for chemicals of concern (COCs) at a rate of one sample per 150 cubic yards of treated soil. Clarify that the ISM sample(s) are collected while the soil is in the ETC. It is unclear how the treated soils in quadrants with verification samples below standards will be managed while a failing quadrant is subject to further treatment. Clarify if the entire load in the ETC unit goes through additional treatment or, will quadrants that pass be removed and stockpiled? Would new untreated soil go in? What sampling technique will be used for the ETC soil; ISM (ITRC guidance or 2011 Leidos), discrete?	The treatment verification samples will be collected as composite samples as described in Table 11-2 (not incremental samples) while the soil is in the ETC. Supplemental text provided below was added to Section 5.6.2 of the Work Plan. In addition, this text was also added to Table 11-2 which is provided as an attachment to this comment response table. Page 5-14, Lines 28-30, the following text was added "If a quadrant does not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling."

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 9	QAPP-Appendix A	Confirm that the lab receiving the sample can achieve the necessary detection limits necessary. The QAPP Table 15 shows the cleanup goals, reporting limits, detection limits, etc. and Worksheet #23 lists the labs that will be used for specific parameters: CT will be conducting PCB, PAH, metal and explosive work. Chemtech is doing just PCB and PAH work. It is not clear how work is divided between these two labs when the work involves PCBs and PAH analysis.	Laboratories identified for project use have confirmed capacity to achieve required analytical detection limits. There was not one lab that could do all of the analyses at the desired expedited turnaround times. Chemtech Laboratory (CT) was added to allow us to get rush data on PCBs and PAHs for the treatment verification samples. Page 12, Lines 3-4, the following text was added to the QAPP "CT Laboratories is the primary laboratory and will analyze the majority of the soil samples. Chemtech Laboratory will support expedited TAT for some treatment verification sample analyses." With identification of CT as the primary project laboratory, Analytical SOP references presented in Table 23-1 on Worksheet #23 were updated to include "LSOP-05, GT002 Processing of Multi-increment Samples and Subsampling". Table 23-1 is provided as an attachment to this comment response table.

Attachment 1
Incremental Sampling of Surface Soil
Standard Operating Procedure (per comment SNW2, June 11)

STANDARD OPERATING PROCEDURE

Incremental Sampling Method for Surface Soil

1 Purpose and scope

The purpose of this standard operating procedure (SOP) is to summarize requirements for the effective field implementation of increment sampling method (ISM) for soil undertaken as part of site characterization at contaminated sites. The ISM soil sampling process provides a view of mean contaminant concentrations over the area of a DU.

This SOP applies to all CH2M HILL personnel and subcontractors who perform ISM activities, and is limited to describing methods for obtaining surface soil samples (considered less than 1-foot below ground surface) for non-volatile, semi-volatile and inorganic analyses using ISM techniques. ISM techniques have been developed for volatile organic compounds and subsurface soil, however, they are not included in this SOP. This SOP was developed according to the following reference documents:

- *American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.*
- *Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.*
- *ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.*
- *Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.*
- *Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.*
- *Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.*
- *U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.*

This SOP focuses on the most commonly used ISM soil sampling tasks and applications anticipated at a field site and should be used in conjunction with other applicable project SOPs.

2 General

The objective of ISM is to reduce the variability created by taking discrete samples, and improve the reliability and representativeness of environmental data by obtaining multiple sub-samples (sample increments) over a decision unit (DU) (defined as the area or volume in question). These "increments" are combined into one bulk ISM sample, which is submitted to the laboratory, resulting in a better representation of actual mean concentrations in a DU.

The DU encompasses the area or volume about which a decision is necessary (e.g., deciding whether risks are acceptable or not). Appropriate decision units must be identified for ISM to be valid. Therefore, the identification of decision units is one of the most important factors when using ISM. Identification and delineation of the decision units should be conducted during project planning and identified in a client and regulatory approved Workplan prior to obtaining ISM samples. Since ISM sampling provides an "average" concentration of a DU, agreement on the DU boundaries is extremely important prior to collecting the "bulk increment sample".

The number of increments incorporated into the bulk ISM, and the overall size of the ISM collected are not dependent on the size of the decision unit. The sampling theory is based on an assumption (and empirical observations) that 30 to 100 increments from a given decision unit of any size will result in a sample that is adequately representative of the average contaminant level in the decision unit as a whole. If the decision unit is the size of a small backyard garden, then 30 to 100 increments are collected. If the decision unit is a 10-acre, neighborhood-size area in a former agricultural field, then 30 to 100 increments of a similar mass are likewise collected.

If the contaminant distribution is expected to be very heterogeneous, it may be preferable to increase the number of increments collected to the recommended maximum of 100 for larger DUs. This may help to reduce field sampling error and minimize the variation between replicate samples used to evaluate the precision of the data collected. It has been reported that increasing the number of increments from 30 up to 100 may improve the reproducibility of data collected, and since the ISM sample is submitted as one sample, the number of increments collected does not typically increase analytical costs except that a small fee may be added for the excess sample mass management in the laboratory.

This SOP describes procedures for selecting sampling locations, marking field sampling locations, collecting incremental soil samples, and submitting these samples for laboratory analyses. This SOP assumes that the DU, and method for selecting increment locations within the DU has already been determined in the project work plan or project Quality Assurance Project Plan (QAPP), and that analyses and the laboratory conducting the analyses have been identified in the QAPP.

3 Responsibilities

This section describes the responsibilities of key project personnel including the PM, SM, DM, HSM, FTL, and field sampler.

3.1 Project Manager

The PM provides adequate resources and engages field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The PM will solicit the appropriate technical expertise to adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the PM should be consulted if complications arise in following sample handling and custody procedures.

3.2 Site Manager

The SM coordinates and schedules daily field activities. In addition, the SM trains field staff engaged in this activity and ensures compliance with this SOP.

3.3 Data Manager

The DM maintains and manages the sample tracking and scheduling program used to track field ISM samples. The DM should consult the SM, FTL, and Project Chemist regarding ISM soil sampling field sample processing.

3.4 Health and Safety Manager

The HSM is responsible for site-specific HS&E oversight and overall compliance with project HS&E requirements. The HSM conducts HS&E evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project-specific HSP, and coordinates with the SM to complete and certify the HS&E program.

3.5 Field Team Leader

The FTL maintains compliance with ISM sample techniques and methods, particularly the procedures to be used. The FTL, or their designee, should know the requirements of ISM soil sampling and maintain adequate documentation of sample collection activities. The FTL should take responsibility for collecting ISM samples accurately and correctly and for coordinating with the SM and data manager to successfully conduct any ISM field sample processing before laboratory analysis.

3.6 Field Sampler

The Field Sampler, under the supervision of the FTL (who may be the same person), should confirm that samples are correctly collected, labeled, tracked by chain of custody, and stored until they are delivered to the FTL or data manager. The Field Sampler should maintain custody of the samples until they are relinquished to the FTL or data manager. The Field Sampler informs the FTL and/or data manager of sampling conditions and potential deviations in sample collection.

3.7 Project Chemist

The project chemist is responsible for ensuring that the laboratory selected to analyze the ISM samples is qualified to do the work and meet the project data quality objectives (DQOs).

4 Procedures

ISM samples are prepared by typically collecting 30 to 50 small increments (samples) (up to 100 may be needed if a soil at the DU is determined to be very heterogeneous) of soil from systematic random locations within a specified decision unit and combining these increments into a single sample, referred to as the "bulk ISM sample." Individual soil increments typically weigh between 30 and 50 grams, with bulk ISM typically weighing between 900 and 2,500 grams. The mass of the final bulk ISM depends on the number of increments collected, the size of the sample collection tool utilized. However a minimum final sample size should not be less than 1 kilogram as a general guideline.

4.1 Reconnaissance, Planning and Field Staging

During the DU planning process (Work Plan stage of project), a historical records search and site walk should be conducted to determine if there are areas that may have elevated levels of contamination as it may be desirable to break these "hotspots" into separate decision units. It is also useful for planning sample collection locations if access to some areas will be difficult. Logistics of sampling around buildings or sampling in areas of heavy vegetation should be considered when setting up the random grid (discussed in the following section).

4.2 Setting up a Stratified or Systematic Random Grid

A systematic random or stratified random sample collection scheme is developed from a random starting point in the DU. Typically a systematic random grid is the preferred sampling method. However, both strategies result in sample collection points spread out approximately equally across the DU. For example, a square-shaped decision unit could be divided into six rows and five columns with six increments collected from each of the five rows in a systematic, random fashion to obtain 30 increments for one bulk ISM.

The following are the definitions for these two sampling collection options:

1. Stratified Random Sampling Mode: DU into representative strata, sample at random within each strata, with number of samples proportional to relationship of each strata to the entire DU. This is used when there is high heterogeneity expected within the DU.
2. Systematic Random Sampling: DU into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

The project planning documents should generate a map, showing the DU(s) and approximate proposed sample locations (increments) within the DU(s). Random locations for incremental sample collection points can be pre-determined in the office using a random number generating program, or in the field. For more rectangular-shaped decision units, a fewer number of rows might be used with more increments per row collected. Row lengths and increments per row may be modified as needed for odd-shaped decision units.

4.3 Field Delineation of DU

Corners of the DU and some other strategic locations should be entered into a Global Positioning Device (GPS) in the office prior to going to the field. Using the GPS device, it is useful to mark the ends of each row with flags to help establish approximate lines for the collection of increments. Flags may also be placed along the edges of the decision unit parallel to the rows to help ensure approximate spacing. Placing flags at every increment collection point is usually not necessary. Often, just the four corners of the DU (or enough points to delineate the DU shape, if irregular) are located via GPS to document the DU location and to create maps for the soil investigation report.

Once the corners and rows of the DU have been marked using the GPS, the increment samples may be collected by pacing the same number of steps within each subunit or row of the DU where the sample increments are to be collected.

4.4 Tools for Collection of ISM

Using the wrong tools, or collecting a sample that contains more soil particles from the top of the sample than the bottom (or vice versa) could lead to biased sample results due to the heterogeneous distribution of contaminated particles in the soil. Care should be taken to collect increments in a manner that produces a cylindrical or core-shaped sample. This can be accomplished using a soil coring sampler (preferred), a trowel (if used to collect a "core-shaped" sample), or even a large drill in some soils. The most appropriate type of sampling device is dependent in part on the hardness of the soil, or how rocky it is. For soft soils, a soil core barrel that can be advanced by hand/foot is quick and efficient. Battery-operated drills with large bits may also be an option. For harder or rocky soils, a coring device with slide hammer, a mattock (large pick), hydraulic, or electric-assisted device, may be needed to advance the core barrel or access the soil column for sampling. Whatever tool(s) is used, the objective should focus on collecting core-shaped sample increments. It is important to understand field conditions and test proposed sampling tools at the site before selecting a particular type or combination of tools. If the site cannot be visited ahead of time, then a mix of sampling tools should be taken to help ensure that adequate soil samples can be collected in as efficient a manner as possible.

4.5 Sample Collection

Once the DU has been delineated with flags in the field collection of sample increments may begin.

Use flags or survey twine to define the edges of each grid cell and complete construction of the ISM sample grid as depicted in Figure 1 below.

Figure 1. Example Completed ISM Sample Grid

Sketch the ISM sample grid design, orientation (compass bearing), overall dimensions, cell dimensions, nearby features, and any other valuable information in the field notebook. Photograph the completed sample grid for future reference. Survey the center and corner stake locations of the DU or record them with a GPS unit.

If using stratified random sampling mode, a grid is set up over the DU making each part of the grid equal size, and one increment is collected at random from each subunit of the grid. If using systematic random sampling mode, select a random starting point in one subunit, then collect an increment sample at this location, and the same location at each subsequent subunit of the DU.

In either mode the following procedures should be followed:

- Sampling tools shall be new or decontaminated prior to use according to the project planning documents.
- Sampling tools need not be decontaminated between each sample increment, but shall be decontaminated or discarded prior to sampling a new DU.
- Test the proposed sampling tool(s), and determine what tool(s) will provide the best sample increments.
- Samples should be collected from the same depth at all incremental sampling locations.
- Larger sized particles (rocks, cobbles, and coral) and roots should be avoided or discarded prior to transferring the sample into the bulk ISM container.
- The laboratory is going to sieve out anything >2 millimeters (mm), so collect enough sample at each increment such that there will still be sample for analysis after the portion > 2mm has been sieved out. This may require collection of multiple aliquots per increment if ISM samples are collected using a small diameter coring device.
- The sample collector will describe and classify soils collected according to Universal Soil Classification System (USCS) nomenclature. At a minimum, this will be done for the final bulk ISM sample after all the increments have been collected. Additionally, during collection of increments, the soil will be described at each significant change in lithology type encountered across the DU. Soil descriptions and classifications will be recorded in the field logbook.

- Individual increments collected are placed into a single sample container to produce the bulk ISM.
- If replicates and triplicates are being collected (strongly recommended), replicate increments may be collected from near the normal sample location by pacing off a few feet from the normal sample collection and obtaining a replicate increment. The triplicate increment may be collected by pacing another few feet from the duplicate increment sampling location (see Section 4.6).
- Store bulk ISM samples as required by the project planning documents.
- Pack and ship samples to the laboratory in accordance with the project planning documents.

4.6 Collection of Field Replicate ISM Samples

To statistically evaluate sampling precision for each DU, replicate ISM samples are collected from selected decision units. Typically two replicate increments are collected from the same depth as the normal sample in different locations. A different random starting location is determined for each replicate collected in the selected DU(s). Replicate sample increments are generally collected along the same approximate directional lines established through the DU for the initial ISM samples, though at different systematic random locations than initially used. This is accomplished by pacing off the replicate increments from a different random starting location on the first line/row of the DU, and continuing to sample at this different random interval throughout the DU.

Replicate samples may be collected by establishing rows for increment collection that run perpendicular to or at a 45 degree angle to the direction used to collect the initial ISM. Another option is to use the same rows but collect increments in between the locations used for the initial sample. Replicate samples should be sent to the laboratory as “blind” samples, meaning the laboratory does not know they represent replicate samples of the initial ISM.

The replicate samples are prepared and analyzed in the same manner as carried out for the initial sample. Triplicate samples (i.e., initial ISM plus two replicates) are preferred and more useful than just duplicates for statistical analysis. If only one DU is being investigated, triplicate samples are recommended. If multiple DUs are being investigated, it may not be necessary to collect triplicates at all DUs.

4.7 Laboratory Processing of ISM Samples

The bulk ISM is submitted to the laboratory for analysis. Careful planning with the laboratory for processing of ISM samples by the Project Chemist prior to sample collection is essential to obtain meaningful results. Details of project requirements will be described in the project planning documents.

It is important to note that, while the laboratory is receiving a bulk sample of up to 2,500g, it will only analyze a subset of this sample. One issue discussed in both the Environmental Protection Agency (EPA) and American Society of Testing Materials (ASTM) guidance documents is the choice of a minimum sub-sample mass for extraction/analysis of soil samples in order to reduce “Fundamental Error” of the lab analyses to approximately 15% or less. The minimum appropriate mass is based on the maximum particle size in the soil samples. For samples with a maximum particle size of <2mm, the minimum analysis mass is 10 grams. If the analytical method to be used typically calls for sample extraction/analysis mass of less than 10 grams, the method should be modified to increase extraction/analysis mass to at least 10 grams for samples with maximum particle sizes of <2mm (larger mass could be beneficial for some analyses). For analyses of fine particulates (e.g., <250 µm), a one-gram sub-sample may be adequate to reduce Fundamental Error below 15%; however a larger mass may be reliably run by the method (e.g., 2-10 grams).

4.8 Investigation Derived Waste

Any IDW generated during sample collection (such as used PPE and soil collection apparatus) should be disposed of properly in accordance with the project planning documents.

5 Records

Record all ISM soil sampling activities, including field bulk sample collection in a field notebook, in accordance with the Work Plan and applicable project SOPs. Chain-of-custody forms, photographs, and any other sampling documentation should comply with the project planning documents.

6 References

American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.

Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.

Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.

HDOH. May 11, 2007. Pesticides in Former Agricultural Lands and Related Areas – Updates on Investigation and Assessment (arsenic, technical chlordane, and dioxin test methodologies and action levels and field sampling strategies). Office of Hazard Evaluation and Emergency Response. 07-241 RB.

ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.

Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.

Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.

U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.

7 Definitions

Bulk ISM Sample: The compilation of all ISM soil sampling increments collected from a DU.

Compositional Heterogeneity: The variability of contaminant concentrations between the particles that make up the population. This type of heterogeneity results in fundamental error (FE).

Decision Unit (DU): The area or volume in which a decision must be made (for example, deciding whether risks are acceptable or not). The DU may be as small as a 55-gallon drum or as large as acres in size.

Distributional Heterogeneity: The non-random distribution across a population due to slight spatial variations. This type of heterogeneity results in grouping and segregation error (GSE).

Fundamental Error (FE): A result of not representing proportional concentrations of all of the particles in a population.

Increment: A group of particles collected from a population with a single operation of the sampling device.

Sieving: Pouring material (for example, the bulk ISM sample) through a sieve.

Stratified Random Sampling: A statistical sampling method that divides the sample population (DU) into representative strata (grid cells), then randomly sampling within each stratum with the number of samples proportional to relationship of each stratum to the entire population.

Systematic Random Sampling: divide population (DU) into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

Sub-sampling: Dividing the sieved bulk ISM sample to create a final laboratory sample.

Attachment 1 - Figures Illustrating Systematic Random Sampling Method

(Source: HDOH *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, 2020)

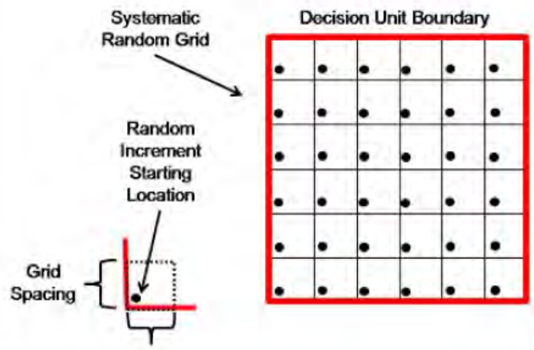

Figure 4-9. Example Increment Collection Locations Based on a Systematic Random Grid Scheme
Grid spacing determined based on DU area and number of desired increments. Initial increment location selected from random location, subsequent increments collected at uniform spacing within DU.

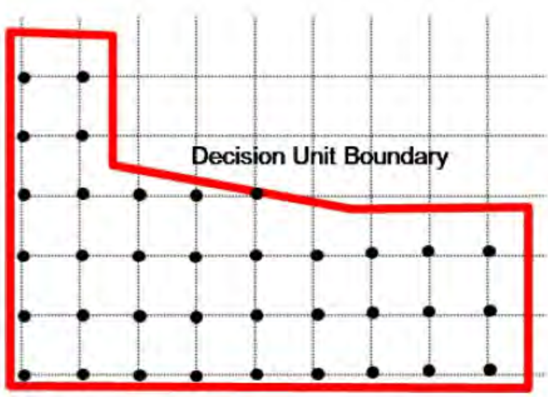

Figure 4-11. Systematic Increment Locations for Odd Shaped DUs (compare to Figure 4-9)
The number of increments collected within grid rows can vary in different areas of the DU.

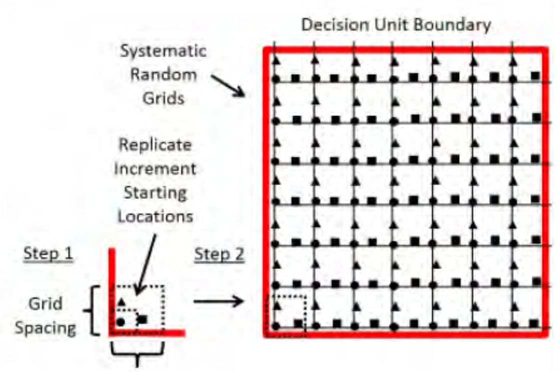

Figure 4-12. Example Collection of Increment Location Points for Triplicate Multi Increment Samples
Increments collected in a systematic random method. Circles, triangles and squares depict increment collection locations for three, respective Multi Increment samples (increments collected halfway between initial increment grid point locations).

Attachment 2
Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf
(per comment SNW, August 4 and 14)

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

4.2.7.3 EVALUATION OF DATA REPRESENTATIVENESS

Statistical methods to evaluate the representativeness of Multi Increment sample data have been included in the HEER Office TGM since 2008. A refined approach for use in Hawai'i based on experience at sites over the past seven years, as well as consideration of statistical methods discussed in the ITRC document Incremental Sampling Methodology (ITRC 2012), is provided below. The discussion applies to evaluation of both field and laboratory replicate data.

Acceptance criteria for the statistical evaluation of the MIS data are established as part of the DQO process for the site investigation. A two-step process is presented. The Relative Standard Deviation (RSD) of the contaminant concentration reported for each replicate sample is first calculated. This provides a measure of the precision of the Multi Increment sampling method used to estimate the mean contaminant concentration for the DU in terms of combined field and laboratory error. The lower the RSD the more precise the sampling approach used, and the more reproducible the data. As discussed below, an RSD of 35% is considered to indicate good reproducibility and reliable data for decision making. An RSD of >100% is considered to be very poor, and not typically appropriate for final decision making (see discussion below).

A 95% Upper Confidence Level (UCL) of the mean contaminant concentration can be calculated for the DU if necessary. This can be used to assist in decision making regarding the potential risks posed by the contamination and the need for remedial actions. Under some circumstances, the RSD can also be used to evaluate MIS data for DUs with similar characteristics in the absence of separate replicate data for those DUs. These topics are discussed in more detail below.

Data Precision

Data precision is evaluated by comparing data for replicate samples collected from the same DU. Replicate Multi Increment samples are intended to provide estimates of the mean concentration of a contaminant in a DU that approximate a statistically normal distribution. This allows statistical evaluation of data with as few as three replicate samples. The precision of the data for a given DU can be evaluated in terms of the Standard Deviation (SD) or more specifically the Relative Standard Deviation (RSD) of replicates. The SD and RSD reflect the total sum of field and laboratory error in the data (i.e., field sampling error + lab processing/subsampling error + lab analysis error).

Standard deviation is a well-known measure of the variation from the mean among a group of samples (USEPA 2006g,b). The lower the standard deviation (i.e., the closer the replicate data are to the mean) the more precise the site data are as an estimate of average contaminant concentration in the DU under investigation. When the mean concentration of a contaminant reported for a set of MIS replicate samples is close to the HDOH EAL, a lower standard deviation for the replicates provides stronger evidence that the true DU mean is indeed below the action level. A low standard deviation for soil sample data is achieved by minimizing error in sample collection, processing and analysis to the extent feasible.

The RSD represents the ratio of the standard deviation of the replicate set over the mean of the replicate set, expressed as a percentage:

$$RSD\ (\%) = \frac{Replicate\ Standard\ Deviation}{Replicate\ Mean} \times 100\% \quad \text{Eq. 2)}$$

An RSD less than 35% is considered to reflect good precision for estimates of the average (see ITRC 2012). Good precision implies that the sampling method used, including the number, spacing, and size/shape of increments collected was adequate to capture and reflect small-scale heterogeneity of contaminant distribution within the DU and that error in the laboratory processing and analysis methods was low.

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

For example, assume that concentrations of 9 mg/kg, 10 mg/kg and 11 mg/kg are reported for a target contaminant in triplicate Multi Increment samples collected from a DU. The mean concentration is 10 mg/kg. The SD is 1 and the RSD is 10%, indicating good precision of the data. Now consider concentrations of 5 mg/kg, 10 mg/kg and 15 mg/kg for a set of triplicate samples. The mean is again 10 mg/kg. The SD is now 5 mg/kg and the RSD is 50%, indicating lower precision and confidence in the replicate data.

The higher the RSD, the less confidence there is that the mean contaminant concentration estimated for any individual DU (i.e. the mean of a replicate set of samples for a DU) is representative of the true mean for the DU. A higher RSD (e.g., >35%) could be due to error in the field and/or laboratory. Field sampling error is the most likely source of data variability. Inadequate sample processing and subsampling is the main source of error at the laboratory, rather than analytical error. This can be evaluated by a review of sample collection, processing and subsampling procedures, as well as testing of replicate samples. The field replicate RSDs are used to estimate the total error for the sample data. The lab subsampling and analysis RSDs are use to estimate the lab subsampling and analysis error for the sample data. The lab subsampling and analysis error can then be subtracted from the total error to compare errors attributable to 1) field sampling, and 2) to lab subsampling and analysis. This analysis should be routinely carried out to evaluate sample data and help identify errors that may be corrected. In limited instances, grinding of samples in the laboratory might be required to reduce the grain size and allow the collection of more representative subsamples, since the ability to increase the mass of soil extracted and tested is limited (see Subsection 4.2.6).

If the RSD for field replicate samples (total error) is high, and RSD(s) for the lab subsampling and analysis replicates are reasonably low, then field error is the indicated source. A high RSD typically indicates the presence of small nuggets of the contaminant in soil or the presence of small, randomly scattered areas of high contamination within the DU. This problem is not insurmountable. One of the strong points of the Multi Increment sampling approach is that field precision and sample representativeness can be evaluated in an efficient manner. The field precision of replicate samples for a DU can be improved by increasing the number of increments and total sample mass to provide better coverage and sample support. The original DU can also be subdivided into smaller DUs for characterization.

The latter may or may not be beneficial, depending on the nature of contaminant distribution. The use of smaller DUs in the absence of increasing the number of increments collected will improve MIS data precision if the contaminant is concentrated within one area of the original DU. The use smaller DUs might not improve data precision, however, if the contaminant is evenly dispersed throughout the DU but highly heterogeneous at the scale of an individual increment. In this case, an increase in the number of increments collected and the mass of sample collected will be necessary to obtain representative and reproducible data.

As the RSD exceeds 35% and replicate contaminant concentrations approach a target action level, there is increasing uncertainty that the data are adequately representative of the true mean of the DU. This calls for an assessment of the sample collection approach employed as well as increasing reliance on other statistical measures to determine the need for further action. As discussed in the next section, this includes use of the 95% Upper Confidence Level (UCL) of the mean for comparison to action levels and for final decision making. This will necessarily be a site-specific decision and is part of the iterative, DQO process described in Section 3 of the TGM.

Adjustment of Data for Decision Making

Table 4-2 presents a recommended approach for evaluation of DU data based on a review of replicate sample data, either collected directly from the DU in question or based from replicate data from similar DUs. Although somewhat subjective, the approach helps to minimize the need to re-sample DUs when proper field and laboratory protocols are followed, while balancing the need to ensure that significant risks to human health and the environment are not inadvertently missed.

RSD ≤35%

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

Direct comparison of unadjusted DU data, or the arithmetic mean of replicate data to target action levels, is acceptable when the RSD of the representative replicate data set for the contaminant of concern is less than 35%. Adjustment of the data with respect to the RSD (or calculation of a 95% Upper Confidence Level) is not considered warranted given the overall acceptable sample precision. This assumes, of course, that the samples were collected, processed, and tested in an unbiased manner and are reasonably representative of the targeted DU. If soil remediation is carried out then unadjusted DU data can be used for confirmation samples.

RSD >35% but <u><</u>50%

A thorough review of field and laboratory procedures should be included in the site investigation report to determine the adequacy of DU-MIS methods used for cases where the RSD for replicate samples exceeds 35%. This review can help identify the need for improvements in field or laboratory methods for future investigations. If recommended field and laboratory procedures were properly followed, and the RSD is greater than 35% but less than or equal to 50%, then unadjusted DU data can be used for initial screening of DUs and determination of the need for remedial actions.

The collection of additional Multi Increment samples is recommended for confirmation of remediation of DUs that exceeded action levels, even if Perimeter DU data collected during the initial investigation were below action levels. The confirmation sampling should include the use of a greater number of increments per DU and/or division of the area into smaller DUs for characterization.

RSD >50% but <u><</u>100%

If the replicate RSD(s) fall between 50% and 100%, the adequacy of field sampling methods and laboratory processing and analysis methods used in the investigation is (again) important to review, and a discussion of potential sources of error should be included in the investigation report.

If analysis of the field sampling error vs the laboratory subsampling and analytical error reveals that a large majority of the error may be attributable to laboratory subsampling and analysis error rather than field sampling error, then the laboratory should be contacted regarding the need to subsample and reanalyze the selected (lab replicate) MI sample again (which should still be stored at the laboratory), as well as potentially subsample and re-analyze any associated DU samples analyzed in that same "batch" of samples.

A 95% UCL concentration should be calculated in cases where the RSD exceeds 50%, using the Chebyshev method. A 95% UCL should also be estimated for related DUs from which replicates were not collected, as described. Use the highest RSD calculated if replicate samples were collected from multiple DUs. Data for associated DUs should likewise be adjusted for comparison to action levels. Note that the RSD will differ between targeted chemicals.

The 95% UCL should be compared to 150% of the target action level (see Use of 95% UCL subsection below). This helps to ensure that potentially significant risk to human health and the environment is not inadvertently overlooked under a worst-case scenario when the true mean does in fact exceed the action level (e.g., non-cancer Hazard Quotient not significantly greater than 1 and within target 10^{-4} to 10^{-6} excess cancer risk range; see USEPA 2006g and HDOH, 2016).

Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes. This can, for example, include knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process, and analyze samples, and the approximation of the data to action levels.

Additional confirmation sampling should be carried out following removal or *in situ* treatment of contaminated soil. This should include the use of smaller DUs and/or a larger number of increments in order to improve field precision of the data. Replicate samples should also be collected and evaluated in the same manner described above (e.g., minimum 10% of DUs).

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

RSD >100%

Contaminants present in soil primarily as small nuggets rather than disseminated throughout the soil matrix can result in replicate RSDs above 100% even when strict collection protocols are followed in the field. High RSDs are often generated for soils contaminated with chips of lead-based paint, lead pellets at shooting ranges or even PCBs (see HDOH, 2015), Re-sampling of such sites might not be feasible due to cost or access limitations. This requires especially careful designation of DUs (e.g., multiple small DUs vs single large DU; see Subsection 3.4.3) as well as the collection of a greater sample mass from a large number of increment locations (see Subsection 4.2.2). Grinding of samples may also be required to manage laboratory subsampling error (see Subsection 4.2.6.3).

Data should be considered especially suspect when the RSD for replicate samples exceeds 100%. Field sample collection and laboratory processing methodologies should again be evaluated and potential sources of error in the data discussed. If analysis of the sampling data reveals that a large majority of the error is attributable to laboratory subsampling and analysis error rather than field sampling error, then the laboratory should be contacted regarding the need to subsample and reanalyze the selected (lab replicate) MI sample again, as well as potentially subsample and re-analyze any associated DU samples analyzed in that same "batch" of samples.

If one or more of the replicate samples exceeds the target action level then remediation of the DU should be considered, even if the mean concentration is well below the target action level. In the absence of other information, remediation of associated DUs where replicate samples were not collected should also be considered, regardless of the concentration of the contaminant reported. Re-sampling of the DU using a greater number of increments and/or smaller DUs is otherwise recommended.

If all replicate samples are below the action level then the approach described above for cases where the RSD falls between 50% and 100% can be followed, provided that confirmation samples are collected for DUs where remediation is ultimately carried out. Data for associated DUs should likewise be adjusted for comparison to action levels.

Additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes should be provided. This approach recognizes cases where two of three replicate samples might be significantly lower than the action level, but the variance between the data yields a high RSD. Consider for example a case where a DU tested for lead yields replicate data of 20 mg/kg, 30 mg/kg and 205 mg/kg with a target action level of 200 mg/kg. The mean of the replicate samples is 85 mg/kg, but the RSD is a very high 122%, indicating poor data precision. It is unlikely that the HEER office would recommend re-sampling or remediation of this DU, however. Compare this to a scenario where the variance between triplicate samples is very low but are just under the target action level, for example 175 mg/kg, 190 mg/kg and 205 mg/kg lead, with a mean of 190 mg/kg lead. The RSD of 8% implies very good data precision. The second DU is clearly more contaminated than the previous example, however, and would be considered a higher priority for remediation if it were to be required.

Table 4-2. Recommended Adjustment of Multi Increment Data for Decision Making Based on Relative Standard Deviation (RSD) of Replicate Samples.

RSD Data	Decision Unit Data Adjustment
Good Precision (RSD ≤35%)	• DU-MIS samples should be collected, processed, and tested in an unbiased manner; • Compare unadjusted MI data directly to target action level for decision making (use arithmetic mean for replicate sample sets);

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

	• Data can be used for confirmation purposes without the need for additional sampling, if action levels are met.
Moderate Precision (RSD >35% but ≤50%)	• Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.); • Compare unadjusted MI data directly to target action level for decision making (use the arithmetic mean for the replicate sample sets); • *Additional confirmation sampling recommended following remediation of DUs that exceed action levels*, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.
Poor Precision (RSD >50% but ≤100%)	• Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report; • If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates; • *Compare the 95% UCL* (Chebyshev method) *for replicate data to 150% of the target action level for decision making* ; • Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the target action level; • Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to action levels; • Additional confirmation sampling *recommended following remediation of DUs that exceed action level* , including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.
Very Poor Precision (RSD ≥100%)	• *Data should be considered suspect;* • If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates; • Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

	• *Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;* • If one or more of the replicate samples exceeds the target action level then remediation of the DU should be considered, even if the mean concentration is well below the target action level. Remediation of associated DUs where replicate samples were not collected should also be considered; • If all replicate samples are below the Action Level, *then compare the 95% UCL* (Chebyshev method) *for replicate data to the* unadjusted *target action level for decision making* ; • If all replicate samples are below the Action Level, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to *unadjusted* target action levels; • Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above levels of concern, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to action levels; • Additional confirmation sampling *recommended following remediation of DUs that exceed action levels* , including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Use of 95% UCL

Multiple approaches are available for calculation of UCL values, based in part on the variance between individual replicate sample data. An increase in variance between replicate samples will cause a similar increase in confidence intervals and a less precise estimate of the mean. Two equations can be used to bracket the range of UCL values that might be calculated from a set of multi increment replicate samples, the Student's-t UCL and the Chebyshev UCL (ITRC, 2012).

Calculation of a 95% Upper Confidence Limit (UCL) of the mean contaminant concentration for a DU is not required if the RSD for replicate data is equal to or less than 35% (see Table 4-2). If use of a 95% UCL is required for risk assessment or other purposes outside of the HEER Office (and RSD is equal to or less than 35%), then use of the Student's-t method is recommended (see ITRC 2012). This method assumes a normal distribution of replicate data with a UCL calculated as follows:

$$95\%\, UCL = mean + t_{(1-\alpha)(r-1)} \times \frac{SD}{\sqrt{r}} \qquad \text{Eq. 3)}$$

where
mean = arithmetic mean of replicate samples;
SD = standard deviation of replicate samples;
r = number of replicate samples; and
α = acceptable level of potential decision error (e.g., 0.05 or 5% for a 95% UCL);

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

t = (1-α)th quantile of the Student's-t distribution with (r-1) degrees of freedom.

The Chebyshev method is considered to be most appropriate for estimation of a 95% UCL when the variance between replicate samples is high (e.g., >35%; after ITRC 2012). This method assumes a non-normal or skewed, nonparametric distribution of data and is calculated as follows:

$$95\%\ UCL = mean + \left(\sqrt{\frac{1}{\alpha} - 1} \times \frac{SD}{\sqrt{r}}\right) \quad \text{Eq. 4)}$$

where the symbol α is again the acceptable level of potential decision error.

The need for replicate data and calculation of a 95% UCL should be evaluated as part of the systematic planning process described in Section 3. A 95% UCL should ideally be calculated based on replicate sample data specific to the DU in question. If replicate data are not available for a DU, then the a 95% UCL value should be estimated based on replicate data collected for a similar DU at the site. This is done by multiplying the contaminant concentration reported for that DU by the ratio of the 95% UCL and the mean for the replicate data set:

$$Estimated\ 95\%\ UCL = Conc. + \left(Conc. \times \frac{95\%\ UCL}{X}\right) \quad \text{Eq. 5)}$$

where "Conc." is the concentration of the targeted contaminant reported for the subject DU and "X" is mean concentration of the replicate data set used to calculate the initial 95% UCL.

As discussed in Subsection 4.2.4, this approach should only be applied for DUs that can reasonably be assumed to have a similar history and distribution of contamination (see also Subsection 3.4, DU designation). Note that approaches for calculation of a 95% UCL may differ for different chemicals, depending on the calculated RSD for each targeted chemical. Additional, DU-specific replicate samples may be warranted for more direct assessment of mean contaminant concentrations in DUs that could pose a potentially high risk. Examples include a playground area where contaminant concentrations approach an action level and replicate samples from related DUs suggest poor precision of the data.

As discussed in the previous section, direct comparison of a UCL value to a published action level is not required, since the probability that this value is representative of the true mean concentration for the DU is by intent assumed to be very low (i.e., 0.05 or 5%). The 95% UCL should instead be compared to a concentration of the chemical in the soil that could pose an especially heightened risk of adverse health effects in the unlikely event that this concentration represented the true mean for the DU (refer to USEPA 2006g). As a default, an alternative screening level equal to 150% of the original screening level is considered appropriate. This reflects only a marginal increase in overall health risk for screening levels based on a target cancer risk of 10^{-6} and a non-cancer hazard of 1. Alternative approaches should be discussed with the HEER office on a case-by-case basis.

Excerpt from Hawaii Department of Health Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan, Section 4 Decision Unit Characterization, Interim Final - August, 2016 http://hawaiidoh.org/tgm-pdfs/TGM.pdf:

In some cases, the DQO/SAP may specify use of an alternate approach to measure and evaluate variation from the mean in replicate sample data. These alternatives should be clearly identified and discussed with a HEER Office project manager for use in the site investigation. Calculated 95% UCL values can also be used in a forward risk assessment to quantify excess cancer risk and non-cancer hazard.

Attachment 3

Pages Revised in response to comment SNW 2, August 14

Table 11-1. DQO #1 – Excavation Delineation

Step 1 – Statement of Problem: The extent of soil exceeding the industrial cleanup goals at the planned excavation locations requires confirmation of COC concentrations after excavation.

Step 2 – Identify the Goals of the Study: Excavate soil at the planned excavation locations until the sidewalls and bottom of the excavation do not exceed the industrial cleanup goals.

Step 3 – Identify Information Inputs: Previous investigations at the Load Lines identified human health risk from COCs in surface and subsurface soil at Load Lines 1, 2, 3, 4 and 12 for likely future land use (for example, commercial/industrial). ROD Amendment (Leidos, 2019) identifies ex situ thermal treatment of soil at the planned excavation locations as part of the selected remedy to reduce the risk and be protective of human health.

Step 4 – Define the Boundaries of the Study: The remedial action will remove soil from 24 planned excavation locations at Load Lines 1, 2, 3, 4 and 12 identified in the ROD Amendment (see RD Work Plan Table 2-1 and Figures 3 to 7). Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation using ISM to confirm that soils exceeding the industrial cleanup goals have been successfully removed. The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.

Step 5 – Develop the Analytical Approach: In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP). An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the ISM field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample triplicate for metals and the RPD for laboratory subsample duplicates (ISM analyses for PAHs and PCBs). An RSD of less than or equal to 20% will be the goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).

Laboratory results will be compared to applicable industrial receptor cleanup goals in ROD Amendment (see Table 4-1 of RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional excavation will be conducted at locations with exceeding results until cleanup goals are met. Analytical data quality will be evaluated per this QAPP. The analytical methods specified in this QAPP will provide the lowest available detection limits using standard methods that will allow the data to be screened against the cleanup goals.

Step 6 – Specify Performance or Acceptance Criteria: All sample locations are known in accordance with the ROD Amendment and RD Work Plan which define soil removal boundaries for confirmation. Any soil removal beyond planned boundaries will be completed until industrial cleanup goals are met. Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed on known quality to meet project objectives as defined in Worksheet 36.

In response to Ohio EPA comments, the first three ISM excavation confirmation samples will be collected in triplicate. Following review of the triplicate data for the first three confirmation samples, additional ISM field triplicates will be collected such that 1 in 10 excavation confirmation samples are collected in triplicate overall. The results of the ISM field triplicate samples and the results of the associated laboratory subsample triplicate samples (ISM metals and SW8330B explosives analyses) and laboratory subsample duplicate samples (PAHs and PCBs) will be submitted to Ohio EPA for concurrence on meeting the following DQOs:

- An RSD of less than or equal to 30 to 35% as a goal (RSD less than or equal to 35%) will be incorporated into the field ISM triplicate sample data evaluations.
- An RSD of less than or equal to 20% as a goal for ISM SW8330B explosives analysis of laboratory subsample triplicates (one per laboratory batch of up to 20 samples).
- An RPD or RSD, as applicable, of less than or equal to 30 to 35% as a goal (RPD or RSD, as applicable, less than or equal to 35%) for PAH, PCB and metals analyses of ISM laboratory subsample duplicates/triplicates (one per laboratory batch of up to 20 samples).

If these DQOs are not met for the ISM triplicates samples or the associated laboratory subsample replicates, then Ohio EPA will work with the Army to determine whether there are concerns with the data quality, using Table 1 of the Ohio EPA Field Standard Operating Procedure (FSOP) as a guide (see Attachment 1). If there are concerns with the data quality, then the Army, Ohio EPA and CH2M will work together to determine the path forward, following the guidance below excerpted from the Hawai'i Department of Health Technical Guidance Manual Section 4.2.7.3 "Evaluation of Data Representativeness, Table 4-2 Recommended Adjustment of Multi Increment Data for Decision Making Based on RSD of Replicate Samples", http://hawaiidoh.org/tgm-pdfs/TGM.pdf (HDOH, 2016).

Good Precision (RSD <35%)

- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Data can be used for confirmation purposes without the need for additional sampling, if cleanup goals are met.

Table 11-1. DQO #1 – Excavation Delineation (continued)

Moderate Precision (RSD >35% but <50%)

- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error (e.g., improper increment collection methods, inadequate number or mass of increments, unrepresentative laboratory subsampling methods, etc.);
- Compare unadjusted ISM sample data directly to cleanup goal for decision making (for RVAAP, the maximum field replicate value will be used to compare to the cleanup goal);
- Additional confirmation sampling recommended following remediation of decision units (DUs) that exceed cleanup goals, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Poor Precision (RSD >50% but <100%)

- Review and discuss field sampling methods and laboratory processing and discuss potential sources of error in report;
- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Compare the 95% UCL (Chebyshev method) for replicate data to 150% of the cleanup goal for decision making;
- Estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data; Compare results to 150% of the cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples, and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Very Poor Precision (RSD >100%)

- If the large majority of total error is attributable to laboratory subsampling and analysis error, request laboratory to subsample and analyze the batch of DU samples again using correct techniques, and include additional subsampling replicates;
- Review and discuss field sampling methods and laboratory processing and analysis methods and discuss potential sources of error in report;
- Consider re-sampling of DU(s) most suspect for contamination using a larger number of increments and/or smaller DUs;
- If one or more of the replicate samples exceeds the cleanup goal then remediation of the DU should be considered, even if the mean concentration is well below the cleanup goal. Remediation of associated DUs where replicate samples were not collected should also be considered;
- If all replicate samples are below the cleanup goal, then compare the 95% UCL (Chebyshev method) for replicate data to the unadjusted cleanup goal for decision making;
- If all replicate samples are below the cleanup goal, estimate a 95% UCL for DUs where replicates were not collected based on the 95% UCL and mean calculated for the replicate data and compare results to unadjusted cleanup goal;
- Provide additional, multiple lines of evidence for acceptance (or rejection) of the data for decision making purposes including knowledge of the site history and the anticipated potential for contamination above cleanup goal, the adequacy of the methods used to collect, process and analyze samples and the approximation of the data to cleanup goal;
- Additional confirmation sampling recommended following remediation of DUs that exceed cleanup goal, including use of smaller DUs and/or a larger number of increments and collection of additional replicate samples.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the attached SOP, *Incremental Sampling for Surface Soil*. A systematic random sampling scheme will be used in selecting the aliquot sampling locations for each sidewall and the excavation bottom to ensure that the aliquots are spread out relatively equally. This will be accomplished by gridding the bottom and the contaminated interval of each sidewall into approximately equally sized grids, and then collecting an aliquot from the sidewall/bottom surface at the center of each grid. If field triplicate samples are being collected for a particular DU, the aliquots will be collected from completely independent systematic random locations in the grid (i.e., aliquots for the field triplicate samples will not be collected around a single grid point used for the parent sample since this may not adequately test small-scale variability within the DU) (HDOH, 2016). The duplicate and triplicate aliquots will be placed in separate containers to be submitted to the laboratory).

The results will be compared to the Industrial cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP). Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days.

If field triplicate samples were collected for a DU, then the results of the field triplicate samples and the results of the associated laboratory subsample replicate samples will be submitted to Ohio EPA for concurrence on meeting the DQOs as described above in Step 6.

If the excavation confirmation samples for an excavation meet the applicable cleanup goals, then the excavation will be backfilled.

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Table 11-1. DQO #1 – Excavation Delineation (continued)

Step 7 – Develop the Detailed Plan for Obtaining Data (continued):

If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. As discussed in Step 6 above, this will also apply in the case of ISM field triplicate samples if ~~any of the~~a field replicate sample~~s~~ exceeds an applicable cleanup goal. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the cleanup goals, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR.

Once an excavation meets the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil excavated/treated.

Table notes:

CH2M =CH2M HILL Constructors, Inc.
COC = contaminant of concern
COR = Contracting Officer’s Representative
DoD = U.S. Department of Defense
ISM = incremental sampling methodology
ITRC = Interstate Technology Research Council
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
RSD = relative standard deviation

Worksheet #20—Field Quality Control Sample Summary

Field QC sampling requirements and procedures are specified in the sections below. Table 20-1 provides a summary of the types of samples to be collected and analyzed during the project. Its purpose is to show the relationship between the number of field samples and associated QC samples for each combination of analyte/analytical group and matrix.

Table 20-1. Field Quality Control Samples

Matrix	Analyte/Analytical Group	Field Samples	FDs or ISM FD and Triplicate/Laboratory Subsample	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total Analyses
Soil (ISM excavation confirmation samples)	PAHs, explosives, PCBs and/or metals (location dependent)	142	14/14	7	7	7	0	191
Soil (treatment verification)	PAHs, explosives, PCBs and/or metals (location dependent)	38	4	2	2	2	0	48
Soil quality assurance split	PAHs, explosives, PCBs and/or metals (location dependent)	18	0	0	0	0	0	18

Table notes:
FD = field duplicate
ISM = incremental sampling methodology
PAH = polycyclic aromatic hydrocarbon(s)
PCB = polychlorinated biphenyls

Field Duplicate and Triplicates

An FD is an additional sample collected at the same time from the same location as the original sample. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. FD samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity.

FD samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. The samples may be either co-located samples or sub samples of a single sample collection. The sample containers are assigned a unique identification number in the field. Specific locations should be designated for collection of FD samples before the beginning of sample collection. The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the incremental sampling methodology (ISM) excavation confirmation samples, the ROD Amendment requires that the ISM samples be collected in duplicate. However, to follow current DoD and Interstate Technology Research Council (ITRC) requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with DoD QSM and ITRC requirements incorporating a field duplicate and triplicate sample collection for one per 10 samples collected. The laboratory will also collect a laboratory subsample duplicate (PAHs and PCBs) and triplicate (explosives and metals) for each batch of up to 20 samples ~~field sample,~~ ~~along with one laboratory duplicate~~ to verify the subsampling precision. A relative standard deviation (RSD) of less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent) will be incorporated into the field primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicates/triplicates for analytes other than explosives (for explosives analysis of laboratory subsample triplicates, the RSD goal is 20 percent).

Worksheet #23—Analytical Standard Operating Procedure References

The analytical SOP references in Table 23-1 were provided by the laboratories. Only SOPs for sample data being validated are presented. IDW data will not be validated. Note that the laboratory SOPs have not been modified specifically for this project to meet the DQO requirements. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements and UFP-QAPP to technical staff. Laboratory SOPs are provided as Attachment 2 of this QAPP.

Table 23-1. Analytical SOP References

Reference Number	Title, Revision Number, and Date	Definitive/ Screening Data	Matrix/ Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
LSOP-01	SV-004 Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 11. 8/8/19	Definitive	PCBs	GC/ECD	CT	No
LSOP-02	SV-006 Semivolatile Organic Compounds by GC/MS, Method SW8270D. Revision 0. 5/29/19	Definitive	PAHs	GC/MS	CT	No
LSOP-03	MT-009 Method 6010- Inductively Coupled Plasma. Revision 5.3. 4/16/19	Definitive	Metals	ICP	CT	No
LSOP-04	SV-010, Explosives by Modified Method SW8330B. Revision 5.1. 6/13/19	Definitive	Explosives	HPLC	CT	No
LSOP-05	GT002 Processing of Multi-incremental Samples and Subsampling	Definitive	Explosives, PCBs, PAHs and metals	GC/MS. HPLC, ICP, GC/EICD	CT	No
LSOP-06	Determination of Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 3/29/17	Definitive	PCBs	GC/ECD	Chemtech (treatment verification samples with expedited turnaround)	No
LSOP-07	Determination of Extractable Semivolatile Organic Compounds by Method SW8270D. Revision 6/6/19	Definitive	PAHs	GC/MS	Chemtech (treatment verification samples with expedited turnaround)	No

Table notes:
Chemtech = Chemtech Laboratory, Inc.
CT = CT Laboratories, LLC
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS tuning check	Before ICAL and calibration verification, every 12 hours	Refer to criteria listed in method description Use 4-bromofluorobenzene or decafluorotriphenylphosphine	Retune instrument and verify	Not appropriate
Multipoint ICAL for all analytes (minimum five standards)	Before sample analysis	Option 1: Linear—RSD for each analyte is less than 15% Option 2: Linear—linear least squares regression r is more than 0.995. Linear least square regression r^2 is equal to or more than 0.99 (SW8260C) for each analyte Option 3: Nonlinear—coefficient of determination is equal to or more than 0.99 (6 points will be used for second order; 7 points will be used for third order). Nonlinear calibrations models are not a preferred option and must only be used for compounds that typically will not demonstrate a linear model If the specific version of a method requires additional evaluation (for example, response factors or low calibration standard analysis and recovery criteria), then these additional requirements must also be met	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Calibration may not be forced through the origin
Second-source calibration verification	Once per ICAL	All analytes within ±20% of expected value	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical sequence	Position will be set using the midpoint standard of the ICAL curve. On days when an ICAL is not performed, the initial CCV is used	N/A	N/A
RT window verification for each analyte	Each sample	RRT of the analyte within ±0.06 RRT units of ICAL. Laboratories may update the RTs based on the CCV to account for minor performance fluctuations or after routine system maintenance (for example, column clipping. With each sample, the RRT will be compared with the most recently updated RRT. If the RRT has changed by more than ±0.06 RRT units since the last update, there has been a significant change in system performance and the laboratory must take appropriate corrective actions as required by the method and rerun the ICAL to re-establish the RTs.	Correct problem then reanalyze all samples analyzed since the last RT check	Not appropriate, no target compounds are to be reported when the RRT is out of control

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
CCV	Daily, before sample analysis (unless ICAL performed on same day), after every 12 hours of analysis time and at the end of the analytical batch run.	All analytes within ±20%D of expected value of true value All analytes within ±50%D of expected value of true value for ending CCV	Correct problem, then rerun CCV If that fails, then repeat ICAL	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
Internal standard	Each sample, standard, and QC sample	Retention time within ±10 seconds from retention time of the midpoint standard in the ICAL; extracted ion current profile area within -50% to +100% of area from internal standards in ICAL mid-point standard	Inspect MS and GC for malfunctions and make corrections as appropriate Reanalysis of samples analyzed while the system was malfunctioning is mandatory	Apply Q-flag to all results for analytes associated with failed internal standards
Method blank	One per analytical batch	No analytes detected more than one-half LOQ; or more than one-tenth the amount measured in any sample or one-tenth the regulatory limit, whichever is greater For common laboratory contaminants, no analytes detected more than LOQ See Worksheet #36	Assess data and correct problem If necessary, reprepare and analyze method blank and all samples processed with the contaminated blank	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15	Correct problem, then reanalyze If still out, then reprepare and reanalyze the LCS and all samples in the affected batch	If corrective action fails, then apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch

Table 28-1. Summary of Calibration and Quality Control Procedures for Method SW8270D (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error Analyze LCS for failed target analytes Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if any following criteria met: • %R for MS or MSD is more than upper control limit • %R for MS or MSD is less than lower control limit • MS/MSD RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤35 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, then discuss in case narrative	Apply Q-flag to all associated analytes if acceptance criteria are not met
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
D = difference when using response factors or drift when using least square, regression, or nonlinear calibration
DoD = U.S. Department of Defense
GC = gas chromatography
ICAL = initial calibration
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PQO = project quality objective
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RRT = relative retention time
RSD = relative standard deviation
RT = retention time

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICAL	At instrument setup, after ICV or CCV failure, before sample analysis	ICAL must meet one of the three options below: • Option 1: RSD for each analyte equal to or less than 20% • Option 2: linear least squares regression for each analyte: r^2 more than or equal to 0.99 • Option 3: nonlinear least squares regression (quadratic) for each analyte r^2 more than or equal to 0.99	Correct problem, then repeat ICAL	Problem must be corrected Samples may not be analyzed until there is a valid ICAL Quantitation for multicomponent analytes such as chlordane, toxaphene and Aroclors must be performed using a 5-point calibration
ICV	Immediately following ICAL, analysis of second source standard before sample analysis	±20% of expected value All reported analytes within established RT windows	Correct problem and rerun ICV. If that fails, repeat ICAL	Problem must be corrected Samples may not be analyzed until the calibration has been verified
RT window position establishment	Once per ICAL and at the beginning of the analytical sequence	Midpoint of ICAL curve when ICAL is performed On days ICAL is not performed, the initial CCV is used	Not applicable	Not applicable
RT window width	At method set up and after major maintenance	RT width is ±3 times standard deviation for each analyte RT from the 72-hour study	Not applicable	Not applicable
CCV	Daily, before sample analysis; after every 10 samples, and at the end of the analysis sequence with the exception of CCVs for pesticides and multicomponent analytes (toxaphene, chlordane), which are only required before sample analysis	Reported analytes within established RT windows All reported analytes and surrogates within ±20% of true value	Recalibrate and reanalyze affected samples since last acceptable CCV Or immediately analyze 2 additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action and recalibrate; then reanalyze affected samples	If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to results for the specific analyte(s) in samples since last acceptable CCV
Method blank	One per preparatory batch	No analytes detected greater than one-half LOQ or more than one-tenth amount measured in any sample or one-tenth regulatory limit, whichever is greater Common contaminants must not be detected more than LOQ	Correct problem. If necessary, re-prepare and analyze method blank and samples processed with the contaminated blank	Apply B-flag to associated positive results for the specific analyte(s), as appropriate See Worksheet #36
LCS	One per preparatory batch	Acceptance criteria: Worksheet #15	Correct the problem and reanalyze the LCS and samples in the preparatory batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch

Table 28-2. Summary of Calibration and Quality Control Procedures for Method SW8082 (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
MS	One per preparatory batch	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS > upper control limit (2) %R for MS < lower control limit
MSD, matrix duplicate	One per preparatory batch LCSD analyzed if no MS/MSD analyzed	Acceptance criteria: Worksheet #15	Assess data to determine whether there is a matrix effect or analytical error. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the DQOs	For the specific analyte(s) in the parent, apply J-flag if any of following criteria are met: • %R for MSD is more than upper control limit • %R for MSD is less than lower control limit • RPD is more than control limit
Laboratory Subsample Duplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Acceptance criteria: ≤35 %D Both sample results greater than 5 times LOQ and RPD greater than UCL or One or both samples less than 5 times LOQ and a difference between results of +4 times LOQ for soil	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Surrogate spike	Every sample and batch QC samples	Acceptance criteria: Worksheet #15	Correct the problem. Reprepare and reanalyze the samples with the failed surrogate if sufficient sample material is available If obvious chromatographic interference with the surrogate is present, reanalysis may not be necessary	If corrective action fails, then apply Q-flag to the specific analyte(s) in the samples and explain in case narrative
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as the initial or primary column Results between primary and secondary column RPD less than or equal to 40%	Not applicable	Apply J-flag if RPD is more than 40% and explain in case narrative
LOQ quarterly verification	Quarterly	LCS acceptance criteria: Worksheet #15	Correct problem Data may not be reported without valid verification	N/A

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%R = percent recovery
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICV = initial calibration verification
LCS = laboratory control sample
LCSD = laboratory control sample duplicate
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
QC = quality control
r^2 = regression squared
RPD = relative percent difference
RSD = relative standard deviation
RT = retention time

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
LDR or high-level check standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within ±10% of true value.	Dilute samples within the calibration range, or re-establish/verify the LDR.	Not appropriate.
ICAL (minimum one high standard and a calibration blank)	Daily ICAL prior to sample analysis	If more than one calibration standard is used, r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Problem must be corrected. Samples may not be analyzed until there is a valid ICAL.
ICV/Second-source calibration verification	Once per ICAL prior to sample analysis	All analytes within ± 10% of expected value.	Correct problem and verify second-source standard. Rerun second-source verification. If that fails, correct problem and repeat ICAL.	Problem must be corrected. Samples may not be analyzed until the calibration has been verified.
CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% D of expected value of true value.	Recalibrate and reanalyze all affected samples since last acceptable CCV Or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.	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
Low-level calibration check standard (low-level ICV)	Daily	All analytes within ± 20%D of expected value of true value.	Correct problem and repeat ICAL	Flagging not appropriate. No samples will be analyzed without a valid low-level calibration check standard.
Method blank	One per analytical batch	No analytes detected > ½ LOQ; or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater. For common laboratory contaminants, no analytes detected > LOQ. See Worksheet #36.	Assess data. Correct problem. If necessary, re-prepare and analyze method blank and all samples processed with the contaminated blank.	Apply B-flag to all associated positive results for the specific analyte(s), as appropriate. See Worksheet #36.
ICB/CCB	Before beginning a sample run, after every 10 field samples, and at end of the analysis sequence.	No analytes detected >LOD.	Correct problem and repeat ICAL. All samples following the last acceptable calibration blank must be reanalyzed.	Flagging is not appropriate.

Table 28-3. Summary of Calibration and Quality Control Procedures for Methods SW6010C (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
ICS (also called spectral interference checks)	After ICAL and prior to sample analysis.	ICS-A: Absolute value of concentration for all nonspiked project analytes < LOD (unless they are 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 failed ICS.
LCS for all analytes	One LCS per analytical batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze. If still out, re-prepare and reanalyze the LCS and all samples in the affected batch.	If corrective action fails, apply Q-flag to the specific analyte(s) in all samples in the associated preparatory batch.
MS/MSD or matrix duplicate	One per 20 samples per matrix as a minimum and as defined on the chain-of-custody form	Acceptance criteria: Worksheet #15. ~~RPD ≤ 20% between MS/MSD or sample and MD.~~	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs.	For the specific analyte(s) in all samples collected from the same site matrix as the parent, apply J-flag if: (1) %R for MS or MSD > upper control limit (2) %R for MS or MSD < lower control limit (3) MS/MSD RPD > control limit
Soil sample triplicate (ISM only)	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest concentration within the quantitation range of the method The RSD for results above the LOQ must not exceed 35%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative
Dilution test Only applicable for samples with concentrations more than 50 times LOQ (prior to dilution) Use along with MS/MSD or PDS data to confirm matrix effects	Once per preparatory batch if MS or MSD fails	Five-fold dilution must agree within ± 10% of the original measurement.	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met
PDS addition Criteria apply for samples with concentrations less than 50 times LOQ prior to dilution	One per preparatory batch if MS or MSD fails (using the same sample as used for the MS/MSD if possible)	Recovery within 80 to 120%	N/A	For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
CCB = continuing calibration blank
CCV = continuing calibration verification
CH2M = CH2M HILL Constructors, Inc.
ICAL = initial calibration
ICB = initial calibration blank
ICS = Interference Check Solutions
ICV = initial calibration verification
LCS = laboratory control sample
LDR Linear Dynamic Range
LOD= limit of detection
LOQ = limit of quantitation
MD = matrix duplicate
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS post digestion spike
PQO = project quality objective
RPD = relative percent difference

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Soil-drying procedure	Each sample, LCS and method blank	Laboratory must have a procedure to determine when the sample is dry to constant mass. Record date, time, and ambient temperature on a daily basis while drying samples	Not applicable	Not appropriate
Soil-sieving procedure	Each sample, LCS and method blank	Weigh entire sample. Sieve entire sample with a 10 mesh sieve. Breakup pieces of soil (especially clay) with gloved hands. Do not intentionally include vegetation in the portion of the sample that passes through the sieve unless this is a project specific requirement. Collect and weigh any portion unable to pass through the sieve	Not applicable	Not appropriate
Soil-grinding procedure	Initial demonstration	The laboratory must initially demonstrate that the grinding procedure is capable of reducing the particle size to < 75 micrometers by passing representative portions of ground sample through a 200 mesh sieve (ASTM E11)	Not applicable	Not appropriate
Soil-grinding blank	At least one grinding blank per batch must be analyzed	A grinding blank using clean solid matrix (such as Ottawa sand) must be prepared (for example, ground and subsampled) and analyzed in the same manner as a field sample No reported analytes must be detected > 1/2 LOQ	Blank results must be reported, and the affected samples must be flagged accordingly if blank criteria are not met	If any individual grinding blank is found to exceed the acceptance criteria, apply B-flag to the samples following that blank
Soil-subsampling process	Each sample, duplicate, LCS, and Method Blank	Entire ground sample is mixed, spread out on a large flat surface (for example, baking tray), and 30 or more randomly located increments are removed from the entire depth to sum a ~10 g subsample	Not applicable	Not appropriate
Soil sample triplicate	At the subsampling step, one sample per batch Cannot be performed on any sample identified as a blank	Three 10 g subsamples are taken from a sample expected to contain the highest levels of explosives within the quantitation range of the method The RSD for results above the LOQ must not exceed 20%	Examine the project specific requirements Contact the client as to additional measures to be taken	If reported per the client, apply J-flag if acceptance criteria are not met and explain in the case narrative

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Initial Calibration (ICAL) for all analytes (including surrogates)	At instrument setup and after ICV or CCV failure, prior to sample analysis.	ICAL must meet one of the three options below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression for each analyte: $r^2 \geq 0.99$; Option 3: non-linear least squares regression (quadratic) for each analyte: r2 ≥ 0.99.	Correct problem, then repeat ICAL.	Flagging is not appropriate.
Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analyte(s) and surrogates within ± 20% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.	Flagging is not appropriate.
Continuing Calibration Verification (CCV)	Before sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All reported analytes and surrogates within ± 20% of the true value.	Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails or if two consecutive CCVs cannot be run, perform corrective action(s) and repeat CCV and all associated samples since last successful CCV. Alternately, recalibrate if necessary; then reanalyze all associated samples since the last acceptable CCV.	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.
Internal Standards (IS)	If employed, every field sample, standard and QC sample.	Retention time within ± 30 seconds from retention time of the midpoint standard in the ICAL; Internal standard signal (area or height) within -50% to +100% of ICAL midpoint standard. On days when ICAL is not performed, the daily initial CCV can be used.	Inspect instrumentation for malfunctions and correct problem. Reanalysis of samples analyzed while system was malfunctioning is mandatory.	If corrective action fails in field samples, data must be qualified and explained in the Case Narrative. Apply Q-flag to analytes associated with the non-compliant IS. Flagging is not appropriate for failed standards.

Table 28-4. Summary of Calibration and Quality Control Procedures for Method SW8330B (continued)

Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action [a]	Flagging Criteria [b]
Method Blank (MB)	One per preparatory batch.	No analytes detected > 1/2 LOQ or > 1/10th the amount measured in any sample or 1/10th the regulatory limit, whichever is greater.	Correct problem. If required, reprep and reanalyze Method Blank and all QC samples and field 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.
LCS for analytes	One LCS per preparatory batch	Acceptance criteria: Worksheet #15.	Correct problem, then reanalyze If still out, re-prepare and reanalyze the LCS and samples in the affected batch	If corrective action fails, apply Q-flag to the specific analyte(s) in samples in the associated preparatory batch
MS/MSD or matrix duplicate	One per preparatory batch	Acceptance criteria: Worksheet #15. ~~MS/MSD RPD of analytes ≤ 20 percent (between MS and MSD or sample and matrix duplicate)~~	Assess data to determine whether there is a matrix effect or analytical error. Analyze LCS for failed target analytes. Potential matrix effects should be communicated to CH2M so an evaluation can be made regarding the PQOs	For the specific analyte(s) in the parent, apply J-flag if: (1) %R for MS or MSD greater than upper control limit (2) %R for MS or MSD less than lower control limit (3) MS/MSD RPD greater than control limit
Surrogate spike	Every sample, spiked sample, standard, and method blank	Acceptance criteria: Worksheet #15.	Correct problem, then re-prepare and reanalyze the affected samples If matrix effect is verified, discuss in case narrative	Apply Q-flag to associated analytes if acceptance criteria are not met
Confirmation of positive results (second column)	Positive results must be confirmed	Calibration and QC criteria for second column are the same as for initial or primary column analysis Results between primary and secondary column/detector RPD ≤ 40%	N/A	Apply J-flag if RPD > 40%Discuss in the case narrative

Table notes:

[a] Corrective actions associated with project work will be documented, and records will be maintained by the laboratory. The analysis technician is responsible for corrective actions.

[b] Flagging criteria will be applied when acceptance criteria were not met, and corrective action was not successful or corrective action was not performed.

%D = percent difference
%R = percent recovery
ASTM = American Society for Testing and Materials
CH2M = CH2M HILL Constructors, Inc.
g = gram(s)
LCS = laboratory control sample
LOQ = limit of quantitation
MS = matrix spike or mass spectrometry
MSD = matrix spike duplicate
N/A = not applicable
PDS = post digestion spike
PQO = project quality objective
QC = quality control
RSD = relative standard deviation

comparability of field and laboratory duplicates. Discussion will cover PARCC criteria, as described in the following subsections.

Precision

Laboratory precision is measured by the variability associated with duplicate (two) or replicate (more than two) analyses. One type of sample that can be used to assess laboratory precision is the LCS. Multiple LCS analyses over the duration of the project can be used to evaluate the overall laboratory precision for the project. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch, but between LCSs analyzed in multiple batches.

Precision is the measurement of the variability associated with the sampling and analytical process. Precision is determined by analysis of duplicate field samples, laboratory/matrix duplicates, LCSDs and/or MSDs. Field duplicate samples and MSD samples should be collected to assess field precision at a frequency as described in Worksheet #20. The required control limits for LCSD, MSD and laboratory/matrix duplicate precision for each method, matrix, and analyte are provided in Table 15-1. A control limit, relative percent difference (RPD) of ± 50 percent for soil will be used for original and field duplicate concentrations greater than five times the LOQ for treatment samples. For ISM laboratory subsample duplicates a control limit RPD of 35 percent will be used. For ISM ~~duplicate and~~ triplicate results, the precision is measured using the RSD and the control limit for that will be less than or equal to 30 to 35 percent as a goal (RSD less than or equal to 35 percent). The formula for the calculation of RPD and RSD are provided below.

If calculated from duplicate measurements:

$$RPD = 100\% \times \frac{(C_1 - C_2)}{(C_1 + C_2) \times \frac{1}{2}} \quad (1)$$

Where:

RPD = relative percent difference
C_1 = larger of the two observed values
C_2 = smaller of the two observed values

If calculated from three or more replicates, use RSD rather than RPD:

$$RSD = 100\,\% \times (s / \bar{y}) \quad (2)$$

Where:

RSD = relative standard deviation
s = standard deviation
$\bar{y}$ = mean of replicate analyses

Standard deviation, σ, is defined as follows:

$$\sigma = \sum_{i=1}^{n} \sqrt{\frac{(y_i - \bar{y})^2}{n-1}} \quad (3)$$

Where:

σ = standard deviation
y_i = measured value of the i^{th} replicate
$\bar{y}$ = mean of replicate analyses
n = number of replicates

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Excavation							
Erosion and sedimentation Controls	CM/FQM	Verify that erosion and sedimentation controls are installed, maintained and inspected.	IP/FP	D	Erosion and sedimentation controls are installed, maintained and inspected.	ICG install, maintain and inspect erosion and sedimentation controls per Work Plan.	IP/FP Forms; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)
Initial excavation at each excavation location	CM/FQM	Initial excavation: Verify soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1	FP	O	Soil excavated to boundaries marked by land surveyor and depth identified in Table 2-1.	Excavate to the marked boundaries.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM	Verify initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	FP	O	Initial ISM confirmation samples collected from sidewalls and bottom per QAPP Worksheet 18 and QAPP Figures 1 through 4.	Collect sample.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	FP	O	Initial ISM sidewall bottom samples analyzed for the applicable COCs (see Table 2-1).	Analyze for the applicable COCs.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify each COC concentration in the initial ISM samples is less than or equal to the RGO (see table 5-1).	FP	E	Each COC concentration in the initial ISM samples is less than or equal to the RGO.	Discuss with USACE removal of additional soil in the direction of the exceedance. Once approved by USACE COR, excavate additional soil (typically in one-foot increments but may be more depending on magnitude of the exceedance; do not excavate past groundwater or 10 feet bgs, whichever is encountered first).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Verify ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates meet the DQOs specified in QAPP Table 11-1; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	FP	E	The DQO goals in QAPP Table 11-1 have been met for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates; and the data for ISM field triplicates and their associated laboratory subsample duplicates/triplicates have been submitted to Ohio EPA for concurrence.	Provide the data for ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates to Ohio EPA for concurrence. If the DQO goals are not met, the Ohio EPA will work with the Army to determine whether there are concerns with the data quality (see QAPP Table 11-1).	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	CM/FQM and Project Chemist	Verify follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	FP	E	Follow-up ISM sample (following an exceedance) collected and analyzed for the COC that exceeded an RGO in the initial/previous ISM sample.	Collect and analyze for the failed COC.	FP Form; Daily Reports; QC Log and Report
Confirmation Sampling at each excavation	Project Chemist	Final: Verify each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1).	FP	E	Each sidewall and bottom ISM confirmation sample is less than or equal to the RGO for each applicable COC.	Excavation is not complete, return to steps above for sampling and excavation.	FP Form; Daily Reports; QC Log and Report
Excavation dewatering	CM/FQM	Verify analytical results of excavation sidewall and bottom samples meet RGOs AND that Ohio EPA and OHARNG approval has been obtained prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	FP	E	Analytical results of excavation sidewall and bottom samples meet RGOs AND approval obtained from Ohio EPA and OHARNG approval prior to onsite discharge of water accumulated in excavations through approved filter and straw bale setup.	Do not discharge the water onsite. Obtain Ohio EPA and OHARNG approval prior to onsite discharge for water from excavations that meet the RGOs. If the excavation does not meet the RGOs, treat the water in the ETC.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Equipment Inspection	CM/FQM	Verify heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	FP	D	Heavy equipment checked daily by ICG operators for leaks, general equipment condition, fluid levels, etc.	ICG operators check heavy equipment for leaks, general equipment condition, fluid levels, etc.	FP Form; Daily Reports; QC Log and Report; ICG Equipment Inspection Forms/Logs

Table 9-1. Quality Control Inspections (continued)
Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12

Backfill and Site Restoration							
Backfill of Excavations	CM/FQM	Verify sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP	E	Sidewall and bottom excavation confirmation samples are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND excavated volume has been calculated by a post-excavation topographic survey prior to backfilling AND Ohio EPA concurrence obtained on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	Do not backfill. Obtain sidewall and bottom excavation confirmation sample results that are less than or equal to the RGO for each applicable COC (see Tables 2-1 and 5-1) AND perform a post-excavation topographic survey of the open excavation to calculate excavated volume AND obtain Ohio EPA concurrence on ISM field triplicate samples and their associated laboratory subsample duplicates/triplicates.	IP/FP Forms; Daily Reports; QC Log and Report
Off-site backfill material	CM/FQM	Verify off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP	E	Off-site backfill material has been sampled for the parameters in Table 12-1; tabulated results provided in a Field Change Request to and approval received from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	Do not bring the off-site backfill material to the site. ICG obtain samples of backfill material and analyze for the parameters in Table 12-1, and obtain approval from Katie Tait (OHARNG), Kevin Sedlak (ARNG) and Ohio EPA.	IP/FP Forms; Daily Reports; QC Log and Report
Treated Soil	CM/FQM	Verify treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	IP/FP	E	Treated soil being used as backfill has been sampled (one composite sample per 150 CY) and analyzed, all applicable COCs are less than or equal to the applicable RGOs.	Do not use the treated soil as backfill until all applicable COCs are less than or equal to the applicable RGOs.	IP/FP Forms; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify excavations backfilled in lifts approximately 8 inches thick (+/- 25%).	FP	E	Backfill placed in lifts approximately 8-inches thick (+/- 25%).	Add or remove backfill to meet lifts of approximately 8 inches thick (+/- 25%).	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify each lift track packed/wheel packed	FP	E	Each lift track packed/wheel packed.	Track pack/wheel pack each lift before placement of the next lift.	FP Form; Daily Reports; QC Log and Report
Backfill of Excavations	CM/FQM	Verify backfilled excavation matches surrounding grade.	FP	E	Backfilled excavation matches surrounding grade.	Add/remove backfill, grade etc. until backfilled excavation matches surrounding grade.	FP Form; Daily Reports; QC Log and Report
Seeding	CM/FQM	Verify that excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	FP	E	Excavations are seeded using approved seed mixture (see Tables 5-1 and 5-2) covered with mulching material such as straw, woodchips or similar.	Obtain the approved seed mixture and apply, followed by mulching such as straw, woodchips or similar.	FP Form; Daily Reports; QC Log and Report
Traffic Control	CM/FQM	Verify that dirt/mud tracked onto base road ways is cleaned up.	FP	D	Dirt/mud tracked onto base road ways is cleaned up.	ICG clean up dirt/mud tracked onto base road ways.	FP Form; Daily Reports; QC Log and Report
Erosion and sedimentation Controls	CM/FQM	Until 70% vegetative cover is established, verify that erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	FP	W	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly after backfill and restoration (as well as after a ½-inch rain event).	Until 70% vegetative cover is established, erosion and sedimentation controls are maintained and inspected weekly by ICG after backfill and restoration (as well as after a ½-inch rain event).	FP Form; Daily Reports; QC Log and Report; ICG Stormwater Checklist (Appendix D)

Table notes:#

[a] The responsible person (if other than the CM/QCM) is the individual with whom the CM/QCM will coordinate to ensure compliance with requirements and to verify that any necessary follow-up actions are taken.

[c] Quality control phase: PP = preparatory phase, IP = initial phase, and FP = follow-up phase

[d] Frequency: O = once, D = daily, W = weekly, E = each occurrence

% = percent
APP = Accident Prevention Plan
ARNG = Army National Guard
bgs = below ground surface
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
CH2M = CH@M HILL Constructors, Inc.
CJAG = Camp James A. Garfield
CM = construction manager
COC = contaminant of concern
COR = Contracting Officer's Representative
CY = cubic yard(s)
ETC = enhanced thermal conduction
FQM = Field Quality Manager
HSM = Health and Safety Manager
ICG = Iron Creek Group
ISM = incremental sampling methodology
NA = not applicable
OHARNG = Ohio Army National Guard
Ohio EPA = Ohio Environmental Protection Agency
OSR = Off-Site Rule
PCB = polychlorinated biphenyl
PM = Project Manager
QC = quality control
QCM = Quality Control Manager
RCRA = Resource Conservation and Recovery Act
RD = remedial design
RGO = remedial goal option
SCADA = supervisory control and data acquisition
SSHP = Site Safety and Health Plan
SVOC = semivolatile organic compound
TCLP = toxicity characteristic leaching procedure
USACE = U.S. Army Corps of Engineers
VFD = variable frequency drive
VOC = volatile organic compound

Attachment 4
Excerpt from EPA Thermal Desorption Applications Manual (per comment SNW 6)

THERMAL DESORPTION APPLICATIONS MANUAL FOR TREATING NONHAZARDOUS PETROLEUM CONTAMINATED SOILS

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APPENDIX C

CONTRACTOR DIRECTORY, EQUIPMENT, AND PERFORMANCE DATA

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APPENDIX C

CONTRACTOR DIRECTORY, EQUIPMENT, AND PERFORMANCE DATA

1.0 INTRODUCTION

The purpose of Appendix C is to present technical and performance information on commercially available thermal desorption systems that have been used for remediating nonhazardous petroleum contaminated soils. The survey includes data on both stationary and mobile thermal desorption systems. The data in Appendix C was primarily gathered by Focus Environmental, Inc. by conducting a survey of remediation contractors during September, 1992. Other data resources included the technical literature, industry trade associations, equipment vendor's brochures, remediation contractor's brochures, other EPA reports, and telephone interviews with selected state regulatory agency personnel.

The survey was conducted to develop a directory of remediation contractors, collect information on system configurations and typical operating parameters, and summarize existing soil treatment and air emissions performance data. The survey results are organized into five parts:

- Contractor directory (Table C-1)
- Equipment components of thermal desorption systems (Table C-2)
- Operating parameters for thermal desorption systems (Table C-3)
- Soil treatment data (Table C-4)
- Stack emissions data (Table C-5).

2.0 DIRECTORY OF CONTRACTORS

Table C-1 contains a list of all identified remediation contractors, facility locations, and contact information. For stationary facilities, the facility location of the plant is identified. For mobile systems, "facility location" indicates all states the contractor is willing to operate within. Listing of a specific state under "facility location" for a mobile thermal desorption system does not indicate that the system has obtained operating permits in that state.

3.0 EQUIPMENT TYPES

Table C-2 summarizes the types of thermal desorption and offgas treatment equipment being used to remediate petroleum contaminated soils. The four major types of thermal desorption systems being used for treating petroleum contaminated soils include rotary dryers, asphalt plant aggregate dryers, thermal screws, and a conveyor furnace. Table C-2 also indicates the capacity of each system and the soil disposal methods reported by each contractor.

4.0 THERMAL DESORPTION SYSTEM OPERATING PARAMETERS

Information on thermal desorption system operating parameters is summarized in Table C-3. The parameters listed in Table C-3 represent actual operating data rather than maximum design parameters. Data in this table includes soil feed rates, soil feed sizes, soil discharge temperatures, soil residence times, thermal desorber exit gas temperatures, thermal desorber maximum thermal duties, afterburner temperatures, and afterburner gas residence times.

5.0 SOIL TREATMENT PERFORMANCE RESULTS

Table C-4 summarizes case history information on typical site sizes, types of contaminants treated, soil indicator compounds, concentrations of contaminants in the feed material, and concentrations of contaminants in the treated soil. Thermal desorption soil residual concentration data can only be compared when the results are generated using the same analytical methods. Information on the specific analytical tests which were used to determine soil petroleum hydrocarbon residuals are generally not described in the references cited. Therefore, the data presented in Table C-4 should be used as an approximate performance guide but should not be used to compare performance results from various contractors.

TPH treatment data in Table C-4 was analyzed to determine a distribution of values for contaminated soil concentration, treated soil concentration, and removal efficiency. The results of these analyses are presented in Figures C-1, C-2, and C-3 respectively.

6.0 STACK EMISSIONS PERFORMANCE RESULTS

A summary of stack gas composition data is presented in Table C-5. There are no Federal requirements for conducting stack gas performance tests during the thermal treatment of petroleum contaminated soils, therefore test parameters and protocols vary from site to site. Individual states may require stack testing for particulates, volatile organic compounds (VOC), total hydrocarbons (THC), carbon monoxide (CO), nitrogen oxides (NO_x), metals (primarily lead), sulfur dioxide (SO_2), opacity, or other parameters. Most states have not established standards for hydrocarbon or VOC destruction and removal efficiencies (DREs).

The data in Table C-5 indicate that thermal desorption systems with afterburners and conventional gas cleaning equipment (cyclones, baghouses, afterburners, wet scrubbers) typically attain emissions within the following ranges:

- Particulates — 0.01 to 0.05 gr/dscf
- Lead — 0.001 to 0.006 grams/ton of soil feed
- Carbon monoxide — 2 to 20 ppm_v
- Nitrogen oxides — 5 to 60 ppm_v
- VOC — 10 to 100 ppm_v
- VOC destruction and removal efficiency — 95 to 99.9%.

Limited air emissions data were available for systems that do not use afterburners. No air emissions data were reported for systems using condensation and carbon adsorption systems.

Table C-1. Directory of Contractors

Contractor	Facility Location(s)	Contact	Telephone No.
Advanced Soil Technologies, Inc. 2966 White Bear Ave. Maplewood, MN 55109	Mobile (California, Illinois, Michigan, Minnesota, Wisconsin)	Frank Kellogg	(612) 773-9095
Aggregate Recycling 100 Middle St. Portland, ME 04101	Norridgewock, ME	Bill Mitchell	(207) 634-3652
Alaska Interstate Construction 649 West 54th Avenue Anchorage, AK 99518	Anchorage, AK	Dave Thomas	(907) 562-2792
Allied Environmental Services 2163 Merrick Avenue Merrick, NY 11566	Mobile (35 states)	Stuart Berry	(800) 969-3478
American Asphalt of Wisconsin P. O. Box 1726 Wausau, WI 54402	Winona, MN Stevens Point, WI Amery, WI Lacrosse, WI Wisconsin Dells, WI Tomah, WI Mosinee, WI Fenimore, WI New Richmond, WI Eau Claire, WI Dubuque, IA Lake Delton, WI Wausau, WI Mobile (Iowa, Michigan, Minnesota, Wisconsin)	Jim Tryba	(715) 693-5200
American Soil Processing, Inc. P.O.Box 160, Corporate Center Marion, IA 52303	Marion, IA	Tad Cooper	(319) 377-3333
Anchorage Sand & Gravel 1040 O'Malley Road Anchorage, AK 99515	Mobile (Alaska)	Newton Bingham	(907) 349-3333
Anderson-Columbia Environmental P. O. Box 1386 Lake City, FL 32056-1386	Mobile (Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina)	Mike McRae	(904) 752-7585
Atlantic ESI 274 Delaware Avenue Suite 2D Delmar, NY 12054	Mobile (all 50 states)	Mike Dommermuth	(518) 475-0023
Banks Construction P.O. Box 71505 Charleston Heights, SC 29415	Summerville, SC	Reid Banks	(803) 744-8261

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Advanced Soil Technologies, Inc. 2966 White Bear Ave. Maplewood, MN 55109	Mobile (California, Illinois, Michigan, Minnesota, Wisconsin)	Frank Kellogg	(612) 773–9095
Aggregate Recycling 100 Middle St. Portland, ME 04101	Norridgewock, ME	Bill Mitchell	(207) 634–3652
Alaska Interstate Construction 649 West 54th Avenue Anchorage, AK 99518	Anchorage, AK	Dave Thomas	(907) 562–2792
Allied Environmental Services 2163 Merrick Avenue Merrick, NY 11566	Mobile (35 states)	Stuart Berry	(800) 969–3478
American Asphalt of Wisconsin P. O. Box 1726 Wausau, WI 54402	Winona, MN Stevens Point, WI Amery, WI Lacrosse, WI Wisconsin Dells, WI Tomah, WI Mosinee, WI Fenimore, WI New Richmond, WI Eau Claire, WI Dubuque, IA Lake Delton, WI Wausau, WI Mobile (Iowa, Michigan, Minnesota, Wisconsin)	Jim Tryba	(715) 693–5200
American Soil Processing, Inc. P.O.Box 160, Corporate Center Marion, IA 52303	Marion, IA	Tad Cooper	(319) 377–3333
Anchorage Sand & Gravel 1040 O'Malley Road Anchorage, AK 99515	Mobile (Alaska)	Newton Bingham	(907) 349–3333
Anderson–Columbia Environmental P. O. Box 1386 Lake City, FL 32056–1386	Mobile (Alabama, Georgia, Florida, Louisiana, North Carolina, South Carolina)	Mike McRae	(904) 752–7585
Atlantic ESI 274 Delaware Avenue Suite 2D Delmar, NY 12054	Mobile (all 50 states)	Mike Dommermuth	(518) 475–0023
Banks Construction P.O. Box 71505 Charleston Heights, SC 29415	Summerville, SC	Reid Banks	(803) 744–8261

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Bardon Trimount 70 Blanchard Road Burlington, MA 01894	Shrewsbury, MA Stoughton, MA	David Peter	(617) 221-8400
Beede Waste Oil P. O. Box 127 Plaistow, NH 03865	Plaistow, NH	Bob LaFlanne	(603) 382-5761
Brox Industries 85 Greely St. Hudson, NH 03051	Dracut, MA Hudson, NH Marlboro, MA	George Hall George Brox	(603) 856-8077 (617) 454-9105
Cardi Construction Corporation 400 Lincoln Avenue Warwick, RI 02888	Warwick, RI Mobile (Massachusetts, Connecticut, New York)	Steve Cardi, Jr.	(401) 739-8300
Carlo Environmental Technologies 44907 Trinity Drive Clinton Township, MI 48038	Mobile (Michigan)	Mike Carlo	(313) 468-9589
Clean Berkshires 86 S. Main St. Lanesboro, MA 01237	North Adams, MA Mobile (Northeastern U.S.)	John Anthony	(413) 499-9862
Clean Earth of New Castle P. O. Box 1049 New Castle, DE 19720	New Castle, DE Mobile (Continential U.S.)	George Dalphon	(302) 427-6633
Clean Soils 84 2nd Ave, Southeast New Brighton, MN 55112	St. Paul, MN Milwaukee, WI Bakersfield, CA Anchorage, AK Kenai, AK Mobile (Illinois, Michigan, Ohio, Pennsylvania)	Kirk Shellum	(612) 639-8811
Columbia-Anderson Asphalt P.O. Box 1386 Lake City, FL 32056-1386	California Lousiana Ohio New Jersey Texas Mobile (New Jersey)	Bill Sheehan	(714) 261-8860
ConTeck Environmental Services 22460 Hwy 169 NW Elk River, MN 55440	Mobile (Iowa, Minnesota, New Mexico, North Dakota, South Dakota, Texas)	Larry Hicks	(612) 338-6669
Continental Paving 1 Continental Drive Londonderry, NH 03063	Londonderry, NH	Mark Charbonneau	(603) 437-5387

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
C. A. Meyer Paving 4978 McLeod Road Orlando, FL 32805	Orlando, FL	Frank Cox	(407) 849-0770
D'Ambra Construction 800 Jefferson Blvd. Warwick, RI 02887	Warwick, RI	Jenny Parker	(401) 737-1300
DeCato Sand and Gravel RFD15 Box 52 Concord, NH 03301	Loudon, NH	Roger DeCato	(603) 798-5452
Delaware Container Company West 11th Ave & Valley Rd Coatesville, PA 19320	Coatesville, PA	Al Miller	(215) 383-6600
Diversified Contractors, Inc. 1701 West Linden Phoenix, AZ 85007	Phoenix, AZ Mobile (Arizona)	Steve Evers	(602) 274-0787
Domermuth Environmental Services P.O. Box 62 Clarksville, NY 12041-0062	Clarksville, NY	Jim Domermuth	(518) 768-2214
Domermuth Environmental Services 7828 Rutledge Pike Knoxville, TN 37924	Mobile (Alabama, Georgia, Kentucky, Louisiana, North Carolina, South Carolina, Tennessee, Virginia)	Glenn Palmer	(615) 637-5781
DRE Environmental, Inc. P.O. Box 1386 Lake City, FL 32056-1386	Mobile (Alabama, Louisiana, Texas, Virginia)	Chris Sleeper	(904) 758-3164
Dustcoating 695 D'Chene Lane Maple Plain, MN 55359	Maple Plain, NY	Larry Johnson	(612) 479-1593
Earle Asphalt Corporation P. O. Box 757 Farmingdale, NJ 07727	Jackson, NJ Farmingdale, NJ	Walter Earle, Jr.	(908) 657-8551 (908) 323-0053
Eau Claire Asphalt Corporation P. O. Box 326 Eau Claire, WI 54702	Eau Claire, WI	Louis Thune	(715) 835-4858
Enviro-Klean Soils, Inc. Box 2003 Snoqualmie, WA 98065	Mobile (Washington)	Richard Obendorf	(206) 888-9388
EnviroTech Mid-Atlantic 1861 Pratt Drive Blackburg, VA 24060	Danville, VA Chesapeake Bay, VA Fredricksburg, VA Mobile (Alabama, Virginia)	Doug Goldsmith	(703) 231-3983

(Continued)

Table C−1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
EnviroTech Systems 6363 Woodway, Suite 300 Houston, TX 77057	Houston, TX	Bennett Blocker	(713) 789−0400
Falcon Energy Associates P.O. Box 1257 Stockton, CA 95201	Mobile (Arizona, California, Nevada, Oregon, Washington)	Larry Gooden	(209) 463−7108
FERtech Enviro Systems, Inc. 630 N. Morley, Suite 107 Moberly, MO 65270	Mobile (Arkansas, Missouri, Texas)	Shadi Nikfarjam	(800) 362−8808
Four Seasons Industrial Services 3107 South Elm−Eugene Street Greensboro, NC 27406	Mobile (Continental U.S.)	Mike McClung	(919) 273−2718
Gennaro Pavers 1721 Pine St. Warren, OH 44483	Lowellville, OH	David Gennaro	(216) 394−5557
Giant Resources Recovery P. O. Box 352 Harleyville, SC 29448	Harleyville, SC	Al Asaro Luther Rebel	(803) 496−7676 (803) 496−5033
Harry Crooker & Sons, Inc. Old Bath Road RFD4 Box 4079	Brunswick, ME	Dick Morgan	(207) 729−3331
HY−COR−TECH 7828 Old Seward Highway Anchorage, AK 99502	Mobile (all 50 states)	Bob Harding	(907) 522−3728
Industrial Waste, Inc. Ellyson Industrial Park Box 34 Pensacola, FL 32514	Pensacola, FL Mobile (Florida)	Richard Singer	(904) 479−1788
Johnson Blacktop 2320 14th Avenue, NW Rochester, MN 55901	Rochester, MN	Royal Johnson	(507) 254−1854
Kary Asphalt, Inc. Eden Road Eden, MD 21822	Eden, MD	Steve Lambrose	(301) 543−0200
Keystone Block Transport P. O. Box 9 Temple, PA 19560	Sinking Springs, PA	Laura Lubahn	(215) 926−6915
Kleen−Soil International, Inc. 13838 Harlee Road Palmetto, FL 34221	Palmetto, FL	Tony L. Tripi	(904) 471−8628
Lakehead Backtop & Materials 6327 Tower Avenue Superior, WI 54880	Superior, WI	Joe Kimmes	(715) 392−3844

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Marriners, Inc. P. O. Box 600 Rockport, ME 04856	Washington, ME	David Andrus	(207) 236–4317
McCrossan 7855 Jefferson Highway Maple Grove, MN 55369	Maple Grove, MN	Bob Dongoske	(612) 425–4167
Merrimack Timber Services P. O. Box 359 Epsom, NH 03234	Chichester, NH Littleton, NH Hartland, VT	Jim Langille	(603) 798–4557
METCO Environmental, Inc. P. O. Box 368 Cumberland, MD 21502	Cumberland, MD Mobile (West Virginia)	Doug Reineke	(301) 729–6922
Midwest Soil Remediation 27010 St. Charles Rd. Wheaton, IL 60188	Wheaton, IL Mobile (Arkansas, Indiana, Kansas, Mississippi, Michigan, Wisconsin)	John Sweeney	(708) 231–5115
M.L. Chartier, Inc. 9195 Marine City Highway Fair Haven, MI 48023–0069	Mobile (Michigan)	Dennis Heine	(313) 725–8373
M.L. Fuhrman Company, Inc. P.O. Box 1054 Fond du Lac, WI 54935	Mobile (all 50 states)	Mick Fuhrman	(414) 923–2580
Mobile Reclaim, Inc. 4131 NW 13th St., #105 Gainesville, FL 32609	Gainesville, FL	Jeff Borneman	(904) 373–4614
National Soils Inc. No. 8 Towpath Road Fort Edward, NY 12828	Loudon, NH Fort Edward, NY Tuscaloosa, AL	George Bower	(603) 647–6996
Nevada Hydrocarbon 2650 East Mustang Sparks, NV 89431	Sparks, NV	Charles Chisholm	(702) 342–0200
OBG Technical Services 5000 Brittonfield Parkway, Suite 200 Syacuse, NY 13220	Mobile (Connecticut)	Jim Fox	(315) 437–6400
OHM Corporation 16406 U.S. Route 224 East Findlay, OH 45839–0551	Mobile (Continental U.S.)	Greg McCartney	(800) 537–9540
Oregon Hydrocarbon 9333 North Harborgate Portland, OR 97283	Portland, OR	Lex Johnson	(503) 735–9525

(Continued)

Table C–1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Pacific Industrial Services 925 West Esther Street Long Beach, CA 90813	Mobile (California, Montana, Utah, Washington, Wyoming)	John Van Kooy	(800) 359–6397 (310) 590–8626
Pacific Environmental Group, Inc. 1601 Civic Center Drive, Suite 202 Santa Clara, CA 95050	Mobile (California)	Erin Garner	(408) 441–7500
Payne & Dolan P. O. Box 781 Waukasha, WI 53187	Green Bay, WI Madison, WI Sussex, WI	Kurt Bechthold	(414) 524–1769
Peak Oilfield Service 4300 B Street Suite 603 Anchorage, AK	Mobile (all 50 states)	Roger Mechon	(907) 561–3200
Pet–Con Soil Remediation, Inc. P.O. Box 205 Spring Green, WI 53588	Spring Green, WI	Thomas LaBudde	(608) 588–7365
PETREO International, Inc. 13036 Sarah's Lane Houston, TX 77015	Houston, TX Mobile (Texas)	John Sullivan	(713) 453–4000
Phoenix Soils, Inc. P.O. Box 1750 Waterbury, CT 06723–1750	Waterbury, CT	Dave Green	(203) 755–2283
Progressive Development International, Inc. P.O. Box 465 Hartland, WI 53029	Mobile (all 50 states)	Corvin Frank	(414) 367–5044
Purgo, Inc. 5020 Monument Ave.#1 Richmond, VA 23230	Ashland, VA	Robert Carroll	(800) 446–2614 (804) 353–7400
Quantum Soil Remediation, Inc. 1327 South Westgate Avenue, Suite 306 Los Angeles, CA 90025	Mobile (California, Illinois, Michigan, North Carolina, New York, South Carolina, Texas)	Mark Randall	(310) 477–1189
Recovery Specialists, Inc. 201 North Park Yipsilanti, MI 48198	Mobile (California, Louisiana, Texas)	Fred Feitel	(313) 483–9600
Recycling Alternatives, Inc. P. O. Box 1896 Salisbury, MD 21802	Fort Worth, TX Adel, GA Nassawadox, VA New Bern, NC Birmingham, AL Chestertown, MD Richmond, VA	Don Mitchell	(410) 860–0268

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Resource Recovery of America, Inc 2300 Highway, 60 West Mulberry, FL 33860	Mulberry, FL	David Dye	(813) 425-1084
Ryan-Murphy, Inc. 8774 Yates Drive, Suite 100 Westminster, CO 80030	Beaumont, TX Mobile (California, New Jersey, Texas)	Steven Sarada	(303) 427-4567
Separation & Recovery Systems, Inc. 1762 McGaw Avenue Irvine, CA 92714	Mobile (New Jersey, Texas, California)	William Sheehan	(714) 261-8860
SFM Corporation P.O. Box 5504 Midland, TX 79704	Mobile (all 50 states)	Rusty Buckingham	(915) 694-7791
Shewey Environmental P.O. Box 5219 Hemet, CA 92544	Mobile (California)	Buzz Nelson	(714) 765-2780
Site Reclamation Systems, Inc. P.O. Box 11 Howey-in-the-Hills, FL 34747	Mobile (Alaska, Alabama, California, Colorado, Florida, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Massachusetts, Maryland, Michigan, North Carolina, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Tennessee, Texas, Virginia, Washington, Wisconsin, West Virginia)	Larry Woods	(904) 324-3651
Soil Cleansers, Inc. 2803 Dede Road Finksburg, MD 21048	Mobile (Maryland)	Paul Miller	(410) 833-3780
Soil Purification, Inc. P.O. Box 72515 Chattanooga, TN 37407	Chattanooga, TN	Wendell Feltman	(706) 861-0069
Soil Recycling Technologies, Inc. 1200 17th St., Suite 1930 Denver, CO 80202	Wichita, KS Greeley, CO Denver, CO Grand Junction, CO Atlanta, GA Oklahoma City, OK Fargo, ND Casper, WY Billings, MT Phoenix, AZ East St. Louis, IL Kansas City, KS	Joseph Connor	(303) 573-8300

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Soil Remediation Company 1325 S. Colorado Blvd, Suite 503 Denver, CO 80206	Greenville, SC Columbia, SC Mobile (North Carolina, South Carolina, Virginia)	George Chedsey	(800) 441-1968
Soil Remediation Services 2409 North Kerby St. Portland, OR 97227	Mobile (all 50 states)	George Coats	(503) 288-5816
Soil Remediation Service, Inc. 4820 N. 125th St. Butler, WI 53007	Port Washington, WI Mobile (All 50 states)	Tim Crowley	(414) 781-3545
Soil Safe, Inc. 4600 East Fayette Baltimore, MD 21224	Baltimore, MD	Walter Kennell	(301) 327-5753
Soil Services of Texas 950 1/2 East Port Corpus Christi, Texas	Mobile (Texas)	Sam J. Susser	(512) 883-6321
Sonas Systems of Florida P. O. Box 7387 Tallahassee, FL 32314	Tallahassee, FL	George Atkins	(904) 575-8102
Southeastern Soil Recovery, Inc. P. O. Box 70253 Charleston, SC 29415	Charleston Heights, SC	Bob Williams	(803) 566-7065
Southern Soil Services, Inc. 3505 Pugmill Rd Kissimmee, FL 34741-6462	Kissimmee, FL	Vanessa Burgess	(407) 933-8414
Sterling Asphalt 6431 NE 175th Kenmore, WA 98028	Kenmore, WA	Sam Johnson	(206) 485-5667
Stoneco, Inc. P.O. Box 29A Maumee, OH 43537	Toledo, OH	Don Weber	(419) 893-8731
Sunbelt Resources 715 Skyland Blvd. E Tuscaloosa, AL 35405	Tuscaloosa, AL Mobile (Tennessee)	Bob Jamison	(205) 758-3657
Susser Environmental Services P.O. Box 9036 Corpus Christi, TX 78469	Corpus Christi, TX Mobile (Texas)	Jeff Turner	(512) 883-6321
Testco 40 Stonecastle Road Rock Tavern, NY 12575	Mobile (all 50 states)	Perry Songer	(914) 567-1058

(Continued)

Table C-1. (Continued)

Contractor	Facility Location(s)	Contact	Telephone No.
Texas Soil Recycling 5900 Haynesworth Houston, TX 77034	Houston, TX	Patty Mireles	(713) 922-7155
Thermal-Clean Services P. O. Box 1210 Washington, PA 15301-7210	Washington, PA	Bill Spencer	(412) 228-1111
Tilcon Maine, Inc. P. O. Box 209 Fairfield, ME 04937	Fairfield, ME Midway, ME Portland, ME	Dave Bess	(207) 746-5636
TPS Technologies, Inc. 2070 S.Orange Blossom Trail Apopka, FL 32703	Adelanto, CA Palm Beach, FL Sumter, SC Chester, VA	Jim Lousararian	(617) 622-1000
True Enviromental Remediating Company P.O. Drawer 2360 Casper, WY 82602	Mobile (Wyoming)	Renee Taylor	(307) 237-9301
Tyree Environmental Services 208 Rt. 109 Farmingdale, NY 11735	Mobile (New York)	William Tyree, Jr.	(516) 249-3150
USPCI 5665 Flatiron Parkway Boulder, CO 80301	Mobile (Nevada)	Glenn Sprenger	(303) 938-5549
U.S. Waste Thermal Processing 11090 Rose Avenue Fontana, CA 92335	Mobile (California)	Bob Ruppert	(714) 509-7783
Vanguard-Welltech Environmental 13937 Luther Road Houston, TX 77039	Polestine, TX Mobile (All 50 states)	T. L. McDaniel	(713) 987-3800
Vernor Materials & Equipment Company P.O. Box 967 Clute, TX 77531	Freeport, TX	Michael Baker	(409) 233-3366
Western Thermal Soils Company 2950 Terminal Annex Los Angles, CA 90051	Tucson, AZ Mobile (California, Arizona)	George Cosby	(213) 258-2777
Williams Environmental Services 2076 W. Park Pl. Stone Mountain, GA 30087	Mobile (Alabama, Georgia, South Carolina)	Tom McDowell	(404) 498-2020
Woodworth & Company 1200 East D. Street Tacoma, WA 98421	Mobile (Washington)	Mike Tollkuehn	(206) 383-3585

Table C-2. Equipment Components of Thermal Desorption Systems

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
Advanced Soil Technologies	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	21
Advanced Soil Technologies	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Alaska Interstate Construction	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300 tons/hour	Mobile/stationary	Baghouse	B, R, I	(b)
American Soil Processing, Inc.	Rotary dryer	25–40 tons/hour	Mobile	Baghouse, afterburner	B, L, O	(b)
Banks Construction	Rotary dryer	–	–	Baghouse, afterburner	–	7
Brox Industries	Rotary dryer	10–20 tons/hour	Stationary	Baghouse	I	(b)
Brox Industries	Rotary dryer	10–20 tons/hour	Stationary	Baghouse	I	(b)
Cardi Construction Corporation	Rotary dryer	25–50 tons/hour	Mobile	Cyclone, baghouse, afterburner	B, L, R, I	(b)
Clean Berkshires	Rotary dryer	100 tons/hour	Mobile/stationary	Baghouse, afterburner	B, R, L, I	17,(b)

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
Clean Earth of New Castle	Rotary dryer	70 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R, L	11, (b)
Clean Earth of New Castle	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B, R, L	11, (b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile	Baghouse, afterburner, other	B	(b)
Clean Soils	Rotary dryer	90 tons/hour	Stationary	Baghouse, afterburner, other	R	(b)
Clean Soils	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner, other	B	(b)
Clean Soils	Rotary dryer	60 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Clean Soils	Rotary dryer	90 tons/hour	Mobile/stationary	Baghouse, afterburner, other	B, R, O	(b)
Delaware Container Company	Thermal screw	–	Stationary	–	–	41
Domermuth Environmental Services	Rotary dryer	–	Mobile	Baghouse, afterburner	–	6
DRE Environmental, Inc.	Rotary dryer	35 tons/hour	Mobile	Cyclone, baghouse, afterburner	B	(b)
Dustcoating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
Dustcoating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
D'Ambra Construction	Asphalt agg. dryer	75 tons/hour	Mobile/stationary	Baghouse, afterburner	–	33
Earth Purification Engineering	Rotary dryer	–	Mobile	Cyclone, cooler, baghouse	–	37
Enviro-Klean Soils	Thermal processor	3.5–15 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Enviro-Klean Soils	Thermal processor	10 tons/hour	Mobile	Baghouse, afterburner	B	(b)
EnviroTech Mid-Atlantic	Rotary dryer	–	Mobile/stationary	Baghouse, afterburner	–	7
EnviroTech Southeast	Rotary dryer	–	Mobile/stationary	Baghouse, afterburner	–	7
Falcon Energy Associates	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	–	21
Falcon Energy Associates	Rotary dryer	25–40 tons/hour		Baghouse, afterburner	B	(b)
Falcon Energy Associates	Rotary dryer	25–40 tons/hour	Mobile	Baghouse, afterburner	B	(b)
FERtech Enviro Systems	Rotary dryer	15–70 tons/hour	Mobile	Cyclone, BH, AB, heat exchanger	–	(b)
Four Seasons Industrial Services	Rotary dryer	–	Mobile	Baghouse, catalytic afterburner	–	16
Four Seasons Industrial Services	Rotary dryer	10–20 tons/hour	Mobile	Catalytic afterburner	B	(b)
Four Seasons Industrial Services	Rotary dryer	10–20 tons/hour	Mobile	Catalytic afterburner	B	(b)
Gennaro Pavers	Rotary dryer	25 tons/hour	Stationary	Baghouse, afterburner	–	21

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method[a]	References
KleenSoil International	Tile tunnel kiln	60 tons/hour	Stationary	Baghouse, afterburner	L,R	(b)
Midwest Soil Remediation	Rotary dryer	10–20 ton/hour	Mobile	Baghouse	B	(b)
Mobile Reclaim, Inc.	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B, L	(b)
Nevada Hydrocarbon	Rotary dryer	–	Stationary	Baghouse, afterburner	–	7
OHM Corporation	Rotary dryer	–	Mobile	Venturi scrubber	–	53
OHM Corporation	Rotary dryer	–	Mobile	Cyclone, venturi scrubber	–	53
Oregon Hydrocarbon	Rotary Dryer	40–50 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, L, R	(b)
Purgo, Inc.	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recovery Specialists, Inc.	Calciner	–	Mobile	Venturi scrubber, afterburner	–	39
Recovery Specialists, Inc.	Thermal screw	–	Mobile	Venturi scrubber, condenser	–	39
Recycling Alternatives, Inc.	Asphalt agg. dryer	80 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, wet scrubber	R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, afterburner, wet scrubber	R, I	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Cyclone, baghouse	R, I	(b)
Ryan–Murphy, Inc.	Rotary dryer	15 tons/hour	Mobile	Catalytic afterburner, baghouse	–	14
Ryan–Murphy, Inc.	Rotary dryer	10–20 tons/hour	Stationary	Baghouse with catalytic afterburner	B	(b)
Ryan–Murphy, Inc.	Rotary dryer	10–20 tons/hour	Mobile	Baghouse with catalytic afterburner	B	(b)
Separation & Recovery Systems, Inc.	Thermal screw	4 tons/hour	Mobile	Condensation, activated carbon	B	(b)
Site Reclamation Systems	Rotary dryer	–	Mobile	Baghouse, afterburner	–	12, 53
Soil Cleansers	Rotary dryer	25 tons/hour	–	Baghouse, afterburner	–	21
Soil Remediation Company	Rotary dryer	15–30 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R	(b)
Soil Remediation Company	Rotary dryer	15–30 tons/hour	Stationary	Cyclone, baghouse, afterburner	B, R	(b)
Soil Remediation Company	Rotary dryer	–	Mobile	–	B, R	(b)
Soil Remediation Services, Inc.	Rotary dryer	25 tons/hour	Mobile	Afterburner, baghouse	B	(b)
South Coast Asphalt Products	Asphalt agg. dryer	120 tons/hour	Stationary	Cyclone, baghouse	–	36, (b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30 tons/hour	Stationary	Baghouse	–	38
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30 tons/hour	Stationary	Cyclone	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	100 tons/hour	Mobile/stationary	Wet scrubber	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50 tons/hour	Stationary	Wet scrubber	B, R, I	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50 tons/hour	Mobile/stationary	–	B, R, I, O	(b)

(Continued)

Table C-2. (Continued)

Contractor	Desorber Type	Size/Capacity	Mobile or Stationary	Offgas Treatment Train	Soil Disposal Method [a]	References
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90 tons/hour	Stationary	Baghouse, afterburner	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Wet scrubber	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90 tons/hour	Mobile/stationary	Wet scrubber	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Mobile/stationary	Baghouse	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	Stationary	Baghouse	–	(b)
Stoneco	Rotary dryer	25 tons/hour	Mobile/stationary	Baghouse, afterburner	B, O	21
Thermal–Clean Services	Rotary dryer	30–180 tons/hour	Stationary	Baghouse, afterburner	B, L, R	(b)
TPS Technologies, Inc.	Rotary dryer	25 tons/hour	Stationary	Baghouse, afterburner	–	15
True Environmental Remediating	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner, wet scrub.	B, L, R	(b)
Tyree Brothers	Rotary dryer	–	Mobile	Baghouse, afterburner	–	13
U.S. Waste Thermal Processing	Conveyor furnace	5–10 tons/hour	Mobile	Afterburner, wet scrubber	–	43, 53
Vanguard–Welltech Environmental	Thermal screw	4–15 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Western Thermal Soils Company	Rotary dryer	25 tons/hour	Mobile	Baghouse, afterburner	B	(b)
Williams Environmental Services	Rotary dryer	30 tons/hour	Mobile	Baghouse, afterburner	–	22
Williams Environmental Services	Rotary dryer	15 tons/hour	Mobile	Baghouse, afterburner	–	22

Notes:

(–) Indicates no data is available.

(a) Soil disposal methods include:
- B – Backfill
- I – Incorporate into asphalt
- L – Landfill cover
- O – Other
- R – Road base

(b) Survey conducted by Focus Environmental, Inc., September 1992.

Table C-3. Operating Parameters for Thermal Desorption Systems

Contractor	Desorber Type	Soil Feed Rate (tons/hr)	Maximum Feed Size (inches)	Soil Discharge Temperature (°F)	Soil Residence Time (minutes)	Desorber Exit Gas Temperature (°F)	Maximum (a) Thermal Duty (MM Btu/hr)	Afterburner Temperature (°F)	Afterburner Gas Residence Time (sec)	References
Advanced Soil Technologies	Rotary dryer	35	2	600–800	3–5	350–400	50	1,400–1,600	1.8	(b)
American Asphalt of Wisconsin	Asphalt agg. dryer	100–300	1.5	325	2–3	300	–	–	–	(b)
American Soil Processing, Inc.	Rotary dryer	25–40	2	400–500	–	300	–	1,400–1,600	1.0	(b)
Banks Construction	Rotary dryer	25	–	440	5–7	–	–	–	–	7
Cardi Construction Corporation	Rotary dryer	25	2	850	5–8	350	60	1,600	1.5	(b)
Clean Earth	Rotary dryer	70	2	1,000	8	400	60	1,500	1.75	(b)
Clean Earth	Rotary dryer	25	2	650	5	350	40	1,500	1.5	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	20–50	–	300–600	–	–	–	1,400	–	10
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	25	2	750	4–12	1,000	35	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	60	3	900	4–12	1,000	50	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Clean Soils	Rotary dryer	90	3	900	4–12	1,000	57	1,600	1.0	(b)
Confidential No. 1	Rotary dryer	82	–	580	–	–	–	–	–	21
Confidential No. 2	Rotary dryer	29–35	–	530–612	–	–	–	–	–	21
Confidential No. 3	Rotary dryer	22–36	–	580–640	–	–	–	–	–	21
Confidential No. 4	Rotary dryer	22–27	–	650–855	–	–	–	–	–	21
Domermuth Environmental Services	Rotary dryer	20–40	–	400–600	3–4	–	–	1,400–1,600	–	6
DRE Environmental, Inc.	Rotary dryer	35	2	500–1,000	10	400	50	1,600	1.0	(b)
Earth Purification Engineering	Rotary dryer	8	–	500–700	–	710–1,000	3.3	–	–	37
Envirotech Mid–Atlantic	Rotary dryer	30–50	–	750	4.5	–	84	–	–	7, 53
Envirotech Southeast	Rotary dryer	20	–	725	3–5	–	72	1,400–1,600	–	7, 53
Enviro–Klean Soils	Thermal processor	3.5	2	500–750	–	350	5	–	5.0	(b)
Falcon Energy Associates	Rotary dryer	25–40	2	850	5–10	350	42	1,650	1.5	(b)
Falcon Energy Associates	Rotary dryer	25–40	2	850	5–10	350	42	1,650	1.5	(b)
FERtech Enviro Systems, Inc.	Rotary dryer	15–20	2–3	500–800	5–7	700–900	70	1,400–1,800	1.0–2.0	(b)
Four Seasons Industrial Services	Rotary dryer	10–20	2	500–650	8	300	12	1,200	1.0	(b)
Four Seasons Industrial Services	Rotary dryer	10–20	2	500–650	8	300	12	1,200	1.0	(b)
Midwest Soil Remediation	Rotary dryer	10–20	3	600–800	7–8	450	11	1,100	0.075	(b)

(Continued)

Table C-3. (Continued)

Contractor	Desorber Type	Soil Feed Rate (tons/hr)	Maximum Feed Size (inches)	Soil Discharge Temperature (°F)	Soil Residence Time (minutes)	Desorber Exit Gas Temperature (°F)	Maximum (a) Thermal Duty (MM Btu/hr)	Afterburner Temperature (°F)	Afterburner Gas Residence Time (sec)	References
Recovery Specialists, Inc.	Thermal screw	3–5	–	400–575	–	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	7–12	–	400–575	–	–	–	–	–	39
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	3	400	5	400	95	–	–	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	5	450	115	–	–	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	7	450	140	1,400	0.5	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	80	6	500	6	500	175	1,400	1.0	(b)
Recycling Alternatives, Inc.	Asphalt agg. dryer	50	5	400	5	450	115	–	–	(b)
Ryan–Murphy, Inc.	Rotary dryer	10–20	2.5	400–700	4–8	< 450	10	800–1,250	0.17	(b)
Soil Remediation Company	Rotary dryer	15–30	0.5–6	400–700	5–9	700–900	47	1,400–1,800	2.0	(b)
Soil Remediation Company	Rotary dryer	15–30	0.5–6	400–700	5–9	700–900	47	1,400–1,800	2.0	(b)
Soil Remediation Services	Rotary dryer	25	2	200	–	–	–	1,400–1,600	–	(b)
South Coast Asphalt Products	Asphalt agg. dryer	120	–	350–400	–	350–400	–	–	–	34
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30	0.75	500	3–5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	–	–	–	–	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50	2	450–550	3–5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	50	2	500–600	5	–	–	–	–	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	30–40	2	500–600	3–5	–	–	1,500–1,600	0.5	(b)
Soil Recycling Technologies, Inc.	Asphalt agg. dryer	90	1	500–700	3–5	–	–	–	–	(b)
Stoneco	Rotary dryer	25	2	650	5–8	350	42	1,500	1.5	(b)
Thermal–Clean Services	Rotary dryer	30–180	2	600–1,472	0.3–2	350–1,275	160–220	1,600–2,192	1.0	(b)
True Environmental Remediating	Rotary dryer	25	2	1,000	–	600	70	1,600	1.0	(b)
U.S. Waste Thermal Processing	Conveyor furnace	5–8	1.5	300–650	–	–	10	1,800	0.5	43, 53
Vanguard–Welltech Environmental	Thermal Screw	4–15	4	500	20–45	525	8	1,600	1.0	(b)
Western Thermal Soils Company	Rotary dryer	25	2	850	–	350	28.7	1,400–1,600	1.0	(b)
Williams Environmental Services	Rotary dryer	10–15	3	250–1,000	5–20	450	34	1,400–1,600	2.0	22
Williams Environmental Services	Rotary dryer	25–30	4	250–1,000	5–20	450	67	1,400–1,800	2.0	22

Notes:

(–) Indicates no data available.

(a) Includes afterburner duty if system uses an afterburner.

(b) Survey conducted by Focus Environmental Inc., September 1992.

Table C-4. Thermal Desorption System Soil Treatment Data

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
American Soil Processing, Inc.	Rotary dryer	Marion, IA	–	Gasoline, diesel	Varies	<10	>99.9	Varies	<10	–	(a)
Banks Construction	Rotary dryer	Summerville, SC	–	No. 2 fuel oil	34,300	<25	>99.9	–	<25	–	7
Cardi Construction Corporation	Rotary dryer	Warwick, RI	3,000	No. 2 fuel oil	3,000	<50	98	10	1	90	(a)
Clean Berkshires	Rotary dryer	North Adams, MA	–	Gasoline, diesel, No. 2	3,000	<10	>95	>10	0.1	99	(a)
Clean Earth	Rotary dryer	–	–	–	3,950	<50	>98	23	0.005	99	(a)
Clean Earth	Rotary dryer	Trenton, NJ	–	Hydraulic oil	6,020	<10	>99	35	0.005	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Anchorage, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Kenai, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Kenai, AK	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	Multiple sites in PA	–	Gasoline, crude oil	35,000	<10	>99	20	0.1	99	(a)
Clean Soils	Rotary dryer	IL, MI, MN, OH, WI	–	Gasoline, crude oil	35,000	<5	>99	20	0.1	99	(a)
Confidential # 1	Rotary dryer	Confidential	–	Petroleum hydrocarbons	1,300	<48	>96.31	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	No. 2 fuel oil	1,708	<1	>99.94	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	Unleaded gasoline	429	<1	>99.97	–	–	–	21
Confidential # 2	Rotary dryer	Confidential	–	Gasoline	600	<1	>99.83	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Fuel oil	2,200	7	99.68	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Gasoline, diesel	150	22	85.3	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	No. 2 fuel oil	2,600	<2	>99.92	–	–	–	21
Confidential # 3	Rotary dryer	Confidential	–	Gasoline	1,300	6	99.54	–	–	–	21
Confidential # 4	Rotary dryer	Confidential	–	Crude oil	3,403	219	93.56	–	–	–	21
Domermuth Environmental Services	Rotary dryer	Knoxville, TN	1,000	Gasoline	–	<100	–	–	<10	–	6
DRE Environmental, Inc.	Rotary dryer	Mobile, AL	6,000	Waste oil	10,000	<25	99	>100	0.001	99	(a)
Earth Purification Engineering	Rotary dryer	Reno, NV	1,000	Gasoline, diesel, JP–4	5,000	<10	>99.80	–	–	–	37
Earth Purification Engineering	Rotary dryer	San Diego, CA	700	Diesel	67,000	<1,000	>98.51	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	1,085	<1	>99.91	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	5,200	<1	>99.98	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	2,400	<1	>99.96	–	–	–	37
Earth Purification Engineering	Rotary dryer	Kingvale, CA	275	Diesel	1,875	<1	>99.95	–	–	–	37
Envirotech Mid–Atlantic	Rotary dryer	Danville, VA	Fixed	No. 6 fuel oil	8,500	<50	>99.41	–	–	–	7
Envirotech Southeast	Rotary dryer	Munson, FL	–	Motor oil, No. 6 fuel oil	30,000	<40	>99.87	–	–	–	7
Enviro–Klean Soils, Inc.	Thermal processor	Gig Harbor, WA	525	Gasoline	2,100	ND	–	89.5	ND	–	(a)
Enviro–Klean Soils, Inc.	Thermal processor	Auburn, WA	150	Hydraulic, waste oils	580	<52	91	–	–	–	(a)
Falcon Energy Associates	Rotary dryer	Rio Vista, CA	1,000	Stoddard solvent	240	ND	100	0.05	ND	100	(a)

(Continued)

Table C-4. (Continued)

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
Falcon Energy Associates	Rotary dryer	West Sacramento, CA	2,000	Gasoline, diesel	46,000	ND	100	2,790	ND	100	(a)
Four Seasons Industrial Services	Rotary dryer	Conway, SC	1,000	Diesel fuel	3,350	<10	>99.6	35	<0.01	>99.9	(a)
Four Seasons Industrial Services	Rotary dryer	Appomatox, VA	3,000	Petroleum hydrocarbons	3,000	<10	>99.6	10	<0.005	>99.9	(a)
Midwest Soil Remediation	Rotary dryer	Chicago, IL	7,000	JP-4	3,500	10	>98	25	1	96	(a)
Mobile Reclaim, Inc.	Rotary dryer	Orlando, FL	1,045	Diesel	7,660	5	99.9	–	–	–	(a)
Nevada Hydrocarbon	Rotary dryer	Sparks, NV	–	Petroleum hydrocarbons	35,000	<10	>99.97	–	–	–	57
OHM Corporation	Rotary dryer	Cocoa, FL	1,000	Gasoline	–	–	–	–	<0.1	–	53
OHM Corporation	Rotary dryer	Cleveland, OH	1,500	Diesel	–	<50	–	–	–	–	53
OHM Corporation	Rotary dryer	Pennsylvania	1,300	Diesel	–	<100	–	–	–	–	53
OHM Corporation	Rotary dryer	Pennsylvania	1,500	Diesel	–	<100	–	–	–	–	53
Oregon Hydrocarbon	Rotary dryer	Portland, OR	–	Various hydrocarbons	Varies	ND	99	Varies	ND	99	(a)
Recovery Specialists	Thermal screw	–	–	Gasoline	60	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	550	20	96.36	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	560	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	15,000	5,500	63.33	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	17,000	2,100	87.65	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	350	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	390	34	91.28	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	1,340	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	13,000	330	97.46	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	210	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Gasoline	210	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Jet fuel A	550	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Crude oil	43,000	1,400	96.74	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Kerosene	550	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	50,000	820	98.36	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	No. 2 fuel oil	2,100	50	97.62	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Stoddard solvent	1,600	ND	–	–	–	–	39
Recovery Specialists, Inc.	Thermal screw	–	–	Stoddard solvent	1,500	ND	–	–	–	–	39
Ryan-Murphy, Inc.	Rotary dryer	Riverside, CA	14,000	JP-4	1,200	<20	99	2	0.05	96	(a)
Site Reclamation Systems, Inc.	Rotary dryer	Florida	–	Petroleum hydrocarbons	–	–	–	–	<0.1	–	53, 12
Soil Remediation Company	Rotary dryer	Greenville, SC	–	–	2,000	<100	>95.00	–	–	–	(a)
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	800	<45	>94.38	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Crude oil	2,000	<70	>96.50	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	3,400	<39	>98.85	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Diesel	2,450	<76	>96.90	–	–	–	19
Soil Remediation Company	Rotary dryer	Columbia, SC	–	Crude oil	6,000	<240	>96.00	–	–	–	19

(Continued)

Table C-4. (Continued)

Contractor	Desorber Type	Site(s)	Site Size (tons)	Petroleum Product	TPH Initial Concentration (mg/kg)	TPH Final Concentration (mg/kg)	TPH Removal Efficiency (%)	BTEX Initial Concentration (mg/kg)	BTEX Final Concentration (mg/kg)	BTEX Removal Efficiency (%)	References
Stoneco	Rotary dryer	Toledo, OH	10,000	All types	3,000	<40	99	0.442	ND	100	(a)
Thermal-Clean Services	Rotary dryer	Washington, PA	–	–	–	10	–	–	0.12	–	(a)
True Environmental Remediating	Rotary dryer	Casper, WY	–	Fuels, crude oil	25,000	<50	>98	–	10	98	(a)
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	300	Gasoline	5,000	ND	–	–	–	–	(a)
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	300	Diesel fuel	5,000	ND	–	–	–	–	53
U.S. Waste Thermal Processing	Conveyor furnace	Temecula, CA	1,000	Petroleum hydrocarbons	–	<10	–	–	–	–	53
U.S. Waste Thermal Processing	Conveyor furnace	California	540	Petroleum hydrocarbons	–	<10	–	–	–	–	53
Vanguard-Weltech Environmental	Thermal Screw	Pouestine, TX	10,000	Diesel	20,000	80	>99.6	25	ND	100	(a)
Western Thermal Soils Company	Rotary dryer	Tucson, AZ	7,000	Diesel	5,000	<10	99.8	–	–	–	(a)
Williams Environmental Services	Rotary dryer	Arburn, AL	600	Gasoline	–	<100	–	–	–	–	53
Williams Environmental Services	Rotary dryer	Alabama	6,000	Gasoline, diesel	5,000	<100	>98.00	–	–	–	22
Williams Environmental Services	Rotary dryer	Alabama	7,000	Diesel	3,000	<10	>99.67	–	–	–	22
Williams Environmental Services	Rotary dryer	South Carolina	3,500	Gasoline, diesel	3,000	<10	>99.67	–	–	–	22

(–) Indicates no data available.
(a) Survey conducted by Focus Environmental, Inc., September 1992.

Table C–5. Stack Emissions Data

Contractor	Desorber Type	Contaminants	Lead in Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Stack Emissions: Particulate (gr/dscf)	Stack Emissions: Volatile Organic Compounds (ppmv dry)	Stack Emissions: Carbon Monoxide (ppmv dry)	Stack Emissions: Nitrogen Oxides (ppmv dry)	Stack Emissions: Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Asphalt Plant	Asphalt agg. dryer	Baseline (a)	–	(b)	Wet scrubber	0.055	–	–	–	0.003	61–65	35
Asphalt Plant	Asphalt agg. dryer	Gasoline	12	(b)	Wet scrubber	0.20	–	–	–	0.0028	–	35
Asphalt Plant	Asphalt agg. dryer	Diesel	17	(b)	Wet scrubber	0.20	–	–	–	0.0045	–	35
American Soil Processing, Inc.	Rotary dryer	Gasoline, diesel fuel	–	1,400–1,600	Cyclone, baghouse, afterburner	0.03	–	–	–	–	–	(c)
Cardi Construction Corporation	Rotary dryer	No. 2 fuel oil	–	1,600	Cyclone, baghouse, afterburner	0.01	–	10	–	0.001	98	(c)
Clean Berkshires	Rotary dryer	Gasoline, diesel fuel, No. 2 fuel oil	–	1,400	Cyclone, baghouse, afterburner	<0.025	<82	–	–	–	>95	(c)
Clean Earth of New Castle	Rotary dryer	–	–	1,500	Baghouse, afterburner	<0.04	–	–	–	–	98	(c)
Clean Soils	Rotary dryer	Gasoline, crude oil	–	1,600	Baghouse, afterburner	0.02	<20	<20	<50	–	>99	(c)
DRE Environmental, Inc.	Rotary dryer	Waste oil	–	1,600	Cyclone, baghouse, afterburner	0.03	<2	2	–	–	99.9	(c)
Enviro–Klean Soils, Inc.	Thermal processor	Hydraulic oils, waste oils	–	1,400	Baghouse, afterburner	0.04	–	<5	<5	–	98	(c)
Enviro–Klean Soils, Inc.	Thermal processor	Gasoline	–	1,400	Baghouse, afterburner	0.04	–	<5	<5	–	98	(c)
Earth Purification Engineering	Rotary dryer	Diesel fuel	–	(b)	Baghouse	0.13	268 (d)	1,373	–	–	89	(c)

(Continued)

Table C–5. (Continued)

						Stack Emissions						
Contractor	Desorber Type	Contaminants	Lead in Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Particulate (gr/dscf)	Volatile Organic Compounds (ppmv dry)	Carbon Monoxide (ppmv dry)	Nitrogen Oxides (ppmv dry)	Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Falcon Energy Associates	Rotary dryer	Stoddard solvent	–	1,650	Baghouse, afterburner	0.04	1 (e)	11.3	58	–	99.6	(c)
Falcon Energy Associates	Rotary dryer	Gasoline, diesel fuel	–	1,650	Baghouse, afterburner	0.04	1 (e)	11.3	58	–	99.6	(c)
Four Seasons Industrial Services	Rotary dryer	Diesel fuel	–	1,200	Catalytic afterburner, baghouse	0.026	14	2.1	120	–	>99.8	(c)
Four Seasons Industrial Services	Rotary dryer	Petroleum hydrocarbons	–	1,200	Catalytic afterburner, baghouse	0.023	351	2.1	120	–	>99.8	(c)
Midwest Soil Remediation	Rotary dryer	JP–4	–	1,100	Baghouse, afterburner	0.04	<50	<10	<50	0.002	99.8	(c)
Mobile Reclaim, Inc.	Rotary dryer	Diesel fuel	–	1,400	Baghouse, afterburner	0.04	–	–	–	–	–	(c)
Oregon Hydrocarbon	Rotary dryer	Various hydrocarbons	–	1,400–1,600	Cyclone baghouse, afterburner	0.025	1.1	–	–	–	98.4	(c)
Ryan–Murphy, Inc.	Rotary dryer	JP–4	–	800–1,250	Catalytic afterburner, baghouse	0.039	0.42	<1	60	–	98.5	(c)
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,500	Baghouse, afterburner	0.002	40	4.5	–	–	99.9	19
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,600	Baghouse, afterburner	0.002	<40	3	–	–	99.9	19
Soil Remediation Company	Rotary dryer	Diesel fuel	–	1,400–1,800	Cyclone baghouse, afterburner	0.002	<40	–	–	–	99.9	(c)
South Coast Asphalt Products	Asphalt agg. dryer	Gasoline	–	(b)	Baghouse	–	175–242 (f)	–	–	0.002	47–64	36

(Continued)

Table C-5. (Continued)

Contractor	Desorber Type	Contaminants	Lead in Feed (mg/kg)	Afterburner Exit Gas Temperature (°F)	Offgas Treatment System	Stack Emissions: Particulate (gr/dscf)	Stack Emissions: Volatile Organic Compounds (ppmv dry)	Stack Emissions: Carbon Monoxide (ppmv dry)	Stack Emissions: Nitrogen Oxides (ppmv dry)	Stack Emissions: Lead (gr/ton of feed)	VOC Destruction and Removal Efficiency (%)	Reference
Stoneco	Rotary dryer	All types	–	1,500	Baghouse, afterburner	0.017	–	–	–	–	>99.88	(c)
Thermal-Clean Services	Rotary dryer	–	–	1,600–2,192	Baghouse, afterburner	0.02	10	–	–	–	99.99	(c)
True Environmental Remediating	Rotary dryer	Fuels and crude oil	–	1,600	Baghouse, wet scrubber	0.04	–	–	–	–	97	(c)
Vanguard-Welltech Environmental	Thermal screw	Diesel fuel	–	1,500	Baghouse, afterburner	–	–	–	–	–	–	(c)
Western Thermal Soils Company	Rotary dryer	Diesel fuel	–	1,400–1,600	Baghouse, afterburner	0.012	<80	–	–	–	>99	(c)
U.S. Waste Thermal Processing	Conveyor furnace	Gasoline	–	1,825	Afterburner, wet scrubber	0.008	23 (d)	2.5	–	0.006	–	43
U.S. Waste Thermal Processing	Conveyor furnace	Diesel fuel	–	1,825	Afterburner, wet scrubber	0.006	16 (d)	1.8	–	0.0023	–	43

(a) Baseline asphalt production, no contaminated soil feed.
(b) No afterburner
(c) Survey conducted by Focus Environmental, Inc., September, 1992
(d) Non-methane VOC's (hydrocarbon basis not identified)
(e) Volatile non-methane organic expressed as carbon.
(f) Total hydrocarbons by flame ionization detector

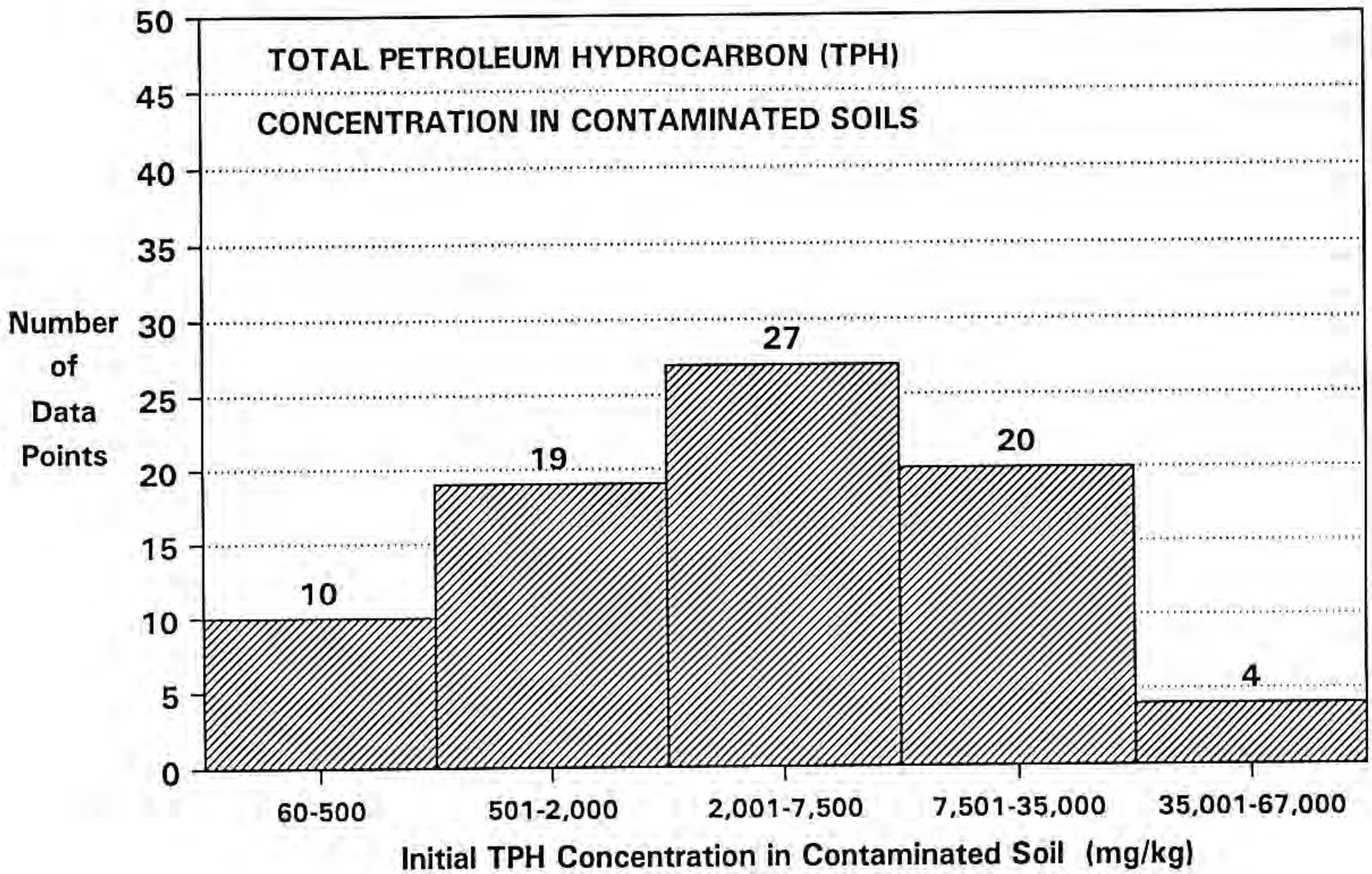

Figure C-1. TPH Concentration Data - Contaminated Soils

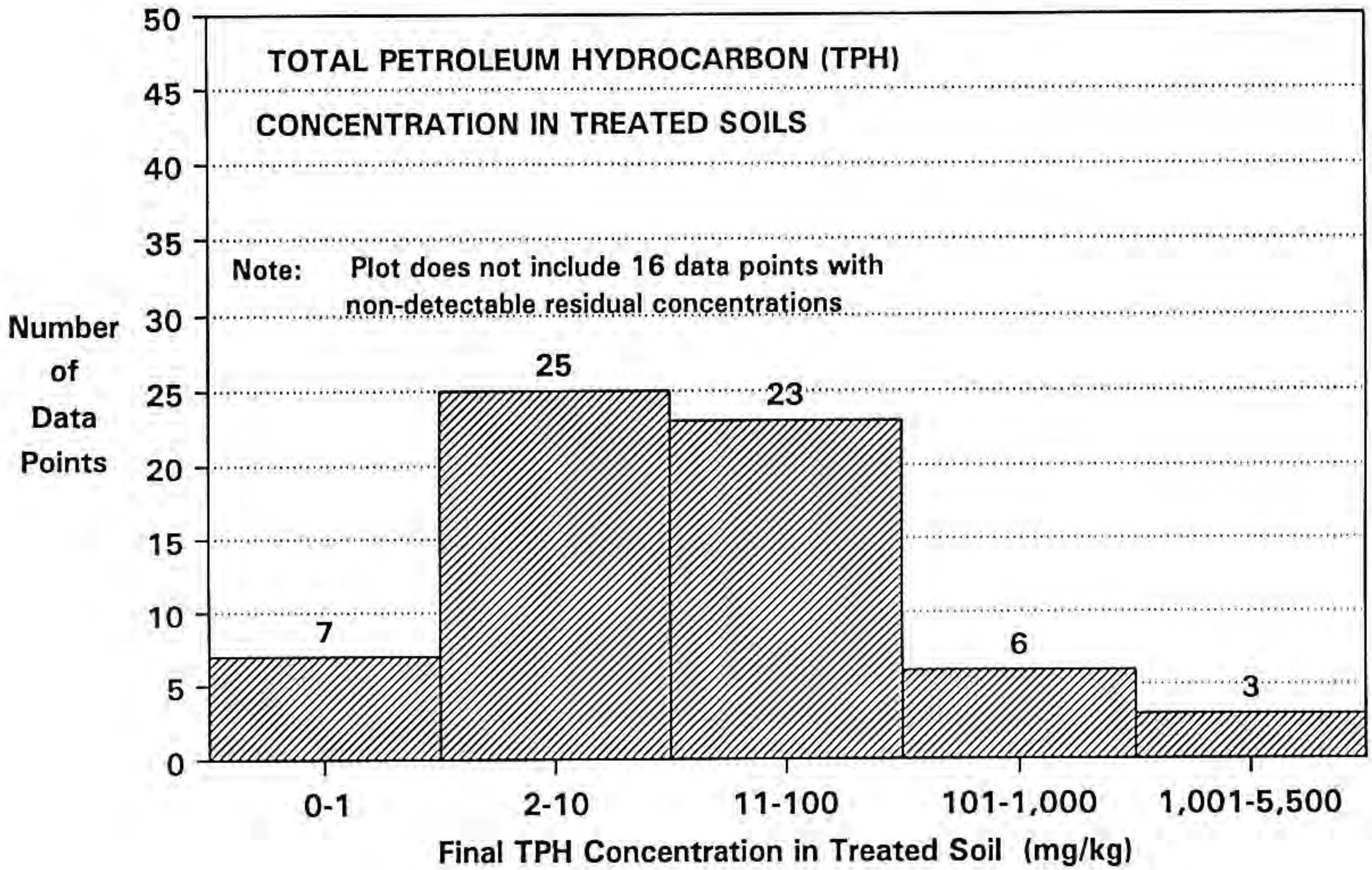

Figure C-2. TPH Concentration Data - Treated Soils

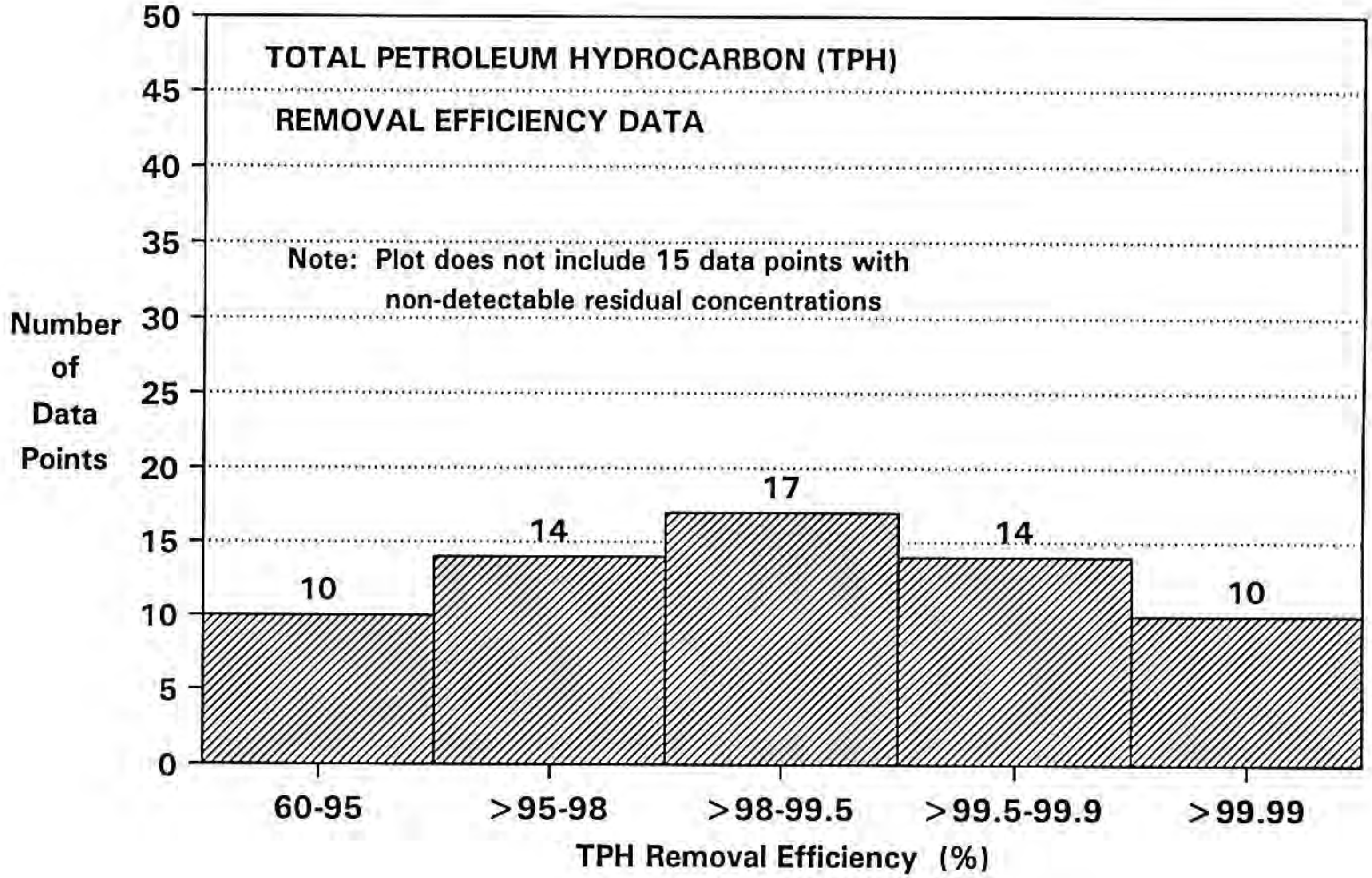

Figure C-3. TPH Removal Efficiency Data

Attachment 5
Revised QAPP Worksheet 11, Table 11-3
(per comment SNW 8)

Table 11-3. DQO #3 – Disposal Characterization for Metals-Impacted Soils

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for metals will be excavated for off-site disposal and waste profile information is needed.
Step 2 – Identify the Goals of the Study: Characterize the excavated metals-impacted soils for off-site disposal as IDW.
Step 3 – Identify Information Inputs: The ROD Amendment identified human health risk for commercial/industrial land use due to antimony and lead, or lead only, at four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4). ROD Amendment (Leidos, 2019) identifies off-site disposal of metals-impacted soil as part of the selected remedy to reduce the risk and be protective of human health. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.
Step 4 – Define the Boundaries of the Study: Metals-impacted soils will be excavated from four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4) as shown on RD Work Plan Table 2-1 and Figures 3 and 6). The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.
Step 5 – Develop the Analytical Approach: One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity. Laboratory results will be provided to the Transportation and Disposal subcontractor who will coordinate with an appropriate disposal facility to obtain approval of the material prior to transporting the excavated soil off-site. Based on generator knowledge, it is expected that these soils will be characterized as nonhazardous. Analytical data quality will be evaluated per this QAPP.
Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. IDW data will not be validated.
Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide SAP (Leidos, 2011), the RD Work Plan and this QAPP. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Table notes:

DoD = U.S. Department of Defense
IDW = investigation derived waste
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCBs = polychlorinated biphenyls
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
SVOC = semivolatile organic compound
TCLP= toxicity characteristic leaching procedure
VOC = volatile organic compound

Attachment 6
Revised QAPP Worksheet 11, Table 11-2
(per comment SNW 8)

Table 11-2. DQO #2 – Treatment Verification

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for PCBs, PAHs and/or explosives will be excavated and undergo ex-situ thermal treatment to meet the cleanup goals.

Step 2 – Identify the Goals of the Study: Confirm that treated soil meets the applicable cleanup goals before being placed back in the excavations as backfill.

Step 3 – Identify Information Inputs: Treated soil will be analyzed for the applicable COCs at a rate of approximately one composite sample per 150 cubic yards (CY) of treated soil.

Step 4 – Define the Boundaries of the Study: Treatment verification sampling will be performed for soil excavated from the planned excavations and treated in the ex situ Enhanced Thermal Treatment cell. Individual treatment cells will be segregated by COCs to facilitate treatment verification sampling and material management based on varying analytical TATs. The temporal boundary for the thermal desorption does not apply.

Step 5 – Develop the Analytical Approach: Treatment verification samples will be collected from treated soil at a rate of approximately one sample per 150 CY of treated soil. Treatment verification samples will be analyzed for the COCs associated with a particular batch of treated soil, based on the excavation from which the soil came as shown on Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP.

The laboratory results will be compared to Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional thermal treatment will be conducted until the cleanup goals are met.

Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed to be of known quality to meet project objectives as defined in Worksheet 36.

Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide Sampling and Analysis Plan (SAP) for Environmental Investigations (Leidos, 2011), the RD Work Plan and this QAPP. One composite treatment verification sample will be collected per 150 CY of treated soil. As each ETC treatment cell contains approximately 500 CY, the cell will be divided into quadrants for sampling and one composite treatment verification sample will be analyzed from each quadrant. After the soil achieves the target treatment temperature and the burners are disconnected, Iron Creek will utilize the excavator bucket to expose the soil in an approximately 4-foot by 6-foot area to a depth of approximately one foot in each quadrant in order to collect the treatment verification sample. While all of the soil will reach the target treatment temperature, the soil in the outer layer of the quadrant is farthest from the heating elements and therefore will reach the target treatment temperature last. Therefore, sampling the outer layer of soil is most conservative for treatment verification. Decontaminated or disposable sampling tools will be used to collect aliquots of approximately equal volume from 10 locations within the 4-foot by 6-foot by 1-foot exposed area. Each aliquot will be placed in a decontaminated stainless steel bowl to allow for further cooling. The aliquots will then be homogenized and placed into laboratory containers for analysis of the applicable COCs (see Table 2-1 of the RD Work Plan).

Treatment verification samples for explosives will be submitted for laboratory analysis with projected turnaround time of 7 days. Treatment verification samples for soil from locations with PAHs and/or PCBs only are planned for laboratory analysis with projected turnaround time of 48 hours.

If a treatment verification sample meets the applicable cleanup goals, then the associated soil will be cleared by CH2M for use as backfill. If a treatment verification sample exceeds an applicable cleanup goal, then the excavator bucket will be used to expose another approximately 4 by 6 by 1-foot area in the outer layer of the quadrant and a second treatment verification sample will be collected for analysis of the COC that exceeded the cleanup goal.

Depending on the magnitude of the exceedance, the second composite treatment verification sample may be collected immediately for analysis of the COC that exceeded the cleanup goal in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected) or the active heating system may be turned on again to further treat the soil prior to collecting the second treatment verification sample. This decision will be based on the professional judgement of the system operator. Should a quadrant not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling. This process will be repeated until the quadrant meets the applicable cleanup goals. The CH2M CM/FQM will review the sampling results and provide approval before the material can be used as backfill.

Table notes:

CH2M = CH2M HILL Constructors, Inc.
COC = contaminant of concern
CY = cubic yard
DoD = U.S. Department of Defense
ETC = enhanced thermal conduction
PAH = polycyclic aromatic hydrocarbon(s)
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB = polychlorinated biphenyl(s)
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RA = remedial action
RD = remedial design
ROD = Record of Decision
TAT = turnaround time

Attachment 7
Revised QAPP Worksheet 23-1
(per comment SNW 9)

Worksheet #23—Analytical Standard Operating Procedure References

The analytical SOP references in Table 23-1 were provided by the laboratories. Only SOPs for sample data being validated are presented. IDW data will not be validated. Note that the laboratory SOPs have not been modified specifically for this project to meet the DQO requirements. The laboratory SOPs are supplemented by internal communication systems within the laboratory to disseminate the project requirements and UFP-QAPP to technical staff. Laboratory SOPs are provided as Attachment 2 of this QAPP.

Table 23-1. Analytical SOP References

Reference Number	Title, Revision Number, and Date	Definitive/ Screening Data	Matrix/ Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Yes/No)
LSOP-01	SV-004 Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 11. 8/8/19	Definitive	PCBs	GC/ECD	CT	No
LSOP-02	SV-006 Semivolatile Organic Compounds by GC/MS, Method SW8270D. Revision 0. 5/29/19	Definitive	PAHs	GC/MS	CT	No
LSOP-03	MT-009 Method 6010- Inductively Coupled Plasma. Revision 5.3. 4/16/19	Definitive	Metals	ICP	CT	No
LSOP-04	SV-010, Explosives by Modified Method SW8330B. Revision 5.1. 6/13/19	Definitive	Explosives	HPLC	CT	No
LSOP-05	GT002 Processing of Multi-incremental Samples and Subsampling	Definitive	Explosives, PCBs, PAHs and metals	GC/MS. HPLC, ICP, GC/EICD	CT	No
LSOP-06	Determination of Polychlorinated Biphenyls as Aroclors by Gas Chromatography by Method SW8082. Revision 3/29/17	Definitive	PCBs	GC/ECD	Chemtech (treatment verification samples with expedited turnaround)	No
LSOP-07	Determination of Extractable Semivolatile Organic Compounds by Method SW8270D. Revision 6/6/19	Definitive	PAHs	GC/MS	Chemtech (treatment verification samples with expedited turnaround)	No

Table notes:
Chemtech = Chemtech Laboratory, Inc.
CT = CT Laboratories, LLC
ECD = electron capture detector
GC = gas chromatography
HPLC = high-performance liquid chromatography
ICP = inductively coupled plasma
LSOP = laboratory standard operating procedure
MS = mass spectrometer

Subject: FW: [Non-DoD Source] RD RTC LL 1-4 and 12 final feedback on the QA/QC evaluation for ISM
Attachments: ISM QAQC Final.docx

From: Susan.Netzly-Watkins@epa.ohio.gov <Susan.Netzly-Watkins@epa.ohio.gov>
Sent: Friday, August 14, 2020 1:38 PM
To: Tait, Kathryn S NFG NG OHARNG (USA) <kathryn.s.tait.nfg@mail.mil>; Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>
Cc: bob.princic@epa.ohio.gov; Brian.Tucker@epa.ohio.gov; Thomas.Schneider@epa.ohio.gov
Subject: [Non-DoD Source] RD RTC LL 1-4 and 12 final feedback on the QA/QC evaluation for ISM

Hello Katie and Kevin,

Thanks again for meeting with us to discuss the RTC -QA/QC step for the LL 1-4 and 12 RD.
Ohio EPA has been taking a closer look at DQOs being applied at remedial projects across the state to ensure consistent application of ISM.
In the attachment, we outlined the points discussed yesterday.

Happy to discuss if further clarification is needed.

Enjoy the weekend.

Sue Netzly-Watkins
Ohio EPA-Northeast District Office

GOAL: Meet the remediation goal at the RVAAP Areas of Concern (AOCs) with a high level of confidence that field sampling errors and laboratory analysis errors have been minimized.

Clear direction is requested so RVAAP team can detect issues with field sampling or laboratory sample preparation. Keeping Ohio EPA in the loop on the quality control checks will increase our confidence of the results.

ACTION: Revise Step 5 to include update data quality (DQ) steps to ensure appropriate use of incremental sampling methodology (ISM). Develop an "if…then" decision tree. This is a two-part quality assurance/quality control (QA/QC) where both the field team's performance and the laboratory's performance need to be within the limit deemed necessary to show the remediation goal was met.

- Ohio EPA recommends front loading the triplicate sampling QA/QC. The first three confirmation ISM samples should be taken with field triplicates and laboratory duplicates and the results submitted to Ohio EPA for concurrence on meeting data quality objectives (DQOs). Following the initial sampling and data review, the listed 1 triplicate per 10 samples is recommended. If necessary, Ohio EPA will notify RVAAP when the tightness of the data quality is an issue. The goal will be to meet the ITRC guidance of a relative standard deviation (RSD) of 30-35% of the field samples, laboratory samples should be lower. In addition, Ohio EPA will also review the data with above RSD and their FSOP internal guidance and note if there are any concerns with data quality and if our FSOP should be revised. Note: If sample personnel are significantly changed following the initial quality check then, another three ISM sample evaluation may be needed.

- As noted in the Hawaii guidance provided for review (http://www.hawaiidoh.org/tgm-Content/0402a.aspx?f=T): "(t)riplicate samples (*i.e.*, original sample plus two replicates) should be collected to evaluate the precision of field sampling methods used. Each set of replicate increments must be collected from completely independent (systematic random) locations. Collection of increments around a single grid point is not appropriate for replicate samples, since this might not adequately test small-scale variability within the decision unit (DU)." Revise step seven (7) to be consistent with the method provided above.

- Ohio EPA concurs that if any of a triplicate ISM samples exceeds a cleanup goal (CUG), then additional excavation and confirmation sampling would be required.

Subject: FW: RVAAP - RTC LL 1-4 & 12 confirmation sampling/ISM

From: Tait, Kathryn S NFG NG OHARNG (USA) <kathryn.s.tait.nfg@mail.mil>
Sent: Tuesday, August 11, 2020 1:33 PM
To: Meyers, Sarah/WDC <Sarah.Meyers@jacobs.com>
Cc: nathaniel.peters.II@usace.army.mil; Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>
Subject: [EXTERNAL] FW: RVAAP - RTC LL 1-4 & 12 confirmation sampling/ISM

Feedback from Ohio EPA on the RTCs… to be discussed on the Thursday call. Katie

From: Susan.Netzly-Watkins@epa.ohio.gov <Susan.Netzly-Watkins@epa.ohio.gov>
Sent: Tuesday, August 11, 2020 1:26 PM
To: Tait, Kathryn S NFG NG OHARNG (USA) <kathryn.s.tait.nfg@mail.mil>
Cc: Brian.Tucker@epa.ohio.gov; bob.princic@epa.ohio.gov
Subject: [Non-DoD Source] RE: RVAAP - RTC LL 1-4 & 12 confirmation sampling/ISM

Katie,

We had a chance to look over the RTC for the RSD comment and have some feedback that we can discuss further during Thursday's call.

The RSD is not the same as the 5-10% difference goal in Ohio EAP FSOP. We can accept the <35 RSD with the addition of Ohio EPA's recommendation of < 10% difference between replicate sample concentrations as a goal.
That would mean we have two goals to use in the evaluation of triplicate confirmation samples.
Ohio EPA recommends that if the values are above either criterion, then Ohio EPA reviews the data prior to any decision on the removal meeting performance standards at the AOC/DU.

The other option could be a blanket failure and you would excavate more and resample.

From: Tait, Kathryn S NFG NG OHARNG (USA) <kathryn.s.tait.nfg@mail.mil>
Sent: Monday, August 10, 2020 11:58 AM
To: Netzly-Watkins, Susan <Susan.Netzly-Watkins@epa.ohio.gov>; Tucker, Brian <Brian.Tucker@epa.ohio.gov>; Princic, Bob <bob.princic@epa.ohio.gov>
Cc: Nathaniel Peters - USACE, Louisville District (Nathaniel.Peters.II@usace.army.mil) <Nathaniel.Peters.II@usace.army.mil>; Sedlak, Kevin M CIV (USA) <kevin.m.sedlak.civ@mail.mil>; Meyers, Sarah/WDC <Sarah.Meyers@jacobs.com>
Subject: RE: RVAAP - RTC LL 1-4 & 12 confirmation sampling/ISM

Sue:
Attached is the Draft RTC table to respond to your comments on the RD for LL1-4 and 12. This will be used during the Thursday meeting. Talk to you then. Thanks. Katie

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

August 3, 2020

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Army National Guard
Installation and Environment
Clean-up Branch
IPA Designation
1438 State Route 534 SW
Newton Falls, OH 44444

RE: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859263

Subject: Review of the Response to Comments of the Draft Remedial Design Work Plan for RVAAP Load Lines 1 – 4 and 12 (RVAAP-08 through RVAAP-12), Dated June 29, 2020

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed your response to our comments (RTC) to the document entitled "Draft Remedial Design for RVAAP Load Lines 1 – 4 and 12."

The Draft Remedial Design (RD) document, received by Ohio EPA's NEDO on April 2, 2020, was prepared for the U.S. Army Corps of Engineers Louisville District, by CH2M HILL Constructors, Inc., 2411 Dulles Corner Park, Suite 500, Herndon, VA. The RTC was provide to Ohio EPA in a letter dated June 29, 2020, from the National Guard Bureau.

Most of Ohio EPA's comments were addressed in the RTC letter. Ohio EPA had a call with you on July 31, 2020, to discuss remaining comments that focus on verification of soils meeting the clean-up goals and the process chain that will be followed to make this determination. Several worksheets in the Quality Assurance Project Plan (QAPP) contain information that was inconsistent or require further clarification.

Cmt. No.	Comment Resolution	Original Comment	Follow Up Comment
SNW 1	Resolved.	The total number of areas subject to excavation and remedial activities seems to be inconsistently referenced in the April 2020 Draft RD Work Plan.	

SNW 2	Need Clarification.	Verification that full extent of impacted soil area in each of the load line remediation areas has been archived.	The June 2020 RTC states that an SOP regarding ISM sampling has been added to Appendix A of the QAPP. Also, some edits/ clarifications in several of the QAPP worksheets is requested. **QAPP Worksheet 11.1**: Step 5. An RSD of 35% as a goal is too high. Ohio EPA recommends an RSD between 5 – 10%. **QAPP Worksheet 11.2:** Confirming that one composite sample will be collected from each 150 cubic yards of treated soil. From our July 31 call we learned that the ETC operator will determine if a confirmation sample result that exceeds the CUG warrants further treatment. Since the soils remain heated, additional chemical destruction occurs. Specifics were not available on the expected rate of additional COC reduction post treatment. Include further details regarding the decision tree that will be used to determine when treated soils at the ETC have met CUGs or when further treatment is warranted. **QAPP Worksheet 18:** In Section 2 of the SOP it notes the "appropriate decision units must be identified for ISM to be valid." This SOP doesn't provide specific information on how the decision units (DUs) are determined for the AOCs Clarify what is the representative area of an ISM sample. In our July 31 call, it was noted that a separate ISM sample will be collected for each side wall and a separate ISM sample for the bottom of the excavation. Some excavation areas are subdivided. Clarify the process to determine if additional remedial action would be undertaken at an excavation/DU if the ISM sample is above the CUGs. What parties are informed or involved in the decision making on the additional soil removal activity. Following additional removal is another ISM verification sample collected in the same manner as it had been the first time? **General comment** about QAPP Worksheet Table Notes: ITRC = Interstate Technology & **Regulatory** Council
SNW 3	Resolved.	Section 5.4 Thermal Treatment.	
SNW 4	Resolved.	Section 5.6.2 Treatment Verification Samples.	
SNW 5	Resolved.	Back Fill and Site Restoration.	
SNW 6	Resolved.	Section 7 Environmental Management.	

SNW 7	Resolved.	Section 8 Storm Water Pollution Prevention.	
SNW 8	Resolved	Table 11-2 DQO#2 Treatment Verification, process clarification is needed.	
SNW 9	Resolved.	QAPP- Appendix A.	

Ohio EPA requests the comments above be addressed prior to submitting the final version of the document. Providing the noted revised worksheets with your RTC may help limit additional rounds of comments.

As a precautionary response to COVID-19, Ohio EPA is currently operating with most staff working remotely. During this time, we will not be issuing hard-copy mail. This letter is an official response from Ohio EPA that will be maintained as a public record. If you have any questions or concerns, please do not hesitate to contact me at (330) 963-1235.

Sincerely,

Sue Netzly-Watkins

Sue Netzly-Watkins
Site Coordinator
Division of Environmental Response and Revitalization

SNW/sc

ec: Nat Peters, USACE
Craig Coombs, USACE
Katie Tait, OHARNG RTLS
Sarah Meyers, CH2M
Rebecca Shreffler, Chenega
Natalie Oryshkewych, Ohio EPA, NEDO, DERR
Bob Princic, Ohio EPA, NEDO, DERR
Tom Schneider, Ohio EPA, SWDO, DERR
Tim Christman, Ohio EPA, CO, DERR
Duane LaClair, ARAQMD
Kelly Kanoza, ARAQMD

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

June 29, 2020

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Ms. Sue Netzly-Watkins, Site Coordinator
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program, Portage/Trumbull Counties, Responses to Ohio EPA comments on the Draft Remedial Design Work Plan for Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12) (Work Activity No. 267-000-859-263)

Dear Ms. Netzly-Watkins:

An electronic version of the responses to Ohio EPA comments received June 11, 2020 on the March 2020 *Draft Remedial Design Work Plan for RVAAP Load Lines 1, 2, 3, 4, and 12 (RVAAP-08 to 12)* will be sent for your review and approval using the Ohio EPA LiquidFile system. This response to comments was prepared for the Army in support of the RVAAP restoration program. Please contact the undersigned at 614-336-6000 Ex 2053 or kevin.m.sedlak.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,

SEDLAK.KEVIN.MICHAEL.1254440171
Digitally signed by SEDLAK.KEVIN.MICHAEL.1254440171
Date: 2020.06.29 10:46:26 -04'00'

Mr. Kevin Sedlak
RVAAP Restoration Program Manager
Army National Guard Directorate

cc: Tom Schneider, Ohio EPA SWDO (Email transmittal letter only)
Bob Princic, Ohio EPA NEDO-DERR (Email transmittal letter only)
Natalie Oryshkewych, Ohio EPA NEDO-DERR (Email transmittal letter only)
Katie Tait, OHARNG, CJAG (pdf via Email or ftp)
Admin Records Manager – Jennifer Tierney, Vista Sciences Corp (pdf via Email or ftp)
Pat Ryan, Leidos-REIMS (Email transmittal letter only)
Craig Coombs, USACE – Louisville District (Email transmittal letter only)
Nathaniel Peters, USACE – Louisville District (pdf via Email or ftp)
John Hearn, USACE – Louisville District - WPAO (pdf via Email or ftp)

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov) Dated June 10, 2020; Received June 11, 2020

Date: June 22, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 1		The total number of areas subject to excavation and remedial activities seems to be inconsistently referenced in the April 2020 Draft Remedial Design (RD) Work Plan (draft RD work plan). Several places in the draft RD work plan text indicate a different number of excavation areas than are reflected in the Figures and Tables. Below are several places in the draft RD work plan that should be revised:	
	Section 1.2 Scope	Section 1.2 Scope: Line 23 notes that the remedy includes excavation of soil from 25 locations. This number is not consistent in the draft RD work plan. The number provided in the report narratives is inconsistent with the number provided in figures and in tables.	The following text revisions were performed in Section 1.2 Page 1-1, Lines 18-21 were revised to "The ROD identifies <u>24</u> locations at Load Lines 1-4 and 12 which require soil removal in order to achieve the Remedial Action Objective (RAO) to reduce risk from contaminants of concern (COCs) in surface and subsurface soil to acceptable levels (remedial goal options [RGOs]) for likely future use (i.e., Commercial/Industrial Land Use) that are protective of human health." Page 1-1, Lines 22-25 were revised to "The approved remedy includes excavation of soil from <u>24</u> locations, ex-situ thermal treatment of the majority of the excavated soil, off-site disposal of the remaining portion of the excavated soil (metals-contaminated), confirmation sampling, backfill and site restoration."

Comment Resolution Table

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SNW 1 (cont.)	Section 2.2.3 Load Line 3:	Section 2.2.3 Load Line 3: Line 4 indicates there are eight planned excavations. Figure 5 shows 10. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.3: Page 2-3, Lines 4-5 were revised to "Load Line 3 is located in the southeastern portion of the former RVAAP and contains ten (10) planned excavations (Figure 5: Load Line 3 Excavation Plan)." Page 2-3, Line 5-6 were revised to "All but one of the planned excavations within Load Line 3 are located adjacent to or beneath former buildings."
	Section 2.2.4 Load Line 4:	Line 14 indicates there are three planned excavations. Figure 6 shows 6. Table 2-1 reflects similar info as found in the figure.	The following text changes were made in Section 2.2.4: Page 2-3, Lines 14-16 were revised to "Load Line 4 is located in the south central portion of the former RVAAP and contains four (4) planned excavations (Figure 6: Load Line 4 Excavation Plan). Three of the planned excavations within Load Line 4 are located adjacent to or beneath former buildings."

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SNW 2	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved.	The draft RD work plan references a 2011 Leidos Standard Operating Procedure (SOP) will be used as guidance for conducting incremental sampling methodology (ISM) sampling activities. Based on our May 27, 2020 call with your team to discuss our preliminary comments on this draft work plan, we learned that the contractor, CH2M, had identified a different ISM sampling approach in a Quality Assurance Project Plan (QAPP). The QAPP in Appendix C, page 4, Step 7 of this draft RD work plan cites the 2011 Leidos SOP. Ohio EPA recommends using the most current Interstate Technology Research Council (ITRC) ISM sampling guidance.	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

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SNW 2 (cont.)		• Worksheet #18 shows the locations for collecting soil within the Load Line remediation area, but it is not clear what data quality objective (DQO) was applied to determine the number of samples needed to be representative of the bottom or side wall was necessary. Is this in the 2011 Leidos SOP?	Worksheet #18 is premised on resolution of DQO#1 (Excavation Delineation) presented on Page 2, Table 11-1 of the QAPP. Text provided in Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)."

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SNW 2 (cont.)	Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved. (cont.)	• Worksheet #20 Field Quality Control regarding duplicates: The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the ISM excavation confirmation samples, the Record of Decision (ROD) Amendment requires that the ISM samples be collected in duplicate. However, to follow current Department of Defense (DoD) and ITRC requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with the DoD Quality Systems Manual (QSM) and ITRC.	Text provided in Table 11-1 Step 5 has been altered to "In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP)." Worksheet #20 text contained on Page 29, lines 22-30 is consistent with the note revision to Table 11-1 step 5 text above; no changes were made to this worksheet.
		• Worksheet #21 states "Field Standard Operating Procedures Project sampling activities will be conducted in accordance with the procedures described in the Facility-wide SAP (Leidos, 2011) and this QAPP". This reviewer did not have the Field SOP from Leidos. Please clarify if the ISM sample will be processed in the field or in the lab?	The Leidos 2011 document is the RVAAP Facility-wide Sampling and Analysis Plan (FWSAP) for Environmental Investigations. To provide more detail on collection of incremental samples and to reflect the most recent guidance on incremental sampling, including ITRC guidance, an SOP has been added to Appendix A of the QAPP to describe incremental sampling procedures. The subject SOP is additionally provided as an attachment to this comment resolution table.

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SNW 3	Section 5.4 Thermal Treatment	Provide further clarification in the text of on the design of the thermal treatment system: • Are the laterals sealed on the ends or does heated air flow entirely through them?	The laterals are not sealed on the ends, they are perforated – allowing the hot air to flow through and conductively transfer heat to the soil. Text describing the treatment system in Section in 5.3.5 has been edited as follows: Page 5-7, Lines 10-11 were revised to "Perforated lateral steel pipes (3.5-inch x 16-feet) will be attached to each side of the manifold using tees placed along the cell length." Page 5-7, Lines 12-16 were revised to "A second layer of pipes composed of 12-foot perforated laterals and a 12-inch diameter manifold will be placed on top of the second layer of contaminated soil. A third layer of contaminated soil will be placed upon the pipes and manifolds. Followed by installation of a third layer of perforated lateral pipes (9-foot laterals) and 12-inch diameter manifolds."
SNW 3 (cont.)	Section 5.4 Thermal Treatment (cont.)	• Where does the hot air stream from the manifolds go at the end of the dirt pile?	Supplemental text describing hot air was provided in Section 5.3.5. Page 5-7, After line 18, the following text was inserted: "During operation of the ETC treatment cell, hot air is injected into each manifold where it flows into each lateral. As the heated air exits each perforated lateral, it is forced through the soil providing treatment. Air and contaminant vapor pushed through the soil is subsequently captured by the Quonset hut cover (described below). Vapor extracted from the Quonset hut cover is destroyed using a standalone Thermal Oxidizer described in section 5.4.2."

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SNW 3 (cont.)		• Section 5.3.5 Soil Stacking indicates that the total height of the typical soil cell will be approximately 9.5 feet at the top; however, in Section 5.4.2 Thermal Oxidizer it indicates that the insulated steel chamber is only five feet high. So, roof height differs in the thermal oxidizer unit and the soil cells?	The ETC treatment cell and thermal oxidizer are different pieces of equipment. The ETC cell is 9.5 feet high as described in Section 5.3.5; the thermal oxidizer is approximately 5 feet high as detailed in Section 5.4.2. Supplemental text in Section 5.3.5 was provided as noted previously to differentiate treatment system components and function.

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SNW 3 (cont.)	Section 5.4 Thermal Treatment (cont.)	• It is not clear if the Thermal Oxidizer unit described in this draft RD work plan is the same as the VEG Technology used in the pilot study. Please provide comparison information on these two treatment systems that show this proposed thermal treatment system is as effective as the previously used VEG Technology. • It is unclear why the VEG Technology is proposed in the draft RD work plan for Load Line 9 and is not being used at Load Lines 1-4 and 12. Please provide a brief explanation of the rationale for this difference.	The thermal treatment described in the Work Plan is not the VEG technology used in the pilot study. The federal government is not permitted to specify a treatment technology in Request for Proposals (RFP). The RFP requested thermal treatment for the soil remediation at the sites. The VEG contractor was on one of the teams but due to a death of their president shortly after the site visit, they removed themselves from the bidding process. Additionally, the VEG process is a proprietary technology. Therefore, the contractor for the RA is not privy to the technical details to provide a comparison. The ETC technology has been used to successfully treat a broad range of petroleum hydrocarbon impacts including diesel range organics, crude oil, coal tars, heavy hydrocarbons and PAHs. This design has been deployed around the world to effectively remediate hundreds of thousands of tons of hydrocarbon and organic contaminant impacted soils since the mid 1990s and several of these projects have been remote in nature. To date, projects have been successfully completed for many organizations including Progress Energy, Chevron Corporation, U.S. Navy, U.S. Department of Defense, U.S. Department of Energy, Department of Transportation, Department of Corrections, NOAA, and Thiess Services.

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SNW 4	Section 5.6.2 Treatment Verification Samples.	A flow chart or decision tree showing the decision process would be helpful to clarify the following: the use of the second verification sample, what action will be taken if the first sample exceeds cleanup standards, what happens if the second sample is below cleanup standards, how will the next decision for backfilling or additional treatment be made?	Once a sample from the treated soil meets the applicable RGOs, the soil will be considered suitable for backfill. The CH2M Construction Manager/Field Quality Manager will confirm that the soil has been sampled and has met the applicable RGOs before approving its use as backfill. Text has been added to Section 5.6.2 to clarify as follows: • Page 5-14, Lines 20-23 was revised to "If the magnitude of the exceedance is small, a second composite treatment verification sample will be collected immediately for analysis of the COC that exceeded the RGO in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected)." • Page 5-14, Lines 24-25 was revised to "If the magnitude of the exceedance is large, the active heating system will be restarted to provide additional treatment prior to collecting the second treatment verification sample." • Page 5-14, Lines 26-27 was revised to "The decision to restart the heating system will be based on laboratory analytical measurements and the professional judgement of the team members including the system operator."

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SNW 5	Section 5.8 Backfill and Site Restoration.	Are there any calculations as to the volume of the projected estimate for treated soil and estimated volume of clean fill to restore the site to its original contours?	The ex situ soil treatment process does not impact the volume of the soil; therefore, it is expected that off-site backfill material will only be required to make up for the volume of excavated soil that is transported and disposed off-site. As detailed in Table 2-1, approximately 160 yards of soil contaminated by metals will be excavated and disposed off-site. Remaining soil with organic contaminants (roughly 5,700 cubic yards) will be treated to meet remedial goals and reused in backfilling operations.
SNW 6	Section 7 Environmental Management	Line 8 indicates that, "a separate vegetation removal plan will be submitted under separate cover to describe this activity." Ohio EPA did not receive this plan prior to performing the tree felling activities which we understand occurred prior to March 31, 2020. Is this the February 21, 2020 Iron Creek Group letter included in this submittal?	Yes, the referenced submittal constitutes the vegetation removal plan developed by Iron Creek. Page 7-1, Lines 5-10 were revised to "Text in the introduction to Section 7 has been revised to read: "Felling of trees larger than 3 inches in diameter at breast height in areas of excavation was performed prior to March 31, 2020 to prevent wildlife (including the Northern Long Eared Bat) from nesting within the areas of excavation. Because this activity occurred prior to completion of this RD Work Plan, a separate vegetation removal plan (Appendix A) was submitted under separate cover to describe this activity and approved by the Army."

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SNW 6 (cont.)	Line 30 Section 7.2 Air Permitting	The CERCLA exemption does not apply to the existing facility roadways. In our discussion with representatives of the Akron Regional Air Quality Management District (ARAQMD), they requested to be provided a roadway installation date to determine if the particulate emission (PE) limit applies to this project. If you will be adding new roadways this would be considered a modification, assuming the roadway remains after this remedial activity is completed.	No additional roadways will be constructed for this project. Page 7-2, Following Line 4, the following text was added "No additional roadways will be constructed for this project. The existing roads in the load lines and south service road were built in the early 1940s as the facility was constructed. Many of the existing load line roads are old railroad beds that were used for area access following removal of the rails that formerly served facility operations. Access to the excavation and treatment areas will be gained using existing travel paths within the various load lines (primarily the former rail beds) which will remain unimproved. External travel between the load lines will be via existing road infrastructure at the facility."
SNW 6 (cont.)	Line 30 Section 7.2 Air Permitting (cont.)	Include more in the draft RD work plan on how you will address fugitive dust to address the substantive requirements of the regulation. The draft RD work plan Table 7-2 "Review of Rule Applicability" identifies broadly the federal or state air regulation that applies to the proposed activities. The table notes that the facility will submit required reports and conduct monitoring if required by Ohio EPA under Ohio Revised Code 3745-15.	Additional text has been added to Section 8.2, Dust Controls Page 8-2, Lines 18-21 the following text was added: "In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust. During instances of high winds resulting in excessive dust, additional dust control measures or work stoppage may be implemented.

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SNW 6 (cont.)	Section 7.2 Air Permitting	Table 7-2 indicates that Chapter 17 - Particulate Matter Standards apply. The "Comments" column on the table notes that emissions of fugitive dust from roadways and construction activities will be minimized by the use of water or other suitable dust suppression chemicals. Provide additional information in the RD work plan to address fugitive dust. In addition to water, decreasing vehicle speed, truck tarping, and reducing the drop height of materials can also help mitigate fugitive dust. Clarify under what conditions may work be stopped to address fugitive dust issues and who and at what frequency will you monitor fugitive dust at roadways, parking areas, soil piles and at the thermal treatment area.	Additional text has been added to Section 8.2, Dust Controls as noted below: Page 8-2, Line 15, the following text was added “Iron Creek personnel, including the Site Supervisor, will monitor working conditions and fugitive dust throughout daily operations. During operations, the crew will be working along the active haul routes, excavation area(s) and at the treatment pad itself. Real time conditions will be communicated to the Iron Creek Site Supervisor and work stoppage related to mitigating fugitive dust will be at the Site Supervisor’s discretion.” Page 8-2, Lines 23-24 the following text was added “In addition to utilizing water for dust control, decreasing vehicle speed and reducing the drop height of materials will be utilized to help mitigate fugitive dust.”

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SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	Confirm any soil piles created as a result of the remedial action described in this work plan are temporary and are associated to this remedial action. The draft RD work plan noted that topsoil will be placed near the excavation area. Clarification is needed if this would include just sod or if loose soil will be piled at these locations. Please describe work practices to be implemented to mitigate against fugitive dust releases at all stages/locations of the remedy, and controlling waterborne runoff, etc.	Based on field reconnaissance of the proposed excavation areas at the facility, it appears that the majority of the surface material to be removed prior to excavating is composed of sod and duff. This material, along with any surface growing media will be removed and placed adjacent to the excavation for storage while soil treatment operations for the impacted soil is underway. Table 7-2 the following text was added in the comments column for OAC 3745, Chapter 17: "Erosion control measures, as outlined in the Section 8 of the Work Plan, will be implemented as needed to prevent runoff and/or fugitive dust emissions at all work areas and during all stages of the RA. This includes regular inspection of excavation areas and soil piles, implementation of non-structural BMPs (minimizing disturbance, quick turnaround of backfilling and vegetation reestablishment, etc.), installation of structural BMPs (berms, silt fence, etc.), and application of dust suppressant, as required."

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SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	It is our understanding from our May 27, 2020 call with RVAAP and USACE personnel that the backup generator is propane-fueled. Revise the draft RD work plan to clearly state what fuel type is used to power the 125-kw generator noted in the draft RD work plan under section 5.2.4. Confirm it is exempt as a non-road engine under Ohio Administrative Code (OAC) 3745-31-03(B)(1)(qq).	Text was added to specify generator fuel source as noted below: Page 5-1, Line 34 "propane-fired" was inserted before 125 (kw) generator. Page 7-2, Lines 32-34 the following text was added "The portable engine is propane fired and meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)." Table 7-2 2 the following text was added in the comments column for OAC 3745, Chapter 31: "The propane-fired 125 kw generator meets the definition of nonroad engine in 40 CFR Part 1068.30. The engine is exempt from permitting as a non-road engine under OAC 3745-31-03(B)(1)(qq)."

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SNW 6 (cont.)	Section 7.2 Air Permitting (cont.)	The substantive requirements for the thermal oxidizer will need to be met. OAC 3745-17-07 (A)(1)(a) indicates that visible particulate emissions for any stack shall not exceed 20% opacity, as a six-minute average. Please include the OEM documentation on volatile organic compound (VOC) destruction efficiency at the 950° F operating temperature.	Attached is the Thermal Desorption Applications Manual that provides the destruction efficiency for thermal oxidizers operated on multiple projects. As highlighted in table C-5, DRE numbers exceeding 99% are achieved at operating temperatures in the 1,400 to 1,600°F range, which is more in line with operational conditions that we expect for this project. The minimum operating temperature of 950°F is included in the RD text as it is a common Code of Practice baseline for the bottom end of operational temperatures for this type of equipment, while the higher temperatures in the 1,400 to 1,600°F range are more indicative of what we expect to see at Ravenna. In terms of opacity, we would not expect to see stack exhaust opacity near the 20% range for this project for any oxidizer temperature >950 °F, however, the higher temperatures referenced will demonstrate the VOC removal efficiency, as outlined in the manual. Page 5-11, lines 11- 12 the following was text was added "The minimum operating temperature of the thermal oxidizer is 950 degrees Fahrenheit (°F); the typical operating range for this type of waste is 1,400 to 1,600°F."
SNW 7	Section 8 Storm Water Pollution Prevention	Appendix D - Iron Creek Stormwater Pollution Prevention Inspection Checklist & Corrective Action Log: Will this be implemented at the ETC area, roll-off box storage areas and excavation areas? By whom?	This will be implemented at all areas of the site involved in the remedial action including the ETC treatment area, excavation areas, and storage areas; and will be coordinated by the onsite Iron Creek Supervisor. The metals-impacted soils in roll-off boxes will be transported off-site as soon as possible pending the disposal characterization analytical results and completed waste profile/shipping manifests.

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SNW 8	Table 11-2 DOO#2 Treatment Verification	Process clarification is needed: Steps 1 and 2 • Because confirmation sampling includes analysis for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and explosives, what management steps are taken at soil excavation areas when the soil from the excavation is not heading to ETC, but will be disposed offsite due to metals?	Text has been added to Work Plan Section 5.3.1 for clarity regarding soil management steps for metals-impacted soils. Page 5-4, Lines 14-22: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. The total estimated volume of metals impacted soil scheduled for disposal is +/- 160 CY. Stormwater Pollution Prevention best management practices (BMPs) outlined in Section 8 will be integrated into the excavation operations, as required." Table 11-3 has been added to the QAPP to describe the DQO for sampling the metals-impacted soils for disposal characterization. The table is also provided as an attachment to support this comment response.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	• More detail is needed on how the soil excavation areas are managed: o Will soil go directly into roll-off box containers? QAPP Section 5.3.2 indicates that impacted soils will be excavated ant then transported to the ETC pad. Confirm if at any time, will the impacted soils be stockpiled on the ground prior to treatment and verification?	Text has been added to Section 5.3.2 (Soil for Ex Situ Thermal Treatment) for clarity. Page 5-4, Lines 24 -33, the following text was added "For each planned excavation area with soil that will be thermally treated, the overlying uncontaminated surface soil, if applicable (see Table 2-1), will be removed and stockpiled nearby; erosion/runoff mitigation for the stockpiled uncontaminated surface soil will be implemented per Section 8. The impacted soils will then be excavated to the boundaries of the surveyed area as shown on Figures 3 through 7 and placed into a truck to be transported immediately to the ETC pad shown on Figure 8. Once the material arrives at the ETC pad wheel loaders will be used to place it directly into one of the ETC cells for thermal treatment. Each ETC cell will contain a soil volume of +/-525 CY. Stockpiling of the impacted pre-treatment soil is generally not required at either the excavation area or at the ETC treatment pad. Stormwater Pollution Prevention BMPs outlined in Section 8 will be integrated into the excavation operations, as required."
		o Once a roll-off box is full, will it be stored at the excavation site for some time prior to being transported under tarp to the ETC or at another area at RVAAP, or will it go directly offsite if it is one of the four metal contamination area or waste not slated for ETC?	For metals-impacted soils, the soil will be placed in roll-off boxes pending the results of disposal characterization analytical results and waste profile/shipping documentation. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal.

Comment Resolution Table

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Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov) Dated June 10, 2020; Received June 11, 2020
Date: June 22, 2020

Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	o Will soils treated from a particular excavation area be placed back in the same excavation area where it originated?	Not necessarily. Soil handling logistics will drive where the treated soil is used as backfill.
		o Are roll-off boxes transporting the untreated soil decontaminated if they will be used to transport treated soil?	Roll-off boxes will be used to contain soil excavated from metals-impacted locations pending the results of disposal characterization sampling. The roll-off boxes are not involved in the ex situ thermal treatment of soils. As noted above text in section 5.3.1 has been amended as follows: Page 5-4, Lines 14-18: "The metals-impacted soils will be excavated to the boundaries of the surveyed area as shown on Figures 3 and 6, placed into roll off bins positioned near these excavation areas, sampled as described in Section 5.6.3, and prepared for offsite transport and disposal. In addition, details regarding decontamination procedures were added to section 5.7 as follows: Page 5-15, Lines 31-35: "Trucks used for transporting soil material will be decontaminated when shifting from hauling impacted soil to clean treated soil. The equipment will be decontaminated utilizing a pressure washer at the proposed lined, decon area located within the treatment pad and waste water collected from the process will be added to the treatment cells for processing with the impacted soil material."
		o Will treated soil be transported under tarp?	Trucks transporting soil to and from the ETC process within RVAAP do not require tarps.

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 8 (cont.)	Table 11-2 DOO#2 Treatment Verification (cont.)	• Step 3 notes that treated soil will be analyzed for chemicals of concern (COCs) at a rate of one sample per 150 cubic yards of treated soil. o Clarify that the ISM sample(s) are collected while the soil is in the ETC. o It is unclear how the treated soils in quadrants with verification samples below standards will be managed while a failing quadrant is subject to further treatment. Clarify if the entire load in the ETC unit goes through additional treatment or, will quadrants that pass be removed and stockpiled? Would new untreated soil go in? o What sampling technique will be used for the ETC soil; ISM (ITRC guidance or 2011 Leidos), discrete?	The treatment verification samples will be collected as composite samples as described in Table 11-2 (not incremental samples) while the soil is in the ETC. Supplemental text provided below was added to Section 5.6.2 of the Work Plan. In addition, this text was also added to Table 11-2 which is provided as an attachment to this comment response table. Page 5-14, Lines 28-30, the following text was added "If a quadrant does not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling."

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Cmt. No.	Page or Sheet and Issue	Comment	Response
SNW 9	QAPP- Appendix A:	Confirm that the lab receiving the sample can achieve the necessary detection limits necessary. The QAPP Table 15 shows the cleanup goals, reporting limits, detection limits, etc. and Worksheet #23 lists the labs that will be used for specific parameters: CT will be conducting PCB, PAH, metal and explosive work. Chemtech is doing just PCB and PAH work. It is not clear how work is divided between these two labs when the work involves PCBs and PAH analysis.	Laboratories identified for project use have confirmed capacity to achieve required analytical detection limits. There was not one lab that could do all of the analyses at the desired expedited turnaround times. Chemtech Laboratory (CT) was added to allow us to get rush data on PCBs and PAHs for the treatment verification samples. Page 12, Lines 3-4, the following text was added to the QAPP "CT Laboratories is the primary laboratory and will analyze the majority of the soil samples. Chemtech Laboratory will support expedited TAT for some treatment verification sample analyses." With identification of CT as the primary project laboratory, Analytical SOP references presented in Table 23-1 on Worksheet #23 were updated to include "LSOP-05, GT002 Processing of Multi-increment Samples and Subsampling". Table 23-1 is provided as an attachment to this comment response table.

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Attachment 1
Incremental Sampling of Surface Soil Standard Operating Procedure

STANDARD OPERATING PROCEDURE

Incremental Sampling Method for Surface Soil

1 Purpose and scope

The purpose of this standard operating procedure (SOP) is to summarize requirements for the effective field implementation of increment sampling method (ISM) for soil undertaken as part of site characterization at contaminated sites. The ISM soil sampling process provides a view of mean contaminant concentrations over the area of a DU.

This SOP applies to all CH2M HILL personnel and subcontractors who perform ISM activities, and is limited to describing methods for obtaining surface soil samples (considered less than 1-foot below ground surface) for non-volatile, semi-volatile and inorganic analyses using ISM techniques. ISM techniques have been developed for volatile organic compounds and subsurface soil, however, they are not included in this SOP. This SOP was developed according to the following reference documents:

- *American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.*
- *Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.*
- *ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.*
- *Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.*
- *Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.*
- *Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.*
- *U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.*

This SOP focuses on the most commonly used ISM soil sampling tasks and applications anticipated at a field site and should be used in conjunction with other applicable project SOPs.

2 General

The objective of ISM is to reduce the variability created by taking discrete samples, and improve the reliability and representativeness of environmental data by obtaining multiple sub-samples (sample increments) over a decision unit (DU) (defined as the area or volume in question). These "increments" are combined into one bulk ISM sample, which is submitted to the laboratory, resulting in a better representation of actual mean concentrations in a DU.

The DU encompasses the area or volume about which a decision is necessary (e.g., deciding whether risks are acceptable or not). Appropriate decision units must be identified for ISM to be valid. Therefore, the identification of decision units is one of the most important factors when using ISM. Identification and delineation of the decision units should be conducted during project planning and identified in a client and regulatory approved Workplan prior to obtaining ISM samples. Since ISM sampling provides an “average” concentration of a DU, agreement on the DU boundaries is extremely important prior to collecting the “bulk increment sample”.

The number of increments incorporated into the bulk ISM, and the overall size of the ISM collected are not dependent on the size of the decision unit. The sampling theory is based on an assumption (and empirical observations) that 30 to 100 increments from a given decision unit of any size will result in a sample that is adequately representative of the average contaminant level in the decision unit as a whole. If the decision unit is the size of a small backyard garden, then 30 to 100 increments are collected. If the decision unit is a 10-acre, neighborhood-size area in a former agricultural field, then 30 to 100 increments of a similar mass are likewise collected.

If the contaminant distribution is expected to be very heterogeneous, it may be preferable to increase the number of increments collected to the recommended maximum of 100 for larger DUs. This may help to reduce field sampling error and minimize the variation between replicate samples used to evaluate the precision of the data collected. It has been reported that increasing the number of increments from 30 up to 100 may improve the reproducibility of data collected, and since the ISM sample is submitted as one sample, the number of increments collected does not typically increase analytical costs except that a small fee may be added for the excess sample mass management in the laboratory.

This SOP describes procedures for selecting sampling locations, marking field sampling locations, collecting incremental soil samples, and submitting these samples for laboratory analyses. This SOP assumes that the DU, and method for selecting increment locations within the DU has already been determined in the project work plan or project Quality Assurance Project Plan (QAPP), and that analyses and the laboratory conducting the analyses have been identified in the QAPP.

3 Responsibilities

This section describes the responsibilities of key project personnel including the PM, SM, DM, HSM, FTL, and field sampler.

3.1 Project Manager

The PM provides adequate resources and engages field staff with adequate experience and training to successfully comply with and execute project-specific SOPs and implement the project HS&E program. The PM will solicit the appropriate technical expertise to adequately identify the best methods and technology for the job given the current understanding of the site and project goals. In addition, the PM should be consulted if complications arise in following sample handling and custody procedures.

3.2 Site Manager

The SM coordinates and schedules daily field activities. In addition, the SM trains field staff engaged in this activity and ensures compliance with this SOP.

3.3 Data Manager

The DM maintains and manages the sample tracking and scheduling program used to track field ISM samples. The DM should consult the SM, FTL, and Project Chemist regarding ISM soil sampling field sample processing.

3.4 Health and Safety Manager

The HSM is responsible for site-specific HS&E oversight and overall compliance with project HS&E requirements. The HSM conducts HS&E evaluations, selects the appropriate safety procedures for the project, lists the requirements in the project-specific HSP, and coordinates with the SM to complete and certify the HS&E program.

3.5 Field Team Leader

The FTL maintains compliance with ISM sample techniques and methods, particularly the procedures to be used. The FTL, or their designee, should know the requirements of ISM soil sampling and maintain adequate documentation of sample collection activities. The FTL should take responsibility for collecting ISM samples accurately and correctly and for coordinating with the SM and data manager to successfully conduct any ISM field sample processing before laboratory analysis.

3.6 Field Sampler

The Field Sampler, under the supervision of the FTL (who may be the same person), should confirm that samples are correctly collected, labeled, tracked by chain of custody, and stored until they are delivered to the FTL or data manager. The Field Sampler should maintain custody of the samples until they are relinquished to the FTL or data manager. The Field Sampler informs the FTL and/or data manager of sampling conditions and potential deviations in sample collection.

3.7 Project Chemist

The project chemist is responsible for ensuring that the laboratory selected to analyze the ISM samples is qualified to do the work and meet the project data quality objectives (DQOs).

4 Procedures

ISM samples are prepared by typically collecting 30 to 50 small increments (samples) (up to 100 may be needed if a soil at the DU is determined to be very heterogeneous) of soil from systematic random locations within a specified decision unit and combining these increments into a single sample, referred to as the “bulk ISM sample.” Individual soil increments typically weigh between 30 and 50 grams, with bulk ISM typically weighing between 900 and 2,500 grams. The mass of the final bulk ISM depends on the number of increments collected, the size of the sample collection tool utilized. However a minimum final sample size should not be less than 1 kilogram as a general guideline.

4.1 Reconnaissance, Planning and Field Staging

During the DU planning process (Work Plan stage of project), a historical records search and site walk should be conducted to determine if there are areas that may have elevated levels of contamination as it may be desirable to break these “hotspots” into separate decision units. It is also useful for planning sample collection locations if access to some areas will be difficult. Logistics of sampling around buildings or sampling in areas of heavy vegetation should be considered when setting up the random grid (discussed in the following section).

4.2 Setting up a Stratified or Systematic Random Grid

A systematic random or stratified random sample collection scheme is developed from a random starting point in the DU. Typically a systematic random grid is the preferred sampling method. However, both strategies result in sample collection points spread out approximately equally across the DU. For example, a square-shaped decision unit could be divided into six rows and five columns with six increments collected from each of the five rows in a systematic, random fashion to obtain 30 increments for one bulk ISM.

The following are the definitions for these two sampling collection options:

1. Stratified Random Sampling Mode: DU into representative strata, sample at random within each strata, with number of samples proportional to relationship of each strata to the entire DU. This is used when there is high heterogeneity expected within the DU.

2. Systematic Random Sampling: DU into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

The project planning documents should generate a map, showing the DU(s) and approximate proposed sample locations (increments) within the DU(s). Random locations for incremental sample collection points can be pre-determined in the office using a random number generating program, or in the field. For more rectangular-shaped decision units, a fewer number of rows might be used with more increments per row collected. Row lengths and increments per row may be modified as needed for odd-shaped decision units.

4.3 Field Delineation of DU

Corners of the DU and some other strategic locations should be entered into a Global Positioning Device (GPS) in the office prior to going to the field. Using the GPS device, it is useful to mark the ends of each row with flags to help establish approximate lines for the collection of increments. Flags may also be placed along the edges of the decision unit parallel to the rows to help ensure approximate spacing. Placing flags at every increment collection point is usually not necessary. Often, just the four corners of the DU (or enough points to delineate the DU shape, if irregular) are located via GPS to document the DU location and to create maps for the soil investigation report.

Once the corners and rows of the DU have been marked using the GPS, the increment samples may be collected by pacing the same number of steps within each subunit or row of the DU where the sample increments are to be collected.

4.4 Tools for Collection of ISM

Using the wrong tools, or collecting a sample that contains more soil particles from the top of the sample than the bottom (or vice versa) could lead to biased sample results due to the heterogeneous distribution of contaminated particles in the soil. Care should be taken to collect increments in a manner that produces a cylindrical or core-shaped sample. This can be accomplished using a soil coring sampler (preferred), a trowel (if used to collect a “core-shaped” sample), or even a large drill in some soils. The most appropriate type of sampling device is dependent in part on the hardness of the soil, or how rocky it is. For soft soils, a soil core barrel that can be advanced by hand/foot is quick and efficient. Battery-operated drills with large bits may also be an option. For harder or rocky soils, a coring device with slide hammer, a mattock (large pick), hydraulic, or electric-assisted device, may be needed to advance the core barrel or access the soil column for sampling. Whatever tool(s) is used, the objective should focus on collecting core-shaped sample increments. It is important to understand field conditions and test proposed sampling tools at the site before selecting a particular type or combination of tools. If the site cannot be visited ahead of time, then a mix of sampling tools should be taken to help ensure that adequate soil samples can be collected in as efficient a manner as possible.

4.5 Sample Collection

Once the DU has been delineated with flags in the field collection of sample increments may begin.

Use flags or survey twine to define the edges of each grid cell and complete construction of the ISM sample grid as depicted in Figure 1 below.

Figure 1. Example Completed ISM Sample Grid

Sketch the ISM sample grid design, orientation (compass bearing), overall dimensions, cell dimensions, nearby features, and any other valuable information in the field notebook. Photograph the completed sample grid for future reference. Survey the center and corner stake locations of the DU or record them with a GPS unit.

If using stratified random sampling mode, a grid is set up over the DU making each part of the grid equal size, and one increment is collected at random from each subunit of the grid. If using systematic random sampling mode, select a random starting point in one subunit, then collect an increment sample at this location, and the same location at each subsequent subunit of the DU.

In either mode the following procedures should be followed:

- Sampling tools shall be new or decontaminated prior to use according to the project planning documents.
- Sampling tools need not be decontaminated between each sample increment, but shall be decontaminated or discarded prior to sampling a new DU.
- Test the proposed sampling tool(s), and determine what tool(s) will provide the best sample increments.
- Samples should be collected from the same depth at all incremental sampling locations.
- Larger sized particles (rocks, cobbles, and coral) and roots should be avoided or discarded prior to transferring the sample into the bulk ISM container.
- The laboratory is going to sieve out anything >2 millimeters (mm), so collect enough sample at each increment such that there will still be sample for analysis after the portion > 2mm has been sieved out. This may require collection of multiple aliquots per increment if ISM samples are collected using a small diameter coring device.
- The sample collector will describe and classify soils collected according to Universal Soil Classification System (USCS) nomenclature. At a minimum, this will be done for the final bulk ISM sample after all the increments have been collected. Additionally, during collection of increments, the soil will be described at each significant change in lithology type encountered across the DU. Soil descriptions and classifications will be recorded in the field logbook.

- Individual increments collected are placed into a single sample container to produce the bulk ISM.
- If replicates and triplicates are being collected (strongly recommended), replicate increments may be collected from near the normal sample location by pacing off a few feet from the normal sample collection and obtaining a replicate increment. The triplicate increment may be collected by pacing another few feet from the duplicate increment sampling location (see Section 4.6).
- Store bulk ISM samples as required by the project planning documents.
- Pack and ship samples to the laboratory in accordance with the project planning documents.

4.6 Collection of Field Replicate ISM Samples

To statistically evaluate sampling precision for each DU, replicate ISM samples are collected from selected decision units. Typically two replicate increments are collected from the same depth as the normal sample in different locations. A different random starting location is determined for each replicate collected in the selected DU(s). Replicate sample increments are generally collected along the same approximate directional lines established through the DU for the initial ISM samples, though at different systematic random locations than initially used. This is accomplished by pacing off the replicate increments from a different random starting location on the first line/row of the DU, and continuing to sample at this different random interval throughout the DU.

Replicate samples may be collected by establishing rows for increment collection that run perpendicular to or at a 45 degree angle to the direction used to collect the initial ISM. Another option is to use the same rows but collect increments in between the locations used for the initial sample. Replicate samples should be sent to the laboratory as “blind” samples, meaning the laboratory does not know they represent replicate samples of the initial ISM.

The replicate samples are prepared and analyzed in the same manner as carried out for the initial sample. Triplicate samples (i.e., initial ISM plus two replicates) are preferred and more useful than just duplicates for statistical analysis. If only one DU is being investigated, triplicate samples are recommended. If multiple DUs are being investigated, it may not be necessary to collect triplicates at all DUs.

4.7 Laboratory Processing of ISM Samples

The bulk ISM is submitted to the laboratory for analysis. Careful planning with the laboratory for processing of ISM samples by the Project Chemist prior to sample collection is essential to obtain meaningful results. Details of project requirements will be described in the project planning documents.

It is important to note that, while the laboratory is receiving a bulk sample of up to 2,500g, it will only analyze a subset of this sample. One issue discussed in both the Environmental Protection Agency (EPA) and American Society of Testing Materials (ASTM) guidance documents is the choice of a minimum sub-sample mass for extraction/analysis of soil samples in order to reduce “Fundamental Error” of the lab analyses to approximately 15% or less. The minimum appropriate mass is based on the maximum particle size in the soil samples. For samples with a maximum particle size of <2mm, the minimum analysis mass is 10 grams. If the analytical method to be used typically calls for sample extraction/analysis mass of less than 10 grams, the method should be modified to increase extraction/analysis mass to at least 10 grams for samples with maximum particle sizes of <2mm (larger mass could be beneficial for some analyses). For analyses of fine particulates (e.g., <250 µm), a one-gram sub-sample may be adequate to reduce Fundamental Error below 15%; however a larger mass may be reliably run by the method (e.g., 2-10 grams).

4.8 Investigation Derived Waste

Any IDW generated during sample collection (such as used PPE and soil collection apparatus) should be disposed of properly in accordance with the project planning documents.

5 Records

Record all ISM soil sampling activities, including field bulk sample collection in a field notebook, in accordance with the Work Plan and applicable project SOPs. Chain-of-custody forms, photographs, and any other sampling documentation should comply with the project planning documents.

6 References

American Society for Testing and Materials (ASTM) D-6323-98. 2003 (re-approved). Standard Guide for Laboratory Subsampling of Media Related to Waste Management Activities.

Alaska Department of Environmental Conservation (ADEC). March 2009. Draft Guidance on Multi-Increment Soil Sampling. State of Alaska Department of Environmental Conservation Division of Spill Prevention and Response Contaminated Sites Program.

Hawaii State Department of Health (HDOH). 2020. Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan. Office of Hazard Evaluation and Emergency Response. Sections 3.4 and 4.2.

HDOH. May 11, 2007. Pesticides in Former Agricultural Lands and Related Areas – Updates on Investigation and Assessment (arsenic, technical chlordane, and dioxin test methodologies and action levels and field sampling strategies). Office of Hazard Evaluation and Emergency Response. 07-241 RB.

ITRC. February 2012. Technical and Regulatory Guidance, Incremental Sampling Methodology. The Interstate Technology & Regulatory Council Incremental Sampling Methodology Team.

Ramsey, C. and A. Hewitt (Ramsey, et. al.). 2005. A Methodology for Assessing Sample Representativeness, Environmental Forensics. 6:71-75.

Pitard, Francis F. Pierre Gy's. Sampling Theory and Sampling Practice. 1993. 2nd edition. CRC Press.

U.S. Environmental Protection Agency (USEPA). November 2003. Guidance for Obtaining Representative Laboratory Analytical Subsamples from Particulate Laboratory Samples. R.W. Gerlach and J.M. Nocerino, EPA/600/R-03/027. http://www.cluin.org/download/char/epa_subsampling_guidance.pdf.

7 Definitions

Bulk ISM Sample: The compilation of all ISM soil sampling increments collected from a DU.

Compositional Heterogeneity: The variability of contaminant concentrations between the particles that make up the population. This type of heterogeneity results in fundamental error (FE).

Decision Unit (DU): The area or volume in which a decision must be made (for example, deciding whether risks are acceptable or not). The DU may be as small as a 55-gallon drum or as large as acres in size.

Distributional Heterogeneity: The non-random distribution across a population due to slight spatial variations. This type of heterogeneity results in grouping and segregation error (GSE).

Fundamental Error (FE): A result of not representing proportional concentrations of all of the particles in a population.

Increment: A group of particles collected from a population with a single operation of the sampling device.

Sieving: Pouring material (for example, the bulk ISM sample) through a sieve.

Stratified Random Sampling: A statistical sampling method that divides the sample population (DU) into representative strata (grid cells), then randomly sampling within each stratum with the number of samples proportional to relationship of each stratum to the entire population.

Systematic Random Sampling: divide population (DU) into equal subunits, select starting location in first subunit, and sample all other subunits in the same location (grid sampling). This is the most reproducible sampling mode.

Sub-sampling: Dividing the sieved bulk ISM sample to create a final laboratory sample.

Attachment 1 - Figures Illustrating Systematic Random Sampling Method

(Source: HDOH *Technical Guidance Manual for the Implementation of the Hawaii State Contingency Plan*, 2020)

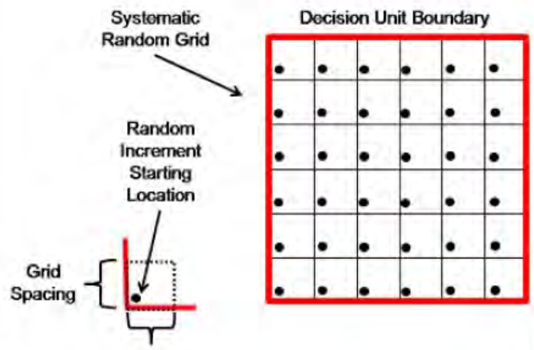

Figure 4-9. Example Increment Collection Locations Based on a Systematic Random Grid Scheme
Grid spacing determined based on DU area and number of desired increments. Initial increment location selected from random location, subsequent increments collected at uniform spacing within DU.

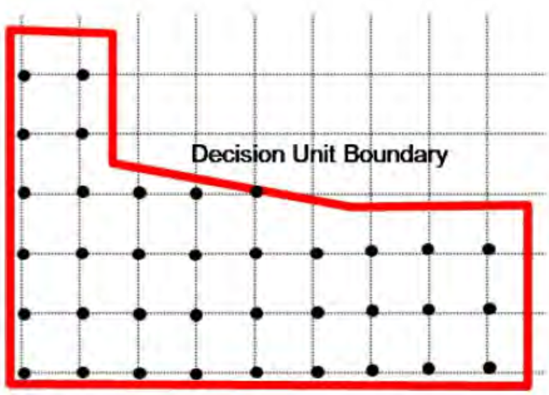

Figure 4-11. Systematic Increment Locations for Odd Shaped DUs (compare to Figure 4-9)
The number of increments collected within grid rows can vary in different areas of the DU.

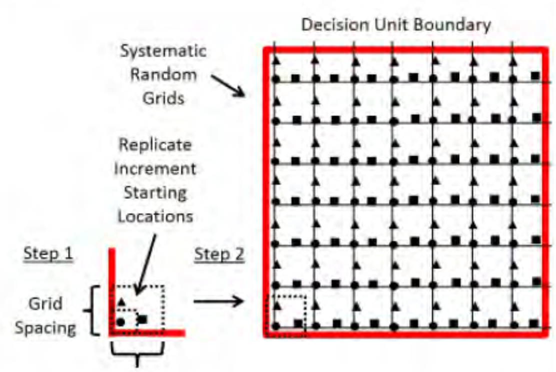

Figure 4-12. Example Collection of Increment Location Points for Triplicate Multi Increment Samples
Increments collected in a systematic random method. Circles, triangles and squares depict increment collection locations for three, respective Multi Increment samples (increments collected halfway between initial increment grid point locations).

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Date: June 22, 2020

Attachment 2
Table 11-1. DQO #1 – Excavation Delineation

Table 11-1. DQO #1 – Excavation Delineation

Step 1 – Statement of Problem: The extent of soil exceeding the industrial cleanup goals at the planned excavation locations requires confirmation of COC concentrations after excavation.
Step 2 – Identify the Goals of the Study: Excavate soil at the planned excavation locations until the sidewalls and bottom of the excavation do not exceed the industrial cleanup goals.
Step 3 – Identify Information Inputs: Previous investigations at the Load Lines identified human health risk from COCs in surface and subsurface soil at Load Lines 1, 2, 3, 4 and 12 for likely future land use (for example, commercial/industrial). ROD Amendment (Leidos, 2019) identifies ex situ thermal treatment of soil at the planned excavation locations as part of the selected remedy to reduce the risk and be protective of human health.
Step 4 – Define the Boundaries of the Study: The remedial action will remove soil from 24 planned excavation locations at Load Lines 1, 2, 3, 4 and 12 identified in the ROD Amendment (see RD Work Plan Table 2-1 and Figures 3 to 7). Excavation confirmation samples will be collected from the sidewalls and bottom of each excavation using ISM to confirm that soils exceeding the industrial cleanup goals have been successfully removed. The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.
Step 5 – Develop the Analytical Approach: In accordance with the ROD Amendment (Leidos, 2019), incremental sampling will be used to collect excavation confirmation samples. Excavation confirmation samples will be collected from each sidewall and the bottom of each planned excavation. ISM samples collected for confirmation will include 30 to 50 aliquots per sample, incorporating duplicate and triplicate sample collection for one per 10 ISM samples along with one laboratory duplicate to verify the subsampling precision. An RSD of 35% as a goal will be incorporated into the primary, duplicate and triplicate data evaluations as well as that of the laboratory subsample duplicate. Analytical testing will be for COCs associated with each respective excavation area (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP). Laboratory results will be compared to applicable industrial receptor cleanup goals in ROD Amendment (see Table 4-1 of RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional excavation will be conducted at locations with exceeding results until cleanup goals are met. Analytical data quality will be evaluated per this QAPP. The analytical methods specified in this QAPP will provide the lowest available detection limits using standard methods that will allow the data to be screened against the cleanup goals.
Step 6 – Specify Performance or Acceptance Criteria: All sample locations are known in accordance with the ROD Amendment and RD Work Plan which define soil removal boundaries for confirmation. Any soil removal beyond planned boundaries will be completed until industrial cleanup goals are met. Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed on known quality to meet project objectives as defined in Worksheet 36.
Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the attached SOP, *Incremental Sampling for Surface Soil* . A systematic random sampling scheme will be used in selecting the aliquot sampling locations for each sidewall and the excavation bottom to ensure that the aliquots are spread out relatively equally. This will be accomplished by gridding the bottom and the contaminated interval of each sidewall into approximately equally sized grids, and then collecting an aliquot from the sidewall/bottom surface at the center of each grid (with the duplicate and triplicate aliquots, as applicable, collected from separate locations adjacent to the primary sample in each grid; the duplicate and triplicate aliquots will be placed in separate containers to be submitted to the laboratory). The results will be compared to the Industrial cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP). Excavation confirmation samples will be submitted for laboratory analysis with projected turnaround time of 7 days. If an excavation confirmation sample meets the applicable cleanup goals, the excavation will be backfilled. If an excavation confirmation sample exceeds an applicable cleanup goal, CH2M will inform the USACE COR to discuss removal of additional soil at that location. Once authorized by the USACE COR, additional soil may be removed in the direction of the exceedance, typically in one-foot increments (in any case where the exceedance is more than one order of magnitude above the cleanup goals, the excavation may be increased by more than 1-foot dependent on authorization from the USACE COR). For excavations where bottom testing indicates an exceedance, excavations will not be extended past groundwater or 10 feet below ground surface in depth, whichever is encountered first. Following removal of the additional soil, an additional excavation confirmation sample will be collected and analyzed for the COC that exceeded the cleanup goal in the initial excavation confirmation sample. Any excavation beyond the limits shown in Figures 3 to 7 or the total depth/volume identified in Table 2-1 requires prior authorization from the USACE COR. Once an excavation meets the applicable cleanup goals, the final extent (horizontal and vertical) will be surveyed to establish the final volume of soil treated.

Table notes:

CH2M =CH2M HILL Constructors, Inc.
COC = contaminant of concern
COR = Contracting Officer's Representative
DoD = U.S. Department of Defense
ISM = incremental sampling methodology
ITRC = Interstate Technology Research Council
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
RSD = relative standard deviation

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP

Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov) Dated June 10, 2020; Received June 11, 2020

Date: June 22, 2020

Attachment 3
Table 11-2. DQO #2 – Treatment Verification

Table 11-2. DQO #2 – Treatment Verification

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for PCBs, PAHs and/or explosives will be excavated and undergo ex-situ thermal treatment to meet the cleanup goals.
Step 2 – Identify the Goals of the Study: Confirm that treated soil meets the applicable cleanup goals before being placed back in the excavations as backfill.
Step 3 – Identify Information Inputs: Treated soil will be analyzed for the applicable COCs at a rate of approximately one composite sample per 150 cubic yards (CY) of treated soil.
Step 4 – Define the Boundaries of the Study: Treatment verification sampling will be performed for soil excavated from the planned excavations and treated in the ex situ Enhanced Thermal Treatment cell. Individual treatment cells will be segregated by COCs to facilitate treatment verification sampling and material management based on varying analytical TATs. The temporal boundary for the thermal desorption does not apply.
Step 5 – Develop the Analytical Approach: Treatment verification samples will be collected from treated soil at a rate of approximately one sample per 150 CY of treated soil. Treatment verification samples will be analyzed for the COCs associated with a particular batch of treated soil, based on the excavation from which the soil came as shown on Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP. The laboratory results will be compared to Industrial Receptor cleanup goals in the ROD Amendment (also see Table 4-1 of the RD Work Plan and Worksheet #15 of this QAPP) for each respective excavation (see Table 2-1 of the RD Work Plan and Worksheet #18 of this QAPP for the COCs applicable to each planned excavation), and additional thermal treatment will be conducted until the cleanup goals are met.
Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. The analytical methods will provide the lowest available detection limits using standard methods that will allow the data to be screened against the Industrial cleanup goals in Worksheet #15-1. Final analytical data will be validated and confirmed to be of known quality to meet project objectives as defined in Worksheet 36.
Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide Sampling and Analysis Plan (SAP) for Environmental Investigations (Leidos, 2011), the RD Work Plan and this QAPP. One composite treatment verification sample will be collected per 150 CY of treated soil. As each ETC treatment cell contains approximately 500 CY, the cell will be divided into quadrants for sampling and one composite treatment verification sample will be analyzed from each quadrant. After the soil achieves the target treatment temperature and the burners are disconnected, Iron Creek will utilize the excavator bucket to expose the soil in an approximately 4-foot by 6-foot area to a depth of approximately one foot in each quadrant in order to collect the treatment verification sample. While all of the soil will reach the target treatment temperature, the soil in the outer layer of the quadrant is farthest from the heating elements and therefore will reach the target treatment temperature last. Therefore, sampling the outer layer of soil is most conservative for treatment verification. Decontaminated or disposable sampling tools will be used to collect aliquots of approximately equal volume from 10 locations within the 4-foot by 6-foot by 1-foot exposed area. Each aliquot will be placed in a decontaminated stainless steel bowl to allow for further cooling. The aliquots will then be homogenized and placed into laboratory containers for analysis of the applicable COCs (see Table 2-1 of the RD Work Plan). Treatment verification samples for explosives will be submitted for laboratory analysis with projected turnaround time of 7 days. Treatment verification samples for soil from locations with PAHs and/or PCBs only are planned for laboratory analysis with projected turnaround time of 48 hours. If a treatment verification sample meets the applicable cleanup goals, then the associated soil will be cleared by CH2M for use as backfill. If a treatment verification sample exceeds an applicable cleanup goal, then the excavator bucket will be used to expose another approximately 4 by 6 by 1-foot area in the outer layer of the quadrant and a second treatment verification sample will be collected for analysis of the COC that exceeded the cleanup goal. Depending on the magnitude of the exceedance, the second composite treatment verification sample may be collected immediately for analysis of the COC that exceeded the cleanup goal in the initial treatment verification sample (since the soil remaining in the pile has continued to heat for some period since the first sample was collected) or the active heating system may be turned on again to further treat the soil prior to collecting the second treatment verification sample. This decision will be based on the professional judgement of the system operator. Should a quadrant not meet the required criteria upon completion of the second round of analysis, the soil in that section of the ETC cell would be removed and incorporated into the next treatment cell for further thermal processing followed by further sampling. This process will be repeated until the quadrant meets the applicable cleanup goals. The CH2M CM/FQM will review the sampling results and provide approval before the material can be used as backfill.

Table notes:
CH2M = CH2M HILL Constructors, Inc.
COC = contaminant of concern
CY = cubic yard
DoD = U.S. Department of Defense
ETC = enhanced thermal conduction
PAH = polycyclic aromatic hydrocarbon(s)
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCB = polychlorinated biphenyl(s)
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RA = remedial action
RD = remedial design
ROD = Record of Decision
TAT = turnaround time

Comment Resolution Table

Installation: Camp James A Garfield/Former RVAAP
Document: Draft Remedial Design Work Plan for RVAAP Load Lines 1 - 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020
Reviewer(s): Sue Netzly-Watkins (SNW), Site Coordinator, Ohio EPA (330-963-1235 or Susan.Netzly-Watkins@epa.ohio.gov) Dated June 10, 2020; Received June 11, 2020
Date: June 22, 2020

Attachment 4
Table 11-3. DQO #3 – Disposal Characterization for Metals-Impacted Soils

Table 11-3. DQO #3 – Disposal Characterization for Metals-Impacted Soils

Step 1 – Statement of Problem: Soil exceeding the cleanup goals for metals will be excavated for off-site disposal and waste profile information is needed.
Step 2 – Identify the Goals of the Study: Characterize the excavated metals-impacted soils for off-site disposal as IDW.
Step 3 – Identify Information Inputs: The ROD Amendment identified human health risk for commercial/industrial land use due to antimony and lead, or lead only, at four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4). ROD Amendment (Leidos, 2019) identifies off-site disposal of metals-impacted soil as part of the selected remedy to reduce the risk and be protective of human health. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.
Step 4 – Define the Boundaries of the Study: Metals-impacted soils will be excavated from four planned excavations (CB-2, CB-13B and the Outlet Channel in Load Line 1; and the Former Water Tower in Load Line 4) as shown on RD Work Plan Table 2-1 and Figures 3 and 6). The temporal boundary for the remedial action does not apply as contamination boundaries are known for this remedial action.
Step 5 – Develop the Analytical Approach: One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity. Laboratory results will be provided to the Transportation and Disposal subcontractor who will coordinate with an appropriate disposal facility to obtain approval of the material prior to transporting the excavated soil off-site. Based on generator knowledge, it is expected that these soils will be characterized as nonhazardous. Analytical data quality will be evaluated per this QAPP.
Step 6 – Specify Performance or Acceptance Criteria: Analytical data quality will be compared to DoD QSM Version 5.1.1 specification for PARCCS as defined by this QAPP. IDW data will not be validated.
Step 7 – Develop the Detailed Plan for Obtaining Data: Sampling will be performed in accordance with the Facility-wide SAP (Leidos, 2011), the RD Work Plan and this QAPP. One composite sample of the metals-impacted soil excavated at Load Line 1 and one composite sample of the metals-impacted soil excavated at Load Line 4 will be analyzed for TCLP VOCs, SVOCs, metals, pesticides, herbicides; PCBs; ignitability; and corrosivity.

Table notes:

DoD = U.S. Department of Defense
IDW = investigation derived waste
PARCCS = precision, accuracy, representativeness, comparability, completeness, and sensitivity
PCBs = polychlorinated biphenyls
QAPP = Quality Assurance Project Plan
QSM = Quality Systems Manual
RD = remedial design
ROD = Record of Decision
SVOC = semivolatile organic compound
TCLP= toxicity characteristic leaching procedure
VOC = volatile organic compound

Ohio Environmental Protection Agency

Mike DeWine, Governor
Jon Husted, Lt. Governor
Laurie A. Stevenson, Director

June 10, 2020

RE: US Army Ravenna Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
ID # 267000859263

TRANSMITTED ELECTRONICALLY

Mr. Kevin Sedlak
Army National Guard
Installation and Environment
Clean-up Branch
IPA Designation
1438 State Route 534 SW
Newton Falls, OH 44444

Subject: Receipt and Review of the "Draft Remedial Design Work Plan for RVAAP Load Lines 1 – 4 and 12 (RVAAP-08 through RVAAP-12), Dated April 2, 2020

Dear Mr. Sedlak:

The Ohio Environmental Protection Agency (Ohio EPA), Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) has received and reviewed the document entitled "Draft Remedial Design for RVAAP Load Lines 1 – 4 and 12." This document, received by Ohio EPA, NEDO on April 2, 2020, was prepared for the U.S. Army Corps of Engineers (USACE) Louisville District, by CH2M HILL Constructors, Inc. (CH2M), 2411 Dulles Corner Park, Suite 500, Herndon, VA.

Comment 1: The total number of areas subject to excavation and remedial activities seems to be inconsistently referenced in the April 2020 Draft Remedial Design (RD) Work Plan (draft RD work plan). Several places in the draft RD work plan text indicate a different number of excavation areas than are reflected in the Figures and Tables. Below are several places in the draft RD work plan that should be revised.

- Section 1.2 Scope: Line 23 notes that the remedy includes excavation of soil from 25 locations. This number is not consistent in the draft RD work plan. The number provided in the report narratives is inconsistent with the number provided in figures and in tables.
- Section 2.2.3 Load Line 3: Line 4 indicates there are eight planned excavations. Figure 5 shows 10. Table 2-1 reflects similar info as found in the figure.
- Section 2.2.4 Load Line 4: Line 14 indicates there are three planned excavations. Figure 6 shows 6. Table 2-1 reflects similar info as found in the figure.

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Comment 2: Verification that full extent of impacted soil area in each of the Load Line remediation areas has been achieved. The draft RD work plan references a 2011 Leidos Standard Operating Procedure (SOP) will be used as guidance for conducting incremental sampling methodology (ISM) sampling activities. Based on our May 27, 2020 call with your team to discuss our preliminary comments on this draft work plan, we learned that the contractor, CH2M, had identified a different ISM sampling approach in a Quality Assurance Project Plan (QAPP). The QAPP in Appendix C, page 4, Step 7 of this draft RD work plan cites the 2011 Leidos SOP.

Ohio EPA recommends using the most current Interstate Technology Research Council (ITRC) ISM sampling guidance.

- Worksheet #18 shows the locations for collecting soil within the Load Line remediation area, but it is not clear what data quality objective (DQO) was applied to determine the number of samples needed to be representative of the bottom or side wall was necessary. Is this in the 2011 Leidos SOP?
- Worksheet #20 Field Quality Control regarding duplicates: The standard collection frequency for FD samples is one for every 10 field samples per matrix. For the ISM excavation confirmation samples, the Record of Decision (ROD) Amendment requires that the ISM samples be collected in duplicate. However, to follow current Department of Defense (DoD) and ITRC requirements for ISM collection, ISM samples collected for confirmation will include 30 to 50 aliquots per sample, collected in accordance with the DoD Quality Systems Manual (QSM) and ITRC.
- Worksheet #21 states "Field Standard Operating Procedures Project sampling activities will be conducted in accordance with the procedures described in the Facility-wide SAP (Leidos, 2011) and this QAPP". This reviewer did not have the Field SOP from Leidos. Please clarify if the ISM sample will be processed in the field or in the lab?

Comment 3: Section 5.4 Thermal Treatment

Provide further clarification in the text of on the design of the thermal treatment system:

- Are the laterals sealed on the ends or does heated air flow entirely through them?
- Where does the hot air stream from the manifolds go at the end of the dirt pile?
- Section 5.3.5 Soil Stacking indicates that the total height of the typical soil cell will be approximately 9.5 feet at the top; however, in Section 5.4.2 Thermal Oxidizer it indicates that the insulated steel chamber is only five feet high. So, roof height differs in the thermal oxidizer unit and the soil cells?

- It is not clear if the Thermal Oxidizer unit described in this draft RD work plan is the same as the VEG Technology used in the pilot study. Please provide comparison information on these two treatment systems that show this proposed thermal treatment system is as effective as the previously used VEG Technology.
- It is unclear why the VEG Technology is proposed in the draft RD work plan for Load Line 9 and is not being used at Load Lines 1-4 and 12. Please provide a brief explanation of the rational for this difference.

Comment 4: Section 5.6.2 Treatment Verification Samples.

A flow chart or decision tree showing the decision process would be helpful to clarify the following: the use of the second verification sample, what action will be taken if the first sample exceeds cleanup standards, what happens if the second sample is below cleanup standards, how will the next decision for backfilling or additional treatment be made?

Comment 5: Section 5.8 Backfill and Site Restoration.

Are there any calculations as to the volume of the projected estimate for treated soil and estimated volume of clean fill to restore the site to its original contours?

Comment 6: Section 7 Environmental Management

- Line 8 indicates that, "a separate vegetation removal plan will be submitted under separate cover to describe this activity." Ohio EPA did not receive this plan prior to performing the tree felling activities which we understand occurred prior to March 31, 2020. Is this the February 21, 2020 Iron Creek Group letter included in this submittal?
- Line 30 Section 7.2 Air Permitting.
  - The CERCLA exemption does not apply to the existing facility roadways. In our discussion with representatives of the Akon Regional Air Quality Management District (ARAQMD), they requested to be provided a roadway installation date to determine if the particulate emission (PE) limit applies to this project. If you will be adding new roadways this would be considered a modification, assuming the roadway remains after this remedial activity is completed.

    Include more in the draft RD work plan on how you will address fugitive dust to address the substantive requirements of the regulation. The draft RD work plan Table 7-2 "Review of Rule Applicability" identifies broadly the federal or state air regulation that applies to the proposed activities. The table notes that the facility will submit required reports and conduct monitoring if required by Ohio EPA under Ohio Revised Code 3745-15.

Table 7-2 indicates that Chapter 17 – Particulate Matter Standards apply. The "Comments" column on the table notes that emissions of fugitive dust from roadways and construction activities will be minimized by the use of water or other suitable dust suppression chemicals. Provide additional information in the RD work plan to address fugitive dust. In addition to water, decreasing vehicle speed, truck tarping, and reducing the drop height of materials can also help mitigate fugitive dust. Clarify under what conditions may work be stopped to address fugitive dust issues and who and at what frequency will you monitor fugitive dust at roadways, parking areas, soil piles and at the thermal treatment area.

Confirm any soil piles created as a result of the remedial action described in this work plan are temporary and are associated to this remedial action. The draft RD work plan noted that topsoil will be placed near the excavation area. Clarification is needed if this would include just sod or if loose soil will be piled at these locations. Please describe work practices to be implemented to mitigate against fugitive dust releases at all stages/locations of the remedy, and controlling waterborne runoff, etc.

- It is our understanding from our May 27, 2020 call with RVAAP and USACE personnel that the backup generator is propane-fueled. Revise the draft RD work plan to clearly state what fuel type is used to power the 125-kw generator noted in the draft RD work plan under section 5.2.4. Confirm it is exempt as a non-road engine under Ohio Administrative Code (OAC) 3745-31-03(B)(1)(qq).

- The substantive requirements for the thermal oxidizer will need to be met. OAC 3745-17-07 (A)(1)(a) indicates that visible particulate emissions for any stack shall not exceed 20% opacity, as a six-minute average. Please include the OEM documentation on volatile organic compound (VOC) destruction efficiency at the 950° F operating temperature.

Comment 7: Section 8 Storm Water Pollution Prevention

Appendix D - Iron Creek Stormwater Pollution Prevention Inspection Checklist & Corrective Action Log: Will this be implemented at the ETC area, roll-off box storage areas and excavation areas? By whom?

Comment 8: Table 11-2 DQO#2 Treatment Verification: process clarification is needed.

Steps 1 and 2

- Because confirmation sampling includes analysis for polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and explosives, what management steps are taken at soil excavation areas when the soil from the excavation is not heading to ETC, but will be disposed offsite due to metals?

- More detail is needed on how the soil excavation areas are managed:
  - Will soil go directly into roll-off box containers? QAPP Section 5.3.2 indicates that impacted soils will be excavated ant then transported to the ETC pad. Confirm if at any time, will the impacted soils be stockpiled on the ground prior to treatment and verification?
  - Once a roll-off box is full, will it be stored at the excavation site for some time prior to being transported under tarp to the ETC or at another area at RVAAP, or will it go directly offsite if it is one of the four metal contamination area or waste not slated for ETC?
  - Will soils treated from a particular excavation area be placed back in the same excavation area where it originated?
  - Are roll-off boxes transporting the untreated soil decontaminated if they will be used to transport treated soil?
  - Will treated soil be transported under tarp?

- Step 3 notes that treated soil will be analyzed for chemicals of concern (COCs) at a rate of one sample per 150 cubic yards of treated soil.
  - Clarify that the ISM sample(s) are collected while the soil is in the ETC.
  - It is unclear how the treated soils in quadrants with verification samples below standards will be managed while a failing quadrant is subject to further treatment. Clarify if the entire load in the ETC unit goes through additional treatment or, will quadrants that pass be removed and stockpiled? Would new untreated soil go in?
  - What sampling technique will be used for the ETC soil; ISM (ITRC guidance or 2011 Leidos), discrete?

Comment 9: QAPP- Appendix A: Confirm that the lab receiving the sample can achieve the necessary detection limits necessary.

The QAPP Table 15 shows the cleanup goals, reporting limits, detection limits, etc. and Worksheet #23 lists the labs that will be used for specific parameters: CT will be conducting PCB, PAH, metal and explosive work. Chemtech is doing just PCB and PAH work. It is not clear how work is divided between these two labs when the work involves PCBs and PAH analysis.

Ohio EPA requests the comments above be addressed prior to submitting the final version of the document. If you have any questions or concerns, please do not hesitate to contact me at (330) 963-1235.

Sincerely,

Sue Netzly-Watkins

Sue Netzly-Watkins
Site Coordinator
Division of Environmental Response and Revitalization

SNW/sc

ec: Katie Tait, OHARNG RTLS
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