FINAL

WORK PLAN AND SAMPLING AND ANALYSIS PLAN ADDENDA

FOR THE

PHASE II REMEDIAL INVESTIGATION OF DEMOLITION AREA 2 AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

PREPARED FOR

US ARMY OPERATIONS SUPPORT COMMAND
CONTRACT NO. DAAA09-01-G-0009
DELIVERY ORDER NO. 0003

JUNE 2002

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Prepared by

SpecPro, Inc.
8451 State Route 5
Ravenna, OH 44266

Part I

Final Work Plan and Field Sampling Plan for the Phase II Remedial Investigation of Demolition Area 2 at the Ravenna Army Ammunition Plant, Ravenna, Ohio

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CONTENTS

FIGURES

TABLES

ACRONYMS

AE	Architectural and Engineering
amsl	above mean sea level
AOCs	areas of concern
BATF	Bureau of Alcohol, Tobacco and Firearms
bgs	below ground surface
BHHRA	baseline human health risk assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical of concern
COPCs	chemicals of potential concern
COPEC	chemicals of potential ecological concern
CSM	conceptual site model
DLA	Defense Logistics Agency
DNT	dinitrotoluene
DoD	Department of Defense
DOT	Department of Transportation
DQO	data quality objective
EMM	earth-moving machinery
EMR	electromagnetic radiation
EOD	explosive ordnance disposal
EPA	U.S. Environmental Protection Agency
ERA	ecological risk assessment
EU	exposure unit
FID	flame ionization detector
FS	Feasibility Study
FSA	Field Staging Area
GPS	global positioning system
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IDW	investigation-derived waste
NTU	nephelometric turbidity unit
OD	outside diameter
OE	ordnance and explosives
Ohio EPA	Ohio Environmental Protection Agency
OSC	Operations Support Command
OVA	organic vapor analyzer
PAH	polycyclic aromatic hydrocarbon
PBT	persistant, bioaccumulative, and toxic
PCB	polychlorinated biphenyl
PF	Parshall flume
PID	photoionization detector
PPE	personal protective equipment

PRG	preliminary remediation goal
PVC	polyvinyl chloride
PZ	piezoelectric
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RGO	remedial goal option
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SHHRA	screening human health risk assessment
SRA	screening risk assessment
SRC	site-related contaminant
SSHP	Site Safety and Health Plan
SVOC	semivolatile organic compound
T&E	threatened and endangered
TAL	target analyte list
TKN	total kjeldahl nitrogen
TNB	trinitrobenzene
TNT	trinitrotoluene
UCL95	95 percent upper confidence limit
USACE	U.S. Army Corps of Engineers
USAESCH	U.S. Army Engineering and Support Center, Huntsville
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UXO	unexploded ordnance
UXOSO	unexploded ordnance safety officer
VOCs	volatile organic compound
WBG	Winklepeck Burning Grounds
WP	white phosphorous

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

The Phase II Remedial Investigation (RI) of Demolition Area 2 at the Ravenna Army Ammunition Plant (RVAAP), Ohio will expand on previous efforts, conducted primarily on areas north of Sand Creek, to evaluate and characterize the nature and extent of contamination to the shallow and deep soils, groundwater, surface water and sediment media resulting from activities at this site. The data gathered will form the basis for the performance of a baseline risk assessment for the site, and for proposed remedial action alternatives, including simply limiting future access to this area of concern (AOC). There are known significant amounts of unexploded ordnance (UXO) at Demolition Area 2 that have led to the proposed plan to restrict access to the area. Within Demolition Area 2 there is a smaller 2.5-acre area regulated under the Resource Conservation and Recovery Act (RCRA) that was used until 1992 for open detonation activities. This area is being addressed separately, however data generated on this area from site investigations performed in 1992 and 1997, RCRA compliance data, additional Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigations in 1999, historic aerial photographs, and historical plans will be included as part of this Phase II investigation where appropriate.

The primary objectives of the RI Phase II are to:

- determine the boundaries of the AOC at Demolition Area 2,
- measure the AOC physical characteristics,
- identify the sources of contamination, especially south of Sand Creek,
- characterize the nature and extent of contamination at Demolition Area 2, especially south of Sand Creek,
- assess the risk posed to human health and the environment (Baseline Risk Assessment),
- establish a system to monitor potential off-site migration of contaminants.

This Phase II RI Sampling and Analysis Plan (SAP) Addendum for Demolition Area 2 at RVAAP has been prepared by SpecPro, Inc. under contract DAAA09-01-G-0009 with the U.S. Operations Support Command. The SAP Addendum has been developed to tier under and to supplement the facility-wide SAP (USACE 2000) and includes all of the sampling and analysis objectives, rationales, planned activities, and criteria specific to the Phase II RI at Demolition Area 2. The Facility-wide SAP provides the base documentation, technical

procedures, and investigative protocols for conducting RIs under CERCLA at RVAAP.

Both the Facility-wide SAP and this SAP Addendum have been developed following the USACE guidance document *Requirements for the Preparation of Sampling and Analysis Plans, EM200-1-3, February, 2001* (USACE 2001), to collectively meet the requirements established by the Ohio Environmental Protection Agency (Ohio EPA), Northeast District, and the U.S. Environmental Protection Agency (EPA), Region 5, for conducting CERCLA investigations.

1.2 HISTORY AND CONTAMINANTS

The RVAAP is located in northeastern Ohio in Portage and Trumbull counties and lies about 16 kilometers (10 miles) east of Ravenna, Ohio (Figure 1-1). Operations at the facility began in September 1941 and included the storage, handling, and packing of military ammunition and explosives. The facility encompasses 8,668 hectares (21,419 acres) and is jointly operated by the Operations Support Command (OSC) of the U.S. Army and the National Guard Bureau. The OSC controls environmental AOCs and bulk explosives storage areas. A detailed history of process operations and waste disposal processes for each AOC at RVAAP (Figure 1-2) is presented in the *Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996).

Demolition Area 2 was used since 1948 to detonate large caliber munitions and off-spec bulk explosives that could not be deactivated or demilitarized by any other means due to their condition. Materials treated by open detonation in Demolition Area 2 have included primer elements, bombs, and various caliber munitions. The past standard operating procedures for demolition by open detonation were to place the explosives to be detonated in a pit that had been excavated to a minimum depth of 4 feet. The trench was then backfilled with 2 feet of soil, and the explosives were detonated. After detonation, the site was carefully policed for shrapnel, scrap metal, or any unexploded ordnance. It should be noted, however, that fragments of exploded or unexploded ordnance items forcefully propelled away from the detonation pits during detonation activities (kickouts) can be found several thousand feet away from the detonation site. Default distances for fragment protection range from 1,250 feet for non-fragmenting explosives materials to 4,000 feet for munitions 5-inch caliber or larger (DOD 6055.9-STD).

The principal metals associated with munitions treated in Demolition Area 2 include steel (mostly iron), brass (copper and zinc), lead, and cadmium. More recent burning and detonation activities related to facility operations occurred until 1994 in a 2.5 acre area covered under a RCRA permit application. Since 1994, this area has been used for a small number of non-routine and emergency detonations by Explosive Ordnance Disposal (EOD) personnel from Wright

Patterson AFB, and other contractor UXO professionals. A geophysical survey of the area in July of 1999 indicated the presence of large amounts of metallic debris with several large anomalies indicative of UXO contamination. UXO clearance to a depth of 4 feet was performed by SpecPro in 1999 -2000, during which over 105,000 UXO items and over 150,000 pounds of scrap metal were recovered.

In addition, past operations at this AOC may have included the burial of munitions and ordnance components.

Wastes known to be disposed of at this AOC include unexploded ordnance, shrapnel, white phosphorus, explosive residues, and heavy metals. Based on the operational history for Demolition Area 2, waste constituents and potential contaminants at this AOC include white phosphorus; explosive compounds; propellants; and metals from the demilitarization or disposal of munitions and ordnance components.

Within the boundaries of this AOC, there are five known potential source areas-

- Open Detonation Areas (including the RCRA Unit) – areas in which detonation was accomplished in backhoe-dug pits with a minimum depth of 4 feet. After detonation, metal parts were typically removed from the site, and the pits were backfilled, mulched, and seeded.

- Open Burning Area – an area within the RCRA unit in which, from 1981 - 1986, the sludge from Load Line 6 Evaporation Unit was thermally destroyed.

- Prototype Testing Range - an area where projectiles were fired into targets.

- Burial Sites 1 and 2– areas where possible scrap ordnance components may have been buried. Burial Site 1 is approximately two acres in size, located approximately 200 feet northeast of Bldg. 1501. Burial Site 2 is approximately one acre in size, and is located approximately 100 feet north of Bldg. 1503.

- Sand Creek Disposal Area – an area that is posted, “Off Limits, Dangerous Material” and is located along a 70-feet embankment northeast of Bldg. 1503 overlooking Sand Creek where scrap ordnance components have been disposed on the surface.

Locations of these potential source areas within the Demolition Area 2 AOC are shown on Figure 1.3. Additional information regarding site-related contamination

identified in previous environmental investigations of this AOC is presented in Section 1.3.

1.3 SUMMARY OF EXISTING DATA

Several previous investigations have been conducted at Demolition Area 2: (1) *Hazardous Waste Management Study No. 37-26-0442-84* (USAEHA 1984); (2) *Geohydrologic Study No. 38-26-KF95-92* (USAEHA 1992); (3) *Preliminary Assessment for the Ravenna Army Ammunition Plant* (USACE 1996); (4) *Phase I Remedial Investigation of High Priority Areas of Concern at the Ravenna Army Ammunition Plant* (USACE 1998); (5) *RCRA Closure Field Investigation Report for the Deactivation furnace Area, Open Detonation Area, Building 1601, and Pesticides Building, Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1998); and (6) *Report of Analytical Results Demolition Area #2 CERCLA Sites* (USIOC 2000). Three of the six previous investigations (Nos. 1, 2 and 5 above) focused exclusively on the 2.5 acre RCRA portion of Demolition Area 2. A summary of the previous investigations is provided in the following sections. Selected results from previous investigations are provided in Appendix A.

1.3.1 RCRA Unit

Previous investigations of the 2.5-acre RCRA unit within Demolition Area 2 included surface and subsurface soil, surface water, sediment, surface runoff, and aquatic organism sampling.

In 1983, a total of ten surface soil samples were taken within the “horseshoe” bermed area (Figure 1-4). The samples were analyzed for EP Toxicity (heavy metals) and explosives. Analyses indicated that explosives were present in all ten samples; EP toxicity analysis showed detectable amounts of heavy metals in four samples (barium in one sample; lead in three). One of the samples exceeded the EP Toxicity level for lead; all other results were below EP Toxicity levels. A summary of the sample results is provided in Appendix A, page 82.

In 1992, four groundwater monitoring wells (one upgradient, three downgradient) were installed and sampled at the RCRA unit (Figure 1-4) and were sampled for explosives, metals, non-metals, and volatile organic compounds (VOCs). Initial groundwater results did not indicate the presence of explosives or VOCs in samples, and the analytical results for metals did not indicate contamination. In April of 2000, the upgradient groundwater monitoring well (DET-1) was abandoned and replaced with a well designated DET-1B. The groundwater monitoring wells installed at the Demolition Area 2 RCRA unit have been sampled on a quarterly basis since 1992. Analytical results from quarterly

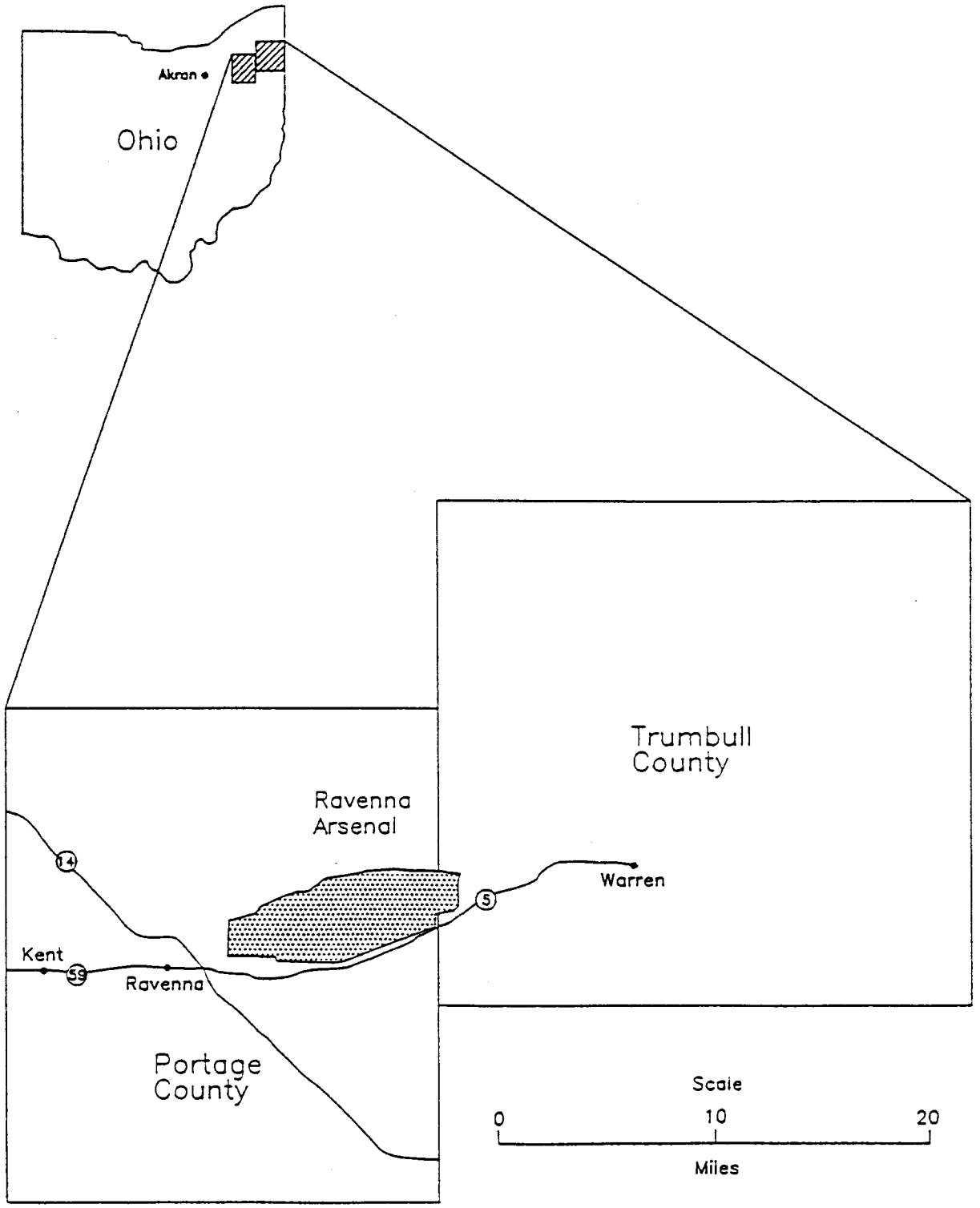


Figure 1-1. General Location and Orientation of RVAAP

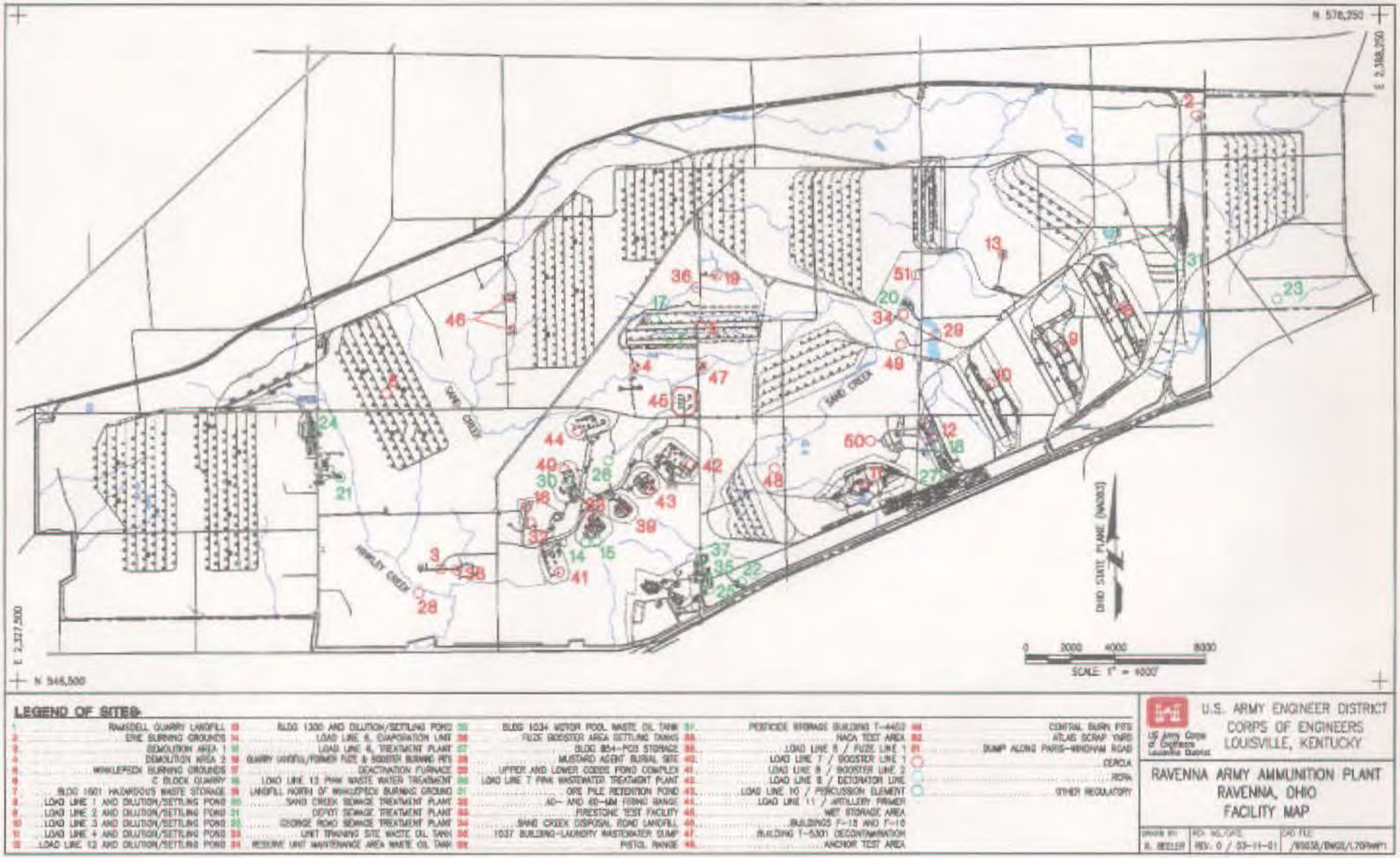


Figure 1-2. Ravenna Army Ammunition Plant Facility Map

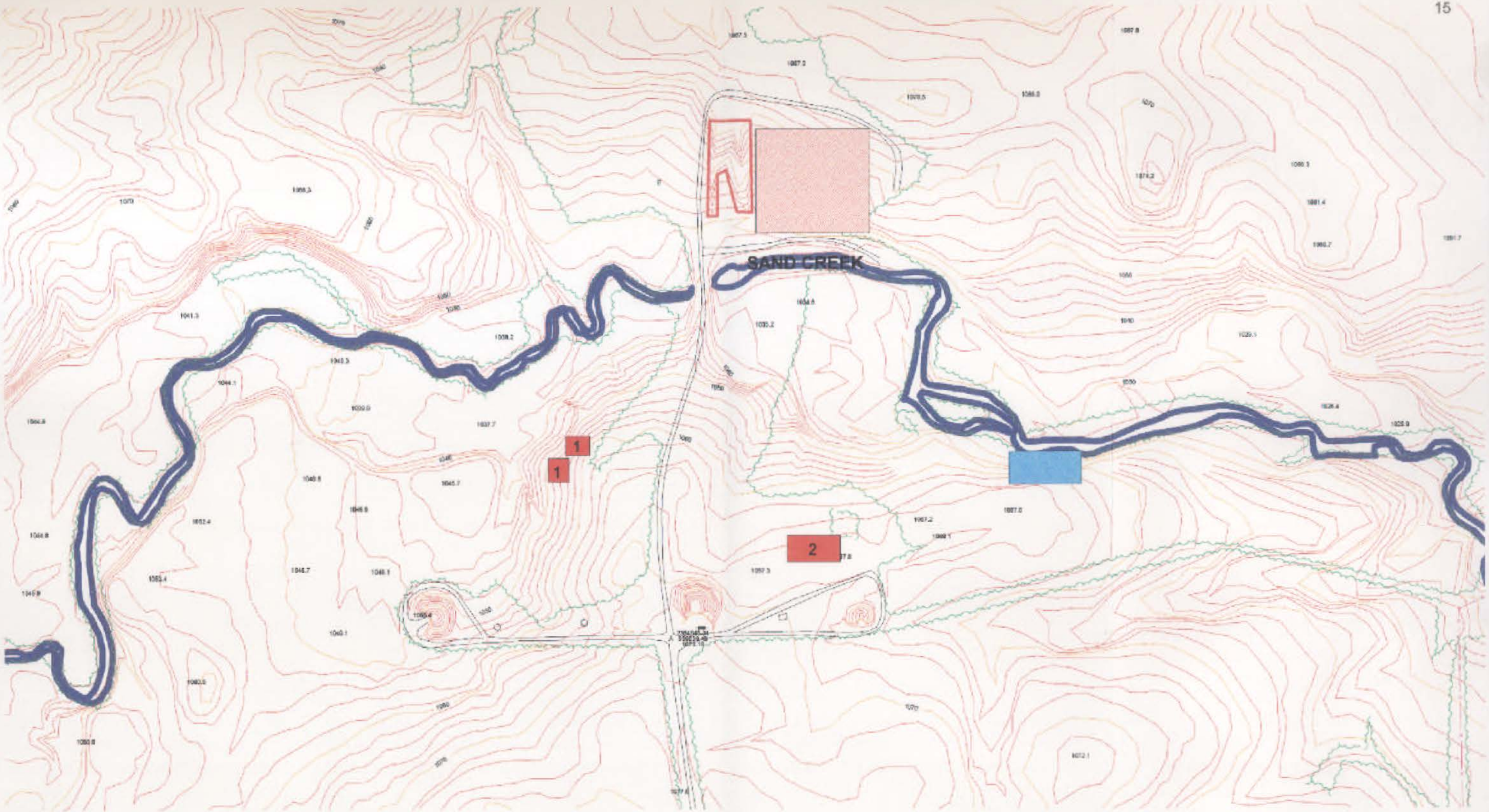


Figure 1.3: Locations of the RCRA Area, the Prototype Test Range, the Burial Sites, and the Sand Creek Disposal Area.

sampling have since shown the detection of explosives in all wells, including the newly-installed background well. In addition, metals exceeding site-wide background values were detected in DET-2 (arsenic) and in DET-4 (selenium) in 2000.

Also in 1992, 47 surface and subsurface (to >10 feet in depth) soil samples were collected (Figure 1-4) and analyzed for explosives, metals, and non-metals. A total of 24 samples were also collected for background comparison purposes from a fire break located approximately one mile northeast of Demolition Area 2. For explosive parameters, any detectable amounts in sample results were considered to be indicative of contamination. For other naturally occurring parameters, results were considered indicative of contamination if they exceeded the corresponding background mean plus the 95 percent confidence interval using a one-tailed t-test.

Soil sample analysis indicated the presence of explosives in seven of the 47 samples, and the presence of arsenic, barium, cadmium, mercury, lead, nitrate-nitrates, phosphorus, and total kjeldahl nitrogen (TKN) above background values in several of the samples. Three co-located surface water and sediment samples were collected from Sand Creek, one upstream and two downstream from the RCRA unit (Figure 1-4). A grab sample of surface runoff from the RCRA unit to Sand Creek was also taken during a rain event as part of the study. The surface water, sediment, and runoff samples were analyzed for explosives, metals, non-metals, and VOCs. As part of the surface water investigation, benthic macroinvertebrates were also collected. Surface water and surface runoff samples indicated the presence of explosives, along with levels of lead, copper, iron, zinc, and mercury that exceeded the state ambient water quality criteria for warmwater habitats. There was no evidence of contamination within the sediment samples. Benthic macroinvertebrates were sampled by Hester Dendy and Surber sampling methods in Sand Creek above and below the RCRA unit. Results from the biological data diversity analysis indicated that the RCRA unit was not adversely affecting the macroinvertebrate community. A summary of sample results is presented for all the above data in Appendix A, pages 84 through 87.

In 1998, as part of a RCRA Closure Field Investigation Report, 29 soil borings to 8 feet in depth (2 of these were taken to a depth of 14', and one was taken to a depth of 20'), and 32 surface locations were sampled within and around the RCRA unit at Demolition Area 2 (Figure 1-4). Metals exceeding site-wide background criteria were indicated in several of the samples; explosives were present in five of the samples; and the propellant nitrocellulose was detected in two surface soil samples. A summary of sample results is presented in Appendix A, pages 89 through 96.

In 1999, UXO removal to a depth of 4 feet was performed in the RCRA unit. The removal action involved excavating soil in the unit to a total depth of 4 feet, screening the excavated soil and removing any UXO, shrapnel, or scrap metal found, and placing the screened soil back on site. The area was then graded and seeded. Over 100,000 UXO items were recovered during this effort, including over 45,000 primer detonators, 19,000 T-bars, several thousand fuzes of various sizes, and several thousand artillery rounds ranging from 22 mm to 155 mm in size.

1.3.2 CERCLA Unit

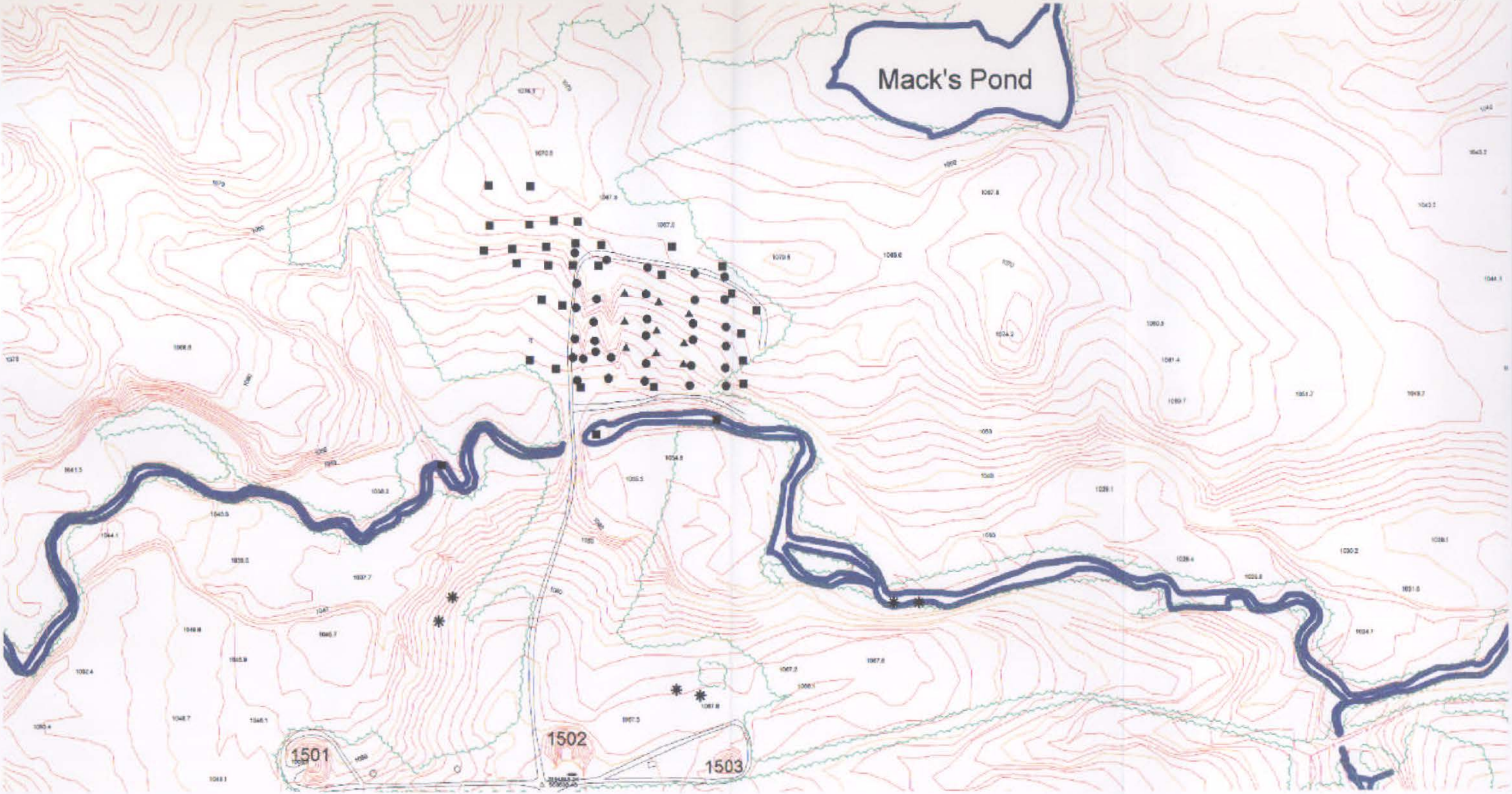
The Preliminary Assessment of Demolition Area 2 performed in 1996 included the Demolition Area 2 site in the list of High Priority sites based on a relative risk ranking methodology. Reevaluation of the Demolition Area 2 risk ranking performed at the completion of the Phase I RI resulted in the site retaining its "High Risk" rating.

The Phase I sampling at Demolition Area 2 included surface soil, subsurface soil, and sediment sampling of areas north of Sand Creek. Samples were collected from 30 soil locations and 3 sediment locations (Figure 1-4). Contamination of surface and subsurface soil by explosive compounds and inorganic analytes was identified during the Phase I. Explosive compounds were identified in five surface soil and six subsurface soil samples at concentrations ranging from .420 to 4.4 mg/kg. Inorganic analytes detected above site-wide background were found in surface, subsurface soil, and sediment samples. Aluminum, arsenic, barium, cadmium, chromium, lead, magnesium, mercury, nickel, potassium, selenium, sodium, thallium, and zinc were detected above background in surface soils; arsenic, barium, cadmium, lead, mercury, sodium, thallium, and zinc in subsurface soils; and cadmium, sodium, and thallium in sediment samples. No contamination from voliatile or semi-volatile organic compounds was indicated in the samples analyzed during the Phase I investigation. A summary of the Phase I sample results is presented in Appendix A, pages 98 through 102.

In 2000, sampling of surface soils, subsurface soils, and sediment was conducted at three suspected disposal/burial sites within Demolition Area 2 – Burial Site #1, Burial Site #2 and Sand Creek (Figure 1-4). Soil samples were collected from two locations and three depths (to 4' depth) at Burial Sites #1 and #2; and at four locations and three depths (to 4' depth) at Sand Creek. Explosives were detected at all locations, and the propellant nitrocellulose was detected at Burial Site #2 and at Sand Creek. Metals above site-wide background criteria were also found in all three areas: antimony, barium, beryllium, cadmium, cobalt, copper and lead at Burial Site #1; arsenic, chromium, copper, magnesium, nickel, and zinc at Burial Site #2; and antimony, barium, cadmium, copper, magnesium, manganese, lead, silver, and zinc at Sand Creek. A summary of sample results is presented in Appendix A, pages 104 - 107.

1.4 SPECIFIC SAMPLING AND ANALYSIS PROBLEMS

Per the Site Safety and Health Plan (SSHP) Addendum, all sampling personnel will be advised specifically on potential safety hazards and pertinent preventive measures. Ordnance and explosives (OE) are potentially present; therefore, OE (anomaly) avoidance will be performed prior to and during the sampling effort. Demolition Area 2 also provides habitat for wildlife that represents potential biological hazards (e.g., wasps, hornets, snakes, and ticks) during the planned field activities.



LEGEND

May 1992 * ▲
April 1997 ■
April 1998 ●
March 2000 ✱
*locations are approximate

300 0 300 600 Feet

N
W E
S

Figure 1.4: Locations of previous soil and sediment sampling locations from 1992 - 2000.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The Demolition Area 2 Phase II RI project organization and responsibilities are presented in Figure 2-1. The functional responsibilities of all key personnel Coordinator are described in Chapter 2.0 of the Facility-wide SAP and, therefore, are not presented here. Figure 2-2 presents the baseline project schedule.

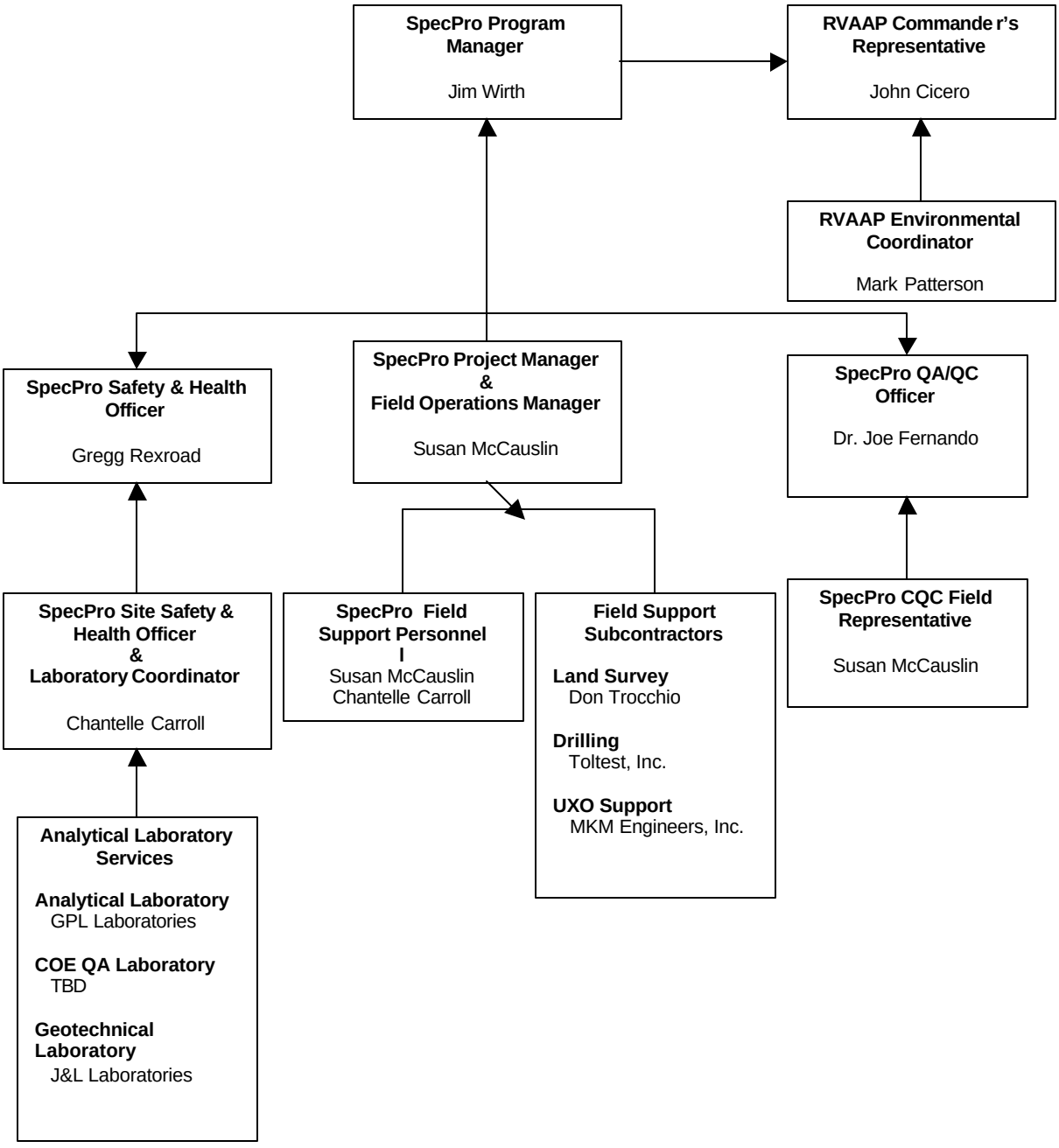
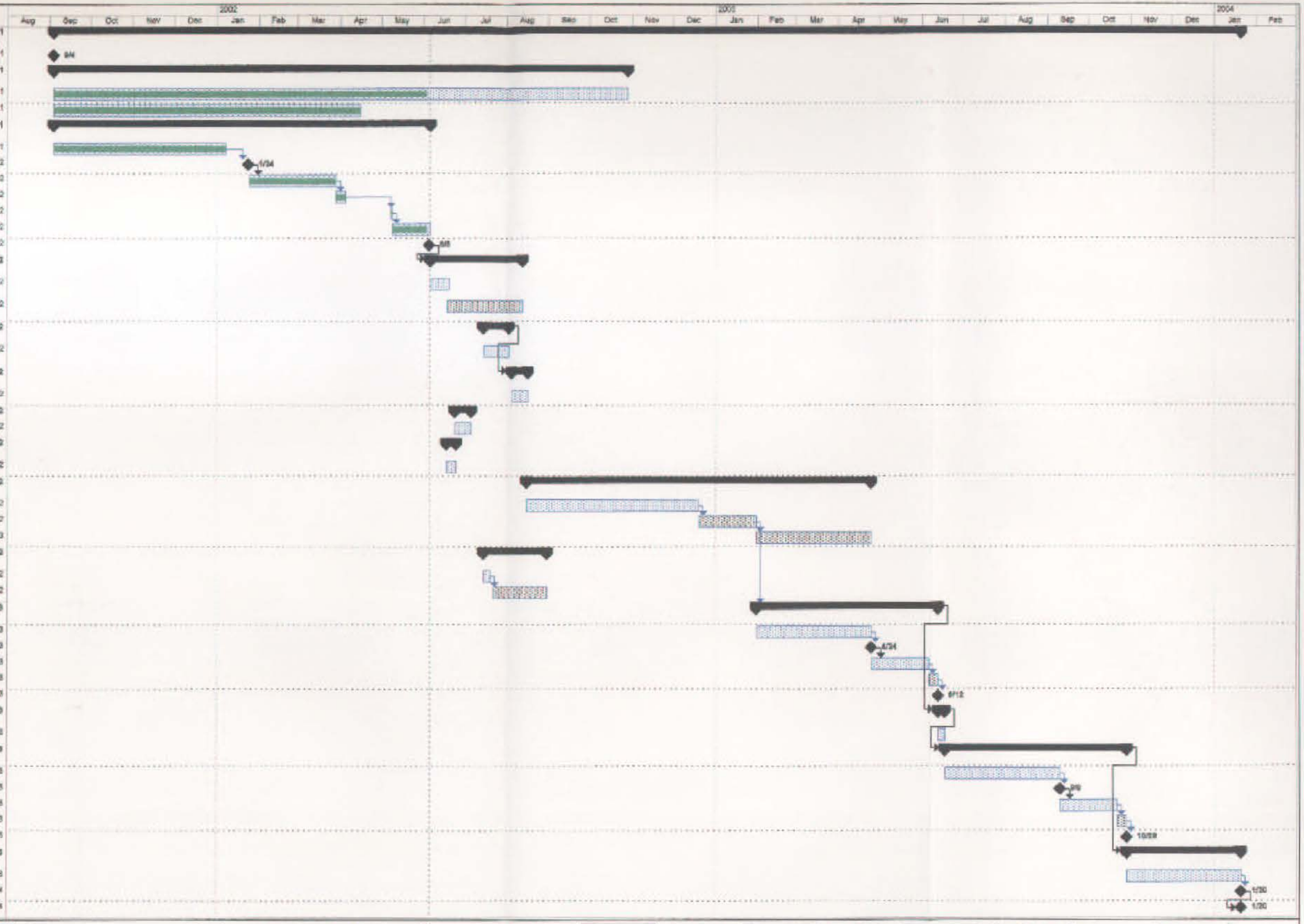


Figure 2-1. Project Organization Chart for the Phase II RI Demolition Area 2

Task Name	Duration	Start
Phase II Remedial Investigation - Demolition Area 2	**521 days**	**Tue 9/4/01**
Contract Award	0 days	Tue 9/4/01
Task 1- Project Management and Administrative Support	**300 days**	**Tue 9/4/01**
Project Management & Support	15 mons	Tue 9/4/01
Procurement and Preparation	8 mons	Tue 9/4/01
Task 2 - Project Preparation/Plans	**197 days**	**Tue 9/4/01**
Prepare Draft Work Plan Addenda	90 days	Tue 9/4/01
Submit Draft Work Plan Addenda	1 day	Thu 1/24/02
Review Draft Work Plan Addenda	45 days	Fri 1/25/02
Prepare Comment Response Tables	5 days	Fri 3/29/02
Work Plan Meeting	1 day	Wed 5/8/02
Prepare Final Work Plan Addenda	20 days	Thu 5/9/02
Submit Final Work Plan Addenda	1 day	Wed 5/5/02
Task 3 - Mobilization/Demobilization	**40 days**	**Thu 5/9/02**
Work Zone Delineation & Site Preparation	10 days	Thu 5/9/02
UXO Field Support/Anomaly Avoidance	6 wks	Tue 6/18/02
Task 4 - Groundwater Monitoring Well Installation and Development	**15 days**	**Mon 7/15/02**
Monitoring Well Installation & Development	3 wks	Mon 7/15/02
Task 5 - Groundwater Sampling	**10 days**	**Mon 8/5/02**
Groundwater Sampling	2 wks	Mon 8/5/02
Task 6 - Soil Sampling	**10 days**	**Mon 8/26/02**
Soil Sampling	2 wks	Mon 8/26/02
Task 7 - Surface Water and Sediment Sampling	**5 days**	**Tue 9/10/02**
Surface Water & Sediment Sampling	1 wk	Tue 9/10/02
Task 8 - Data Validation and Risk Assessment	**160 days**	**Fri 9/16/02**
Laboratory Analysis	90 days	Fri 9/16/02
Data Verification/Validation	30 days	Fri 12/20/02
Risk Assessment	60 days	Fri 1/31/03
Task 9 - Surveying and Mapping	**58 days**	**Mon 7/15/02**
Surveying & Mapping	5 days	Mon 7/15/02
Prepare Surveying Report	30 days	Mon 7/22/02
Task 10 - Draft Remedial Investigation Report	**65 days**	**Fri 1/31/03**
Prepare Draft Phase II RI Report	60 days	Fri 1/31/03
Submit Draft Phase II RI Report	0 days	Thu 4/24/03
Review Draft Phase II RI Report	50 days	Fri 4/25/03
Prepare Comment Response Tables	5 days	Fri 6/6/03
Submit Comment Response Tables	0 days	Thu 6/12/03
Task 11 - Meeting to Discuss the Draft Report	**5 days**	**Fri 6/13/03**
Comment Response Meeting	3 days	Fri 6/13/03
Task 12 - Draft Final Remedial Investigation Report	**95 days**	**Wed 6/18/03**
Prepare Draft Final Phase II RI Report	80 days	Wed 6/18/03
Submit Draft Final Phase II Report	0 days	Tue 9/9/03
Review Draft Final Phase II Report	50 days	Wed 9/10/03
Prepare Comment Response Tables	5 days	Wed 10/22/03
Submit Comment Response Tables	0 days	Tue 10/28/03
Task 13 - Final Remedial Investigation Report	**90 days**	**Wed 10/29/03**
Prepare Final Phase II RI Reports	90 days	Wed 10/29/03
Submit Final Phase II RI Report	0 days	Tue 1/20/04
Period of Performance End Date	**0 days**	**Tue 1/20/04**



Project: Schedule
Date: Wed 9/5/02

Task · Split · Progress · Milestone · Summary · Project Summary · External Tasks · External Milestone · Deadline

SpecPro

Project Schedule For The Phase II Remedial Investigation of Demolition Area 2

3.0 SCOPE AND OBJECTIVES

3.1 PHASE II RI SCOPE AND OBJECTIVES

The Phase II Remedial Investigation (RI) of Demolition Area 2 at the Ravenna Army Ammunition Plant (RVAAP), Ohio will expand on previous efforts, conducted primarily on areas north of Sand Creek, to evaluate and characterize the nature and extent of contamination to the shallow and deep soils, groundwater, surface water and sediment media resulting from activities at this site. The data gathered will form the basis for the performance of a baseline risk assessment for the site, and for proposed remedial action alternatives, including simply limiting future access to this AOC. There are known significant amounts of UXO at Demolition Area 2 that have led to the current plan to restrict access to the area.

The primary objectives of the RI Phase II are to:

- determine the boundaries of the AOC at Demolition Area 2,
- measure the AOC physical characteristics,
- identify the sources of contamination, especially south of Sand Creek,
- characterize the nature and extent of contamination at Demolition Area 2, especially south of Sand Creek,
- assess the risk posed to human health and the environment (Baseline Risk Assessment, see 3.4, page 32 and 3.5, page 33),
- establish a system to monitor potential off-site migration of contaminants.

The approach that will be taken to achieve these objectives is discussed below.

3.1.1 Characterize the AOC Physical Characteristics

Data on the physical characteristics of the AOC and surrounding areas will be collected to the extent necessary to define potential transport pathways and receptor populations and to provide sufficient engineering data for screening of remedial action alternatives. Information needed shall include as a minimum: surface features, subsurface (geophysical) data, soils, geology, surface water hydrology, hydrogeology, meteorology, human populations, land uses and ecology.

3.1.2 Characterize the Sources of Contamination

Readily available information, including the RCRA Part B permit application, shall be evaluated on the source locations, types and amounts, potential releases,

physical and chemical properties of the wastes present, and engineering characteristics that are important in the evaluation of remedial actions.

3.1.3 Characterize the Nature and Extent of Contamination

The final objective of this goal is to characterize the nature and extent of contamination such that informed decisions can be made as to the level of risk presented at the site and the appropriate type(s) of remedial response.

The locations of sampling shall be selected on a judgmental basis, wherein sample locations are based on results of previous sampling, site physical characteristics, construction/operational history, and visual survey. Specifically, results of all previous sampling and testing, existing geologic, geohydrologic, and hydraulic information, as-built drawings, aerial photographs, history of operations, site 2-foot contour topographic maps, and on-the-ground visual judgment shall be used to prudently determine sample locations.

Due to the planned future use of Demolition Area 2, detailed delineation of the extent of contamination will not be performed. If future land use requires environmental remediation, additional efforts to better define nature and extent may be warranted in a later phase of the overall RVAAP remediation program. On going monitoring may be required that extends beyond the span of this investigation.

3.1.4 Baseline Risk Assessment

The Baseline Risk Assessment (BRA) shall provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action. The BRA shall include data evaluation, exposure analysis, toxicity analysis, risk characterization, uncertainty analysis, and a risk assessment summary.

3.2 PHASE II RI DATA QUALITY OBJECTIVES

The project Data Quality Objective (DQO) is to provide sufficient high-quality data to address the primary project objectives identified in Section 3.1.

3.2.1 Conceptual Site Model

The facility-wide hydrogeologic conceptual site model (CSM) for RVAAP, presented in the Facility-wide SAP, is applicable to Demolition Area 2 for this Phase II RI, based on current knowledge. The CSM for RVAAP, operational information, analytical data collected during historical environmental investigations, and applicable data collected during previous investigations at Demolition Area 2 have been used to refine the CSM specific to the project area

as outlined below.

3.2.1.1 Soil

Based on characterization data to date, contaminated soil within and adjacent to former demolition pits and suspected burial areas are potential secondary sources of contamination in sediment, surface water, and groundwater. Contaminants may be released from soil and migrate in storm runoff either in dissolved phase or adsorbed to particulates and/or colloids. Further characterization of suspected areas of soil contamination is planned to define contaminant nature and extent and to provide sufficient data for remedial alternatives analysis in a subsequent feasibility study. Subsurface soil characterization is also necessary to determine if leaching processes may be a potential mechanism for contaminant migration to groundwater. The Phase I RI and other historical sampling did not characterize all of the suspected former demolition pits and burial areas. Thus, those areas not previously characterized are specifically targeted for biased sampling in the Phase II RI.

3.2.1.2 Sediment

Sediment within ditches and tributaries represents a receptor media for contaminants eroded or leached from soil and transported by storm runoff. In addition, sediment may function as a transport mechanism considering that contaminants adsorbed to particulates may be mobilized by surface water flow. Operational data suggest that the ditches in the vicinity of former demolition pits and suspected burial areas represent the most likely locations where contaminants may have accumulated through erosional transport.

Site characteristics and available field data show that the primary surface water and sediment exit pathways for the Demolition Area 2 AOC follow unnamed ditches and tributaries that ultimately feed into Sand Creek. For the portion of the AOC that is located south of Sand Creek, drainage flows to the north and east; for the portion of the AOC that is located north of Sand Creek, drainage flows to the south and east. Considering the available data and the CSM, both confirmed and additional suspected source areas, as well as the exit pathways, are specifically targeted for biased sediment sampling. Previous sediment sampling data show evidence of contamination in the vicinity of former suspected burial areas adjacent to Sand Creek.

3.2.1.3 Surface water

Surface water represents the likely primary mechanism for mobilization and transport of contamination within and off of Demolition Area 2. Most chemical transport via surface water is presumed to occur along the ditches within the AOC and is primarily episodic and related to storm events that produce flushing of the surface water system and mobilization of contaminated soil and

sediment through erosion.

3.2.1.4 Groundwater

Very limited hydrogeologic and analytical data exist for groundwater for the portion of Demolition Area 2 that lies south of Sand Creek. Therefore, an accurate assessment of groundwater flow patterns in that portion of the AOC cannot be provided at present. Hydrogeologic and analytical data for the portion of Demolition Area 2 that includes the RCRA unit has been gathered since the 1992 installation of four groundwater monitoring wells at that site. Quarterly measurement of groundwater levels indicate that the groundwater flow within that area generally follows topography and flows in a general south and east direction toward Sand Creek. For the purposes of DQO development and investigation planning, the CSM presumes that the general groundwater flow patterns south of Sand Creek at Demolition Area 2 would also mimic the site topography and surface water drainage patterns, following a north and east direction toward Sand Creek.

Analytical evidence for groundwater contamination by site-related contaminants (SRCs) identified in source area soil (i.e., explosives and metals) is indicated in the groundwater monitoring wells located around the RCRA unit north of Sand Creek. Since 1992, explosives have been subsequently detected in all four wells, and metals exceeding site-wide background criteria were detected in wells DET-2 and DET-4 in 2000. However, because of the limited available data for Demolition Area 2, other than the RCRA unit, contaminant migration from source areas to groundwater (via leaching or surface water infiltration) is an unknown element of the conceptual model at present. Potential source area SRCs identified to date have low mobility in groundwater. However, previous sampling data from wells around the RCRA unit indicates that the potential exists for groundwater contamination at this AOC. Subsequently, the presence of groundwater contamination and potential migration pathways will be evaluated as part of the Phase II RI.

Groundwater characterization efforts include installation of monitoring wells in a configuration that will provide data on general hydrogeologic characteristics and groundwater flow patterns. Wells will be installed in the vicinity of known and suspected source areas to evaluate whether contaminants are leaching to groundwater. Monitoring wells are also specifically planned for placement in close proximity to Sand Creek to determine whether groundwater flow and potential contaminant transport into Sand Creek and off of the AOC is occurring.

3.2.2 Problem Definition

Past open detonation, open burning, and disposal activities at Demolition Area 2 have contaminated surface and subsurface soils, sediments, and groundwater. Known contaminants include explosives, propellants, and inorganic analytes.

Because surface drainage features represent the most probable contaminant exit pathways beyond the boundaries of Demolition Area 2, surface water and associated sediment media are a specific focus of the Phase II RI. The likelihood of contaminant migration to groundwater via leaching of soil or infiltration of surface water in areas outside of the Demolition Area 2 RCRA unit is currently unknown. Contaminant migration potential to groundwater for the Demolition Area 2 AOC will be evaluated based on SESOIL vadose zone leaching modeling.

3.2.3 Remedial Action Objectives

Section 3.2.3 of the Facility-wide SAP describes the process for identifying remedial action objectives for RVAAP under the CERCLA process.

3.2.4 Identify Decisions

The key decisions for all investigations at RVAAP have been identified in Section 3.2.4 and in Table 3-1 of the Facility-wide SAP. Phase II RI data inclusive of the risk assessment results are necessary for sound remedial decision making and to determine whether additional investigation is needed or what types of response actions are most appropriate.

3.2.5 Define the Study Boundaries

The investigation area boundaries for the Phase II RI at Demolition Area 2 will be defined by the RVAAP team during this RI process and will be established so as to encompass all known or reported historical operations areas, adjacent support areas, and potential surface water exit pathways.

3.2.6 Identify Decision Rules

Decision rules used to guide remediation decisions are provided in Section 3.2.6 of the Facility-wide SAP. Phase I data were not sufficient to fully define the nature and extent of contamination; therefore, risk of exposure to contaminants could not be fully ascertained. The purpose of the Phase II RI data is to more clearly determine the presence, type, concentration, and extent of contamination. The data generated from the field investigation will be used to conduct a quantitative baseline human health and ecological screening risk assessment to identify areas requiring remediation and areas where additional characterization may be needed.

Some of the data generated from previous investigations are of sufficient quality for incorporation into the assessment of contaminant nature and extent and risk

assessment; however, soils in the Demolition Area 2 RCRA unit have been excavated to a depth of four feet, screened for ordnance and scrap metal, and replaced on site. Useable data generated from outside the RCRA unit, and within the RCRA unit at depths greater than four feet, may be pooled with Phase II RI data and screened as discussed in Section 3.3.

3.2.7 Identify Inputs to the Decisions

Inputs to the decision process are the analytical results, risk-assessment results, and the refined site-specific conceptual model developed from field observations and environmental data.

3.2.8 Specify Limits on Decision Error

Limits on decision errors are addressed in Section 3.2.8 of the Facility-wide SAP.

3.2.9 Sample Design

The sample design for the Phase II RI of Demolition Area 2 is described in detail in Chapter 4.0 of this SAP Addendum. Those source areas having confirmed contamination in the Phase I RI, uncharacterized potential source areas, and contaminant accumulation points represent specific focus areas for sampling. Surface water exit pathways are also specifically targeted. Groundwater adjacent to known or potential source areas and along suspected exit pathways will also be characterized. A minimal number of contingency samples are planned for suspected source areas or exit points identified during the field effort.

3.3 DATA EVALUATION METHODS

The methods for identifying SRCs related to AOC operations are described in the following sections. The data evaluation methods to be employed for the Demolition Area 2 Phase II RI are consistent with those established under previous Phase I and Phase II investigations at RVAAP. The general process for identifying SRCs involves initial data reduction, defining data aggregates, data quality assessment, and screening of data against statistical, background, and weight-of-evidence criteria. Analytical results are reported by the laboratory in electronic form and are loaded into a database. Electronic data are then verified against the laboratory hard copy and the sampling records to ensure that the data are complete and to qualify any data that do not meet project DQOs. Ten percent of the data will be submitted to a USACE subcontractor for full independent, third-party validation as described in the Quality Assurance Project

Plan (QAPP). In accordance with USACE Louisville District requirements (USACE 2001c) if full-independent third-party validation of an initial 10 percent of the data identifies significant problems or issues with the data set, additional steps must be taken to review the data. These will include:

• Isolation of the problem to the specific analyses and target analyte.

• Review of project data verification checklists to identify the potential extent of the problem throughout the data set.

• Independent third-party validation of an additional 10 percent of the data set focused on the specific problem, analyses, and analyte.

• The steps outlined above continue as necessary (USACE 2001c. Louisville District Chemistry Guidance, January 2001.)

Quality control data, such as sample splits and duplicates, will not be included in the determination of contaminant nature and extent or in the risk assessment. Diluted samples may be used if the detection limits are not elevated due to the dilution; only one result per sample and analyte are used (either the diluted result or the original result). Samples rejected in the data verification and independent USACE validation process also will be excluded. If, during verification, it is found that a significant number of samples are rejected, the entire data set will be evaluated to determine if a representative data set exists without the rejected data. The percentage of rejected data will be presented in the data quality assessment section of the Phase II RI report. If independent, third-party validation determines that a significant percentage of the data do not meet USACE data quality requirements, subsequent percentages of the data set will be subject to validation as stated in the QAPP.

Corrective action in the laboratory may occur prior to, during and after initial analyses. A number of conditions, such as broken sample containers, multiple phases, low/high pH readings, and potentially high concentration samples, may be identified during sample log-in or just prior to analysis.

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the warning or acceptable windows for precision and accuracy
- Blanks contain target analytes above acceptable levels
- Undesirable trends are detected in spike recoveries or RPD between duplicates
- There are unusual changes in detection limits

- Deficiencies are detected by the QA Department during internal or external audits or from the results of performance evaluation samples

- Inquiries concerning data quality are received.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor and/or QA Officer for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the QA department and documented in the case narrative. The Laboratory QA Officer will coordinate all problem/corrective action situations with the Project Chemist. The Project chemist will coordinate with the LRL Chemist as necessary in resolving corrective action situations.

3.3.1 Determination of AOC Chemical Background

Analytical results will be screened against the final facility-wide background values for RVAAP developed as part of the Phase II RI for WBG (USACE 2001b). These facility-wide background criteria and the processes used to generate them have been reviewed and accepted by USACE and Ohio EPA. This screening step will be used to determine if detected metals are SRCs or if they are naturally occurring.

3.3.2 Definition of Aggregates

Data collected from Demolition Area 2 will be aggregated by environmental medium (soil, sediment, surface water, and groundwater). Soil data will be aggregated by depth interval: surface soil from 0 to 0.3 meter (0 to 1 foot) bgs, and subsurface soil from 0.3 meter to .9 meter (1 to 3 feet) bgs from the soil stations; surface soil from 0 to 0.6 meter (0 to 2 feet) bgs and subsurface soil from 0.6 to 1.2 meter (2 to 4 feet) bgs from the well borings. As part of the Phase II RI reports for these AOCs, data for soil media and potential land use will be evaluated to determine if spatial aggregates may be made on the basis of site operational history and hydrogeologic characteristics. Data for sediment and surface water media will be evaluated with respect to drainage patterns, contaminant sources, and ecological habitat to define logical spatial aggregates if merited. Groundwater will be evaluated as one spatial aggregate unless compelling hydrogeologic data are obtained during the Phase II RI to suggest that further subdivisions be made.

Summary statistics [i.e., minimum concentration, maximum concentration, frequency of detection, mean concentration, and 95 percent upper confidence

limit (UCL95)] will be developed for each environmental medium on an AOC-wide basis and for each spatial aggregate. Source areas ("hot spots") will be identified spatially from the data. Focused discussion of any prevalent SRC that occurs consistently across the AOC and any hot spots will be presented in the Phase II RI report. Evaluation of the spatial distribution of contaminants will include factors such as proximity to sources and surface and groundwater flow patterns. Evaluation of contamination at surface water and groundwater exit points will also be highlighted in the "nature and extent" assessment.

3.3.3 Data Screening

Data screening prior to the risk evaluation will consist of four steps: (1) data quality assessment, (2) frequency of detection screen, (3) background screening, and (4) screening of essential human nutrients. These screens will be used to identify SRCs. Those constituents identified as SRCs will then be evaluated in the screening risk assessments. The application of these screens to the Phase II RI risk assessments is presented in Section 3.4.

• A detailed assessment of the quality of the Phase II RI analytical results will take place. Data that are rejected as a result of the data quality assessment will not be evaluated further in the screening process.

• Chemicals that are never detected will be eliminated as SRCs. For sample aggregations with greater than 20 samples and a frequency of detection of less than 5 percent (i.e., 1 detection in 20 samples), a weight-of-evidence approach will be used to determine if inorganic chemicals, VOCs, SVOCs, pesticides, and PCBs are related to the AOC. The magnitudes and locations (clustering) of the detected values will be evaluated. Consistent with EPA risk assessment guidance (EPA 1989), if the detected results for a chemical show no clustering, if concentrations are not substantially elevated relative to the detection limit, and the constituent is not an SRC in another aggregate, it will be considered spurious, and the chemical eliminated as an SRC. Any detected explosive or propellant compound will be considered as an SRC regardless of its frequency of detection.

• For each inorganic constituent exceeding the frequency of detection screen, concentrations will be screened against pre-established, naturally occurring, facility-wide background levels. If the maximum concentration of a constituent exceeds the background value, the constituent will be considered as an SRC. Facility-wide background levels developed for surface soil, subsurface soil, sediment, surface water, and groundwater within either the unconsolidated interval or bedrock will be employed as appropriate. In the facility-wide background data set, if a constituent was never detected, its background level is assigned as zero. This conservative process ensures that chemicals detected within a particular medium are not eliminated too early in the screening process.

Organic compounds are considered to be anthropogenic; therefore, any compound that is not eliminated by the frequency of detection screening step will be considered to be above background, evaluated as to its nature and extent, and screened using the risk evaluation.

Chemicals that are considered essential nutrients (calcium, chloride, iodine, iron, magnesium, potassium, phosphorous, and sodium) will not be evaluated as SRCs in the human health risk assessment unless determined to be grossly elevated relative to background according to the procedures defined in the USACE guidance document, *Risk Assessment Handbook, EM200-1-4* (USACE, 1999). These chemicals are an integral part of the country's food supply and are often added to foods as supplements; thus, these constituents are not generally addressed as contaminants (EPA 1989, 1995). Data on essential elements, however, will be used to evaluate the subsurface geochemistry.

3.4 HUMAN HEALTH RISK ASSESSMENT

Using the results of the Phase II RI at Demolition Area 2, a screening human-health risk assessment (SHHRA) assessment will be performed. The proposed scope of the human health risk assessment is summarized briefly below:

Data Evaluation – The same methodology used in previous risk assessments at RVAAP will be used. This methodology includes calculating summary statistics and comparing maximum detected concentrations of all analytes to facility-wide background concentrations to identify SRCs and X 0.1 of the residential and industrial preliminary remediation goals (PRGs) to identify chemicals of potential concern (COPCs).

Toxicity Assessment – The same methodology used in previous risk assessments at RVAAP will be used. EPA approved toxicity values taken from IRIS and HEAST will be used. The inclusion of any provisional or withdrawn values will be noted in the report and discussed as a source of uncertainty.

Exposure Assessment and Risk Characterization – Future land-use at this site may be as an active training and explosives demolition area for National Guard (demolition training and grenade familiarization) and FBI (bomb squad training). Based on this known future land-use, the following four receptors will be evaluated in the risk assessment: National Guard/FBI trainee, National Guard/FBI trainer, logger for occasional removal of trees, and trespasser. These receptors may be exposed to surface soil, surface water, and sediment. No groundwater use is anticipated at this site. No activities that require disturbing the soil to greater than 2 feet are anticipated at this site, therefore, exposure to subsurface soil will not be included in the quantitative evaluation. Hunting is currently prohibited in this area due to UXO concerns and will be prohibited or limited to occasional deer removal if necessary. The exposure assessment and

risk characterization will be conducted on background concentrations as well as site-specific concentrations of COPCs. Contributions from background will not be subtracted out as part of the risk assessment process. If unacceptable risks or hazards are estimated a central tendency analysis will also be performed to evaluate the potential range of risks.

3.5 SCREENING ECOLOGICAL RISK ASSESSMENT

Using the results of the Phase II RI at Demolition Area 2, an ecological screening risk assessment will be performed. The ecological risk assessment will consist of two parts:

1. preliminary determination (Phase I in Ohio EPA's proposed ERA)
2. screening ERA (Phase II in Ohio EPA's proposed ERA)

For preliminary determination or Phase I, two conditions must be met: (1) evidence of exposure and (2) presence of ecological resources. Both are true at Demolition Area 2. Thus, a Phase II screening ecological risk assessment, in which ecological screening values (ESVs) are compared to maximum concentrations in each media, will be performed.

The screening ERA or Phase II uses conservative values for a rapid and early look at which chemicals have low concentrations and can be dismissed and which chemicals have concentrations higher than the ESVs and show potential risk. For soil, there is a hierarchy of ESVs recommended by Ohio EPA, and that hierarchy will be used. The same is true about ecotoxicity hierarchies for sediment and surface water. This results in the identification of chemicals of potential ecological concern (COPECs) for the site.

Another part of the screening ERA will be to evaluate whether the COPECs are considered persistent, bioaccumulative, and toxic (PBT) compounds. The PBT compounds are those inorganic COPECs whose maximum bioaccumulative factor (BAF) or bioconcentration factor (BCF) is 2 or greater. Organic compounds whose log octanol-water partition coefficient (Kow) is 4 or greater are also considered to be PBT compounds.

A habitat reconnaissance of Demolition Area 2 that includes a record of the vegetation communities and wildlife, focusing on the location, size, and general features of streams and aquatic resources, will be performed during suitable seasons as part of the screening ecological risk assessment. After the habitat is characterized, and the PBT screen is determined, the screening ecological risk assessment will be completed, and any COPECs for Demolition Area 2 will be identified.

4.0 FIELD ACTIVITIES

A summary of the environmental matrices, number of sampling locations, and sampling rationale, are listed in Table 4-1. The sampling locations are shown on Figures 4-1 and 4-2, which are provided at the end of this chapter.

4.1 GROUNDWATER

4.1.1 Rationale

Limited hydrogeologic and analytical data exist for groundwater outside of the RCRA unit at Demolition Area 2. Accordingly, monitoring wells will be installed to assess impacts to shallow groundwater and to potential migration pathways at Demolition Area 2. The groundwater characterization effort will include installation of monitoring wells in a configuration that will provide data on general hydrogeologic characteristics and groundwater flow patterns. Monitoring wells will also be specifically installed in the vicinity of known and suspected source areas to evaluate whether contaminants are leaching to groundwater. Monitoring wells are also planned to be placed in close proximity to Sand Creek to determine whether groundwater and potential contaminant transport is occurring off of the AOC.

4.1.1.1 Monitoring well locations and installation

Ten new monitoring wells will be installed as a part of the Phase II RI to monitor shallow groundwater at Demolition Area 2 (Figure 4-1). Table 4-1 describes the rationale for the placement of the monitoring wells. The proposed locations were selected on the basis of DQOs, the Phase I RI results, and the CSM developed for Demolition Area 2 (Chapter 3.0). It is anticipated that the depth to the water table will vary between 1.5 meters (5 feet) and 9.1 meters (30 feet) bgs, based on existing monitoring well information from the RCRA wells and site topographic data. Bedrock is anticipated to be encountered in some areas at depths as shallow as 2.5 meters (8 feet).

All monitoring wells will be installed using conventional drilling techniques (hollow-stem auger and air rotary drilling, as required) as described in Section 4.1.2.1. The maximum depth of each monitoring well is expected to be ~15 meters (50 feet) bgs or less. The screened intervals for the wells will be installed so that the water table is within the screen where possible. In the unconsolidated zone where the water table is less than a depth of 6.1 meters (20 feet), which is minimum depth required to set a complete well with a 3.05-meter (10-foot) screen per USACE specifications, a 5-foot screen will be used. For those wells where a shallow completion is required, design and installation of the well will be coordinated/concurred with Ohio EPA prior to installation. The

approach to completing shallow wells will be to follow the sequence of construction specified in Section 4.3.2.3 of the Facility-wide SAP, with thicknesses of the filter pack, bentonite, and grout layers shortened as needed to accommodate placement while maintaining integrity of the monitoring well seal. Where bedrock is encountered at depths less than the minimum required to set a well, the boring will be advanced into the first one to two feet of bedrock and the well set at that depth and completed as described above.

One round of AOC-specific, contemporaneous water level measurements will be performed on the same day for all wells at Demolition Area 2 following development and prior to sampling. Water level measurements will also be collected from the wells at the time they are sampled. Groundwater samples will be collected from each of the 10 monitoring wells installed as part of this Phase II RI. In addition, four existing wells installed as part of the hydrogeologic investigation of the RCRA unit (DET-1B through DET-4), and two existing wells installed as part of the Phase II RI at WBG (WBGmw-012 and WBGmw-013) will be sampled as part of the Phase II RI. The two existing wells located along the southern boundary of the WBG will be sampled to monitor potential off-AOC transport of contamination from WBG and on to Demolition Area 2. The individual sample identification and the required chemical analyses are provided in Chapter 5.0.

4.1.1.2 Sample collection for field and laboratory analysis

All monitoring wells will be field screened for VOCs prior to sample collection using a hand-held photo-ionization detector (PID) or flame ionization detector organic vapor analyzer (OVA). Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe. Field measurements of pH, temperature, specific conductance, turbidity, and dissolved oxygen will be recorded for each groundwater sample. No samples will be collected for additional headspace analysis. Water level measurements will be collected immediately prior to sampling of each well.

An unfiltered groundwater sample will be collected from each monitoring well and submitted for laboratory analysis of explosives, propellants, cyanide, SVOCs, VOCs, pesticides, PCBs, nitrate/nitrite, and sulfide. An ample volume of water will be collected so that filtered TAL metals can be analyzed. Unfiltered samples for TAL metals will not be analyzed. Filtering will be performed in the field according to Section 4.3.5 of the Facility-wide SAP. The specific number of samples and the types of chemical analyses to be performed are delineated in Chapter 5.0.

Table 4-1. Demolition Area 2 Sampling Rationale and Matrix

Description	Principal Suspected Contaminants	Sampling Rationale	Sample Matrix			
			Soil Stations	Sediment Stations	Monitoring Well Boring/ Groundwater Station	Surface Water Station
Suspected potential source areas	Explosives and metals	Identify possible contamination in soil	46			
Site boundaries and areas outside of potential source areas	Explosives and metals	Define extent of contamination in soil	5			
Contingency Samples	TBD	To be assigned in the field	9			
AOC ditches and drainageways	Explosives and metals; full suite to be performed	Characterize potential contaminant exit pathways and accumulation points		12		
Sand Creek	Explosives and metals; full suite to be performed	Characterize potential for contaminant exit from AOC				2
		Characterize conditions upstream of AOC				1
Monitoring wells	Explosives and metals; full suite to be performed	Identify possible contamination in groundwater near source areas			7	
		Identify possible contamination in groundwater and provide an understanding of the flow regime near Sand Creek			2	
		Characterize groundwater conditions in a background location north of the AOC			1	

Full Suite = Explosives, Target Analyte List (TAL) metals, cyanide, VOCs, SVOC, and PCBs/Pesticides
AOC = Area of Concern

4.1.1.3 Quality assurance/quality control, and blank samples and frequency

QC duplicates, USACE QA split groundwater samples, equipment rinsate samples, and matrix spike/matrix spike duplicates will be collected during the Phase II RI. Duplicates and QA splits will be selected randomly (from the same locations, whenever possible) and analyzed for the same parameters as the environmental samples. Duplicate and QA split samples, representative of the sample parameters analyzed, will be collected at a frequency of 10 percent of environmental samples. Equipment rinsate samples will also be collected at a frequency of 10 percent of groundwater samples. Matrix spike/matrix spike duplicates will be collected at a rate of 5 percent of total samples per media. Trip blanks, which originate in the laboratory, will accompany shipment of all VOC groundwater samples and will be analyzed for VOCs only.

One source blank will be collected from the potable water source, which will be used for all potable wash and rinse water for equipment decontamination during the Phase II RI. One source blank will also be collected from the deionized/distilled (ASTM Type I) water source used. The source blanks will be analyzed for the full suite of analyses.

4.1.2 Monitoring Well Installation

In general, monitoring wells to be installed during the Phase II RI will be 2.0-inch, Schedule 40 polyvinyl chloride (PVC) wells with standard above-grade completions. Specifications for drilling, installation, completion, and development of monitoring wells are contained in the following subsections.

4.1.2.1 Drilling methods and equipment

Equipment Condition and Cleaning

Requirements for the condition and cleaning of equipment used for well installation are described in Section 4.3.2.1.1 of the Facility-wide SAP. These requirements, as applicable, will be employed for equipment used to install monitoring wells in the Phase II RI.

Drilling Methods

Conventional drilling techniques (hollow-stem auger and air rotary) will be used to install monitoring wells, as described in Section 4.3.2.1.2 of the Facility-wide SAP. In the event that unconsolidated materials are found to be prone to collapse, then the second drilling scenario (i.e., use of temporary surface casing)

will be employed. The fourth drilling scenario would be applicable to wells that monitor only the unconsolidated interval as is anticipated for this study. Where depth to the water table is great enough, monitoring well boreholes will be drilled to sufficient depth to install the bottom of a 3-meter (10-foot) well screen approximately 2.1 meters (7 feet) below the current water table elevation. If the water table lies at too shallow a depth to place a screen across it and complete a well per specifications of the Facility-wide SAP, then the borehole will be advanced and the well completed as previously described in Section 4.1.1.1 of this SAP. As noted previously, it is anticipated that the depth to the water table will range from 1.5 meters (5 feet) to 9.1 meters (30 feet) bgs at Demolition Area 2, based on existing information. It is anticipated that the depth to bedrock will range between 2.4 meters (8 feet) and 12 meters (39 feet). The maximum depth of monitoring wells at Demolition Area 2 is expected to be approximately 15 meters (50 feet) bgs.

4.1.2.2 Materials

Casing/Screen

The casing and screen materials for monitoring wells were presented in Section 4.3.2.2.1 of the Facility-wide SAP.

Filter Pack, Bentonite, and Grout

The filter pack, bentonite, and grout materials for monitoring wells were presented in Section 4.3.2.2.2 of the Facility-wide SAP.

Surface Completion

All wells will be constructed as above-ground installations, as described in Section 4.3.2.2.3 of the Facility-wide SAP.

Water Source

Potable water from a commercial source will be used during this investigation for monitoring well and decontamination purposes. The collection and evaluation of the source water sample will follow Section 4.3.2.2.4 of the Facility-wide SAP.

Delivery, Storage, and Handling of Materials

All monitoring well construction materials will be delivered, stored, and handled following Section 4.3.2.2.5 of the Facility-wide SAP.

4.1.2.3 Installation

All monitoring well installation will be in accordance with the procedures for

above-ground installations as previously presented in Section 4.1.1.1 of this SAP. Unconsolidated surficial material in each location will be drilled using a 10.8-centimeter (4.25-inch) inside diameter hollow-stem auger having an outside diameter (OD) of at least 16.5 centimeters (6.25 inches). Soil samples will be collected continuously from the surface to bedrock refusal or borehole termination using a split spoon or split-barrel sampler for geologic logging.

4.1.2.4 Documentation

Logs and Well Installation Diagrams

Boring Logs. Boring logs will be completed for all monitoring well boreholes following Section 4.3.2.4.1.1 of the Facility-wide SAP. Visually determined Unified Soil Classification System (USCS) of each soil sample taken will be recorded on each boring log.

Well Construction Diagrams. All monitoring well activities will be documented according to the procedures presented in Section 4.3.2.4.1.2 of the Facility-wide SAP.

4.1.2.5 Well abandonment

Any monitoring wells or boreholes abandoned during the Phase II RI will be abandoned according to the procedures presented in Section 4.3.2.5 of the Facility-wide SAP.

4.1.2.6 Water level measurement

Water level measurements will follow the procedure presented in Section 4.3.2.6 of the Facility wide SAP.

4.1.2.7 Well development

Development of monitoring wells will be accomplished with a pump following Section 4.3.2.3.11 of the Facility-wide SAP. Pumps may be replaced with bottom-filling bailers where well size or slow recharge rates restrict pump usage. Development will proceed until the criteria specified in the Facility-wide SAP are met as below:

- Turbidity readings of 5 nephedometric turbidity unit (NTU) or less are attained. If values of 5 NTU or less cannot be attained, development will continue until the water is clear to the unaided eye or the maximum development time has expired (48 hours).

- The sediment thickness remaining in the well is less than 1 percent of the screen length or <30 millimeters (0.1 foot) for a 3.05-meter (10-foot) screen.

- A minimum of five times the standing water volume in the well has been purged (to include the well screen and casing plus saturated annulus, assuming 30 percent porosity).

- Indicator parameters (pH, temperature, and specific conductance) have stabilized to ±10 percent over three successive well volumes.

If potable water is added to the boring to aid drilling of the well or to control heaving sands, 5 times the volume of any water added will be removed during development. If development to the criteria specified above cannot be achieved due to site conditions, such as slow recharge or persistent turbidity, then the Architectural and Engineering (AE) Field Operations Manager, the Ohio EPA, and the USACE Technical Manager or other field representative will be consulted to determine the appropriate course of action. For each monitoring well developed during the Phase II RI, a record will be prepared to include the information specified in Section 4.3.2.4.2 of the Facility-wide SAP.

4.1.3 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 4.3.3 of the Facility-wide SAP. All monitoring wells will be field screened for VOCs using a PID or OVA during groundwater sample collection. Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe.

4.1.4 Sampling Methods for Groundwater

Groundwater sampling from monitoring wells will follow conventional procedures discussed in Section 4.3.4.1 of the Facility-wide SAP.

4.1.4.1 Well Purging Methods

Purging and sampling of all monitoring wells installed during the Phase II RI will be conducted in accordance with conventional procedures discussed in Section 4.3.4.1 of the Facility-wide SAP.

4.1.4.2 Filtration

Per Section 4.3.5 of the Facility-wide SAP, filtered groundwater samples only for dissolved TAL metals will be collected. Filtration will be performed by using a negative pressure, hand-operated vacuum pump and collection flask and a disposable 0.45-µm pore size filter assembly. Filters will be replaced as they become restricted by solids buildup as well as between sample collection sites.

4.1.5 Sample Containers and Preservation Techniques

Requirements for sample containers and preservation techniques for groundwater samples are presented in Section 4.3.6 of the Facility-wide SAP.

4.1.6 Field Quality Control Sampling Procedures

QC samples for monitoring well groundwater sampling activities will include duplicates and split groundwater samples, equipment rinsates, matrix spike/matrix spike duplicates and trip blanks as described in Section 4.1.1.3 above. Split samples will be submitted to the following USACE contract laboratory for independent analyses: Severn Trent Laboratories, Inc. (STL).

4.1.7 Decontamination Procedures

Decontamination of equipment associated with groundwater sampling will be in accordance with the procedure presented in Section 4.3.8 of the Facility-wide SAP. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

4.1.8 In-Situ Permeability Testing

A slug test will be performed in each of the monitoring wells installed as part of the Phase II RI to determine the hydraulic conductivity of the geologic material surrounding each well. The slug test method involves lowering or raising the static water level in a well bore by the removal or insertion of a cylinder (slug) of known volume. The return of the water level to a pre-test static level is then measured over time. The change in water level over time is plotted on a logarithmic scale to determine hydraulic conductivity (K). K is a function of the formation permeability and the fluid in the formation and is influenced by well construction.

At a minimum, a slug insert (falling head) test will be used for this investigation. A rising head test will also be performed following the falling head test to obtain a corresponding K value for comparative purposes. If possible, the slug test will be performed in such a manner as to prevent the water level in the well from dropping below the top of the screened interval when the slug is removed. All tests will be performed after the groundwater has been sampled, as described in Section 4.1.4, and will be contingent upon a monitoring well containing sufficient water to allow testing.

Slug tests will only be initiated after the well has recovered from groundwater sampling, or after a minimum of 12 hours has elapsed since sampling. A

pressure transducer will be inserted into the well and the water level allowed to equilibrate to static conditions or until at least 6 hours have elapsed. A slug that displaces 0.3 meter (1 foot) of water will be inserted to provide an adequate response for the analysis. Prior to the start of the test, plastic sheeting will be placed around the well in a manner to minimize water contact with the ground surface. The static water level will be measured with an electronic water level indicator and recorded to the nearest 0.003 meter (0.01 foot) below top of casing. The total depth of the well will be measured with an electronic water level indicator and recorded to the nearest 0.003 meter (0.01 foot) below top of casing. These measurements will be used to calculate the water column height in the well. Use of the electronic water level meter will follow procedures outlined in Section 4.3.3.1 of the Facility-wide SAP.

For the rising head test, the slug will be withdrawn quickly from the well without surging. The time of the test will begin as soon as the slug leaves the water column. Water level measurements will be recorded continuously during the test with a pressure transducer and data logger programmed to make measurements to within 0.003 meter (0.01 foot) and record them on a logarithmic scale. Water level change will be recorded for a period of 6 hours or until the well re-equilibrates to 90 percent of the pre-test water level, whichever occurs first.

The test data will be evaluated by the Bouwer and Rice method (1976, 1989) or the Cooper et al. method (1967). If the test geometry is not conducive to analysis to either of these two methods, an alternate method will be used subject to RVAAP team approval (USACE and Ohio EPA).

4.1.9 OE Avoidance

Protocols for OE avoidance during drilling or subsurface soil boring activities are discussed in Section 4.2.3. An OE avoidance plan is contained in Appendix C.

4.2 SUBSURFACE SOIL

4.2.1 Rationale

Subsurface soil samples will be collected during the Phase II RI at Demolition Area 2 to investigate (1) potential subsurface contamination occurring as a result of activities at former operations areas, (2) transport pathways to deeper soil horizons for such contaminants as described in the DQOs (Section 3.2), and (3) determine the vertical extent of contamination.

Table 4-1 describes the rationale for the placement of soil sampling stations. The proposed sampling locations for the soil stations are shown on Figure 4-2. The

number of soil sample stations identified for Demolition Area 2 is summarized on Table 4-1 and detailed in Chapter 5.0 (Table 5-1).

4.2.1.1 Soil boring locations

The proposed locations for subsurface soil sampling were selected on the basis of DQOs, the Phase I RI and other previous study results, and the CSM (Chapter 3.0). The final sample locations will be marked in the field based on site conditions, access considerations, visual survey of the area, and OE considerations.

Subsurface soil samples will be collected from 51 soil stations and from the 10 monitoring well borings. At the soil station locations, subsurface soil samples will be collected from the 0.3- to 0.9-meter (1- to 3-foot) interval. Soil samples from monitoring well borings will be collected from the 0.0- to 0.6-meter (0- to 2- foot) and 0.6- to 1.2-meter (2- to 4-foot) intervals.

4.2.1.2 Discrete/composite soil sampling requirements

Soil borings for the collection of subsurface samples from the soil station locations will be located at the center point of the equilateral triangle created during surface soil composite sampling for explosives and/or propellant analyses (see Section 4.3). All VOC samples will be collected first as discrete aliquots from the middle of the sample interval without homogenization. All remaining sample aliquots will be derived from soil that is homogenized over the depth interval. Soil will be collected over the depth interval using a bucket auger, placed into a stainless steel pan or bowl, and homogenized with stainless steel implements, and representative aliquots will be placed into sample containers in accordance with Section 4.4.2.5.2 of the Facility-wide SAP.

Soil samples from monitoring well borings will be collected so as to represent the entire specified interval in accordance with Section 4.4.2.5.1 of the Facility-wide SAP.

4.2.1.3 Sample collection for laboratory analysis

All subsurface soil samples will be field screened for VOCs using a hand-held PID OVA during collection. No samples will be collected for headspace analysis of VOCs.

All samples collected will be submitted for Explosives and TAL metals analysis at the off-site laboratory. The remaining chemical analysis to be performed on the subsurface soil samples is dependent on the requirements for each location to be sampled and may include VOCs, SVOC, pesticides, propellants (nitroglycerine, nitrocellulose, and nitroguanidine), PCBs, hexavalent chromium, cyanide, nitrate/nitrite, and sulfide. The type of chemical analyses and the number of

samples to be analyzed for soil stations are provided in Table 5-1. Analytical laboratory methods, analytes, and procedures are further discussed in the Phase II RI QAPP addendum.

Requirements for sample containers and preservation techniques for subsurface soil samples are presented in Section 4.4.2.6 of the Facility-wide SAP and in Section 4.0 of the QAPP addendum. In addition, for those samples to be analyzed for hexavalent chromium, additional steps will be taken during collection to minimize sample contact with stainless steel sampling equipment.

4.2.1.4 Organic vapor screening

All soil borings will be field screened for VOCs using a hand-held PID OVA during sample collection. All OVA readings will be recorded in field logbooks. No samples will be collected for headspace analysis of VOCs.

4.2.1.5 Field quality control sampling procedures

Subsurface soil QA/QC samples will be collected during the Phase II RI. Duplicate and split soil samples will be collected at a frequency of 10 percent (1 per 10 environmental samples). Duplicate and split samples will be collected from the same station and depth interval. Matrix spike/matrix spike duplicate samples will be collected at a rate of 5 percent of total samples per media. Split samples will be submitted to the designated USACE contract laboratory for independent analysis. No field or rinsate blanks will be collected for subsurface soil. A trip blank will accompany each cooler containing samples collected for VOC analysis. Table 5-1 and Chapter 8.0 of the QAPP addendum summarize QA/QC sampling requirements.

4.2.2 Sampling Procedures

4.2.2.1 Drilling methods

A hand-operated power auger will be used in conjunction with bucket hand augers to create the subsurface borings. The power auger will be used to advance the soil boring to the top of the target depth interval, if necessary, based on field conditions.

Once the boring has been advanced to the top of the specified sampling interval with the power auger, a bucket hand auger will be used for the collection of the soil sample, as discussed in Section 4.4.2.1.4 of the Facility-wide SAP. After the sample is collected, the power auger will be used to advance the boring to the top of the next interval, if possible. A bucket hand auger will then be used to collect the soil sample.

Equipment Condition and Cleaning

Requirements for the condition and cleaning of power auger equipment used for subsurface soil borings are described in Section 4.3.2.1.1 of the Facility-wide SAP. These requirements, as applicable, will be employed for equipment used to advance soil borings during the Phase II RI.

4.2.2.2 Field measurement procedures and criteria

All field measurement procedures and criteria will follow Section 4.4.2.3 of the Facility-wide SAP, except headspace gases will not be screened in the field for organic vapors.

4.2.2.3 Sampling for geotechnical analysis

Undisturbed subsurface soil samples will be collected from monitoring well borings using a thin-walled (Shelby) tube sampler during hollow-stem auger drilling. Shelby tube sampling will proceed as discussed in Section 4.4.2.4.1 of the Facility-wide SAP. Two Shelby tubes will be collected from each monitoring well boring from within the planned screened interval for each well. All samples will be analyzed for moisture content, Atterberg limits, USCS classification, bulk density, porosity, specific gravity, and pH. One shelby tube sample from each well will also have grain size and hydraulic conductivity analyses. Table 5-4 in Chapter 5.0 provides the specific number and analyses types of geotechnical samples to be collected from each monitoring well boring.

4.2.2.4 Sampling for chemical analysis

Procedures for sampling of subsurface soil for chemical analysis are presented in Sections 4.4.2.5.1 and 4.4.2.5.2 of the Facility-wide SAP. The following general criteria apply for chemical analyses.

- All subsurface soil samples will be analyzed for Explosives and TAL metals.

- Ten percent of the subsurface soil samples collected will be submitted for a full suite of analyses (i.e., TAL Metals, Explosives, Propellants, CN, VOCs, SVOCs, pesticide, and PCB analyses.) Full-suite analyses will be conducted on samples collected from the same station and at the same depths.

The assumptions noted in the above general criteria result in maximum numbers of samples that are allowed to be collected and submitted for analysis. The maximum numbers of samples to be analyzed for each parameter group are provided in Chapter 5.0 (Tables 5-1, 5-2, and 5-4).

4.2.2.5 Sample containers and preservation

Requirements for sample containers and preservation techniques for subsurface soil samples are presented in Section 4.4.2.6 of the Facility-wide SAP and in the QAPP addendum.

Efforts will be made to ensure proper cooling of soil samples en route to the off-site laboratory.

4.2.2.6 Decontamination procedures

The decontamination procedure for subsurface soil sampling activities presented in Section 4.4.2.8 of the Facility-wide SAP will be followed. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

4.2.3 OE Avoidance

An OE avoidance plan prepared is contained in Appendix B and will be presented as part of the initial project safety briefing. OE support staff will be present during all field operations. The OE Team Leader will train all field personnel to recognize and stay away from propellants and OE. Safety briefings for OE will also be provided to all site personnel and site visitors.

All sample locations and access routes into the locations will be cleared for potential OE prior to entry. The OE Team Leader will clearly mark the boundaries of the cleared soil sampling locations and access routes. If surface OE is encountered, the approach path will be diverted away from the OE, the area clearly marked, and the OE Team Leader notified immediately. In the event OE is encountered, notification will be made to the RVAAP Environmental Coordinator along with a map showing the exact location of the item. No item shall be moved without RVAAP approval. In any area where surface metallic OE is encountered, a magnetometer will be used to ensure that no subsurface OE exists within the approach path. Prior to collection of the surface soil sample [0 to 0.3 meter (0 to 1 foot) bgs], the OE team will verify that the location is anomaly free using a magnetometer. Magnetometer equipment will be decontaminated between borings, or, in the case of hand-held magnetometers, a plastic sleeve may be used and replaced between borings.

Where subsurface soil sampling or drilling is to be conducted [0.3 to 0.9 meter (1 to 3 feet) bgs], the auger will be withdrawn at the top of the subsurface interval [0.3 meter (1 foot) bgs] and the magnetometer lowered into the borehole to screen for subsurface magnetic anomalies. Should special circumstances dictate that the borehole be deepened beyond 0.9 meter (3 feet) bgs, then a

magnetometer reading will be taken at the top of each subsequent 0.6-meter (2-foot) interval prior to augering. This process will be repeated to native soil or bedrock encounter, whichever occurs first.

4.3 SURFACE SOIL AND SEDIMENT

4.3.1 Rationale

Surface soil samples from 0.0 to 0.3 meter (0 to 1 foot) will be collected during the Phase II RI at Demolition Area 2 to (1) further define contaminant nature and extent of surface soil contamination; and (2) investigate potential source areas not sampled in Phase I or other previous investigations. The soil sampling program will employ biased sampling (targeted to known or suspected hot spots) to characterize suspected source areas and contaminant accumulation points.

The sampling program also incorporates collection of sediments from drainage ditches in proximity to confirmed and suspected source areas and exit pathways (streams and ditches) in order to assess the potential for contaminant migration via leaching or erosion from surface soil to surface water and sediment.

4.3.1.1 Surface soil sampling locations

Samples for characterization of surface soil are planned as part of this Phase II RI. The proposed stations for soil sampling were selected on the basis of DQOs, the Phase I RI and other previous study results, and the CSM (Chapter 3.0). The final sample locations will be marked in the field based on site conditions, access considerations, visual survey of the area, and OE considerations. Contingency samples are reserved for the purposes of characterization of suspected contaminated areas observed in the field or if additional sampling is required near known sources to adequately confirm contaminant nature and extent. The planned approach for soil sampling is described below.

The proposed locations for surface soil sampling were selected on the basis of DQOs, the Phase I RI and other previous study results, and the CSM (Chapter 3.0). The final sample locations will be marked in the field based on site conditions, access considerations, visual survey of the area, and OE considerations.

Table 4-1 describes the rationale for the placement of soil sampling stations. The proposed sampling locations for the soil stations are shown on Figure 4-2. The number of soil sample stations identified for Demolition Area 2 is summarized on Table 4-1 and detailed in Chapter 5.0 (Table 5-1).

4.3.1.2 Sediment sampling locations

Sediments will be sampled from drainage ditches and in Sand Creek in order to (1) assess the potential for contaminant migration via erosion to surface water and sediment; (2) evaluate potential contaminant accumulation areas, such as runoff collection points, to evaluate if residual contamination exists and if these areas could act as secondary sources for contamination; and (3) evaluate potential contaminant exit pathways from the AOC. All planned sediment sample stations are biased in nature. Final locations will be determined in the field based on site conditions.

A total of ten sediment samples from site drainage pathways will be collected at locations as shown in Figure 4-1 and detailed in Chapter 5.0 (Table 5-2). Table 4-1 describes the rationale for the placement of sediment sampling stations.

The types of sediment samples to be collected include dry sediment from ditch lines and low-lying areas, and subaqueous sediment from Sand Creek. The collection methods for these types of samples differ as discussed in Sections 4.3.2.1 and 4.3.2.2. All dry sediment stations will be sampled from 0.0 to 0.3 meter (0.0 to 1 foot) following the same methods as surface soil stations. Subaqueous sediment samples will be sampled from 0.0- to 0.15-meter (0.0- to 0.5-foot) depth intervals using a stainless-steel scoop, sediment core sampler, or remote device (Eckman sampler) as appropriate.

4.3.1.3 Discrete/composite soil and sediment sampling requirements

Surface Soil

All surface soil samples [from 0 to 0.3 meter (0 to 1 foot)] to be analyzed for explosives and propellants will be composite samples derived from three subsamples collected from about 0.9 meter (3 feet) from one another in a roughly equilateral triangle pattern. Each subsample will be augered to a depth of 30.48 centimeters (1 foot). Equal portions of soil from each of the subsamples will be homogenized with stainless steel implements in a stainless steel bowl following protocols in Section 4.5.2.5 of the Facility-wide SAP.

Samples for all analyses other than explosives or propellants will be discrete samples. A point located at the approximate center of the triangle will be selected for the collection of the remaining samples. Aliquots for VOC analyses will be collected at the center of the interval [15.24 centimeters (0.5 foot)] immediately upon extraction from the boring unless a zone of obvious contamination is observed. No VOC sample will be collected from homogenized or composited soil sample volumes. The remaining soil from the sample interval will be collected, placed in a stainless steel bowl, and homogenized. Sample volumes for analysis of metals, cyanide, SVOCs, pesticides/PCBs, nitrate/nitrite, sulfide and geotechnical analyses will then be taken from the homogenized soil volume.

Dry and Subaqueous Sediment

All sediment samples will be discrete samples. Sediments may be collected using a stainless steel trowel or scoop, hand auger, sediment coring device, or remote sampler where necessary per Section 4.3.2.2. In ditches and flowing streams, sediment samples will be collected from downstream locations first and moving upstream relative to overall flow patterns. Sediment samples will not be collected from areas exhibiting turbid or rapid flow. Where sediment and surface water stations are co-located, surface water samples will be collected first. Samples for VOC analyses will be collected first immediately upon extraction of the requisite sample volume. The remainder of the sample volume will be placed in a decontaminated, stainless steel bowl and homogenized. Sample aliquots for specified non-volatile constituent analyses and geotechnical analyses will be collected from the homogenized material.

4.3.1.4 Sample collection for field and laboratory analysis

Field screening of surface soil and sediment samples for organic vapors will be performed using a PID per Section 4.3.2.3; samples for headspace analyses will not be collected. Geotechnical logging, including estimates of USCS classification, will be performed at the time of sampling.

Sample aliquots for laboratory and geotechnical analyses will be collected as discussed in Section 4.3.1.3. Disturbed samples for geotechnical analyses will be collected at specified surface soil and sediment locations from homogenized soil mixtures.

4.3.1.5 Field quality control sampling procedures

Surface soil/sediment QA/QC samples will be collected during the Phase II RI for Demolition Area 2. Duplicate and split soil samples will be collected at a frequency of 10 percent (1 per 10 environmental samples) for each matrix (soil and sediment). Matrix spike/matrix spike duplicate samples will be collected at a rate of 5 percent of total samples per media. Split samples will be submitted to the USACE contract laboratory for independent analysis, as noted in Section 4.2.1.5. Duplicate and split samples will be derived from the same sampling station, selected on a random basis, and submitted for the same analyses as the environmental samples. Two rinsate blanks will be collected for surface soil/sediment equipment per field cycle. Trip blanks will accompany all shipments containing VOCs. Chapters 5.0 and the QAPP addendum (Chapter 8.0) summarize QA/QC sampling requirements.

4.3.2 Sampling Procedures

4.3.2.1 Sampling methods for soil/dry sediment

Bucket Hand-Auger Method

Surface soil samples will be collected with a bucket hand auger in accordance with Section 4.5.2.1.1 of the Facility-wide SAP. In this investigation, auger buckets 15.24 centimeters (6 inches) in length and 7.62 centimeters (3 inches) in diameter will be used. At each location, an auger will be advanced in 15.24-centimeters (6-inch) increments. As noted in Section 4.3.1.3, composite surface soil samples for explosives and propellant analyses will be created from three subsamples collected in a roughly equilateral triangle pattern with the subsamples positioned about 0.9 meter (3 feet) apart from each other. The remaining analyte fractions will be collected from a point in the middle of the triangle formed by the three subsamples, with the volatile fraction collected first from unhomogenized material.

Trowel/Scoop Method

A stainless steel trowel or scoop may be used, as presented in Section 4.5.2.1.2 of the Facility-wide SAP, to collect surface soil samples in soft, loose soil, if feasible. The protocol for compositing, homogenization, and discrete VOC sample collection will follow that described in Section 4.3.2.1.1 for bucket hand augers.

The trowel will be used to manually obtain soil to a depth of 30.5 centimeters (1 foot) bgs. Extracted material will be placed into a stainless steel bowl. At sample locations where VOC fractions are to be collected, the VOC containers will be filled immediately with the first materials obtained.

4.3.2.2 Sampling methods for sediments

Trowel/Scoop Method

Sediment samples in locations where water depth does not exceed 15.2 centimeters (0.5 foot) will be collected with a stainless steel trowel or scoop following Section 4.5.2.2.1 of the Facility-wide SAP. The trowel will be used to manually obtain sediment to a depth of 15.2 centimeters (0.5 foot) below the sediment surface. Sediment will be placed into a stainless steel bowl as it is collected. At sample locations where VOC fractions are to be collected, the VOC containers will be filled immediately with the first sediment obtained. Sample containers for the remaining nonvolatile analytes will be filled as described in Section 4.5.2.5 of the Facility-wide SAP.

Hand Core Sampler Method

A sediment core sampler will be used to collect sediment at locations where the depth of the surface water exceeds 15.2 centimeters (0.5 foot) and the sediment cannot be accessed directly with trowels and scoops. All samples collected with the sludge sampler will be obtained following the protocol in Section 4.5.2.2.2 of the Facility-wide SAP. The sludge sampler consists of a stainless steel, 8.26-centimeters (3.25-inch) OD, 30.5-centimeter (12-inch)-long capped tube, which can be fitted with either an auger- or core-type sampler end. Each sampler end is equipped with a butterfly valve to prevent loss of sample upon retrieval. In this investigation, the core-type end will be preferentially used. The auger-type sampler end will be used only in the event that the sediment becomes too gravelly or consolidated for the efficient use of the core type-end. The sludge sampler will be extended to the sampling depth by connecting stainless steel extension rods to the sampler. The extension rods will be attached to a cross handle and will be pushed or augered by hand.

Sediment will be placed into a stainless steel bowl as it is collected. At sample locations where VOC fractions are to be collected, the VOC containers will be filled immediately with the first sediment obtained. Sample containers for the remaining nonvolatile analytes will be filled as described in Section 4.5.2.5 of the Facility-wide SAP.

Remote (Eckman) Sampler Method

A remote sediment sampler may be used to collect sediment at locations where the depth of the surface water exceeds 15.2 centimeters (0.5 foot) and the sediment cannot be accessed directly with trowels and scoops. The remote sampler is a stainless steel clamshell device that is lowered to the sample point using a retrieval line or extension rods. The sampler is activated using a second line that closes the clamshell. Sediment will be placed into a stainless steel bowl as it is collected. At sample locations where VOC fractions are to be collected, the VOC containers will be filled immediately with the first sediment obtained. Sample containers for the remaining nonvolatile analytes will be filled as described in Section 4.5.2.5 of the Facility-wide SAP.

4.3.2.3 Field measurement procedures and criteria

Organic Vapor Screening

All field measurement procedures and criteria will follow Section 4.4.2.3 of the Facility-wide SAP, with the following exception. Headspace gases will not be screened in the field for organic vapors. Because there were no notable detections of VOCs during the Phase I RI soil sampling, organic vapor monitoring

of headspace gases is not necessary in Phase II. All OVA readings will be noted in the field boring logs.

4.3.2.4 Sampling for geotechnical analysis

Surface soil and sediment samples collected using the hand-auger, scoop, or sediment corer methods are classified as disturbed samples. Therefore, geotechnical analysis of samples collected using these methods will be limited. Sampling procedures for geotechnical analysis using the above sampling methods are presented in Section 4.5.2.4 of the Facility-wide SAP. All sediment samples collected as part of this Phase II RI will be analyzed for total organic carbon and grain size distribution.

4.3.2.5 Sampling for chemical analysis

Procedures for sampling surface soil for chemical analyses are presented in Section 4.5.2.1 of the Facility-wide SAP. The following general criteria apply for chemical analyses of surface soil.

- All surface soil samples will be analyzed for Explosives and TAL metals.

- Ten percent of surface soil samples collected at Demolition Area 2 will be submitted for a full suite of analyses (i.e., TAL metals, explosives, propellants, cyanide, VOCs, SVOCs, pesticide, PCB, nitrate/nitrite and sulfide analyses.) In addition, hexavalent chromium will be analyzed for all full suite samples.

The general criteria below apply for chemical analyses for sediment samples. Procedures for sampling sediment are presented in Sections 4.5.2.1 and 4.5.2.2, respectively, of the Facility-wide SAP.

- All sediment samples will be submitted for a full suite of analyses (i.e., TAL metals, explosives, propellants, cyanide, VOCs, SVOCs, pesticide, PCB, nitrate/nitrite, sulfide, and hexavalent chromium analyses.)

Requirements for sample containers and preservation techniques for surface soil and sediment samples are presented in Section 4.4.2.6 of the Facility-wide SAP and in the QAPP addendum.

4.3.2.6 Decontamination procedures

The decontamination procedure for surface soil and sediment sampling activities is presented in Section 4.4.2.8 of the Facility-wide SAP. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

4.3.2.7 Sample Container/Preservation Techniques

Sample container and preservation technique requirements will follow those prescribed in Table 4-1 in the Demolition Area 2 QAPP Addendum.

4.3.3 OE avoidance

The protocol for OE avoidance for sampling activities is discussed in Section 4.2.3 and detailed in the Ordnance and Explosives Avoidance Plan (Appendix C). In addition to the protocol in Section 4.2.3, OE technicians will collect soil samples in areas known or suspected (i.e., red soil or raw product) to have explosives concentrations greater than 10 percent (100,000 mg/kg).

4.4 SURFACE WATER

4.4.1 Rationale

A total of 12 surface water samples will be collected from Sand Creek at three locations, one upstream and two downstream, in four separate sampling events – one at high flow conditions, one at low flow conditions, and two at other agreed-upon intervals. Surface water samples will be collected in order to (1) assess the potential for contaminant migration in surface water; (2) evaluate potential contaminant accumulation areas, such as runoff collection points, to evaluate if residual contamination is partitioning to water and are acting as secondary sources for contamination to groundwater and surface water; and (3) evaluate potential contaminant exit pathways from Demolition Area 2.

Surface water drainage patterns within the Demolition Area 2 AOC follow preferred topographic pathways, ultimately discharging into Sand Creek, which flows in an easterly direction through the central portion of the AOC. An upstream sample will be collected to characterize background stream conditions. Downstream surface water sampling will be conducted at locations where potential contaminants could be expected to be transported from source areas into Sand Creek.

4.4.1.1 Locations

All planned water sampling stations are biased to locations and features described in Section 4.4.1 above. All samples will be grab samples. Final locations will be determined in the field based on site conditions. The proposed sampling locations of surface water sampling stations are shown on Figure 4.1.

4.4.2 Sampling Procedures

All surface water sampling will be conducted as described in Section 4.6.2.1 of the Facility-wide SAP. The hand-held bottle method will be used to sample water where water is flowing and in areas where access from the edge is feasible and safe. Section 4.6.2.1.1 of the Facility-wide SAP describes the procedure for sampling using the hand-held bottle method. All surface water sample collection will begin at the sampling point furthest downstream in the channel and proceed upstream to minimize the effects of sediment turbidity on surface water quality.

For water sampling stations that are not readily or safely accessible, a dipper or pond sampler will be employed for sampling per Section 4.6.2.1.2 of the Facility-wide SAP.

4.4.2.1 Sampling methods for surface water filtration

Surface water collected during the Phase II RI at Demolition Area 2 will not be filtered prior to analysis.

4.4.2.2 Field measurement procedures and criteria

Surface water field measurements to be performed during the Phase II RI will include determination of pH, conductivity, dissolved oxygen content, turbidity, and temperature. These measurements will be performed in the same manner as described in Section 4.3.3 of the Facility-wide SAP. All field measurements will be recorded in the sampling logbooks.

4.4.2.3 Sampling for chemical analysis

All surface water samples will be submitted to the analytical laboratory for a full suite of analysis (explosives, propellants, TAL metals, cyanide, VOCs, SVOCs, pesticides, PCBs, nitrate/nitrite, sulfide and hexavalent chromium) as shown in Chapter 5.0 (Table 5-3).

4.4.2.4 Sample containers and preservation techniques

Information regarding sample containers and preservation techniques for surface water samples collected for chemical analysis during the Phase II RI at Demolition Area 2 is presented in the QAPP addendum. All sample containers will be provided by the contracted laboratory, including pre-preserved containers for VOC samples.

4.4.2.5 Field quality control sampling procedures

Surface water QA/QC samples will be collected during the Phase II RI. Duplicate

samples will be collected at a frequency of 10 percent (1 per 10 environmental samples). Split samples will be submitted to the USACE contract laboratory for independent analysis as noted in Section 4.2.1.5. Split samples will be collected at a frequency of 10 percent (1 per 10 environmental samples). Duplicate and split samples will be selected based on a random basis and submitted for the same analyses as the environmental samples. Each set of duplicate and split samples will be collected from the same station. Matrix spike/matrix spike duplicate samples will be collected at a rate of 5 percent of total samples by media. One field blank or rinsate for surface water will be collected (frequency of 5 percent). A trip blank will accompany each cooler containing samples collected for VOC analysis. The QAPP addendum summarizes required QA/QC sampling.

4.4.2.6 Decontamination procedures

Decontamination of any equipment used for collection of surface water samples during the Phase II RI will be conducted in the same manner as described for nondedicated sampling equipment in Section 4.3.8 of the Facility-wide SAP. A final decontamination inspection of any equipment leaving RVAAP at the end of field activities will be conducted to ensure proper decontamination.

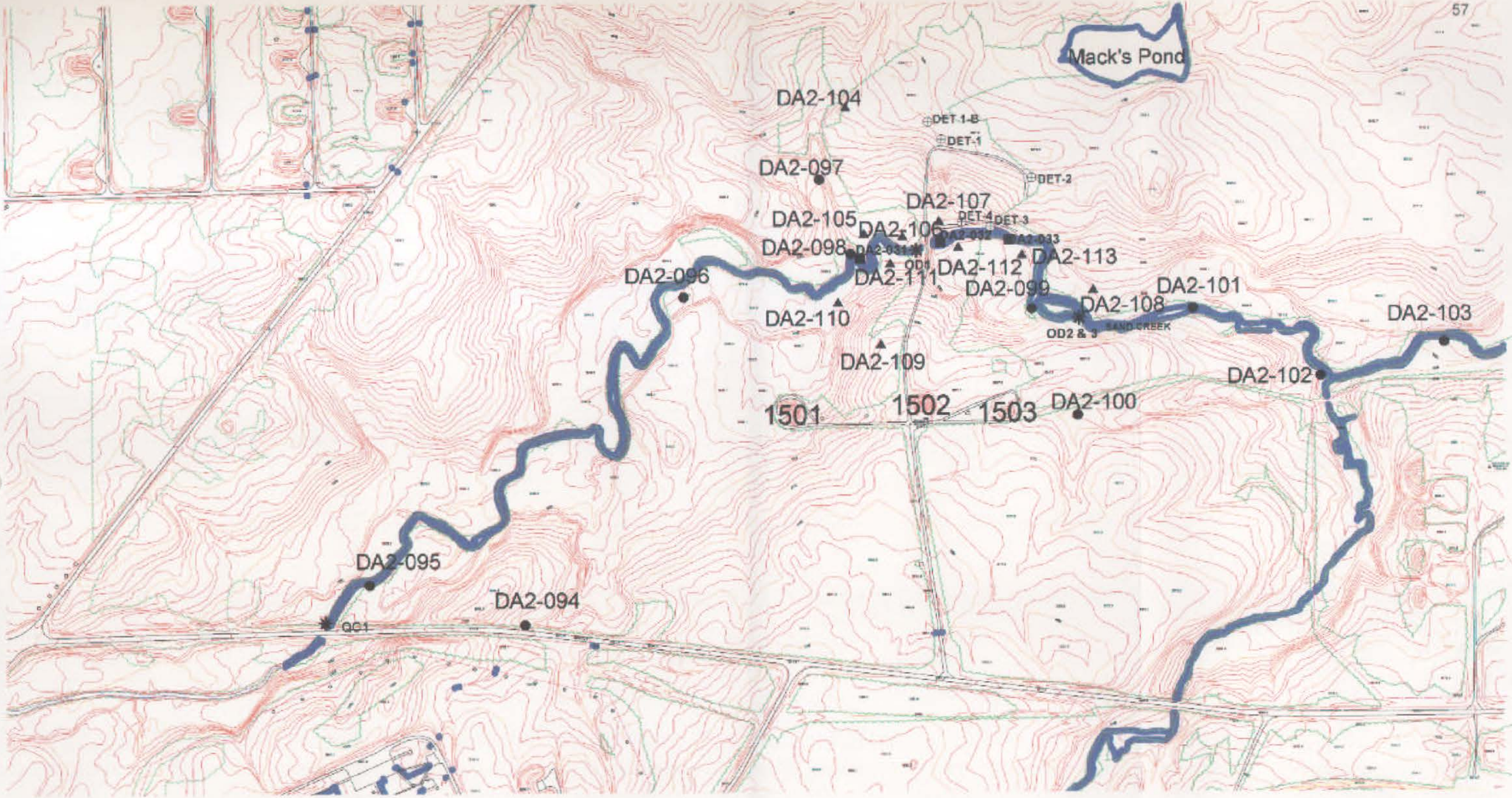
In addition to the surface water sampling equipment, field measurement instruments will also be decontaminated between sampling locations. Only those portions of each instrument that come into contact with potentially contaminated surface water will be decontaminated. This will be accomplished with a deionized-water rinse of the measurement probe and the collection cup.

4.5 SITE SURVEY

Following sampling and well installation activities, the horizontal coordinates of all sampling stations and monitoring wells will be determined to within 0.3 meter (1 foot). The surface elevations of soil and sediment sampling stations will be determined to within 0.06 meter (0.2 foot). For soil sampling stations, the ground elevations will be determined at the point of collection. For sediment sampling stations that are not underwater (i.e., adjacent to the water edge), the ground elevation at the water's edge at the collection point will be determined. For surface water locations and for sediment sampling stations underwater, the elevation of the water surface, depth to bottom, and elevation of the bottom will be determined. For groundwater monitoring wells and piezometers, the horizontal and vertical coordinates will be determined in accordance with the current Facility-wide SAP, which requires 1.0 foot horizontal and 0.01 foot vertical accuracy.

All locations will be conveyed in Ohio State Plane Coordinates (NAD83). The vertical datum for all elevations will be 1929 National Geodetic Vertical Datum.

All coordinates and elevations will be recorded on the boring logs upon receipt of quality assured survey results. In addition, electronic results will be provided to the USACE and RVAAP in ASCII format.



Legend:
Well locations ▲
Sediment/surface water sites ●
Prior Well locations ⊕
Prior sediment (1997) sample locations ■
Prior surface water (1992) sample points ✱

400 0 400 800 Feet

N
W E
S

Figure 4.1: Proposed sediment/surface water and well locations.

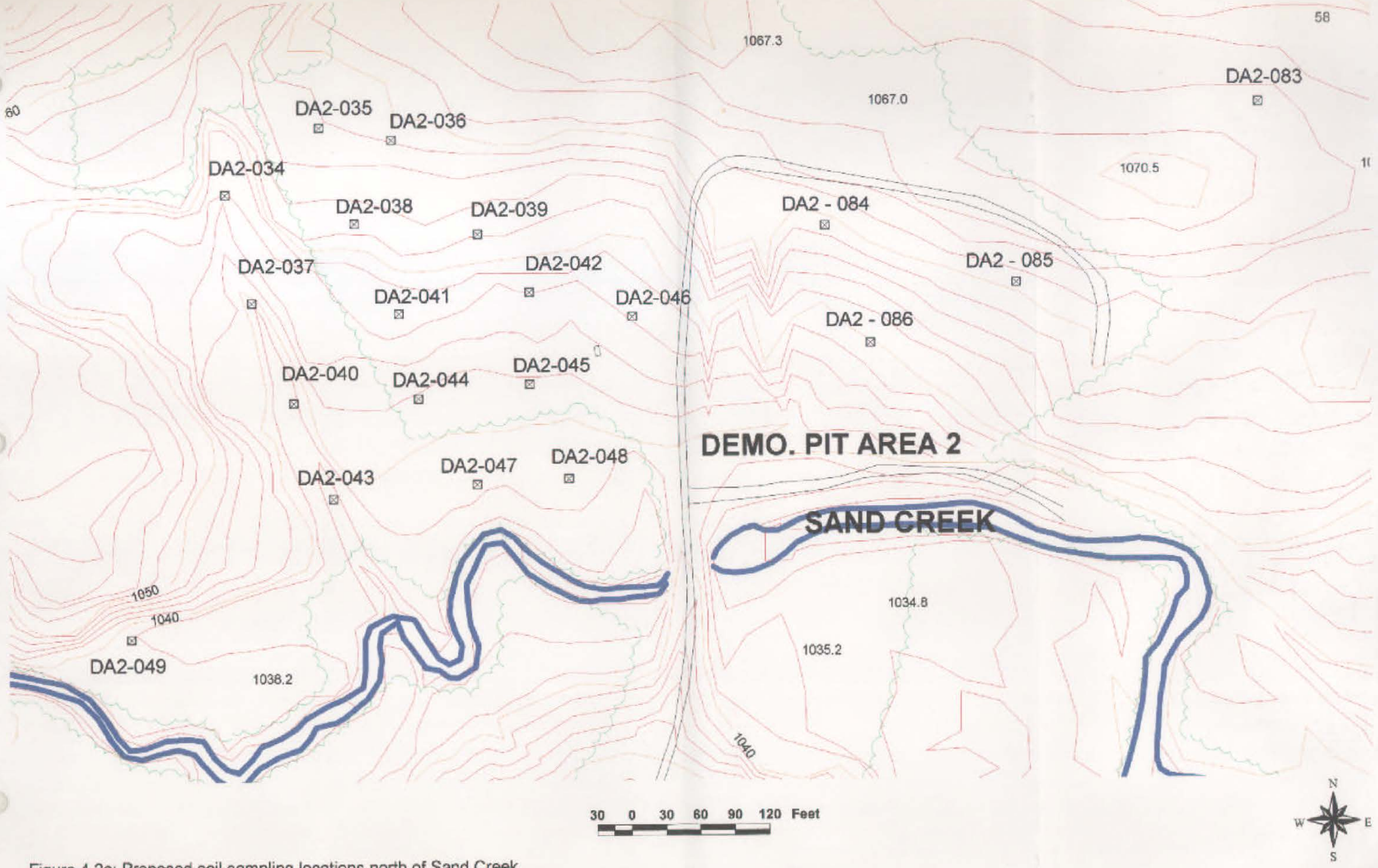
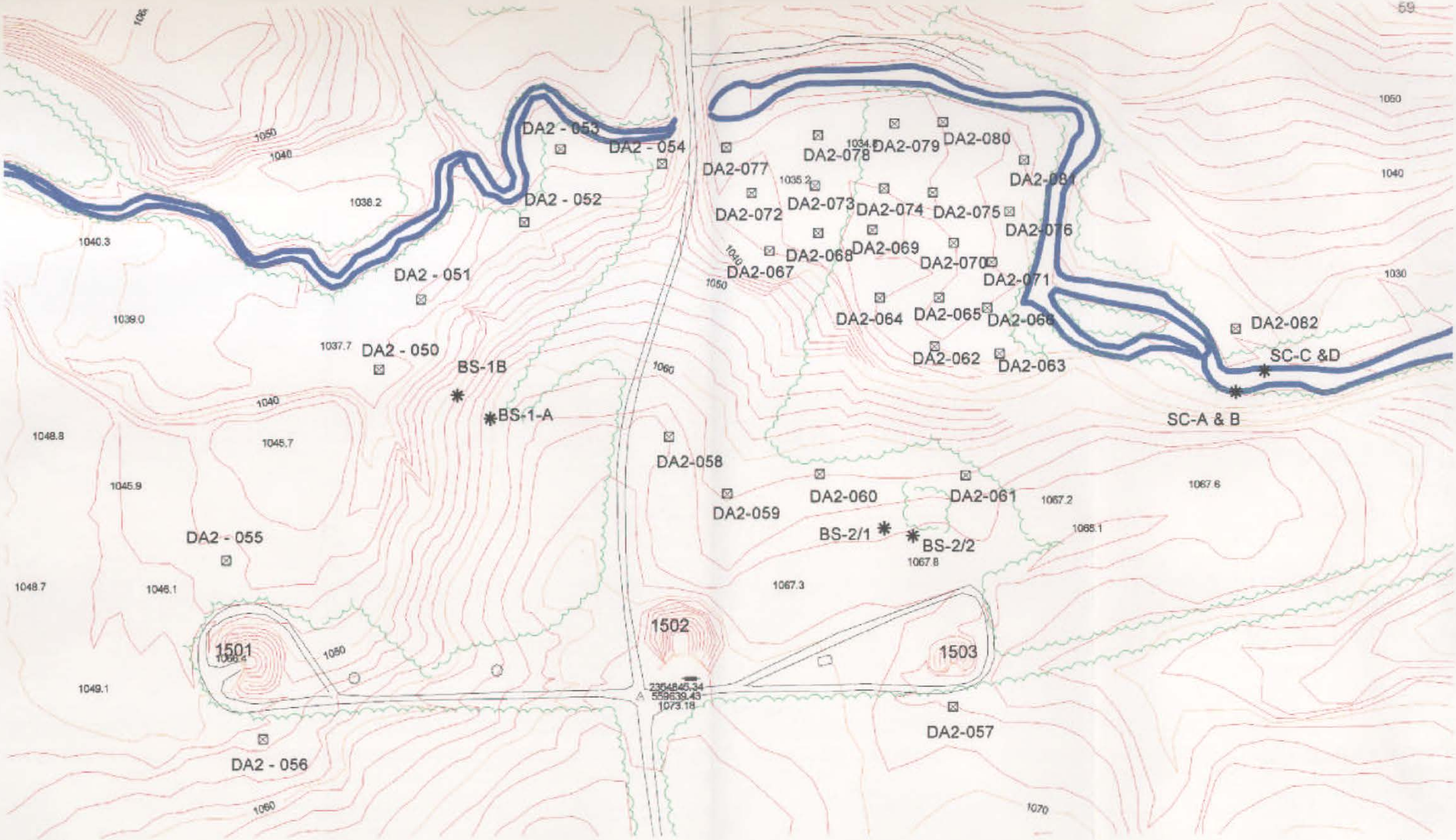


Figure 4.2a: Proposed soil sampling locations north of Sand Creek.



Legend

Proposed sample sites ⊠
2000 sample sites ✱

Figure 4.2b: Proposed soil sampling locations south of Sand Creek.

5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

5.1 FIELD LOGBOOK

All field logbook information will follow structures identified in Section 5.1 of the Facility-wide SAP.

5.2 PHOTOGRAPHS

Information regarding the documentation of photographs for the Demolition Area 2 Phase II RI is presented in Section 4.3.2.4.3 of the Facility-wide SAP. Representative photographs will be taken of the investigative measures during the Phase II RI and any significant observations that are made during the field effort. Photographs will be suitable for presentation in a public forum, as well as for documenting scientific information.

5.3 SAMPLE NUMBERING SYSTEM

The sample numbering system that will be used to identify samples collected during the Phase II RI of Demolition Area 2 is explained in Section 5.3 of the Facility-wide SAP. The specific identifying information that will be used to implement this system during the Phase II RI is presented in Figure 5-1. Samples have already been collected at Demolition Area 2 under the Phase I RI; therefore, sample numbering will continue the sequence established in the previous investigation. Sample Station numbers in the Phase II RI will commence with station no. DA2-034, and sample ID numbers will commence with sample no. 0649. Tables 5-1 through 5-4 present the baseline sample identification listing for the Phase II RI. Samples collected in addition to the baseline set will be identified sequentially by following the numbering system. If a sample in the baseline set is not collected or is reassigned to another location, a specific reason and notation will be given in the project field books.

5.4 SAMPLE DOCUMENTATION

All sample label, logbook, field record, and field form information will follow structures identified in Section 5.4 of the Facility-wide SAP.

5.5 DOCUMENTATION PROCEDURES

Documentation and tracking of samples and field information will follow the series of steps identified in Section 5.5 of the Facility-wide SAP.

5.6 CORRECTIONS TO DOCUMENTATION

Any corrections to documentation will follow guidance established in Section 5.6 of the Facility-wide SAP.

Sample Station Location Identification: XXXmm-NNN(n)-####-tt

XXX = Area Designator
Demolition Area 2 = DA2

mm = Sample Location Type
mw = Groundwater Monitoring Well
so = Soil Boring/Subsurface Soil Sample Location
sw = Surface Water Sample Location
sd = Sediment Sample Location
ss = Surface Soil Sample Location
tr = Trench Sample Location
sp = Seep or Spring Sample Location
wp = Groundwater Well Point

NNN = Sequential Sample Location Number
Unique, sequential number for each sample location beginning with Phase I RI stations and extending into any subsequent investigative phases (i.e., 001- 999).

(n) = Special Identifier
Optional use as needed to identify special sample matrices or sample location characteristics.
c = Stream or Drainage Channel Sample
p = Pond Sample
b = Railroad Ballast Sample
d = Debris Sample
s = Slag Sample

= Sequential Sample Identification Number
Unique, sequential number for each sample beginning with Phase I RI locations and extending into any subsequent investigative phases (i.e., 0001 - 9999).

tt = Sample Type
GW = Groundwater
GF = Groundwater, Filtered
SO = Soil Sample
SD = Sediment Sample
SW = Surface Water Sample
TB = Trip Blank
FB = Field Blank
ER = Equipment Rinsate
FS = Floor Sweep

Sample Identification: XXXmm-NNN(n)-####-tt

Figure 5-1. Demolition Area 2 Phase II RI Sample Identification System

Table 5-1. Demolition Area 2 Soil Samples

Description	Depth (feet)	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	SVOCs / PCBs/ Pest	VOCs	Hex. Cr^{+6}	Other
North of Sand Creek and West of Demolition Road (16)	0-1	DA2-034	DA2ss-034-0649-SO	1	10% TBD will be sub-mitted for analy-sis	1	10% TBD will be submitted for analysis	10% TBD will be sub-mitted for analy-sis	10% TBD will be sub-mitted for analy-sis	10% TBD will be sub-mitted for analy-sis	
	1-3	DA2-034	DA2so-034-0650-SO	1		1					
	0-1	DA2-035	DA2ss-035-0651-SO	1		1					
	1-3	DA2-035	DA2so-035-0652-SO	1		1					
	0-1	DA2-036	DA2ss-036-0653-SO	1		1					
	1-3	DA2-036	DA2so-036-0654-SO	1		1					
	0-1	DA2-037	DA2ss-037-0655-SO	1		1					
	1-3	DA2-037	DA2so-037-0656-SO	1		1					
	0-1	DA2-038	DA2ss-038-0657-SO	1		1					
	1-3	DA2-038	DA2so-038-0658-SO	1		1					
	0-1	DA2-039	DA2ss-039-0659-SO	1		1					
	1-3	DA2-039	DA2so-039-0660-SO	1		1					
	0-1	DA2-040	DA2ss-040-0661-SO	1		1					
	1-3	DA2-040	DA2so-040-0662-SO	1		1					
	0-1	DA2-041	DA2ss-041-0663-SO	1		1					
	1-3	DA2-041	DA2so-041-0664-SO	1		1					
	0-1	DA2-042	DA2ss-042-0665-SO	1		1					
	1-3	DA2-042	DA2so-042-0666-SO	1		1					
	0-1	DA2-043	DA2ss-043-0667-SO	1		1					
	1-3	DA2-043	DA2so-043-0668-SO	1		1					
	0-1	DA2-044	DA2ss-044-0669-SO	1		1					
	1-3	DA2-044	DA2so-044-0670-SO	1		1					
	0-1	DA2-045	DA2ss-045-0671-SO	1		1					
	1-3	DA2-045	DA2so-045-0672-SO	1		1					
	0-1	DA2-046	DA2ss-046-0673-SO	1		1					
	1-3	DA2-046	DA2so-046-0674-SO	1		1					
	0-1	DA2-047	DA2ss-047-0675-SO	1		1					
	1-3	DA2-047	DA2so-047-0676-SO	1		1					
	0-1	DA2-048	DA2ss-048-0677-SO	1		1					
	1-3	DA2-048	DA2so-048-0678-SO	1		1					

Description	Depth (feet)	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	SVOCs / PCBs/ Pest	VOCs	Hex. Cr^{+6}	Other
	0-1	DA2-049	DA2ss-049-0679-SO	1		1					
	1-3	DA2-049	DA2so-049-0680-SO	1		1					
South of Sand Creek (32)	0-1	DA2-050	DA2ss-050-0681-SO	1		1					
	1-3	DA2-050	DA2so-050-0682-SO	1		1					
	0-1	DA2-051	DA2ss-051-0683-SO	1		1					
	1-3	DA2-051	DA2so-051-0684-SO	1		1					
	0-1	DA2-052	DA2ss-052-0685-SO	1		1					
	1-3	DA2-052	DA2so-052-0686-SO	1		1					
	0-1	DA2-053	DA2ss-053-0687-SO	1		1					
	1-3	DA2-053	DA2so-053-0688-SO	1		1					
	0-1	DA2-054	DA2ss-054-0689-SO	1		1					
	1-3	DA2-054	DA2so-054-0690-SO	1		1					
	0-1	DA2-055	DA2ss-055-0691-SO	1		1					
	1-3	DA2-055	DA2so-055-0692-SO	1		1					
	0-1	DA2-056	DA2ss-056-0693-SO	1		1					
	1-3	DA2-056	DA2so-056-0694-SO	1		1					
	0-1	DA2-057	DA2ss-057-0695-SO	1		1					
	1-3	DA2-057	DA2so-057-0696-SO	1		1					
	0-1	DA2-058	DA2ss-058-0697-SO	1		1					
	1-3	DA2-058	DA2so-058-0698-SO	1		1					
	0-1	DA2-059	DA2ss-059-0699-SO	1		1					
	1-3	DA2-059	DA2so-059-0700-SO	1		1					
	0-1	DA2-060	DA2ss-060-0701-SO	1		1					
	1-3	DA2-060	DA2so-060-0702-SO	1		1					
	0-1	DA2-061	DA2ss-061-0703-SO	1		1					
	1-3	DA2-061	DA2so-061-0704-SO	1		1					
	0-1	DA2-062	DA2ss-062-0705-SO	1		1					
	1-3	DA2-062	DA2so-062-0706-SO	1		1					
	0-1	DA2-063	DA2ss-063-0707-SO	1		1					
	1-3	DA2-063	DA2so-063-0708-SO	1		1					
	0-1	DA2-064	DA2ss-064-0709-SO	1		1					
	1-3	DA2-064	DA2so-064-0710-SO	1		1					
	0-1	DA2-065	DA2ss-065-0711-SO	1		1					

Description	Depth (feet)	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	SVOCs / PCBs/ Pest	VOCs	Hex. Cr^{+6}	Other
	1-3	DA2-065	DA2so-065-0712-SO	1		1					
	0-1	DA2-066	DA2ss-066-0713-SO	1		1					
	1-3	DA2-066	DA2so-066-0714-SO	1		1					
	0-1	DA2-067	DA2ss-067-0715-SO	1		1					
	1-3	DA2-067	DA2so-067-0716-SO	1		1					
	0-1	DA2-068	DA2ss-068-0717-SO	1		1					
	1-3	DA2-068	DA2so-068-0718-SO	1		1					
	0-1	DA2-069	DA2ss-069-0719-SO	1		1					
	1-3	DA2-069	DA2so-069-0720-SO	1		1					
	0-1	DA2-070	DA2ss-070-0721-SO	1		1					
	1-3	DA2-070	DA2so-070-0722-SO	1		1					
	0-1	DA2-071	DA2ss-071-0723-SO	1		1					
	1-3	DA2-071	DA2so-071-0724-SO	1		1					
	0-1	DA2-072	DA2ss-072-0725-SO	1		1					
	1-3	DA2-072	DA2so-072-0726-SO	1		1					
	0-1	DA2-073	DA2ss-073-0727-SO	1		1					
	1-3	DA2-073	DA2so-073-0728-SO	1		1					
	0-1	DA2-074	DA2ss-074-0729-SO	1		1					
	1-3	DA2-074	DA2so-074-0730-SO	1		1					
	0-1	DA2-075	DA2ss-075-0731-SO	1		1					
	1-3	DA2-075	DA2so-075-0732-SO	1		1					
	0-1	DA2-076	DA2ss-076-0733-SO	1		1					
	1-3	DA2-076	DA2so-076-0734-SO	1		1					
	0-1	DA2-077	DA2ss-077-0735-SO	1		1					
	1-3	DA2-077	DA2so-077-0736-SO	1		1					
	0-1	DA2-078	DA2ss-078-0737-SO	1		1					
	1-3	DA2-078	DA2so-078-0738-SO	1		1					
	0-1	DA2-079	DA2ss-079-0739-SO	1		1					
	1-3	DA2-079	DA2so-079-0740-SO	1		1					
	0-1	DA2-080	DA2ss-080-0741-SO	1		1					
	1-3	DA2-080	DA2so-080-0742-SO	1		1					
	0-1	DA2-081	DA2ss-081-0743-SO	1		1					
	1-3	DA2-081	DA2so-081-0744-SO	1		1					

Description	Depth (feet)	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	SVOCs / PCBs/ Pest	VOCs	Hex. Cr^{+6}	Other
North of Sand Creek and East of Demolition Road (3)	0-1	DA2-082	DA2ss-082-0745-SO	1		1					
	1-3	DA2-082	DA2so-082-0746-SO	1		1					
	0-1	DA2-083	DA2ss-083-0747-SO	1		1					
	1-3	DA2-083	DA2so-083-0748-SO	1		1					
	0-1	DA2-084	DA2ss-084-0749-SO	1		1					
	1-3	DA2-084	DA2so-084-0750-SO	1		1					
	0-1	DA2-085	DA2ss-085-0751-SO	1		1					
	1-3	DA2-085	DA2so-085-0752-SO	1		1					
	0-1	DA2-086	DA2ss-086-0753-SO	1		1					
	1-3	DA2-086	DA2so-086-0754-SO	1		1					
Contingency (7)	0-1	DA2-087	DA2ss-087-0755-SO	1		1					
	1-3	DA2-087	DA2so-087-0756-SO	1		1					
	0-1	DA2-088	DA2ss-088-0757-SO	1		1					
	1-3	DA2-088	DA2so-088-0758-SO	1		1					
	0-1	DA2-089	DA2ss-089-0759-SO	1		1					
	1-3	DA2-089	DA2so-089-0760-SO	1		1					
	0-1	DA2-090	DA2ss-090-0761-SO	1		1					
	1-3	DA2-090	DA2so-090-0762-SO	1		1					
	0-1	DA2-091	DA2ss-091-0763-SO	1		1					
	1-3	DA2-091	DA2so-091-0764-SO	1		1					
	0-1	DA2-092	DA2ss-092-0765-SO	1		1					
	1-3	DA2-092	DA2so-092-0766-SO	1		1					
	0-1	DA2-093	DA2ss-093-0767-SO	1		1					
	1-3	DA2-093	DA2so-093-0768-SO	1		1					
Total Surface Soil				60	6	60	6	6	6	6	0
Total Subsurface Soil				60	6	60	6	6	6	6	0

CN = Cyanide
Cr^{+6} = Hexavalent chromium
Exp = Explosives
Prop = Propellants (nitroglycerine, nitrocellulose, nitroguanidine)
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds
PCBs = Polychlorinated biphenyls
NO2/NO3 = Nitrate/Nitrite

Table 5-2. Demolition Area 2 Sediment Samples

Description	Depth (feet)	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	SVOCs/ PCBs/ Pest	VOCs	Cr^{+6}	TOC/ GS
	0-0.5	DA2-094	DA2sd-094-0769-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-095	DA2sd-095-0770-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-096	DA2sd-096-0771-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-097	DA2sd-097-0772-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-098	DA2sd-098-0773-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-099	DA2sd-099-0774-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-100	DA2sd-100-0775-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-101	DA2sd-101-0776-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-102	DA2sd-102-0777-SD	1	1	1	1	1	1	1	1
	0-0.5	DA2-103	DA2sd-103-0778-SD	1	1	1	1	1	1	1	1
Total Sediment				10	10	10	10	10	10	10	10

CN = Cyanide
Cr^{+6} = Hexavalent chromium
Exp = Explosives
GS = Grain Size
NO_2/NO_3 = Nitrate/Nitrite
PCBs = Polychlorinated biphenyls
Prop = Propellants (nitroglycerine, nitrocellulose, nitroguanidine)
SVOCs = Semivolatile organic compounds
TOC = Total Organic Carbon
VOCs = Volatile organic compounds

Table 5-3. Demolition Area 2 Surface Water Samples

Description	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	PCBs/ Pest	VOCs	Cr^{+6}	SVOCs
	DA2-095	DA2sw-095-0779-SW	1	1	1	1	1	1	1	1
	DA2-095	DA2sw-095-0780-SW	1	1	1	1	1	1	1	1
	DA2-095	DA2sw-095-0781-SW	1	1	1	1	1	1	1	1
	DA2-095	DA2sw-095-0782-SW	1	1	1	1	1	1	1	1
	DA2-099	DA2sw-099-0783-SW	1	1	1	1	1	1	1	1
	DA2-099	DA2sw-099-0784-SW	1	1	1	1	1	1	1	1
	DA2-099	DA2sw-099-0785-SW	1	1	1	1	1	1	1	1
	DA2-099	DA2sw-099-0786-SW	1	1	1	1	1	1	1	1
	DA2-102	DA2sw-102-0787-SW	1	1	1	1	1	1	1	1
	DA2-102	DA2sw-102-0788-SW	1	1	1	1	1	1	1	1
	DA2-102	DA2sw-102-0789-SW	1	1	1	1	1	1	1	1
	DA2-102	DA2sw-102-0790-SW	1	1	1	1	1	1	1	1
Total Surface Water			12	12	12	12	12	12	12	12

CN = Cyanide
Cr^{+6} = Hexavalent chromium
Exp = Explosives
NO_2/NO_3 = Nitrate/Nitrite
PCBs = Polychlorinated biphenyls
Prop = Propellants (nitroglycerine, nitrocellulose, nitroguanidine)
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

Table 5-4. Demolition Area 2 Monitoring Well Samples

Description	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	PCBs/ Pest	VOCs	Cr^{+6}	SVOCs	Geotech Analyses
Groundwater Samples											
	DA2-104	DA2mw-104-0791-GW	1	1		1	1	1	1	1	
	DA2-104	DA2mw-104-0791-GF			1						
	DA2-105	DA2mw-105-0792-GW	1	1		1	1	1	1	1	
	DA2-105	DA2mw-105-0792-GF			1						
	DA2-106	DA2mw-106-0793-GW	1	1		1	1	1	1	1	
	DA2-106	DA2mw-106-0793-GF			1						
	DA2-107	DA2mw-107-0794-GW	1	1		1	1	1	1	1	
	DA2-107	DA2mw-107-0794-GF			1						
	DA2-108	DA2mw-108-0795-GW	1	1		1	1	1	1	1	
	DA2-108	DA2mw-108-0795-GF			1						
	DA2-109	DA2mw-109-0796-GW	1	1		1	1	1	1	1	
	DA2-109	DA2mw-109-0796-GF			1						
	DA2-110	DA2mw-110-0797-GW	1	1		1	1	1	1	1	
	DA2-110	DA2mw-110-0797-GF			1						
	DA2-111	DA2mw-111-0798-GW	1	1		1	1	1	1	1	
	DA2-111	DA2mw-111-0798-GF			1						
	DA2-112	DA2mw-112-0799-GW	1	1		1	1	1	1	1	
	DA2-112	DA2mw-112-0799-GF			1						
	DA2-113	DA2mw-113-0800-GW	1	1		1	1	1	1	1	
	DA2-113	DA2mw-113-0800-GF			1						
	DET-1	DA2mw-DET1-0801-GW	1	1		1	1	1	1	1	
	DET-1	DA2mw-DET1-0801-GF			1						
	DET-2	DA2mw-DET2-0802-GW	1	1		1	1	1	1	1	
	DET-2	DA2mw-DET2-0802-GF			1						
	DET-3	DA2mw-DET3-0803-GW	1	1		1	1	1	1	1	
	DET-3	DA2mw-DET3-0803-GF			1						

Description	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	PCBs/ Pest	VOCs	Cr^{+6}	SVOCs	Geotech Analyses
	DET-4	DA2mw-DET4-0804-GW	1	1		1	1	1	1	1	
	DET-4	DA2mw-DET4-0804-GF			1						
	WBG-012	WBGmw-012--0805-GW	1	1		1	1	1	1	1	
	WBG-012	WBGmw-012-0805-GF			1						
	WBG-013	WBGmw-013-0806-GW	1	1		1	1	1	1	1	
	WBG-013	WBGmw-013-0806-GF			1						
Total Groundwater Samples			16	16	16	16	16	16	16	16	
Soil Borings & Shelby Tube Samples											
	DA2-104	DA2mw-104-0807-SO	1	10% of 0'-2' and 2'-4' boring TBD will be sub-mitted for analy-sis	1	10% of 0'-2' and 2'-4' borings TBD will be sub-mitted for analysis	10% of 0'-2' and 2'-4' borings TBD will be sub-mitted for analy-sis	10% of 0'-2' and 2'-4' boring TBD will be sub-mitted for analy-sis	10% of 0'-2' and 2'-4' bor-ings TBD will be sub-mitt ed for anal ysis	10% of 0'-2' and 2'-4' borings TBD will be sub-mitted for analy-sis	
	DA2-104	DA2mw-104-0808-SO	1		1						
	DA2-104	DA2mw-104-0809-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-104	DA2mw-104-0810-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-105	DA2mw-105-0811-SO	1		1						
	DA2-105	DA2mw-105-0812-SO	1		1						
	DA2-105	DA2mw-105-0813-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-105	DA2mw-105-0814-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-106	DA2mw-106-0815-SO	1		1						
	DA2-106	DA2mw-106-0816-SO	1		1						
	DA2-106	DA2mw-106-0817-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-106	DA2mw-106-0818-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-107	DA2mw-107-0819-SO	1		1						

Description	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	PCBs/ Pest	VOCs	Cr^{+6}	SVOCs	Geotech Analyses
	DA2-107	DA2mw-107-0820-SO	1		1						
	DA2-107	DA2mw-107-0821-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-107	DA2mw-107-0822-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-108	DA2mw-108-0823-SO	1		1						
	DA2-108	DA2mw-108-0824-SO	1		1						
	DA2-108	DA2mw-108-0825-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-108	DA2mw-108-0826-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-109	DA2mw-109-0827-SO	1		1						
	DA2-109	DA2mw-109-0828-SO	1		1						
	DA2-109	DA2mw-109-0829-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-109	DA2mw-109-0830-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-110	DA2mw-110-0831-SO	1		1						
	DA2-110	DA2mw-110-0832-SO	1		1						
	DA2-110	DA2mw-110-0833-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-110	DA2mw-110-0834-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-111	DA2mw-111-0835-SO	1		1						
	DA2-111	DA2mw-111-0836-SO	1		1						
	DA2-111	DA2mw-111-0837-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-111	DA2mw-111-0838-SO									MC, AL, USCS, SG, BD, P, pH
	DA2-112	DA2mw-112-0839-SO	1		1						
	DA2-112	DA2mw-112-0840-SO	1		1						
	DA2-112	DA2mw-112-0841-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-112	DA2mw-112-0842-SO									MC, AL, USCS, SG, BD, P, pH

Description	Station	Sample ID	Exp	Prop	TAL Metals	NO_2/NO_3 Sulfide CN	PCBs/ Pest	VOCs	Cr^{+6}	SVOCs	Geotech Analyses
	DA2-113	DA2mw-113-0843-SO	1		1						
	DA2-113	DA2mw-113-0844-SO	1		1						
	DA2-113	DA2mw-113-0845-SO									MC,GS,AL,USCS, SG, BD, P, HC, pH
	DA2-113	DA2mw-113-0846-SO									MC, AL, USCS, SG, BD, P, pH
Total Boring Samples			20	2	20	2	2	2	2	2	20

AL = Atterberg Limits
BD = Bulk Density
CN = Cyanide
Cr^{+6} = Hexavalent chromium
Exp = Explosives
GS = Grain Size
HC = Hydraulic Conductivity
MC = Moisture Content
NO_2/NO_3 = Nitrate/Nitrite
PCBs = Polychlorinated biphenyls
P = Porosity
Prop = Propellants (nitroglycerine, nitrocellulose, nitroguanidine)
SG = Specific Gravity
SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample packaging and shipping shall follow Chapter 6.0 of the Facility-wide SAP.

Coolers containing QA samples that are shipped to the USACE contract laboratory for independent analysis will be prepared and shipped in accordance with the Facility-wide SAP. On all shipments to all laboratories, a chain-of-custody form will be prepared for each cooler and the cooler number will be recorded on the chain-of-custody form.

Geotechnical samples do not require refrigeration or other preservation, and will be shipped to the contract laboratory at the conclusion of the sampling effort by conventional methods.

The addresses and points-of-contact for laboratories used for chemical and geotechnical analyses for this field effort are listed in Section 2.0 of the QAPP.

7.0 INVESTIGATION-DERIVED WASTE

All IDW, including auger cuttings, personal protective equipment (PPE), disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Chapter 7.0 of the Facility-wide SAP, federal and state of Ohio large-quantity generator requirements, and RVAAP's Installation Hazardous Waste Management Plan. In addition, all field personnel will become familiarized with the RVAAP Installation Spill Contingency Plan, and will implement the procedures contained within that plan in the event of a spill.

Seven types of IDW are anticipated, which will be contained separately. The types and estimated quantities for each include

- Soil and sediment from depths < 1.8 meters (6 feet), including residual surface and subsurface soil, following sample homogenization and residual dry sediment following sample homogenization and collection; and soil and rock cuttings from borehole installations > 1.8 meters (6 feet) to be contained in a roll-off box. One 10 cubic yard roll-off box is anticipated.

- Development and purge water from monitoring wells. An estimated twenty 55-gallon drums of groundwater IDW are anticipated.

- Decontamination fluids, including those derived from decontamination of sampling equipment and drilling equipment. An estimated three 30-gallon drums of decontamination fluid are anticipated from sampling equipment decontamination. An estimated five 55-gallon drums of drill rig decontamination water and one 55-gallon drum of decontamination pad sludge is anticipated.

- Expendables/solid wastes, including PPE and disposable sampling equipment. One 55-gallon drum of expendable IDW are anticipated.

7.1 IDW COLLECTION AND CONTAINERIZATION

Indigenous solid IDW (soil and rock cuttings) generated from soil and sediment from depths < 1.8 meters (6 feet), including residual surface and subsurface soil soil sampling; and borehole installations >1.8 meters (6 feet) in depth will be collected and contained in a lined roll-off box. The roll-off box will be staged in an approved field staging area (FSA).

All liquid indigenous (groundwater) IDW generated from monitoring well installation, development, and purging will be segregated by sample station. All liquid indigenous IDW will be collected in labeled DOT-approved, 55-gallon,

closed-top drums.

All solid non-indigenous (expendable sampling equipment and trash) IDW will be segregated as non-contaminated and potentially contaminated material. Potentially contaminated and non-contaminated solid non-indigenous IDW will be identified in the field on the basis of visual inspection (e.g., soiled versus non-soiled), usage of the waste material (e.g., outer sampling gloves versus glove liners), and field screening of the material using available field instrumentation (e.g., organic vapor analyzer). All non-indigenous IDW will be contained in trash bags with potentially contaminated non-indigenous IDW being additionally contained in a labeled DOT-approved, open-top, 55-gallon drum equipped with plastic drum liner and sealed with bung-top lid.

All liquid non-indigenous (decontamination rinse water) IDW will be segregated by waste stream (e.g., soap and water/water rinses from methanol and hydrochloric acid rinses) and contained in labeled DOT-approved, 5-gallon closed-top drums. All known potentially hazardous liquid non-indigenous IDW streams, such as methanol and hydrochloric acid rinses, will be contained separately in labeled DOT-approved, closed-top, 5-gallon (or larger) drums.

7.2 WASTE CONTAINER LABELING

All IDW containers will be labeled prior to placing IDW in them. All IDW containers (drums and roll-off boxes) will be labeled in accordance with Section 7.2 of the Facility-wide SAP.

7.3 IDW FIELD STAGING

A FSA will be designated at Demolition Area 2 at the beginning of field activities and approved by the RVAAP Environmental Coordinator. A roll-off box will be located at the designated FSA. A centralized FSA at Building 1502 will be established for the staging of all drums of field IDW. Decontamination IDW containers will be stored at the sample staging area in Building 1036. The FSA will be managed according to the requirements of Section 7.3 of the Facility-wide SAP.

Daily inventories of IDW will be taken and provided to the RVAAP Environmental Coordinator. A final inventory of all IDW staged at the FSA at Building 1502 and at Building 1036, with the exception of the roll-off boxes, will be conducted prior to demobilization from the site. All liquid waste not transported off of the facility within 30 days following project completion will require secondary containment.

7.4 IDW CHARACTERIZATION AND CLASSIFICATION FOR DISPOSAL

All indigenous IDW (soil, sediment, and groundwater) will be characterized for disposal on the basis of either: (1) analytical results from environmental samples collected from each sampling station; or (2) composite samples collected from segregated waste stream storage containers. Composite waste samples will be submitted for laboratory analysis of full toxicity characteristic leaching procedure (TCLP) to characterize each waste stream for disposal. Procedures for composite waste sampling are presented in Sections 7.4.1 and 7.4.2 of the Facility-wide SAP. PPE and expendable sampling equipment will be managed in accordance with Section 7.4 of the Facility-wide SAP.

At the conclusion of field activities for the Demolition Area 2 Phase II RI, letter reports will be submitted to the USACE and RVAAP Environmental Coordinator documenting the characterization and classification of the wastes.

7.5 IDW DISPOSAL

Upon approval of IDW classification reports, all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor in accordance with Section 7.5 of the Facility-wide SAP and all applicable state and federal rules, laws, and regulations. All shipments of IDW off-site will be coordinated through the RVAAP Environmental Coordinator.

8.0 REFERENCES

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APPENDIX A

SELECTED RESULTS FROM PREVIOUS ENVIRONMENTAL INVESTIGATIONS AT DEMOLITION AREA 2

Selected Results From

USAEHA 1984, *Hazardous Waste Management Study No. 37-26-0442-84, Phase 2 of AMC Open-Burning/Open-Detonation Grounds Evaluation Ravenna Army Ammunition Plant Ravenna, Ohio*, *31 October – 3 November 1983,* September

TABLE D-1. OD AREA ANALYTICAL RESULTS

Sample No and Description	EP Toxicity*								Residual Explosive†					
	As	Ba	Cd	Cr	Hg	Pb	Se	Ag	HMX	RDX	Tetryl	TNT	2,6-DNT	2,4-DNT
0442-01 Detonation Residue	BDL	25.3	BDL	BDL	BDL	BDL	BDL	BDL	19598.0	535.0	BDL	238.4	2.4	1.4
0442-02 Detonation Crater	BDL	BDL	BDL	BDL	BDL	535.0	BDL	BDL	80.4	BDL	BDL	BDL	BDL	BDL
0442-03 Detonation Crater	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	75.4	94.6	BDL	1.2	BDL	BDL
0442-04 Detonation Crater	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	21.9	BDL	BDL	BDL	BDL	BDL
0442-05 Detonation Crater	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	225.2	456.9	BDL	14.4	BDL	BDL
0442-06 Detonation Crater	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	5.0	BDL	BDL	BDL	BDL	BDL
0442-07 Detonation Crater	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	1.6	BDL	BDL	BDL	BDL	BDL
0442-08 Crater Drainway	BDL	BDL	BDL	BDL	BDL	1.8	BDL	BDL	25.7	2.2	BDL	1.6	BDL	BDL
0442-09 Crater Drainway	BDL	BDL	BDL	BDL	BDL	4.3	BDL	BDL	69.1	12.7	BDL	BDL	BDL	BDL
0442-10 Crater Drainway	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	9.9	BDL	BDL	BDL	BDL	BDL

* All units in mg/L
† All units in µg/g
BDL - Below Detection Limit

PETER FIANU
Chief, Metals Analysis Branch
Radiological and Inorganic Chemistry Division

RICHARD A. CASSIDY
1LT, MSC
Chief, Chromatographic Analysis Branch
Organic Environmental Chemistry Division

Selected Results From

USAEHA 1992, *Geohydrologic Study No. 38-26-KF95-92, Soils, Ground Water, and Surface Water Characterization for the Open Burning and Open Detonation Areas, Ravenna Army Ammunition Plant, Ravenna, Ohio*, May.

TABLE 3.
RESULTS OF CHEMICAL ANALYSES FOR EXPLOSIVES COMPOUNDS,
OPEN DETONATION AREA, RAVENNA AAP, RAVENNA, OHIO.

SAMPLE #	SAMPLE DEPTH	2-4 DNT mg/kg	2-6 DNT mg/kg	HMX mg/kg	RDX mg/kg	TNT mg/kg	TNB mg/kg	Date Collected
X-1	surface	<1.0	<1.0	7.05	72.6	7.57	<1.0	28 April 1992
X-5	surface	<1.0	<1.0	<1.0	1.7	<1.0	<1.0	28 April 1992
X-8	surface	<1.0	<1.0	<1.0	1.18	<1.0	<1.0	29 April 1992
X-13	surface	<1.0	<1.0	<1.0	2.66	<1.0	<1.0	29 April 1992
X-24	surface	<1.0	<1.0	<1.0	<1.0	2.69	<1.0	1 May 1992
X-42	surface	<1.0	<1.0	<1.0	1.36	10.7	<1.0	2 May 1992
X-48	6-7 feet	<1.0	<1.0	<1.0	1.05	<1.0	<1.0	28 April 1992

TABLE 4.

RESULTS OF CHEMICAL ANALYSES FOR METALS AND NON-METALS IN SOIL SAMPLES FROM OPEN DETONATION AREA, RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO.

All units ug/g.

SURFACE (0-2 FEET) SAMPLE

	NO2NO3	PHOSPHORUS	TKN	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
U95% CI	0.73	305	682	No test	21	57	No test	17	No test	19	0.69
X-1	1.5*	290	430	<0.50	24.0*	120*	<0.25	13.0	0.12*	30.0*	<0.50
X-4**	1.30*	330*	450	<0.50	18.0	170*	3.5*	14.0	0.21*	69.0*	<0.50
X-5**	1.6*	320*	440	<0.50	17.0	170*	3.4*	14.0	0.14*	69.0*	<0.50
X-8	2.20*	380*	680	<0.50	18.0	64*	1.3*	17.0	0.12*	25.0*	<0.50
X-13	2.50*	350*	390	<0.50	20.0	77*	0.63*	13.0	0.14*	19.0	<0.50
X-17**	2.80*	340*	470	<0.50	17.0	54	0.52*	12.0	0.27*	16.0	<0.50
X-18**	2.8*	310*	470	<0.50	18.0	55	0.33*	13.0	0.21*	40.0*	<0.50
X-24	2.30*	370*	320	<0.50	16.0	55	0.73*	11.0	0.11*	27.0*	<0.50
X-30	0.39	360*	380	<0.50	17.0	42	<0.25	14.0	<0.10	20.0*	<0.50
X-36	0.98*	350*	400	<0.50	20.0	46	0.30*	14.0	<0.10	15.0	<0.50
X-42	3.40*	380*	540	<0.50	35.0*	58*	0.64*	13.0	0.11*	7.6	<0.50

* Designates sample results that exceeded background U95% CI.
** Designates field duplicates.

Note: Samples X-1-7, 48, collected 28 April 1992.
Samples X-8-16 collected 29 April 1992.
Samples X-17-29 collected 1 May 1992.
Samples X-30-46 collected 2 May 1992.

TABLE 4. (CONTINUED)

All units ug/g.

3-5 FEET SAMPLE

	NO2NO3	PHOSPHORUS	TKN	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
U95%CI	0.33	443	433	No test	28	74	No test	25	No test	44	2.40
X-2	0.40*	340	420	<0.50	21.0	56	<0.25	13.0	<0.10	23.0	<0.50
X-6**	0.73*	290	370	<0.50	17.0	68	1.3*	15.0	0.12*	29.0	<0.50
X-7**	0.98*	310	450*	<0.50	17.0	70	1.8*	15.0	0.17*	32.0	<0.50
X-9	0.88*	300	360	<0.50	40.0*	26	0.34*	12.0	<0.10	27.0	<0.50
X-14	1.1*	370	270	<0.50	21.0	21	<0.25	10.0	<0.10	17.0	<0.50
X-19	3.3*	360	520*	<0.50	18.0	86*	0.41*	14.0	0.24*	38.0	<0.50
X-25**	1.4*	350	350	<0.50	16.0	32	<0.25	12.0	<0.10	5.8	<0.50
X-26**	1.3*	380	340	<0.50	16.0	33	0.35*	13.0	<0.10	15.0	<0.50
X-31	0.2	340	330	<0.50	15.0	36	<0.25	11.0	<0.10	5.8	<0.50
X-37	0.5*	360	400	<0.50	23.0	46	0.34*	13.0	<0.10	26.0	<0.50
X-43	2.3*	340	430	<0.05	37.0*	56	0.51*	14.0	<0.10	13.0	<0.50

5-8 FEET SAMPLE

	NO2NO3	PHOSPHORUS	TKN	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
U95%CI	0.54	391	426	No test	32	57	No test	26	No test	26	No test
X-3	0.39	310	430*	<0.50	25.0	77*	<0.25	14.0	0.11*	26.0	<0.50
X-48	0.48	340	440*	<0.50	24.0	82*	<0.25	13.0	0.28*	22.0	<0.50
X-10	0.76*	300	400	<0.50	20.0	33	0.27*	14.0	<0.10	30.0*	<0.50
X-15	1.1*	270	160	<0.50	15.0	58*	<0.25	4.8	<0.10	25.0	<0.50
X-20	0.67*	330	310	<0.50	21.0	31	<0.25	15.0	<0.10	4.0	<0.50
X-21**	0.70*	310	320	<0.50	17.0	27	<0.25	11.0	<0.10	5.5	<0.50
X-27**	0.98*	350	370	<0.50	18.0	27	<0.25	12.0	<0.10	18.0	<0.50
X-32**	0.3	330	300	<0.50	16.0	34	<0.25	12.0	<0.10	5.0	<0.50
X-33**	0.4	340	300	<0.50	15.0	37	<0.25	13.0	<0.10	5.6	<0.50
X-38	0.29	480*	340	<0.50	22.0	47	<0.25	15.0	<0.10	5.5	<0.50
X-44	0.89*	330	370	<0.50	30.0	35	<0.25	12.0	<0.10	5.2	<0.50

TABLE 4. (CONTINUED)

All units ug/g.

8-10 FEET SAMPLE

	NO2NO3	PHOSPHORUS	TKN	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
U95%CI	1.01	533	521	No test	46	60	No test	21	No test	17	No test
X-11	0.49	330	740*	<0.50	20.0	23	<0.25	12.0	<0.10	44.0*	<0.50
X-16	0.79	320	270	<0.50	13.0	21	<0.25	7.9	<0.10	16.0	<0.50
X-22	0.2	330	250	<0.50	19.0	30	<0.25	11.0	<0.10	5.3	<0.50
X-28	0.58	290	200	<0.50	13.0	16	<0.25	6.	<0.10	16.0	<0.50
X-34	0.29	310	290	<0.50	12.0	29	<0.25	10	<0.10	5.4	<0.50
X-39	0.7	370	370	<0.50	17.0	29	<0.25	3.0	<0.10	5.4	<0.50
X-45	0.3	330	270	<0.50	42.0	28	<0.25	11.0	<0.10	4.2	<0.50

GREATER THAN 10 FEET SAMPLE

	NO2NO3	PHOSPHORUS	TKN	Silver	Arsenic	Barium	Cadmium	Chromium	Mercury	Lead	Selenium
U95%CI	0.86	439	629	No test	13	63	No test	23	No test	41	No test
X-12	0.8	280	230	<0.50	14.0*	22	<0.25	7.8	<0.10	16.0	<0.50
X-23	0.49	290	180	<0.50	14.0*	20	<0.25	9.9	<0.10	14.0	<0.50
X-29	0.49	270	200	<0.50	7.5	8.2	<0.25	4.1	<0.10	16.0	<0.50
X-35	0.69	350	310	<0.50	12.0	28	<0.25	12.0	<0.10	18.0	<0.50
X-40**	0.38	370	410	<0.50	34.0*	33	<0.25	13.0	<0.10	3.4	<0.50
X-41**	0.69	340	390	<0.50	26.0*	31	<0.25	11.0	<0.10	3.3	<0.50
X-46	0.59	310	330	<0.05	36.0*	38	<0.25	12.0	<0.10	24.0	<0.50

Selected Results From

USACE 1998, *Final RCRA Closure Field Investigation Report for the Deactivation Furnace Area, Open Detonation Area, Building 1601, and Pesticides Building Ravenna Army Ammunition Plant, Ravenna, Ohio,* DACA 27-97-D-0025, D.O. 0002

RVAAP OPEN DEMOLITION AREA 2 TAL LEVEL Nov-97

BORING	DEPTH (FT)	ALL READINGS IN MG/KG AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
SB01	0-2	11,100	<0.57	**16.2**	59.5	0.57	<0.57	11,800	17.4	<17.1	**19.7**	**27,000**	11.7	**4,610**	311	<0.11	**25.5**	**1,880**	<0.57	<1.1	<570	<0.57	18.7	**69.0**
SS-01	0-0.3	7,290	<0.57	9.1	**117.0**	<0.57	<0.57	**161,000**	10.4	<17.1	**47.7**	15,400	16.8	**3,140**	469	<0.11	17.6	**1,320**	<0.57	<1.1	<570	<0.57	12.6	**82.1**
S-01 DUP	0-0.3	6,070	<0.53	7.5	**113.0**	<0.53	**0.58**	**202,000**	8.7	<15.9	**36.1**	11,700	11.3	**3,340**	514	<0.11	15.3	**1,100**	<0.53	<1.1	<529	<0.53	10.8	57.6
	2-4	8,710	<0.57	17.4	46.2	<0.57	<0.57	7,960	14.2	<17.1	19.8	25,900	11.6	3,960	781	<0.11	34.9	1,670	<0.57	<1.1	<569	<0.57	16.0	63.0
	4-6	9,640	<0.59	17.8	35.7	<.59	<0.59	7,420	15.8	<17.7	19.8	27,800	11.2	4,790	441	<0.12	28.1	1,680	<0.59	<1.2	<590	<0.59	16.7	66.1
	6-8	13,600	<0.60	**20.4**	59.0	<0.60	<0.60	17,000	20.1	<17.9	22.0	29,000	10.2	6,030	430	<0.12	27.8	2,870	<0.60	<1.2	<598	<0.60	24.9	64.5
	12-14	6,550	<0.59	13.3	36.5	<0.59	<0.59	21,300	11.6	<17.8	16.9	17,700	9.4	2,810	326	<0.12	16.8	1,460	<0.59	<1.2	<594	<0.59	12.8	51.8
SB02	0-2	10,800	<0.60	15.2	**108.0**	0.64	<0.60	2,050	**17.8**	<18.0	**20.8**	**25,200**	13.6	**3,240**	343	<0.12	**37.6**	**1,710**	<0.60	<1.2	<600	<0.60	20.0	**74.9**
SS-02	0-0.3	7,630	<0.64	13.3	**96.8**	<0.64	**1.00**	6,930	13.8	<19.1	**89.3**	20,700	**61.7**	2,990	329	<0.13	21.1	**1,270**	<0.64	<1.3	<637	<0.64	14.9	**202.0**
S-02 DUP	0-0.3	8,910	0.75	14.6	**92.2**	<0.65	**1.40**	7,340	15.2	<19.4	**93.9**	22,500	**78.5**	**3,320**	325	**0.80**	**22.0**	**1,450**	<0.65	<1.3	<647	<0.65	16.7	**214.0**
	2-4	11,500	<0.57	15.8	54.4	<0.57	<0.57	16,400	18.4	<17.2	17.3	25,300	11.3	4,240	330	<0.11	26.9	2,290	<0.57	<1.1	<573	<0.57	20.3	62.6
	4-6	9,570	<0.60	19.5	44.9	<0.60	<0.60	5,250	16.5	<18.1	19.4	26,700	11.7	3,550	449	<0.12	27.8	1,500	<0.60	<1.2	<602	<0.60	17.7	68.2
	6-8	14,800	<0.62	19.2	61.2	0.69	<0.62	2,520	24.1	<18.7	21.0	34,600	13.5	4,840	430	<0.12	34.6	2,970	<0.62	<1.2	<622	<0.62	26.3	77.1
SB03	0-2	15,200	<0.59	12.8	**101.0**	0.64	<0.59	**16,300**	**24.0**	<17.7	**21.9**	**28,800**	15.8	**5,760**	413	<0.12	**36.2**	**2,540**	<0.59	<1.2	<590	**0.59**	28.1	**74.7**
SS-03	0-0.3	14,100	<0.61	15.0	62.3	<0.61	<0.61	12,500	**21.4**	<18.4	**71.7**	**26,300**	20.2	**3,320**	329	<0.12	**23.5**	**2,170**	<0.61	<1.2	<612	<0.61	25.3	**132.0**
S-03 DUP	0-0.3	13,800	<0.61	14.8	73.4	<0.61	<0.61	8,010	**22.8**	<18.4	**51.8**	**27,200**	19.5	**3,640**	398	<0.12	**26.1**	**2,030**	<0.61	<1.2	<612	<0.61	25.6	**103.0**
	2-4	11,500	<0.57	12.3	70.9	<0.57	<0.57	27,800	19.2	<17.2	20.6	25,400	11.1	7,710	366	<0.11	29.5	2,020	<0.57	<1.1	<575	<0.57	21.8	66.5
	4-6	14,000	<0.59	15.8	80.3	0.69	<0.59	29,000	25.6	<17.6	22.0	**37,200**	14.2	7,000	546	<0.12	34.1	3,280	<0.59	<1.2	<588	0.61	30.5	72.1
	6-8	9,500	<0.57	17.8	64.7	<0.57	<0.57	10,600	15.7	<17.2	18.6	25,300	11.1	4,580	1020	<0.11	34.9	1,900	<0.57	<1.1	<573	0.83	17.2	66.4
SB04	0-2	12,500	<0.58	10.1	**133.0**	<0.58	<0.58	**103,000**	16.1	<17.4	**30.7**	20,100	11.2	**3,630**	311	<0.12	**21.6**	**1,700**	<0.58	<1.2	<580	<0.58	20.3	58.1
SS-04	0-0.3	8,920	<0.58	11.8	**98.4**	<0.58	**0.86**	**75,400**	14.1	<17.3	**89.1**	18,600	17.3	**3,240**	430	<0.12	20.8	**1,710**	<0.58	<1.2	<577	<0.58	16.3	**85.2**
S-04 DUP	0-0.3	5,500	<0.56	7.3	**92.0**	<0.56	**0.64**	**167,000**	8.8	<16.7	**47.5**	12,300	12.6	2,930	476	<0.11	15.6	**979**	<0.56	<1.1	<557	<0.56	9.7	60.7
	2-4	11,500	<0.58	18.6	59.8	<0.58	<0.58	12,100	17.1	<17.3	20.4	26,800	11.5	4,970	366	<0.12	26.3	2,350	<0.58	<1.2	<577	<0.58	19.2	62.9
	4-6	11,300	<0.57	17.7	51.7	<0.57	<0.57	7,150	17.1	<17.0	19.8	27,000	12.1	4,990	352	<0.11	26.7	2,260	<0.57	<1.1	<567	<0.57	18.7	64.4
	6-8	13,100	<0.58	17.4	53.4	<0.58	<0.58	11,700	20.2	<17.4	19.9	27,300	12.3	5,240	522	<0.12	29.0	2,920	<0.58	<1.2	<579	<0.58	22.4	65.2
SB05	0-2	11,500	<0.59	**21.6**	70.0	<0.59	<0.59	25,400	**17.9**	<17.7	**19.2**	**30,200**	11.1	**4,140**	350	<0.12	**34.1**	**1,340**	<0.59	<1.2	<591	<0.59	17.7	**64.1**
MRD QA	0-2	15,300	<0.60	**20.9**	95.9	**0.94**	<0.08	4,040	**22.1**	**18.2**	**23.4**	**37,400**	14.5	**4,680**	391	0.01	**36.20**	**1,770**	<0.6	<0.4	60.0	<1.0	23.40	**74.7**
SS-05	0-0.3	8,860	<0.60	12.8	69.4	<0.60	**0.61**	48,700	14.4	<17.9	**56.0**	20,500	17.6	2,930	397	<0.12	20.4	**1,120**	<0.6	<1.2	<595	<0.6	17.0	**90.5**
SS-5 DUP	0-0.3	5,490	<0.58	**19.6**	64.4	<0.58	**0.80**	**137,000**	10.7	<17.5	**64.2**	16,900	16.8	2,790	441	<0.12	17.3	862	<0.58	<1.2	<582	<0.58	10.4	**73.8**
	2-4	11,900	<0.58	18.1	60.2	<0.58	<0.58	28,100	17.9	<17.5	21.3	27,100	11.8	4,500	334	<0.12	28.0	1,950	<0.58	<1.2	<582	<0.58	19.3	65.0
	4-6	8,400	<0.58	**20.9**	34.8	<0.58	<0.58	18,300	13.7	<17.4	19.5	26,100	11.3	4,450	397	<0.12	26.5	1,340	<0.58	<1.2	<581	<0.58	14.4	59.6
	6-8	10,800	<0.62	**20.5**	37.3	<0.62	<0.62	7,140	17.6	<18.6	21.8	31,000	12.6	6,290	442	<0.12	31.8	1,530	<0.62	<1.2	<619	<0.62	17.7	67.2

Bold and underlined = > Surface or Subsurface Phase II 1998 Facility-Wide Soil Background

EPA	REGION 9	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
RESIDEN	PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.167				17.5			No test			0.7767	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA 2 TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SB06	0-2	9810	<0.58	14.8	72.5	<0.58	**4.50**	6400	14.9	<17.4	**79.0**	**24800**	**30.1**	**3690**	390	<0.12	**21.7**	**1950**	<0.58	<1.2	<581	<0.58	17.3	**134.0**
SS-06	0-0.3	9170	<0.63	**16.5**	81.5	<0.63	**1.20**	5990	15.5	<18.8	**101.0**	22700	22.0	**3670**	402	<0.13	**22.0**	**1690**	<0.63	<1.3	<628	<0.63	16.8	**145.0**
S-06 DUP	0-0.3	8280	0.68	14.0	63.2	<0.66	**1.80**	11000	14.0	<19.8	**102.0**	21100	**36.6**	**3850**	333	**0.13**	**21.5**	**1390**	<0.66	<1.3	<660	<0.66	14.9	**162.0**
	2-4	8450	<0.53	15.8	41.9	<0.53	**2.10**	5720	**1306.0**	<15.8	**39.5**	20800	**37.1**	3560	349	<0.11	31.9	1720	<0.53	<1.1	<527	<0.53	14.7	81.3
	4-6	4700	0.60	**99.4**	39.3	<0.57	<0.57	7080	9.2	<17.2	16.0	28400	**20.2**	2770	667	<0.11	18.1	998	<0.57	<1.1	<573	<0.57	9.6	60.1
	6-8	5450	<0.56	**22.0**	<22.6	<0.56	<0.56	4950	10.2	<16.9	13.8	21400	8.6	2830	315	<0.11	18.5	971	<0.56	<1.1	<564	<0.56	10.8	61.9
SB07	0-2	7310	0.72	**16.7**	**194.0**	<0.56	**2.30**	4050	13.2	<16.9	**108.0**	**25000**	**192.0**	**3040**	334	<0.11	20.9	**1170**	<0.56	<1.1	<564	<0.56	14.1	**187.0**
SS-07	0-0.3	8600	<0.62	**15.5**	31.3	<0.62	**0.95**	8890	14.1	<18.6	**95.8**	20800	24.3	**3760**	365	**0.23**	20.9	**1640**	<0.62	<1.2	<621	<0.62	15.9	**125.0**
S-07 DUP	0-0.3	8740	<0.62	13.8	71.6	<0.62	**1.10**	6160	14.5	<18.7	**94.8**	21000	24.3	**3710**	342	**0.15**	**21.2**	**1400**	<0.62	<1.2	<624	<0.62	15.8	**158.0**
	2-4	8170	**3.20**	16.0	**296.0**	<0.58	**11.20**	4150	14.7	<17.5	**454.0**	22300	**281.0**	3100	350	<0.12	50.6	1450	<0.58	<1.2	<583	<0.58	15.7	**373.0**
	4-6	5780	**1.60**	10.8	73.4	<0.57	**2.60**	2040	10.2	<17.0	**53.4**	18200	**105.0**	2070	290	<0.11	21.2	1110	<0.57	<1.1	<567	<0.57	12.6	87.1
	6-8	4910	<0.55	9.3	<21.9	<0.55	<0.55	14100	9.1	<16.5	15.3	24400	9.9	2250	467	<0.11	16.1	966	<0.55	<1.1	<548	<0.55	11.5	54.7
SB08	0-2	7700	<0.57	15.1	30.8	<0.57	<0.57	6990	14.1	<17.0	16.2	22900	9.8	**3880**	274	<0.11	**21.9**	**1330**	<0.57	<1.1	<567	<0.57	13.7	58.5
SS-08	0-0.3	8270	0.65	14.7	67.3	<0.61	**0.69**	8060	17.1	<18.4	**76.7**	**30800**	20.9	**3590**	494	<0.12	**23.3**	**1110**	<0.61	<1.2	<612	<0.61	17.1	**158.0**
S-08 DUP	0-0.3	10700	<0.59	14.9	85.7	<0.59	**0.78**	4110	17.4	<17.8	**93.3**	**25000**	25.0	**3430**	648	<0.12	**23.0**	**1400**	<0.59	<1.2	<594	<0.59	20.9	**158.0**
	2-4	7050	<0.60	15.9	30.7	<0.60	<0.60	9540	13.1	<17.9	20.3	23400	12.2	4290	229	<0.12	22.1	1250	<0.60	<1.2	<595	<0.60	13.7	67.2
	4-6	9800	<0.60	**23.3**	35.4	<0.60	<0.60	14000	16.2	<17.9	25.6	27300	12.6	7250	333	<0.12	24.7	1990	<0.60	<1.2	<596	<0.60	18.5	65.7
	6-8	11100	<0.61	**22.8**	41.0	<0.61	<0.61	5170	19.1	<18.4	19.0	29700	11.9	5230	326	<0.12	28.8	2340	<0.61	<1.2	<614	<0.61	20.5	67.3
SB09	0-2	10800	<0.59	**18.0**	44.2	<0.59	<0.59	3570	16.9	<17.8	**20.6**	**27700**	12.6	**4270**	356	<0.12	**26.9**	**1840**	<0.59	<1.2	<593	<0.59	17.8	**66.2**
SS-09	0-0.3	11200	<0.60	**18.1**	50.9	<0.60	<0.60	1950	**18.5**	<17.9	**19.7**	**28200**	11.6	**3660**	351	<0.12	**28.2**	**2020**	<0.60	<1.2	<595	<0.60	20.0	**68.3**
S-09 DUP	0-0.3	11500	<0.59	**16.8**	31.7	<0.59	<0.59	2600	**18.5**	<17.8	**28.0**	**26000**	15.2	**3450**	447	<0.12	**28.3**	**2290**	<0.59	<1.2	<592	<0.59	22.3	**77.9**
	2-4	10100	<0.55	17.1	38.7	<0.55	<0.55	5650	15.3	<16.6	19.3	24900	10.9	4230	385	<0.11	25.3	2110	<0.55	<1.1	<553	<0.55	17.1	60.7
	4-6	8030	<0.56	15.8	32.9	<0.56	<0.56	6390	13.1	<16.8	18.2	24300	11.1	4200	266	<0.11	20.9	1510	<0.56	<1.1	<559	<0.56	14.0	58.0
	6-8	9610	<0.59	**22.6**	43.9	<0.59	<0.59	6630	15.6	<17.6	19.3	26500	13.3	4880	263	<0.12	21.4	2060	<0.59	<1.2	<585	<0.59	17.1	59.4
SB10	0-2	12400	<0.58	**18.9**	65.1	<0.58	<0.58	4540	**19.5**	<17.5	**51.2**	**28700**	16.0	**4500**	379	<0.12	**29.6**	**2130**	<0.58	<1.2	<584	<0.58	21.0	**81.9**
MRD QA	0-2	12900	<0.60	**18.9**	71.0	0.72	<0.08	4040	**19.7**	**12.3**	**47.6**	**31900**	16.4	**4490**	363	<0.03	**31.1**	**1910**	<0.60	<0.40	70	<1.0	20.3	**78.3**
SS-10	0-0.3	11800	<0.60	**17.3**	84.3	<0.60	<0.60	3530	**19.6**	<18.0	**29.1**	**29000**	13.9	**4040**	333	<0.12	**31.5**	**1540**	<0.60	<1.2	<600	<0.60	21.5	**85.0**
S-10 DUP	0-0.3	13700	<0.61	13.0	**123.0**	0.86	<0.61	3640	**22.0**	<18.3	**25.4**	**26500**	14.1	**4060**	537	<0.12	**35.1**	**2130**	<0.61	<1.2	<612	<0.61	25.1	**70.8**
	2-4	9640	<0.57	15.9	38.7	<0.57	<0.57	6170	15.8	<17.1	20.0	25200	11.4	4320	255	<0.11	32.8	1720	<0.57	<1.1	<571	<0.57	16.1	62.3
	4-6	1100	<0.59	18.2	37.5	<0.59	<0.59	8380	17.1	<17.8	20.5	27800	11.6	4830	298	<0.12	25.7	1940	<0.59	<1.2	<592	<0.59	18.6	66.5
	6-8	8650	<0.57	15.2	33.5	<0.57	<0.57	6860	13.8	<17.1	18.4	23600	10.6	4040	333	<0.11	22.3	1600	<0.57	<1.1	<569	<0.57	15.3	62.7
	12-14	6490	<0.56	19.4	28.6	<0.56	<0.56	**45700**	10.2	<16.7	15.6	21900	8.9	3530	467	<0.11	21.6	1340	<0.56	<1.1	<557	<0.56	11.8	49.8
	16-18	7340	<0.56	16.8	28.4	<0.56	<0.56	8130	12.4	<16.8	17.2	22400	8.6	5030	333	<0.11	21.7	1440	<0.56	<1.1	<560	<0.56	12.5	50.3
	19-20	4690	<0.55	13.3	<21.8	<0.55	<0.55	4680	9.9	<16.4	13.5	17200	10.9	2980	270	<0.11	18	948	<0.55	<1.1	<546	<0.55	9.1	62.8

Bold and underlined => Surface or Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA 2 TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SB11	0-2	11400	**17.80**	**30.7**	**173.0**	0.58	**1.90**	4120	**18.6**	<17.2	**172.0**	**37300**	**4950.0**	**3920**	454	<0.11	**31.7**	**2190**	<0.57	<1.1	<574	<0.57	24.3	**806.0**
SS-11	0-0.3	9790	<0.66	**15.8**	**109.0**	<0.66	**2.50**	4730	**18.9**	<19.7	**156.0**	**25300**	31.0	**3950**	373	**0.15**	**25.3**	**1980**	<0.66	<1.3	<657	<0.66	17.5	**184.0**
SS-11 DUP	0-0.3	7650	<0.62	13.1	68.8	<0.62	**1.30**	5520	13.1	<18.7	**128.0**	20100	24.0	**3540**	378	**0.17**	20.7	**1240**	<0.62	<1.2	<622	<0.62	13.8	**264.0**
	2-4	8350	**1.10**	15.2	81.1	<0.57	**1.20**	3480	13.8	<17.0	**50.4**	23100	**168.0**	2500	336	**0.15**	19.1	1370	<0.57	<1.1	<567	<0.57	15.7	**114.0**
	4-6	8590	**2.80**	14.6	44.9	<0.56	<0.56	1800	14.9	<16.9	**98.7**	22800	**478.0**	2310	375	<0.11	23.0	1520	<0.56	<1.1	<564	<0.56	16.7	**295.0**
SB12	0-2	9460	<0.59	**15.7**	83.2	<0.59	**1.40**	10500	16.2	<17.8	**3200.0**	**24300**	**168.0**	**3780**	403	**0.14**	**23.8**	**1280**	<0.59	<1.2	<594	<0.59	18.1	**724.0**
SS-12	0-0.3	8930	0.60	14.5	75.6	<0.60	**1.20**	5780	15.0	<17.9	**103.0**	21100	**92.8**	**3560**	358	<0.12	20.7	**1650**	<0.60	<1.2	<598	<0.60	16.8	**192.0**
SS-12 DUP	0-0.3	10100	0.64	15.2	77.4	<0.59	**1.30**	5500	16.1	<17.6	**119.0**	**23400**	**28.8**	**3480**	374	**0.13**	**22.5**	**1760**	<0.59	<1.2	<587	<0.59	18.7	**181.0**
	2-4	8300	<0.58	16.4	42.8	<0.58	<0.58	12000	14.4	<17.3	**50.9**	23400	14.0	4070	507	<0.12	23.2	1820	<0.58	<1.2	<577	<0.58	16.2	**202.0**
	4-6	8800	<0.55	17.2	30.6	<0.55	<0.55	9030	14.9	<16.5	23.4	22100	11.6	5130	288	<0.11	22.9	2010	<0.55	<1.1	<550	<0.55	16.3	57.1
	6-8	8500	<0.56	15.1	31.4	<0.56	<0.56	8550	14.7	<16.8	17.1	23300	10.9	5120	331	<0.11	22.9	1940	<0.56	<1.1	<561	<0.56	15.7	63.6
SB13	0-2	8300	<0.56	**16.3**	37.5	<0.56	<0.56	7230	12.7	<16.9	**91.5**	21500	11.7	**4140**	557	<0.11	**21.9**	**1360**	<0.56	<1.1	<564	<0.56	13.1	**69.2**
SS-13	0-0.3	11700	<0.60	**16.6**	59.1	<0.60	**0.71**	5330	**17.9**	<18.0	**96.9**	**27300**	18.3	**4580**	374	<0.12	**26.4**	**1760**	<0.60	<1.2	<599	<0.60	20.0	**102.0**
SS-13 DUP	0-0.3	13000	<0.59	11.7	48.6	<0.59	<0.59	2010	17.3	<17.8	**30.4**	22200	13.6	2870	185	<0.12	15.5	**1200**	<0.59	<1.2	<592	<0.59	25.8	**62.5**
	2-4	7130	<0.56	13.5	45.6	<0.56	<0.56	16500	11.7	<16.9	**33.5**	20800	11.4	4980	586	<0.11	20.0	1270	<0.56	<1.1	<562	<0.56	11.8	61.7
	4-6	7740	<0.55	13.5	30.7	<0.55	<0.55	7980	12.8	<16.5	17.4	22300	8.7	5080	343	<0.11	21.1	1600	<0.55	<1.1	<549	<0.55	14.0	53.8
	6-8	7990	<0.55	15.4	33.2	<0.55	<0.55	8800	15.2	<16.6	23.7	23600	15.0	5230	365	<0.11	22.2	1640	<0.55	<1.1	<552	<0.55	13.9	58.6
SB14	0-2	8900	<0.55	13.8	65.7	**0.90**	**0.79**	**29200**	8.7	<16.6	**49.9**	17300	16.0	**7590**	512	<0.11	15.0	826	<0.55	<1.1	<552	<0.55	9.2	**177.0**
SS-14	0-0.3	10600	<0.60	**16.0**	72.5	<0.60	**1.40**	4640	17.3	<18.1	**127.0**	**24800**	**29.4**	**3740**	383	<0.12	**24.6**	**1980**	<0.60	<1.2	<604	<0.60	19.8	**190.0**
SS-14 DUP	0-0.3	12000	<0.60	**15.7**	**552.0**	<0.60	**0.79**	3860	**19.0**	<17.9	**96.3**	**25200**	21.5	**3770**	353	**0.14**	**26.0**	220	<0.60	<1.2	<598	<0.60	21.7	**126.0**
	2-4	5630	<0.60	16.3	28.1	<0.60	<0.60	8450	10.0	<17.9	22.1	20500	11.7	4040	335	<0.12	18.1	978	<0.60	<1.2	<598	<0.60	10.7	57.7
	4-6	8000	<0.57	16.3	36.3	<0.57	<0.57	7860	13.7	<17.2	21.4	24100	10.9	4370	564	<0.11	25.4	1360	<0.57	<1.1	<575	<0.57	14.0	62.0
	6-8	7030	<0.56	17.8	31.9	<0.56	<0.56	7770	11.8	<16.8	17.4	23800	10.0	3560	351	<0.11	19.8	1330	<0.56	<1.1	<560	<0.56	13.0	64.7
SB15	0-2	5590	<0.58	10.2	35.1	<0.58	<0.58	**25700**	9.0	<17.5	12.6	13000	17.4	1500	303	<0.12	10.8	826	<0.58	<1.2	<583	<0.58	10.6	51.3
SS-15	0-0.3	6660	<0.60	12.9	73.3	<0.60	**0.82**	10100	13.1	<18.1	**78.5**	21500	24.9	2510	379	<0.12	20.4	**1170**	<0.60	<1.2	<602	<0.60	12.7	**164.0**
	2-4	11800	<0.61	14.2	51.0	<0.61	<0.61	1320	16.7	<18.2	19.1	22300	**22.0**	2400	533	<0.12	23.1	1870	<0.61	<1.2	<607	<0.61	21.4	79.7
	4-6	8400	<0.62	13.9	42.1	<0.62	<0.62	1290	13.1	<18.5	17.6	21100	**25.9**	2160	387	<0.12	21.0	976	<0.62	<1.2	<617	<0.62	15.5	63.1
	6-8	10600	<0.62	12.1	57.5	<0.62	<0.62	1570	14.9	<18.6	16.8	19100	**34.3**	2290	274	**0.14**	16.5	1410	<0.62	<1.2	<619	<0.62	20.1	91.1

Bold and Underlined => Surface and Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	SURFACE 0 - 1	17,700	0.96	15.4	88.4	0.88	0	15,800	17.4	10.4	17.7	23,100	26.1	3,030	1,450	0.04	21.1	927	1.4	0	123	0	31.1	61.8
PH II 1998 BG	SUB-SURF > 1'	19,500	0.96	19.8	124	0.88	0	35,500	27.2	23.2	32.3	35,200	19.1	8,790	3,030	0.04	60.7	3,350	1.5	0	145	0.91	37.6	93.3

RVAAP OPEN DEMOLITION AREA 2 TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SB16	0-2	8780	<0.56	**15.9**	44.4	0.56	<0.56	**28600**	**17.6**	<16.9	**18.7**	**24100**	11.0	3100	379	<0.11	**23.4**	**1350**	<0.56	<1.1	<565	<0.56	15.0	59.7
SS-16	0-0.3	12600	<0.57	**15.6**	62.9	0.61	<0.57	**79900**	17.0	<17.2	**391.0**	16500	**39.1**	3740	460	<0.11	17.4	**1560**	<0.57	<1.1	<574	**0.57**	14.2	**77.9**
	2-4	11000	<0.61	19.3	48.2	0.66	<0.61	2080	18.1	<18.4	20.9	30000	12.1	3700	308	<0.12	29.5	1810	<0.61	<1.2	<613	<0.61	18.2	67.3
	4-6	7210	<0.58	**20.0**	33.2	<0.58	<0.58	1680	12.6	<17.3	18.1	23900	10.5	2620	336	<0.12	20.2	1190	<0.58	<1.2	<578	<0.58	13.5	60.2
	6-8	9000	<0.58	**20.2**	38.3	<0.58	<0.58	2600	15.2	<17.4	19.7	28400	10.5	3560	438	<0.12	25.6	1460	<0.58	<1.2	<580	<0.58	15.9	65.5
SB17	0-2	11700	<0.57	**17.5**	66.7	<0.57	**1.60**	2590	**18.4**	<17.2	**405.0**	**25900**	**40.5**	3380	373	**0.30**	**24.4**	**2170**	<0.57	<1.1	<574	<0.57	22.4	**178.0**
SS-17	0-0.3	7900	<0.59	14.3	72.8	<0.59	**1.50**	5160	13.8	<17.7	**136.0**	21300	**27.7**	3280	344	**0.33**	**21.5**	**1310**	<0.59	<1.2	<591	<0.59	14.7	**219.0**
	2-4	9000	<0.57	17.0	36.2	0.77	<0.57	3280	15.0	<17.1	28.9	**41500**	13.1	2670	531	<0.11	19.9	1510	<0.57	<1.1	<571	<0.57	21.2	76.8
	4-6	7900	<0.56	18.0	36.2	<0.56	<0.56	4040	14.0	<16.7	**53.2**	23500	13.9	2910	371	**0.12**	22.6	1220	<0.56	<1.1	<556	<0.56	15.6	89.9
	6-8	8080	<0.57	17.9	36.0	<0.57	<0.57	5990	15.5	<17.1	24.4	23100	12.5	3480	385	<0.11	39.2	1660	<0.57	<1.1	<570	<0.57	16.5	72.2
SB18	0-2	7960	<0.57	**19.5**	32.2	<0.57	<0.57	8580	13.0	<17.0	**18.1**	**25200**	10.2	4070	508	<0.11	**21.5**	**1450**	<0.57	<1.1	<567	<0.57	13.9	61.1
SS-18	0-0.3	11800	<0.61	14.3	74.5	<0.61	**0.76**	3810	**17.9**	<18.2	**76.1**	**23100**	20.9	3760	339	<0.12	**24.5**	**2400**	<0.61	<1.2	<605	<0.61	21.0	**137.0**
	2-4	8170	<0.57	19.0	45.7	**1.00**	<0.57	15800	12.3	<17.1	15.4	20300	9.8	3100	455	<0.11	18.2	2070	<0.57	<1.1	<568	<0.57	14.9	51.2
	4-6	4820	<0.55	13.7	<22.2	<0.55	<0.55	28700	7.5	<16.6	16.6	15700	12.9	16700	343	<0.11	15.5	915	<0.55	<1.1	<554	<0.55	9.1	51.7
	6-8	6560	<0.57	16.2	24.5	<0.57	<0.57	8840	10.9	<17.1	19.4	24000	10.9	3440	439	<0.11	22.8	1270	<0.57	<1.1	<570	<0.57	12.1	69.0
SB19	0-2	8460	<0.56	15.4	**165.0**	<0.56	**2.30**	5700	14.0	<16.9	**2860.0**	23100	**36.9**	3670	370	**0.84**	**22.3**	**1310**	<0.56	<1.1	<564	<0.56	14.5	**580.0**
MRD QA	0-2	9670	<0.60	15.2	59.7	0.54	**2.25**	8120	14.8	10.1	**98.7**	**26200**	25.4	4570	401	**1.08**	**23.8**	**1510**	<0.60	<0.40	75	<1.0	15.4	**171.0**
SS-19	0-0.3	10100	<0.58	**16.5**	80.9	<0.58	**1.3**	4870	17.2	<17.4	**167**	**23600**	24	3690	342	**0.17**	**24**	**1660**	<0.58	<1.2	<579	<0.58	18	**162**
	2-4	7670	<0.56	14.4	47.7	<0.56	**1.60**	7390	13.5	<16.7	**73.3**	21700	**25.9**	4060	405	**0.37**	21.0	1330	<0.56	<1.1	<555	<0.56	13.4	**184.0**
	4-6	8960	<0.55	14.5	38.9	<0.55	**0.58**	9850	15.4	<16.6	**42.5**	23100	**24.2**	4980	336	**0.79**	22.0	1810	<0.55	<1.1	<552	<0.55	15.6	**94.0**
	6-8	4430	<0.56	17.7	22.7	<0.56	<0.56	5700	8.1	<16.7	17.2	16100	8.7	2970	307	<0.11	14.4	852	<0.56	<1.1	<557	<0.56	9.3	57.6
SB20	0-2	8530	<0.58	14.0	53.2	<0.58	<0.58	2430	13.6	<17.5	**35.4**	21400	16.3	2190	1360	<0.12	18.2	**1110**	<0.58	<1.2	<582	<0.58	15.4	**79.6**
SS-20	0-0.3	7580	<0.59	11	66.4	<0.59	**1**	**22800**	11.7	<17.7	**129**	16900	22.5	2920	371	<0.12	17	**1400**	<0.59	<1.2	<591	<0.59	12.8	**181**
	2-4	8410	<0.60	15.5	34.1	<0.60	<0.60	2670	13.6	<17.9	24.7	21700	12.7	2980	406	**0.13**	23.7	1270	<0.60	<1.2	<595	<0.60	14.9	78.2
	4-6	9520	<0.56	14.1	37.7	<0.56	<0.56	1220	14.0	<16.8	21.4	20000	12.1	2250	309	**0.13**	21.6	1560	<0.56	<1.1	<561	<0.56	17.2	66.0

Bolded and Underlined => Surface and Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA 2 TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SB21	0-2	7980	<0.58	14.7	42.3	<0.58	<0.58	3110	13.2	<17.4	**56.1**	22900	14.1	**3370**	471	<0.12	**22.0**	**1190**	<0.58	<1.2	<580	<0.58	13.6	**88.6**
SS-21	0-0.3	8510	<0.69	13	**127**	<0.69	**1.8**	8000	**19.3**	<20.8	**126**	**24300**	**29.5**	**3490**	455	**0.16**	18.7	**1680**	<0.69	<1.4	<693	<0.69	14.2	**215**
	2-4	7120	<0.57	15.6	30.0	<0.57	<0.57	12600	12.6	<17.1	20.6	24600	11.7	7170	388	<0.11	25.1	1290	<0.57	<1.1	<571	<0.57	13.1	60.0
	4-6	7280	<0.57	13.2	30.6	<0.57	<0.57	10800	14.1	<17.0	19.8	23400	10.1	5900	365	<0.11	**82.5**	1430	<0.57	<1.1	<568	<0.57	13.4	77.4
	6-8	10100	<0.57	17.6	39.5	<0.57	<0.57	7980	16.3	<17.1	20.6	25400	11.0	4530	451	<0.11	26.1	2310	<0.57	<1.1	<571	<0.57	18.4	69.1
SB22	0-2	6780	<0.55	11.9	23.5	<0.55	<0.55	11600	11.9	<16.4	15.5	18500	8.1	**3890**	389	<0.11	18.1	**1660**	<0.55	<1.1	<546	<0.55	13.8	48.9
SS-22	0-0.3	9880	<0.59	**15.7**	**202**	<0.59	**1.7**	6000	**17.9**	<17.6	**167**	22600	**35**	**3470**	365	**0.15**	**22.6**	**1880**	<0.59	<1.2	<587	<0.59	17.9	**260**
	2-4	7320	<0.55	13.3	30.9	<0.55	<0.55	10400	13.7	<16.4	15.0	19400	8.4	5230	335	<0.11	26.8	1760	<0.55	<1.1	<546	<0.55	14.9	49.1
	4-6	3760	<0.55	12.6	25.6	<0.55	<0.55	20000	7.8	<16.5	16.9	18000	9.2	3610	449	<0.11	15.9	678	<0.55	<1.1	<551	<0.55	8.3	56.3
	6-8	4390	<0.56	9.2	28.9	<0.56	<0.56	14600	12.3	<16.7	14.4	15500	9.0	3990	363	<0.11	**84.7**	950	<0.56	<1.1	<555	<0.56	10.2	54.7
SB23	0-2	7690	<0.55	**16.7**	26.7	<0.55	<0.55	6730	12.8	<16.5	**18.2**	21200	15.3	**3830**	325	<0.11	19.0	**1700**	<0.55	<1.1	<550	<0.55	14.6	58.5
SS-23	0-0.3	9920	<0.58	**16.4**	43.6	<0.58	<0.58	1750	15.8	<17.4	**22.4**	**23800**	12.5	2780	363	<0.12	**22.4**	**2290**	<0.58	<1.2	<581	<0.58	18.4	**72.6**
	2-4	5270	<0.55	**35.7**	25.8	<0.55	<0.55	10400	9.9	<16.4	15.2	22000	13.7	3330	320	<0.11	23.0	1110	<0.55	<1.1	<548	<0.55	10.8	46.9
	4-6	6040	<0.56	12.7	24.6	<0.56	<0.56	6830	12.3	<16.8	15.4	17000	9.6	3090	313	<0.11	16.5	1190	<0.56	<1.1	<559	<0.56	11.1	49.8
	6-8	7100	<0.62	12.3	<25.0	<0.62	<0.62	10500	11.7	<18.7	16.3	21300	9.8	4340	312	<0.12	19.0	1500	<0.62	<1.2	<624	<0.62	13.3	56.0
SB24	0-2	11200	<0.58	**16.6**	**125.0**	<0.58	**2.40**	4390	16.3	<17.3	**238.0**	**25100**	**35.2**	**3740**	326	**0.17**	**24.0**	**1430**	<0.58	<1.2	<575	<0.58	17.0	**214.0**
MRD QA	0-2	11100	<0.60	**15.8**	**100.0**	0.59	**1.53**	5660	16.7	10.2	**195.0**	**26900**	**31.1**	**4130**	374	**0.26**	**23.8**	**1590**	<0.60	<0.40	82	<1.0	17.0	**206.0**
SS-24	0-0.3	10200	0.62	15.3	**117**	<0.61	**1.4**	6590	15.9	<18.2	**102**	**28000**	**28.9**	**3630**	417	**0.17**	**22.4**	**1980**	<0.61	<1.2	<608	<0.61	17.9	**190**
	2-4	9260	<0.57	15.7	79.8	<0.57	**1.40**	3780	15.2	<17.1	**124.0**	23900	**34.6**	3440	316	**0.17**	23.0	1240	<0.57	<1.1	<571	<0.57	15.4	**197.0**
	4-6	4520	<0.57	13.8	<22.9	<0.57	<0.57	3280	8.9	<17.2	**39.4**	17600	9.1	2340	320	<0.11	16.6	899	<0.57	<1.1	<573	<0.57	9.7	61.6
MRD QA	4-6	5330	<0.60	15.7	30.6	0.26	<0.08	3740	10.5	6.8	**387.0**	19000	**20.6**	2550	258	0.02	16.7	957	<0.6	<0.4	42	<1.0	9.9	**114.0**
	6-8	6080	<0.55	11.0	<21.9	<0.55	<0.55	7230	10.6	<16.4	14.2	18100	11.8	3820	312	<0.11	18.2	1290	<0.55	<1.1	<548	<0.55	12.2	48.1
	12-14	7950	<0.55	15.0	35.8	<0.55	<0.55	11400	13.4	<16.5	18.2	22900	9.6	5780	390	<0.11	22.9	1560	<0.55	<1.1	<549	<0.55	13.6	58.3
SB25	0-2	9900	0.58	9.6	**114.0**	0.65	**0.87**	**35000**	15.0	<17.2	**102.0**	14200	**50.1**	**3630**	529	<0.11	12.6	**1300**	<0.57	<1.1	<573	<0.57	12.3	**200.0**
SS-25	0-0.3	12100	<0.60	9.5	**106**	**2.9**	**0.87**	**57500**	11.5	<18.0	**62.8**	15100	17.8	**11200**	788	<0.12	14.6	**1850**	<0.60	<1.2	<600	<0.60	13.8	**100**
	2-4	10500	0.60	15.1	52.6	<0.59	<0.59	5250	16.2	<17.8	26.6	23300	15.5	2900	551	<0.12	28.7	1380	<0.59	<1.2	<594	<0.59	18.5	77.0
	4-6	11100	<0.61	15.6	50.1	<0.61	<0.61	2200	18.7	<18.2	20.3	24200	14.1	2690	363	<0.12	28.7	1560	<0.61	<1.2	<605	<0.61	21.1	64.6

Bold and Underlined => Surface and Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA 2 TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SB26	0-2	9850	**355**	**110**	**115**	<0.61	**1.8**	3300	15.9	<18.2	**199**	21100	**40800**	2830	425	**0.15**	19.7	**1440**	<0.61	<1.2	<605	<0.69	16.8	**281**
SS-26	0-0.3	7310	0.88	15	**142**	<0.78	**1.2**	8070	**20.9**	<23.4	**118**	**29000**	**35.4**	**3440**	504	<0.16	**26.1**	**1340**	<0.78	<1.6	<781	<0.78	14.1	**246**
	2-4	16900	**3.3**	15.9	110	0.64	<0.63	1830	23.6	<18.8	**41.6**	28000	**186**	3400	790	<0.13	24.6	2160	<0.63	<1.3	<626	<0.63	30.7	**94.2**
	4-6	13300	**1.7**	14.6	90.1	<0.61	<0.61	1740	18.8	<18.3	**39.3**	26900	**175**	2780	1000	<0.12	19.8	1350	<0.61	<1.2	<611	<0.61	26.4	72.9
	6-8	10300	**1.8**	15.1	121	<0.61	**4.1**	2680	15.8	<18.2	**120**	22800	**285**	3230	292	**0.15**	21.3	2010	<061	<1.2	<605	<0.61	19	128
SB27	0-2	8330	<0.58	**15.6**	69.8	<0.58	<0.58	1410	13.2	<17.5	**43.5**	**23800**	16.7	2650	372	<0.12	**21.7**	**1190**	<0.58	<1.2	<583	<0.58	14.5	**88.7**
SS-27	0-0.3	8650	<0.67	<12.9	**99.5**	<0.67	**1.4**	3840	14	<20.0	**85.5**	20000	**33.9**	**3340**	319	<0.13	20.2	**1770**	<0.67	<1.3	<668	<0.67	15.7	**157**
	2-4	11200	<0.58	13.9	38.6	<0.58	<0.58	2080	18.4	<17.5	18.9	27500	10	4500	391	<0.12	31.1	1720	<0.58	<1.2	<584	<0.58	18	68.5
	4-6	8960	<0.61	13.1	38.5	<0.61	<0.61	2010	15.7	<18.4	19.5	23300	10.5	3160	406	<0.12	24.4	1700	<0.61	<1.2	<615	<0.61	16.4	64.2
SB28	0-2	10500	<0.57	15.3	42.1	<0.57	<0.57	3620	15.4	<17.2	**23.2**	22500	12.2	2840	375	<0.11	20.9	**2000**	<0.57	<1.1	<575	<0.57	18.5	**69.7**
SS-28	0-0.3	8900	<0.60	13.4	82.9	<0.60	**1.4**	5620	14.1	<17.9	**112**	19000	**30.3**	**3120**	368	<0.12	18	**1570**	<0.60	<1.2	<598	<0.60	14.3	**161**
	2-4	7200	<0.56	18.3	22.9	<0.56	<0.56	7510	12	<16.9	**37.6**	22600	10.8	4410	388	<0.11	22	1310	<0.56	<1.1	<563	<0.56	13	64.1
	4-6	7670	<0.57	16.4	34.2	<0.57	<0.57	9190	13	<17.2	26.7	25100	11.7	4690	415	<0.11	21.2	1390	<0.57	<1.1	<573	<0.57	13.7	85.9
	6-8	10200	<0.57	17.5	53	<0.57	<0.57	12500	16.6	<17.1	19.8	26900	11.6	5880	390	<0.11	26.1	2000	<0.57	<1.1	<570	<0.57	17.9	61
SB29	0-2	8940	<0.57	14.8	**112**	<0.57	**1.3**	3640	13.7	<17.2	**65.5**	22600	20.1	**3270**	380	**0.18**	20.9	**1160**	<0.57	<1.1	<573	<0.57	15.5	**122**
SS-29	0-0.3	8770	<0.60	14.1	77.6	<0.61	**1.2**	3730	14.8	<18.2	**102**	21000	22.3	**3210**	342	<0.12	**21.2**	**1520**	<0.61	<1.2	<606	<0.61	15.7	**149**
	2-4	9890	<0.59	16.7	74.3	<0.59	**1.3**	2610	15.5	<17.8	**70**	26100	**22.3**	3150	336	**0.18**	22.6	1220	<0.59	<1.2	<593	<0.59	17.8	**121**
	4-6	4240	<0.57	10.3	24.2	<0.57	**7.4**	3370	9.7	<17.0	28.4	20400	17.8	1980	269	<0.11	20.5	747	<0.57	<1.1	<567	<0.57	8.9	**141**
MRD QA	4-6	7890	<0.60	14.2	48.3	0.43	**5.82**	6470	12.8	8.7	**54.8**	23400	**22.8**	3560	384	**0.05**	20.1	1330	<0.6	<0.4	63	<1.0	13.4	**142**
	6-8	7100	<0.55	11.7	24.7	<0.55	<0.55	10900	11.4	<16.5	15.4	22400	8.3	4770	557	<0.11	19.1	1460	<0.55	<1.1	<550	<0.55	13	48.9

Bold and Underlined => Surface and Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA TAL LEVELS Nov-97

BORING	DEPTH (FT)	AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
		ALL READINGS IN MG/KG																						
SS-01	0-0.3	7290	<0.57	9.1	**117.0**	<0.57	<0.57	**161000**	10.4	<17.1	**47.7**	15400	16.8	**3140**	469	<0.11	17.6	**1320**	<0.57	<1.1	<570	<0.57	12.6	**82.1**
SS-01 DUP	0-0.3	6070	<0.53	7.5	**113.0**	<0.53	**0.58**	**202000**	8.7	<15.9	**36.1**	11700	11.3	**3340**	514	<0.11	15.3	**1100**	<0.53	<1.1	<529	<0.53	10.8	57.6
SS-02	0-0.3	7630	<0.64	13.3	**96.8**	<0.64	**1.00**	6930	13.8	<19.1	**89.3**	20700	**61.7**	2990	329	<0.13	21.1	**1270**	<0.64	<1.3	<637	<0.64	14.9	**202.0**
SS-02 DUP	0-0.3	8910	0.75	14.6	**92.2**	<0.65	**1.40**	7340	15.2	<19.4	**93.9**	22500	**78.5**	**3320**	325	**0.80**	**22.0**	**1450**	<0.65	<1.3	<647	<0.65	16.7	**214.0**
SS-03	0-0.3	14100	<0.61	15.0	62.3	<0.61	<0.61	12500	**21.4**	<18.4	**71.7**	**26300**	20.2	**3320**	329	<0.12	**23.5**	**2170**	<0.61	<1.2	<612	<0.61	25.3	**132.0**
SS-03 DUP	0-0.3	13800	<0.61	14.8	73.4	<0.61	<0.61	8010	**22.8**	<18.4	**51.8**	**27200**	19.5	**3640**	398	<0.12	**26.1**	**2030**	<0.61	<1.2	<612	<0.61	25.6	**103.0**
SS-04	0-0.3	8920	<0.58	11.8	**98.4**	<0.58	**0.86**	**75400**	14.1	<17.3	**89.1**	18600	17.3	**3240**	430	<0.12	20.8	**1710**	<0.58	<1.2	<577	<0.58	16.3	85.2
SS-04 DUP	0-0.3	5500	<0.56	7.3	**92.0**	<0.56	**0.64**	**167000**	8.8	<16.7	**47.5**	12300	12.6	2930	476	<0.11	15.6	**979**	<0.56	<1.1	<557	<0.56	9.7	60.7
SS-05	0-0.3	8860	<0.60	12.8	69.4	<0.60	**0.61**	**48700**	14.4	<17.9	**56.0**	20500	17.6	2930	397	<0.12	20.4	**1120**	<0.6	<1.2	<595	<0.6	17.0	**90.5**
SS-5 DUP	0-0.3	5490	<0.58	**19.6**	64.4	<0.58	**0.80**	**137000**	10.7	<17.5	**64.2**	16900	16.8	2790	441	<0.12	17.3	862	<0.58	<1.2	<582	<0.58	10.4	**73.8**
SS-06	0-0.3	9170	<0.63	**16.5**	81.5	<0.63	**1.20**	5990	15.5	<18.8	**101.0**	22700	22.0	**3670**	402	<0.13	**22.0**	**1690**	<0.63	<1.3	<628	<0.63	16.8	**145.0**
SS-06 DUP	0-0.3	8280	0.68	14.0	63.2	<0.66	**1.80**	11000	14.0	<19.8	**102.0**	21100	**36.6**	**3850**	333	**0.13**	**21.5**	**1390**	<0.66	<1.3	<660	<0.66	14.9	**162.0**
SS-07	0-0.3	8600	<0.62	**15.5**	31.3	<0.62	**0.95**	8890	14.1	<18.6	**95.8**	20800	24.3	**3760**	365	**0.23**	20.9	**1640**	<0.62	<1.2	<621	<0.62	15.9	**125.0**
SS-07 DUP	0-0.3	8740	<0.62	13.8	71.6	<0.62	**1.10**	6160	14.5	<18.7	**94.8**	21000	24.3	**3710**	342	**0.15**	**21.2**	**1400**	<0.62	<1.2	<624	<0.62	15.8	**158.0**
SS-08	0-0.3	8270	0.65	14.7	67.3	<0.61	**0.69**	8060	17.1	<18.4	**76.7**	**30800**	20.9	**3590**	494	<0.12	**23.3**	**1110**	<0.61	<1.2	<612	<0.61	17.1	**158.0**
SS-08 DUP	0-0.3	10700	<0.59	14.9	85.7	<0.59	**0.78**	4110	17.4	<17.8	**93.3**	**25000**	25.0	**3430**	648	<0.12	**23.0**	**1400**	<0.59	<1.2	<594	<0.59	20.9	**158.0**
SS-09	0-0.3	11200	<0.60	**18.1**	50.9	<0.60	<0.60	1950	**18.5**	<17.9	**19.7**	**28200**	11.6	**3660**	351	<0.12	**28.2**	**2020**	<0.60	<1.2	<595	<0.60	20.0	**68.3**
SS-09 DUP	0-0.3	11500	<0.59	**16.8**	31.7	<0.59	<0.59	2600	**18.5**	<17.8	**28.0**	**26000**	15.2	**3450**	447	<0.12	**28.3**	**2290**	<0.59	<1.2	<592	<0.59	22.3	**77.9**
SS-10	0-0.3	11800	<0.60	**17.3**	84.3	<0.60	<0.60	3530	**19.6**	<18.0	**29.1**	**29000**	13.9	**4040**	333	<0.12	**31.5**	**1540**	<0.60	<1.2	<600	<0.60	21.5	**85.0**
SS-10 DUP	0-0.3	13700	<0.61	13.0	**123.0**	0.86	<0.61	3640	**22.0**	<18.3	**25.4**	**26500**	14.1	**4060**	537	<0.12	**35.1**	**2130**	<0.61	<1.2	<612	<0.61	25.1	**70.8**
SS-11	0-0.3	9790	<0.66	**15.8**	**109.0**	<0.66	**2.50**	4730	**18.9**	<19.7	**156.0**	**25300**	**31.0**	**3950**	373	**0.15**	**25.3**	**1980**	<0.66	<1.3	<657	<0.66	17.5	**184.0**
SS-11 DUP	0-0.3	7650	<0.62	13.1	68.8	<0.62	**1.30**	5520	13.1	<18.7	**128.0**	20100	24.0	**3540**	378	**0.17**	20.7	**1240**	<0.62	<1.2	<622	<0.62	13.8	**264.0**
SS-12	0-0.3	8930	0.60	14.5	75.6	<0.60	**1.20**	5780	15.0	<17.9	**103.0**	21100	**92.8**	**3560**	358	<0.12	20.7	**1650**	<0.60	<1.2	<598	<0.60	16.8	**192.0**
SS-12 DUP	0-0.3	10100	0.64	15.2	77.4	<0.59	**1.30**	5500	16.1	<17.6	**119.0**	**23400**	**28.8**	**3480**	374	**0.13**	**22.5**	**1760**	<0.59	<1.2	<587	<0.59	18.7	**181.0**
SS-13	0-0.3	11700	<0.60	**16.6**	59.1	<0.60	**0.71**	5330	**17.9**	<18.0	**96.9**	**27300**	18.3	**4580**	374	<0.12	**26.4**	**1760**	<0.60	<1.2	<599	<0.60	20.0	**102.0**
SS-13 DUP	0-0.3	13000	<0.59	11.7	48.6	<0.59	<0.59	2010	17.3	<17.8	**30.4**	22200	13.6	2870	185	<0.12	15.5	**1200**	<0.59	<1.2	<592	<0.59	25.8	**62.5**
SS-14	0-0.3	10600	<0.60	**16.0**	72.5	<0.60	**1.40**	4640	17.3	<18.1	**127.0**	**24800**	**29.4**	**3740**	383	<0.12	**24.6**	**1980**	<0.60	<1.2	<604	<0.60	19.8	**190.0**
SS-14 DUP	0-0.3	12000	<0.60	**15.7**	**552.0**	<0.60	**0.79**	3860	**19.0**	<17.9	**96.3**	**25200**	21.5	**3770**	353	**0.14**	**26.0**	220	<0.60	<1.2	<598	<0.60	21.7	**126.0**
SS-15	0-0.3	6660	<0.60	12.9	73.3	<0.60	**0.82**	10100	13.1	<18.1	**78.5**	21500	24.9	2510	379	<0.12	20.4	**1170**	<0.60	<1.2	<602	<0.60	12.7	**164.0**
SS-16	0-0.3	12600	<0.57	**15.6**	62.9	0.61	<0.57	**79900**	17.0	<17.2	**391.0**	16500	**39.1**	**3740**	460	<0.11	17.4	**1560**	<0.57	<1.1	<574	**0.57**	14.2	**77.9**
SS-17	0-0.3	7900	<0.59	14.3	72.8	<0.59	**1.50**	5160	13.8	<17.7	**136.0**	21300	**27.7**	**3280**	344	**0.33**	**21.5**	**1310**	<0.59	<1.2	<591	<0.59	14.7	**219.0**
SS-18	0-0.3	11800	<0.61	14.3	74.5	<0.61	**0.76**	3810	**17.9**	<18.2	**76.1**	23100	20.9	**3760**	339	<0.12	**24.5**	**2400**	<0.61	<1.2	<605	<0.61	21.0	**137.0**

Bold and underlined => Surface and Subsurface Phase II 1998 Facility-Wide Soil Background

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SURF > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

RVAAP OPEN DEMOLITION AREA TAL LEVELS Nov-97

BORING	DEPTH (FT)	ALL READINGS IN MG/KG AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	PO	SE	AG	NA	TH	VN	ZN
SS-19	0-0.3	10100	<0.58	**16.5**	80.9	<0.58	**1.3**	4870	17.2	<17.4	**167**	**23600**	24	3690	342	**0.17**	**24**	**1660**	<0.58	<1.2	<579	<0.58	18	**162**
SS-20	0-0.3	7580	<0.59	11	66.4	<0.59	**1**	**22800**	11.7	<17.7	**129**	16900	22.5	2920	371	<0.12	17	**1400**	<0.59	<1.2	<591	<0.59	12.8	**181**
SS-21	0-0.3	8510	<0.69	13	**127**	<0.69	**1.8**	8000	**19.3**	<20.8	**126**	**24300**	**29.5**	3490	455	**0.16**	18.7	**1680**	<0.69	<1.4	<693	<0.69	14.2	**215**
SS-22	0-0.3	9880	<0.59	**15.7**	**202**	<0.59	**1.7**	6000	**17.9**	<17.6	**167**	22600	**35**	3470	365	**0.15**	**22.6**	**1880**	<0.59	<1.2	<587	<0.59	17.9	**260**
SS-23	0-0.3	9920	<0.58	**16.4**	43.6	<0.58	<0.58	1750	15.8	<17.4	**22.4**	**23800**	12.5	2780	363	<0.12	**22.4**	**2290**	<0.58	<1.2	<581	<0.58	18.4	**72.6**
SS-24	0-0.3	10200	0.62	15.3	**117**	<0.61	**1.4**	6590	15.9	<18.2	**102**	**28000**	**28.9**	3630	417	**0.17**	**22.4**	**1980**	<0.61	<1.2	<608	<0.61	17.9	**190**
SS-25	0-0.3	12100	<0.60	9.5	**106**	**2.9**	**0.87**	**57500**	11.5	<18.0	**62.8**	15100	17.8	11200	788	<0.12	14.6	**1850**	<0.60	<1.2	<600	<0.60	13.8	**100**
SS-26	0-0.3	7310	0.88	15	**142**	<0.78	**1.2**	8070	**20.9**	<23.4	**118**	**29000**	**35.4**	3440	504	<0.16	**26.1**	**1340**	<0.78	<1.6	<781	<0.78	14.1	**246**
SS-27	0-0.3	8650	<0.67	<12.9	**99.5**	<0.67	**1.4**	3840	14	<20.0	**85.5**	20000	**33.9**	3340	319	<0.13	20.2	**1770**	<0.67	<1.3	<668	<0.67	15.7	**157**
SS-28	0-0.3	8900	<0.60	13.4	82.9	<0.60	**1.4**	5620	14.1	<17.9	**112**	19000	**30.3**	3120	368	<0.12	18	**1570**	<0.60	<1.2	<598	<0.60	14.3	**161**
SS-29	0-0.3	8770	<0.60	14.1	77.6	<0.61	**1.2**	3730	14.8	<18.2	**102**	21000	22.3	3210	342	<0.12	**21.2**	**1520**	<0.61	<1.2	<606	<0.61	15.7	**149**
SS-30	0-0.3	10600	<0.65	14.4	87.9	<0.65	**1.5**	3610	17.3	<19.5	**98.7**	**23300**	**37.8**	3390	380	**0.18**	**22.7**	**2450**	<0.65	<1.3	<651	<0.65	18.5	**171**
SS-31	0-0.3	11300	0.67	14.7	**106**	**1**	**1.5**	15000	14.7	<18.5	**107**	22000	**90.2**	5300	422	<0.12	20.4	**1930**	<0.62	<1.2	<615	<0.62	16.2	**269**
SS-32	0-0.3	9470	0.79	**19.1**	**94.6**	<0.66	**1.9**	4470	**25.5**	<19.9	**203**	**36300**	**35.1**	2880	432	<0.13	**33.1**	**2280**	<0.66	<1.3	<663	<0.66	17.2	**197**

Bold and underlined => Surface and Subsurface Phase II 1998 Facility-Wide Background Soil

		AL	SB	AS	BA	BE	CD	CA	CR	CO	CU	FE	PB	MG	MN	HG	NI	K	SE	AG	NA	TH	VN	ZN
EPA RESIDEN	REGION 9 PRG'S	77,000	31.0	0.38	5,300	0.14	38.0		30.0	4,600	2,800		400		3,200	6.5	1,500		380	380		6.1	540	23,000
PH I BG	1996	15,600		19.6	75		0.29		18.7				17.9		728	0.08			2.6	<0.24				72.1
USAEHA	1992 BG			20.333	50.333		No test		18.1667				17.5			No test			0.77667	No test				
PH II 1998 BG	**SURFACE 0 - 1**	**17,700**	**0.96**	**15.4**	**88.4**	**0.88**	**0**	**15,800**	**17.4**	**10.4**	**17.7**	**23,100**	**26.1**	**3,030**	**1,450**	**0.04**	**21.1**	**927**	**1.4**	**0**	**123**	**0**	**31.1**	**61.8**
PH II 1998 BG	**SUB-SUR > 1'**	**19,500**	**0.96**	**19.8**	**124**	**0.88**	**0**	**35,500**	**27.2**	**23.2**	**32.3**	**35,200**	**19.1**	**8,790**	**3,030**	**0.04**	**60.7**	**3,350**	**1.5**	**0**	**145**	**0.91**	**37.6**	**93.3**

Selected Results From

USACE 1998. *Phase I Remedial Investigation of High-Priority Areas of Concern at the Ravenna Army Ammunition Plant, Ravenna Ohio*, DACA 69-94-D-0029, D.O. 0010 and 0022

Table 4.1. Demolition Area #2 Analytical Results (Surface Soil, Subsurface Soil, and Sediment)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
SURFACE SOIL									
2,4,6-Trinitrotoluene	µg/kg	4/ 30	.		540	4400		Yes	Detected > 5% of Samples
Tetryl	µg/kg	1/ 30	.		3500	3500		Yes	Detected > 5% of Samples
Aluminum	mg/kg	30/ 30	15600	3/ 30	7730	19900	20000 - 100000	Yes	> 5% Detect Above Background
Arsenic	mg/kg	30/ 30	19.6	6/ 30	11.1	25.7	5.2 - 27.0	Yes	> 5% Detect Above Background
Barium	mg/kg	30/ 30	75	12/ 30	27.1	266	300 - 700	Yes	> 5% Detect Above Background
Beryllium	mg/kg	1/ 1	.		0.51	0.51	1.5 - 2.0	Yes	No Background Data Available
Cadmium	mg/kg	27/ 30	0.29	22/ 30	0.13	3.1	1 - 2	Yes	> 5% Detect Above Background
Calcium	mg/kg	1/ 1	.		4350	4350	1100 - 31000	No	Essential Nutrient
Chromium	mg/kg	30/ 30	18.7	4/ 30	9.7	25.8	15.0 - 100.0	Yes	> 5% Detect Above Background
Cobalt	mg/kg	1/ 1	.		9.8	9.8	7 - 20	Yes	No Background Data Available
Copper	mg/kg	1/ 1	.		67.4	67.4	7.0 - 70.0	Yes	No Background Data Available
Iron	mg/kg	1/ 1	.		23500	23500	15000 - 50000	No	Essential Nutrient
Lead	mg/kg	30/ 30	17.9	16/ 30	12.2	1900	15 - 30	Yes	> 5% Detect Above Background
Magnesium	mg/kg	1/ 1	.		3770	3770	3000 - 15000	No	Essential Nutrient

Table 4.1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Manganese	mg/kg	30/ 30	728	6/ 30	188	1120	150 - 1000	Yes	> 5% Detect Above Background
Mercury	mg/kg	19/ 30	0.08	10/ 30	0.04	0.28	0.03 - 0.22	Yes	> 5% Detect Above Background
Nickel	mg/kg	1/ 1	.		22	22	15 - 50	Yes	No Background Data Available
Potassium	mg/kg	1/ 1	.		1300	1300	11800 - 25100	No	Essential Nutrient
Selenium	mg/kg	26/ 30	2.6	0/ 30	0.35	2	<0.1 - 1.2	No	Below Background
Sodium	mg/kg	1/ 1	.		218	218	5000 - 7000	No	Essential Nutrient
Thallium	mg/kg	1/ 1	.		1.1	1.1		Yes	No Background Data Available
Vanadium	mg/kg	1/ 1	.		14	14	20 - 150	Yes	No Background Data Available
Zinc	mg/kg	30/ 30	72.1	15/ 30	57.9	375	25 - 110	Yes	> 5% Detect Above Background
SUBSURFACE SOIL									
2,4,6-Trinitrotoluene	µg/kg	5/ 29	.		420	2300		Yes	Detected > 5% of Samples
2,4-Dinitrotoluene	µg/kg	1/ 29	.		2600	2600		Yes	Detected > 5% of Samples
Tetryl	µg/kg	2/ 29	.		420	4300		Yes	Detected > 5% of Samples
Aluminum	mg/kg	29/ 29	15600	1/ 29	6700	16600	20000 - 100000	No	<5% Detect Above Background
Arsenic	mg/kg	29/ 29	19.6	8/ 29	10.7	30.8	5.2 - 27.0	Yes	> 5% Detect Above Background

Table 4.1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Barium	mg/kg	29/ 29	75	11/ 29	29.9	593	300 - 700	Yes	> 5% Detect Above Background
Beryllium	mg/kg	2/ 2	.		0.71	0.83	1.5 - 2.0	Yes	No Background Data Available
Cadmium	mg/kg	25/ 29	0.29	12/ 29	0.11	2.9	1 - 2	Yes	> 5% Detect Above Background
Calcium	mg/kg	2/ 2	.		1280	18400	1100 - 31000	No	Essential Nutrient
Chromium	mg/kg	29/ 29	18.7	6/ 29	10	21.9	15.0 - 100.0	Yes	> 5% Detect Above Background
Cobalt	mg/kg	2/ 2	.		10.7	12.4	7 - 20	Yes	No Background Data Available
Copper	mg/kg	2/ 2	.		20.6	23.3	7.0 - 70.0	Yes	No Background Data Available
Iron	mg/kg	2/ 2	.		24600	25900	15000 - 50000	No	Essential Nutrient
Lead	mg/kg	29/ 29	17.9	8/ 29	9.6	87.2	15 - 30	Yes	> 5% Detect Above Background
Magnesium	mg/kg	2/ 2	.		2940	5780	3000 - 15000	No	Essential Nutrient
Manganese	mg/kg	29/ 29	728	2/ 29	132	1080	150 - 1000	Yes	> 5% Detect Above Background
Mercury	mg/kg	9/ 29	0.08	6/ 29	0.04	1	0.03 - 0.22	Yes	> 5% Detect Above Background
Nickel	mg/kg	2/ 2	.		21.8	29.7	15 - 50	Yes	No Background Data Available
Potassium	mg/kg	2/ 2	.		832	1820	11800 - 25100	No	Essential Nutrient
Selenium	mg/kg	21/ 29	2.6	0/ 29	0.35	1.3	<0.1 - 1.2	No	Below Background
Sodium	mg/kg	2/ 2	.		175	236	5000 - 7000	No	Essential Nutrient

Table 4.1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Thallium	mg/kg	2/ 2	.		0.82	1.2		Yes	No Background Data Available
Vanadium	mg/kg	2/ 2	.		17.5	20.5	20 - 150	Yes	No Background Data Available
Zinc	mg/kg	29/ 29	72.1	11/ 29	45.8	235	25 - 110	Yes	> 5% Detect Above Background
Bis(2-ethylhexyl)phthalate	µg/kg	1/ 2	.		50	50		Yes	Detected > 5% of Samples
Methylene chloride	µg/kg	1/ 2	.		6	6		Yes	Detected > 5% of Samples
Toluene	µg/kg	1/ 2	.		170	170		Yes	Detected > 5% of Samples
SEDIMENT									
Cyanide	mg/kg	1/ 1	.		0.15	0.15		Yes	No Background Data Available
Aluminum	mg/kg	3/ 3	15600	0/ 3	1320	2040	20000 - 100000	No	Below Background
Arsenic	mg/kg	3/ 3	19.6	0/ 3	3.1	10.4	5.2 - 27.0	No	Below Background
Barium	mg/kg	3/ 3	75	0/ 3	8	19.7	300 - 700	No	Below Background
Cadmium	mg/kg	2/ 3	0.29	0/ 3	0.1	0.16	1 - 2	No	Below Background
Calcium	mg/kg	1/ 1	.		387	387	1100 - 31000	No	Essential Nutrient
Chromium	mg/kg	3/ 3	18.7	0/ 3	2.2	3	15.0 - 100.0	No	Below Background
Cobalt	mg/kg	1/ 1	.		2	2	7 - 20	Yes	No Background Data Available
Copper	mg/kg	1/ 1	.		3.6	3.6	7.0 - 70.0	Yes	No Background Data Available
Iron	mg/kg	1/ 1	.		4730	4730	15000 - 50000	No	Essential Nutrient
Lead	mg/kg	3/ 3	17.9	0/ 3	2.9	7.1	15 - 30	No	Below Background

Table 4.1 (continued)

Analyte	Units	Frequency of Detects	Background Criteria	Detects > Background	Minimum Detect	Maximum Detect	USGS Value	Site Related?	Justification
Magnesium	mg/kg	1/ 1	.		469	469	3000 - 15000	No	Essential Nutrient
Manganese	mg/kg	3/ 3	728	0/ 3	87.6	401	150 - 1000	No	Below Background
Nickel	mg/kg	1/ 1	.		4	4	15 - 50	Yes	No Background Data Available
Potassium	mg/kg	1/ 1	.		250	250	11800 - 25100	No	Essential Nutrient
Sodium	mg/kg	1/ 1	.		153	153	5000 - 7000	No	Essential Nutrient
Thallium	mg/kg	1/ 1	.		0.4	0.4		Yes	No Background Data Available
Vanadium	mg/kg	1/ 1	.		2.6	2.6	20 - 150	Yes	No Background Data Available
Zinc	mg/kg	3/ 3	72.1	0/ 3	16.4	30.5	25 - 110	No	Below Background
Chloroform	µg/kg	1/ 1	.		2	2		Yes	Detected > 5% of Samples

Selected Results From

US Army IOC 2000, *Report of Analytical Results, Demolition Area #2 CERCLA Sites, Ravenna Army Ammunition Plant, Ravenna, Ohio*, DAAA09-99-D-018, D.O. #0001, March

Table 4. 0-1 Foot Results

Constituent	Sample ID (mg/kg)						
	SC-A	SC-B	SC-C	SC-D	BS-2/1	BS-2/2	USGS/EP\A*
Arsenic	7.1	9.2	8.7	11.7	17.3	10.8	5.2-27.0
Lead	24.2	**338**	24.2	13.6	16.1	16.8	15-30
Antimony	ND	1.8	ND	ND	ND	ND	
Selenium	0.72	ND	ND	ND	0.60	0.56	<0.1-1.2
Silver	ND	ND	0.51	ND	ND	ND	
Aluminum	7710	15300	5180	10900	15900	15600	20,000-100,000
Barium	60.3	125	41.2	49.1	60.9	52.1	300-700
Beryllium	0.21	0.41	ND	0.34	0.49	0.42	1.5-2.0
Calcium	164	687	833	1570	277	129	1,100-31,000
Cadmium	4.7	6.9	0.29	ND	ND	ND	
Cobalt	6.8	8.1	4.3	10.2	9.5	10.1	7-20.0
Chromium	9.3	14.0	10.2	16.4	22.8	19.8	15-100
Copper	15.2	**1910**	**281**	35.0	24.4	17.1	7-70.0
Iron	12400	18400	20600	23800	35300	24300	15,000-50,000
Potassium	403	795	934	1620	1580	1750	11,800-25,100
Magnesium	1150	1810	1140	3040	3780	2670	3,000-15,000
Manganese	301	478	203	**1970**	154	496	150-1,000
Sodium	49.7	251	34.5	285	ND	38.0	5,000-7,000
Nickel	8.3	14.2	9.9	21.2	25.1	15.4	15-50
Vanadium	15.1	21.7	10.2	19.3	27.3	28.0	20-150
Zinc	62.9	3680	44.8	71.9	64.6	61.7	25,000-110,000
Silver, TCLP	ND	ND	ND	ND	ND	ND	5.0
Arsenic, TCLP	ND	ND	ND	ND	ND	ND	5.0
Barium, TCLP	0.36	2.4	ND	0.11	0.29	0.19	100.0
Cadmium, TCLP	0.23	0.14	ND	ND	ND	ND	1.0
Chromium, TCLP	ND	ND	ND	ND	ND	ND	5.0
Lead, TCLP	0.057	3.7	ND	ND	ND	ND	5.0
Selenium, TCLP	ND	ND	ND	ND	ND	ND	1.0
Mercury, TCLP	ND	ND	ND	ND	ND	ND	0.2
Mercury	0.14	0.029	0.058	0.013	0.014	0.069	
Thallium	0.42	0.45	0.41	0.40	0.45	0.43	
Total Cyanide	ND	ND	ND	ND	ND		
Total Residue (%)	79.4	74.8	80.5	81.8	80.2	78.7	
1,3-Dinitrobenzene							
2,4-Dinitrotoluene							
2,6-Dinitrotoluene							
Nitrobenzene							
Nitroglycerin							
1,3,5-Trinitrobenzene							
2,4,6-Trinitrotoluene							
HMX							
RDX							
Tetryl							
2-Nitrotoluene							
3-Nitrotoluene							
Nitroguanidine							
Nitrocellulose							

Table 5. 1-3 feet Results

Constituent	Sample ID (mg/kg)						
	SC-A	SC-B	SC-C	SC-D	BS-2/1	BS-2/2	USGS/EPA*
Arsenic	12.4	9.3	14.2	15.0	18.5	10.5	5.2-27.0
Lead	19.6	818	13.2	12.1	12.2	14.7	15-30
Antimony	ND	15.1	ND	ND	ND	ND	
Selenium	0.55	0.54	ND	ND	ND	0.99	<0.1-1.2
Silver	ND	0.50	ND	ND	ND	ND	
Aluminum	11400	43200	8390	9010	7930	11500	20000-100000
Barium	43.6	331	46.1	40.9	36.4	56.0	300-700
Beryllium	0.37	0.39	0.33	0.37	0.21	0.33	1.5-2.0
Calcium	145	3660	1390	4970	209	341	1100-31000
Cadmium	4.4	29.1	ND	ND	ND	ND	
Cobalt	8.5	7.0	10.0	10.6	7.0	9.2	7-20.0
Chromium	15.5	19.3	13.4	15.1	12.3	15.0	15-100
Copper	23.6	6730	21.8	29.3	21.1	11.2	7-70.0
Iron	23600	28100	21500	26100	24700	23500	15000-50000
Potassium	1210	570	1070	1580	549	797	11800-25100
Magnesium	2370	1920	2660	3940	1730	2170	3000-15000
Manganese	285	758	369	424	246	489	150-1000
Sodium	ND	1190	37.2	51.7	37.1	ND	5000-7000
Nickel	16.5	28.8	20.9	23.9	14.1	13.6	15-50
Vanadium	20.7	15.3	14.7	15.3	15.3	21.0	20-150
Zinc	93.7	21400	57.8	80.4	50.4	55.4	25000-110000
Silver, TCLP	ND	ND	ND	ND	ND	ND	5.0
Arsenic, TCLP	ND	ND	ND	ND	ND	ND	5.0
Barium, TCLP	0.26	2.2	0.10	0.29	0.25	0.29	100.0
Cadmium, TCLP	0.044	0.24	ND	ND	ND	ND	1.0
Chromium, TCLP	0.0089	0.0079	ND	ND	ND	0.01	5.0
Lead, TCLP	ND	0.97	0.038	ND	ND	ND	5.0
Selenium, TCLP	ND	ND	ND	ND	ND	ND	1.0
Mercury, TCLP	0.00095	ND	ND	ND	ND	ND	0.2
Mercury	0.048	0.094	ND	ND	0.007	0.049	
Thallium	0.47	0.42	0.28	0.40	0.44	0.45	
Total Cyanide	ND	ND	ND	ND	ND		
Total Residue (%)	81.1	84.7	84.5	85.2	84.0	84.8	
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND	
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	
Nitrobenzene	ND	ND	ND	ND	ND	ND	
Nitroglycerin	ND	ND	ND	ND	ND	ND	
1,3,5-Trinitrobenzene	ND	2.0	ND	ND	ND	ND	
2,4,6-Trinitrotoluene	ND	50.0	ND	ND	ND	2.8	
HMX	ND	ND	ND	ND	ND	ND	
RDX	ND	ND	ND	ND	ND	ND	
Tetryl	ND	ND	ND	ND	ND	ND	
2-Nitrotoluene	ND	ND	ND	ND	ND	ND	
4-Nitrotoluene	ND	ND	ND	ND	ND	ND	
3-Nitrotoluene	ND	ND	ND	ND	ND	ND	
Nitroguanidine	ND	ND	ND	ND	ND	ND	
Nitrocellulose	ND	14.7	ND	ND	ND	5.8	

Table 6. 3-4 Foot Results

Constituent	Sample ID (mg/kg)						
	SC-A	SC-B	SC-C	SC-D	BS-2/1	BS-2/2	USGS/EPA*
Arsenic	12.8	9.7	10.4	13.1	19.0	9.6	5.2-27.0
Lead	16.0	491	12.0	12.8	13.2	19.4	15-30
Antimony	ND	14.6	ND	ND	ND	ND	
Selenium	0.45	0.94	ND	0.44	0.61	0.87	<0.1-1.2
Silver	ND	0.36	ND	ND	ND	ND	
Aluminum	13300	43900	7950	7790	9290	13500	20000-100000
Barium	91.0	299	37.1	33.9	30.8	66.6	300-700
Beryllium	0.66	0.54	0.41	0.42	0.31	0.45	1.5-2.0
Calcium	886	1540	1530	2130	188	434	1100-31000
Cadmium	1.1	41.3	ND	ND	ND	ND	
Cobalt	12.7	10.6	10.4	9.4	7.0	12.9	7-20.0
Chromium	19.6	21.0	15.4	13.9	14.2	16.0	15-100
Copper	21.5	6490	21.1	19.5	21.6	17.0	7-70.0
Iron	26600	39500	25600	23900	26100	20400	15000-50000
Potassium	2160	1060	1260	1610	1320	1180	11800-25100
Magnesium	3540	2340	2860	2740	2010	2210	3000-15000
Maganese	361	768	465	479	269	1030	150-1000
Sodium	ND	1190	37.2	51.7	37.1	ND	5000-7000
Nickel	16.5	28.8	20.9	23.9	14.1	13.6	15-50
Vanadium	20.7	15.3	14.7	15.3	15.3	21.0	20-150
Zinc	93.7	21400	57.8	80.4	50.4	55.4	25000-110000
Silver, TCLP	ND	ND	ND	ND	ND	ND	5.0
Arsenic, TCLP	ND	ND	ND	ND	ND	ND	5.0
Barium, TCLP	0.26	2.2	0.10	0.29	0.25	0.29	100.0
Cadmium, TCLP	0.044	0.24	ND	ND	ND	ND	1.0
Chromium, TCLP	0.0089	0.0079	ND	ND	ND	0.01	5.0
Lead, TCLP	ND	0.97	0.038	ND	ND	ND	5.0
Selenium, TCLP	ND	ND	ND	ND	ND	ND	1.0
Mercury, TCLP	0.0009	ND	ND	ND	ND	ND	0.2
Mercury	0.048	0.094	ND	ND	0.007	0.049	
Thallium	0.47	0.42	0.28	0.40	0.44	0.45	
Total Cyanide	ND	ND	ND	ND	ND		
Total Residue (%)	81.1	84.7	84.5	85.2	84.0	84.8	
1,3-Dinitrobenzene	ND	ND	ND	ND	ND	ND	
2,4-Dinitrotoluene	ND	ND	ND	ND	ND	ND	
2,6-Dinitrotoluene	ND	ND	ND	ND	ND	ND	
Nitrobenzene	ND	ND	ND	ND	ND	ND	
Nitroglycerin	ND	ND	ND	ND	ND	ND	
1,3,5-Trinitrobenzene	ND	2.0	ND	ND	ND	ND	
2,4,6-Trinitrotoluene	ND	50.0	ND	ND	ND	2.8	
HMX	ND	ND	ND	ND	ND	ND	
RDX	ND	ND	ND	ND	ND	ND	
Tetryl	ND	ND	ND	ND	ND	ND	
2-Nitrotoluene	ND	ND	ND	ND	ND	ND	
4-Nitrotoluene	ND	ND	ND	ND	ND	ND	
3-Nitrotoluene	ND	ND	ND	ND	ND	ND	
Nitroguanidine	ND	ND	ND	ND	ND	ND	
Nitrocellulose	ND	14.7	ND	ND	ND	5.8	

Table 13. Summary of Explosive Analytical Results (mg/kg)

	Nitrobenzene	1,3,5-Trinitrobenzene	2,4,6-Trinitrotoluene	Nitroguanidine	Nitrocellulose
BS-1/A3			0.072		
BS-1/A4			0.088		
BS-2/2 (comp)			0.082		
BS-2/2 (1-3)			2.8		5.8
BS-2/2 (3-4)			4.2		
SC-B(1-3)		2.0	50.0		14.7
SC-B (3-4)	2.1	4.4	170	0.07	30.3

APPENDIX B

ORDNANCE AND EXPLOSIVES AVOIDANCE PLAN

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UNEXPLODED ORDNANCE (UXO) AVOIDANCE PLAN

FOR

PHASE II RI – DEMOLITION AREA 2

RAVENNA ARMY AMMUNITION PLANT

TABLE OF CONTENTS

FIGURES

UNEXPLODED ORDNANCE (UXO) AVOIDANCE PLAN
DEMOLITION AREA 2 PHASE II RI

1.0 Introduction

The purpose of this document is to establish general guidelines and procedures that assure protection of SpecPro, Inc. personnel, its subcontractors, and the public. This plan includes considerations unique to Ordnance and Explosives (OE) operations.

The objective of this plan is to provide supervisors and workers with the necessary information and guidance to maintain a safe and healthy work place environment. SpecPro views safety and accident prevention as the first priority and place the burden of responsibility on all employees, consultants, and contractor/subcontractor team members. A copy of this plan is available to all employees, subcontractors, and visitors. All supervisors and workers are required to read this plan and sign a log acknowledging that they understand the plan prior to entering the work site. Personnel that violate policies contained in this document may be directed to leave the work site.

1.1 General

SpecPro will use MKM Engineers, Inc. UXO personnel to provide on-site UXO support during all well drilling and sampling activities associated with this project. The specific locations are identified in the Sampling and Analysis Plan (SAP) Addendum for the Phase II Remedial Investigation (RI) at Demolition Area 2. Site historical data indicates a probability that OE components may be encountered within the project areas. The MKM UXO team will not move, touch, disturb, or destroy any UXO encountered during the ordnance avoidance phase of this project. The UXO team will report all UXO to the SpecPro Project Manager, and to Mr. Mark Patterson, Environmental Coordinator, Ravenna Army Ammunition Plant (RVAAP). The MKM UXO Team will safely locate and identify any potential OE and ordnance-related scrap hazards, found in the work area.

2.0 References

EM 385-1-1 *Safety Requirements and Health Manual,* (3 September 1996).

EP 75-1-2 *Unexploded Ordnance Construction Support During HTRW and Construction Activities,* (20 November, 2000).

OE MCX Interim Guidance 00-03, *Basic Safety Concepts and Considerations for Ordnance and Explosives Operations,* (22 May 2000).

3.0 Definitions

Ordnance and Explosive (OE). OE consists of either (1) or (2) below: (1)Ordnance and ammunition, ordnance and ammunition components, chemical or biological warfare material or explosives that have been abandoned, expelled from demolition pits or burning pads, lost, discarded, buried, or fired. Such ordnance and ammunition, ordnance and ammunition components, and explosives are no longer under accountable to any U.S. Department of Defense (DOD) organization or activity (HQDA Policy Memorandum "Explosives Safety Policy for Real Property Containing Conventional OE"); (2) Explosive soil. See definition under "Explosive Soil".

Unexploded Ordnance (UXO). Military munitions that have been primed, fuzed, armed, or otherwise prepared for action, and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or material and remain unexploded either by malfunction, design, or any other cause (40 CFR 266.201).

Inert Ordnance. An item that has functioned as designed, leaving an inert carrier. An item manufactured to serve a specific training purpose. Fragments from UXO.

Explosive Ordnance Disposal (EOD) Personnel. Active duty military EOD personnel.

UXO Personnel. Former EOD personnel employed by a civilian contractor.

Recovered Chemical Warfare Material (RCWM). RCWM is defined as chemical agent material and/or associated equipment and surrounding contaminated media discovered either accidentally or during deliberate real estate recovery/restoration operations that were previously disposed of as waste. RCWM is classified as hazardous waste by the Army and not within the scope of the Army Chemical Surety Program.

Chemical Event. Discovery of an actual or suspected chemical agent or container that may require emergency transportation or disposal.

Explosive Soil. Explosive soil refers to mixtures of explosives (primary or secondary) in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive. Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, shock, or friction. Examples include lead azide, lead styphnate, and mercury fulminate. Soil containing 10 percent or more by weight of any secondary explosive or mixture of secondary explosives is considered

"explosive soil". Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

4.0 UXO Team Composition and Qualifications

The following UXO personnel and procedures are proposed for use at the Demolition Area 2 project site. Procedures used at the site will be followed until such time as the UXO supervisor and the USACE representative deem the Procedures unnecessary.

UXO Team Leader. The UXO Team Leader for this project will be either Mr. Lewis Kovarik or Mr. Steven King. They will be the technical lead for all UXO operations on the project. Mr. King and Mr. Kovarik are qualified for this project by virtue of training and experience. Mr. King has over 25 years of military and civilian experience. He has served as Senior UXO Supervisor, UXO Supervisor, Safety Officer and Quality Control Specialist. Duties and assignments include range clearances as EOD Range Control Officer and Range Supervisor of multiple team operations and civilian UXO experience including performance as a Senior UXO Supervisor for OE removal operations. Mr. Kovarik has over 10 years of military and civilian UXO experience. He has served as UXO Supervisor, Safety Officer and Quality Control Specialist. His duties and assignments also include Range Clearances as EOD Range Supervisor of multiple team operations and civilian UXO experience including performance as UXO Supervisor for OE removal operations.

5.0 Responsibilities and Authority

The Team Leader is the technical lead for all UXO avoidance activities and is assigned the following safety- and health-related responsibilities:

- Reports administratively to the SpecPro Project Manager to coordinate schedule and support requirements.
- Overall coordination between operations and safety and health personnel;
- Reviewing and becoming familiar with the project SAP Addendum and Site-Specific Health and Safety Plan (SSHP) Addendum;
- Early detection and identification of potential problem areas, including safety and health matters; and
- Conducts and documents UXO safety briefings for all site personnel and visitors.

6.0 Work and Safety Plans

UXO Specialists are required to comply with the provisions of the project SAP Addendum and SSHP Addendum, and all applicable Federal, State, and local regulations. They report to their assigned UXO Supervisor for performing duties as member of functional teams. The UXO Team Leader will conduct UXO safety briefings for all site personnel and visitors.

MKM UXO personnel will review the detailed history of process and waste operations as described in the Facility-Wide SAP and the SAP Addendum prepared for this project.

7.0 Access Routes to Sampling Locations

Prior to sampling personnel entering the site, the MKM UXO Team will conduct a reconnaissance of the work area for each of the locations identified in the SAP Addendum. The reconnaissance will include locating a clear path for the work crews, vehicles, and equipment to the approach site. The approach path, at a minimum, will be twice the width of the widest vehicle (normally a minimum of 20 feet). The MKM UXO Team will clearly mark all boundaries of the cleared approach path with pin flags or other suitable markers (normally yellow in color) to prevent personnel from straying into areas that have not been cleared. No personnel will be allowed outside the cleared paths.

If UXO is encountered on the surface, MKM UXO personnel will divert the approach path around the UXO, clearly mark the area with two crossed red pin flags or ribbon, and report the UXO.

A magnetometer will be used to insure there is no subsurface UXO within the approach path. If a magnetic anomaly is encountered, MKM personnel will divert the path around the anomaly. Only MKM UXO personnel will operate magnetometers.

8.0 Soil Sampling Sites

The MKM UXO team will locate areas free of subsurface anomalies for soil sampling areas. Pre-selected sampling areas will be surveyed with a magnetometer to insure that anomalies are not present. If a pre-selected area indicates a subsurface anomaly, a new sampling site will be chosen.

MKM UXO personnel will clearly mark the boundaries of the soil-sampling site. Personnel will not go outside the cleared area. As a minimum, the cleared area will be a square, with a side dimension equal to twice the length of the largest vehicle or piece of equipment that will be brought on site.

MKM UXO personnel will use a handheld magnetometer to clear an area prior to commencing sub-surface soil sampling or well drilling operations. At not more than a 2-foot depth, the magnetometer will be lowered into the soil-sampling hole. This procedure will be used to ensure that smaller items of UXO, undetectable from the surface, can be detected. If no magnetic anomalies are located, the procedure will be repeated at 2-foot intervals to the maximum depth of the sample to be taken. Anomaly avoidance for groundwater monitoring wells and test pits will be conducted in 2-foot intervals to native soil or bedrock encounter, whichever occurs first. **NOTE: MKM UXO personnel will not touch, move, or disturb ordnance or ordnance-related materials. The goal of this project is Ordnance Avoidance.**

The following personal protective clothing (PPE) will be used by all MKM UXO personnel while on the site:

- safety glasses or goggles,
- gloves, and
- safety shoes.

NOTE: MKM UXO personnel will not wear steel-toe shoes or other ferrous items on their person because of their interference with the operation of magnetometer/ordnance locators.

The following ordnance locators will be used to support this operation:

- The Schonstedt Models GA-52 and GA-72 magnetic locators will be used for sweeping and sub-surface range clearance operations. These locators are designed to detect the magnetic field between two sensors spaced inside the locators 20 inches and 14 inches apart, respectively.

- The Schonstedt Model MG-220/230 Magnetic Gradiometer may be used for drilling operations. The unit is designed to detect the presence of buried iron or steel objects. The unit responds when the magnetic field strength at the two sensors located in the sensor assembly is different.

- The White Spectrum XLT will be used for sweeping operations. This instrument detects gold, silver, iron, nickel, copper, brass, aluminum, tin, lead, and bronze up to a depth of 12 inches.

9.0 Recovered Chemical Warfare Materials (RCWM)

If suspected RCWM is located at any time, all work will cease immediately. Site workers will withdraw along cleared paths from the area containing the RCWM. The MKM UXO Team Leader will clearly mark the area containing the RCWM, and report the chemical event as specified in Figure C-1. MKM UXO personnel will standby in

an upwind location until relieved by a government representative. The report of discovery of suspected RCWM will be made within one hour of the discovery to the RVAAP Environmental Coordinator. The point-of-contact (POC) will make the final determination as to the actual presence of RCWM.

If the POC confirms the presence of RCWM, the government person in charge will report the chemical event to the appropriate agencies.

When contacting the POC about suspect RCWM, SpecPro will provide the information listed in Figure C-1. Contact with the POC will not be delayed due to lack of information. The suspect RCWM report will follow the format in Figure C-1.

Figure 1. Suspected RCWM Data Report

1. Date and local time of event.
2. Location.
3. Quantity and type of munition(s) or container(s) and chemical agents involved.
4. Description of what has happened.
5. Description of property damage.
6. Personnel casualties and/or injuries.
7. Whether medical services or facilities were required.
8. Assistance required.
9. Any other pertinent information.

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FINAL
SITE SAFETY AND HEALTH PLAN
ADDENDUM NO. 1

FOR THE

PHASE II REMEDIAL INVESTIGATION OF DEMOLITION AREA 2 AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

PREPARED FOR
US ARMY OPERATIONS SUPPORT COMMAND
CONTRACT No. DAAA09-01-G-0009
DELIVERY ORDER NO. 0003

June 2002

FINAL
SITE SAFETY AND HEALTH PLAN ADDENDUM NO. 1
FOR THE
PHASE II REMEDIAL INVESTIGATION
OF
DEMOLITION AREA 2
AT THE
RAVENNA ARMY AMMUNITION PLANT,
RAVENNA, OHIO

June 2002

Prepared for
U.S. Army Operations Support Command
Contract No. DAAA09-01-G-0009
Delivery Order No. 0003

Prepared by
SpecPro, Inc.
8451 State Route 5, Bldg. 1038
Ravenna, OH 44266

APPROVALS

SITE SAFETY AND HEALTH PLAN ADDENDUM NO. 1
FOR THE
PHASE II REMEDIAL INVESTIGATION
OF
DEMOLITION AREA 2
AT THE
RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

Susan McCauslin, SpecPro Project Manager	Phone (330) 358-1753	Date
Gregg Rexroad, SpecPro Health and Safety	Phone (321) 868-7800	Date

CONTENTS

TABLES

ACRONYMS

AOC	Area of Concern
CIH	Certified Industrial Hygienist
COC	contaminant of concern
CSP	Certified Safety Professional
DNT	dinitrotoluene
EC&HS	Environmental Compliance and Health and Safety
EPA U.S.	Environmental Protection Agency
FP	flash point
FSHP	Facility-wide Safety and Health Plan
GFCI	ground-fault circuit interruptor
H&S	Health and Safety
HAZWOPER	Hazardous Waste Site Operations
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IDLH	immediately dangerous to life and health
IP	ionization potential
LEL	lower explosive limit
MSDS	Material Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
NRR	Noise Reduction Rating
OE	ordnance and explosives
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
PID	photoionization detector
PPE	personal protective equipment
PVC	polyvinyl chloride
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
STEL	short-term exposure limit
TLV	threshold limit value
TNB	trinitrobenzene
TNT	2,4,6-trinitrotoluene
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers
USAEHA	U.S. Army Environmental Hygiene Agency
USIOC	U.S. Army Industrial Operations Command
VP	vapor pressure

INTRODUCTION

It is the formal policy of SpecPro, Inc. to provide and maintain a work environment conducive to the safety and health of its employees. Each employee of SpecPro, Inc. is responsible for maintaining a safe environment. To ensure implementation of this policy, the Ravenna Army Ammunition Plant (RVAAP) Facility-wide Safety and Health Plan (FSHP),(USACE 2001) and this Site Safety and Health Plan (SSHP) Addendum collectively set forth the specific procedures required to protect SpecPro, Inc. and it's subcontractor personnel involved in the field activities under this project. These plans are driven by requirements contained in U.S. Army Corps of Engineers (USACE) (1992) and USACE (1996). All field personnel are required to comply with the requirements of these programs and plans. In addition, subcontractors are responsible for providing their employees with a safe work place and nothing in these plans relieves such subcontractors of this responsibility. If the requirements of these plans are not sufficient to protect the employees of a subcontractor, that subcontractor is required to supplement this information with work practices and procedures that will ensure the safety of its personnel.

The FSHP addresses program issues and hazards and hazard controls common to the entire installation. This SSHP Addendum to the FSHP serves as the lower tier document addressing the hazards and controls specific to the Phase II Remedial Investigation (RI) at Demolition Area 2. Copies of the FSHP and this SSHP Addendum will be present at the work site during all fieldwork.

SpecPro will perform a field investigation at Demolition Area 2. Demolition Area 2 was used since 1948 to detonate large caliber munitions and off-spec bulk explosives that could not be deactivated or demilitarized by any other means due to their condition. The CERCLA (IRP) portion of the site is approximately 25 acres in size, and contained within that area is a smaller 2.5-acre area regulated under RCRA located on the north side of Sand Creek, which was regularly used until 1992 for demolition activities.

A Phase I RI was completed for Demolition Area 2 in February 1998. During the course of the Phase I RI, numerous soil, sediment, and surface water samples were obtained for the initial site characterization. The RI found explosives, particularly TNT, and several inorganics, including cadmium, lead, and mercury, in both the surface and subsurface soils. Concentrations of inorganic compounds in sediment were found to be within background values. Groundwater was not investigated at this AOC as part of the Phase I RI, however, four groundwater monitoring wells were installed in the RCRA portion of the site in 1992 as part of an AEHA study. The wells are currently sampled on a quarterly basis. Low levels of explosives have been periodically detected in the

groundwater. Contaminants of concern at this site are white phosphorus, explosives, and heavy metals.

Planned site activities for this project consist of environmental sampling and support tasks. These tasks include soil sampling, surface water and groundwater sampling, sediment sampling, and monitoring well installation.

Potential hazards posed by the planned tasks include injury from ordnance and explosives; noise and cut hazards associated with clearing vegetation; striking, rotation, and noise hazards from excavating and drilling equipment; lifting, noise, and strain hazards associated with operating soil sampling equipment; fuel or decontamination solvent fires; chemical exposure; temperature extremes; stinging/biting insects; poisonous plants; and snakes.

The potential for chemical overexposure appears to be minimal, given the nature of planned tasks. All of the potential contaminants have low vapor pressures, making overexposure through vapor inhalation highly unlikely. All of the planned tasks pose minimal potential for creating airborne particulates. There is some potential for adverse effects due to dermal contact with contaminated soil. The crew will use protective gloves which are known to be resistant to the COCs on site to handle potentially contaminated materials, and, if necessary, the Site Safety and Health Officer (SSHO) will upgrade the required personal protective equipment (PPE) to prevent dermal contact with potentially contaminated materials. Physical hazards are associated with water-borne operations, excavation and drilling equipment, and hand-operated power tools (chainsaw, etc.). Task-specific hazard controls have been specified for these tasks. The SSHO will observe all site tasks during daily safety inspections and will use professional judgment and appropriate monitoring results to determine if upgrading PPE is required. A detailed analysis of these hazards and specific appropriate controls is presented in Chapter 2.0, Table 2-2.

This investigation will be performed in Level D PPE, plus chemical-resistant gloves when handling potentially contaminated materials. If one of several action levels is exceeded or the potential for increased risk becomes apparent during the investigation, engineering controls will be instituted (if possible), or protective procedures, including protective clothing, will be upgraded as necessary by the SSHO.

1.0 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.1 Site Description

The Ravenna Army Ammunition Plant (RVAAP) is located in northeastern Ohio within Portage and Trumbull counties, approximately 16 kilometers (10 miles) northeast of the town of Ravenna. The installation consists of 8,668 hectares (21,419 acres) in a 17.7-kilometer (11-mile) long, 5.6-kilometer (3.5-mile) wide tract bordered by a sparsely inhabited private residential area. The site is an inactive government-owned armament, munitions, and chemical command facility maintained by a contracted caretaker, TolTest, Inc.

The installation was active from 1941 to 1992. Activities included loading, assembling, storing, and packing military ammunition; demilitarization of munitions; production of ammonium nitrate fertilizer; and disposal of "off-spec" munitions. Various munitions were handled on the installation including artillery rounds of 90 mm or more and bombs up to 2,000 pounds.

1.1.1 Demolition Activities

Demolition Area 2 was used since 1948 to detonate large caliber munitions and off-spec bulk explosives that could not be deactivated or demilitarized by any other means due to their condition. Within the boundaries of this AOC, there are five distinct areas-

- Open Detonation Area – an area in which detonation was accomplished in backhoe-dug pits with a minimum depth of 4 feet. After detonation, metal parts were typically removed from the site, and the pits were backfilled, mulched, and seeded.
- Open Burning Area – an area in which, from 1981 - 1986, the sludge from Load Line 6 Evaporation Unit was thermally destroyed.
- Prototype Testing Range - an area where projectiles were fired into targets.
- Burial Sites 1 and 2 – areas where possible scrap ordnance components may have been buried. Burial Site 1 is approximately two acres in size, located approximately 200 feet northeast of Bldg. 1501. Burial Site 2 is approximately one acre in size, and is located approximately 100 feet north of Bldg. 1503.
- Sand Creek Disposal Area – an area that is posted, "Off Limits, Dangerous Material" and is located along a 70-feet embankment northeast of Bldg. 1503 overlooking Sand Creek.

The past standard operating procedures for demolition in the Open Detonation area were to place the explosives to be detonated in a pit that had been excavated to a minimum depth of 4 feet. The trench was then backfilled with 2 feet of soil, and the explosives were detonated. After detonation, the site was carefully policed for shrapnel, scrap metal, or any unexploded ordnance. Materials treated in this area have included primer elements, bombs, and various caliber munitions. In addition, past operations at this AOC may have included the burial of munitions and ordnance components.

Wastes known to be disposed of at this AOC include unexploded ordnance, shrapnel, white phosphorus, explosive residues, and heavy metals. Recent burning and detonation activities occurred until 1994 in a 2.5 acre area covered under a RCRA permit application.

1.2 Contaminants

Table 1-1 lists contaminants known to occur in soil or sediment at Demolition Area 2. Inclusion in this table indicates the potential to encounter a contaminant during Phase II Remedial Investigation (RI) field activities, but it does not necessarily indicate that the contaminant is present in sufficient quantity to pose a health risk to workers.

Table 1-1. Concentrations of Constituents of Potential Concern in Soil at Demolition Area 2[a]

Contaminant	Maximum Concentration (mg/kg)
2,4,6-TNT	170
2,4-DNT	2.6
2,6-DNT	4.2
1,3,5-TNB	4.4
HMX	7.05
Nitrobenzene	2.1
Nitrocellulose	30.0
Nitroguanidine	.07
RDX	72.6
Tetryl	4300
Aluminum	43900
Antimony	8.5
Arsenic	64
Barium	593
Beryllium	.83
Cadmium	71.7
Chromium	28
Cobalt	22.6
Copper	3700
Lead	1900
Manganese	1970
Mercury	2.3
Nickel	29.7
Selenium	2
Thallium	1.2
Vanadium	31
Zinc	375

[a]*Sources*: USAEHA, 1992; USACE, 1998; US Army IOC, 2000.
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine.
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine.
TNB = Trinitrobenzene
TNT = Trinitrotoluene

2.0 HAZARD/RISK ANALYSIS

The purpose of the task hazard/risk analysis is to identify and assess potential hazards that may be encountered by personnel and to prescribe required controls. Table 2-1, a general checklist of hazards that may be posed by this project, indicates whether a particular major type of hazard is present. If additional tasks or significant hazards are identified during the work, this document will be modified by addendum or field change order to include the additional information.

Table 2-1. Hazards Inventory

Yes	No	Hazard
	X	Confined space entry
	X	Excavation entry
X		Heavy equipment (drill rigs, backhoe)
X		Fire and explosion
X		Electrical Shock (utilities and tools)
X		Exposure to chemicals
X		Temperature extremes
X		Biological hazards (poison ivy, Lyme disease)
	X	Radiation or radioactive contamination
X		Noise (heavy equipment)
X		Drowning
X		OE (potential to encounter unexploded ordnance)

OE = Ordnance and explosives.

Specific tasks are as follows:

- soil sampling with powered auger, hand augers, or scoops;
- vegetation clearing with machetes and chainsaws;
- surface water and sediment sampling on streams from shoreline or in-stream;
- civil surveying;
- investigation-derived waste handling and disposition;
- subsurface soil sampling and monitoring well installation using air rigs and/or hollow stem auger drill rigs;
- well development and groundwater sampling; and
- sampling equipment decontamination.

2.1 Task-Specific Hazard Analysis

Table 2-2 presents task-specific hazards, relevant hazard controls, and required monitoring, if appropriate, for all of the planned tasks.

2.2 Potential Exposures

Prior sampling results indicate that the primary contaminants of concern at Demolition Area 2 are explosives residues and metals. Information on the potential contaminants, as well as the reagents and chemicals that will be used for the project, is contained in Table 2-3. It is important to note that the contaminants listed in Table 2-3 have been detected in a number of locations at RVAAP and might be expected to occur at any former operations area. Exposure to chemical tools, such as corrosive sample preservatives, or flammable fuels is a possibility and will be controlled through standard safe handling practices.

Table 2-2. Hazards Analysis

Safety and Health Hazards	Controls	Monitoring Requirements
Civil Surveys and Visual Surveys in Potentially Contaminated Areas		
General safety hazards (moving equipment, slips, falls)	Level D PPE: long pants, shirts with sleeves, safety glasses, safety shoes or boots, and hard hats if overhead hazards are present (see Chapter 5.0 of the FSHP). Hazardous waste safety (40-hour) and site-specific training, buddy system, and proper housekeeping.	Daily safety inspections.
Contact with OE	Pre-entry screening survey and continuous escort by OE specialist support. On-site training in ordnance recognition for all field personnel. Withdrawal of all SpecPro and subcontractor personnel from immediate area and field marking of suspect area if ordnance or suspected ordnance is discovered.	Visual and instrument surveys for ordnance conducted by OE expert personnel.
Exposure to chemicals	Nitrile or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Wash face and hands and any other exposed areas prior to taking anything by mouth. Hazardous waste medical clearance. Site training must include hazards and controls for exposure to site contaminants and chemicals used on-site. MSDSs on-site. All chemical containers labeled to indicate contents and hazard.	None.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Groundwater Well Development, Groundwater Monitoring, Groundwater Sampling, and Sample Preservation		
General safety hazards (moving equipment, lifting, slops, falls)	Level D PPE: long pants, shirts with sleeves, safety glasses, safety shoes or boots, hard hats if overhead hazards are present (see Chapter 5.0 of FSHP). Buddy system. Lifts of >50 lbs will be performed by two or more personnel or with mechanical assistance, extensive heavy lifting will require additional lifting training. Hazardous waste safety training. Exclusion zone if there is a	Daily site safety inspections.

Safety and Health Hazards	Controls	Monitoring Requirements
	potential for unauthorized entry.	
Noise	None, unless SSHO determines that equipment potentially exceeds 85 dBA.	Daily safety inspection.
Fire (fuels)	Fuel stored in safety cans with flame arresters. Fire extinguisher in all fuel use areas. No ignition sources in fuel storage areas. Bonding (metal to metal contact) during pouring. Gasoline-powered equipment must be shut down and allowed to cool for 5 minutes prior to fueling.	Daily site safety inspections.
Exposure to chemicals	Level D PPE, including nitrile or PVC gloves, to handle potentially contaminated material. Minimal contact, wash face and hands prior to taking anything by mouth. Medical clearance for HAZWOPER work. Fifteen-minute eyewash within 100 feet when pouring corrosive sample preservatives; eyewash bottle within 10 feet when adding water to pre-preserved sample containers. Site training must include hazards and controls of exposure to contaminants and chemicals used on-site. MSDSs for chemical tools kept on-site. All chemical containers labeled with contents and hazard.	Daily site safety inspections. PID monitoring if prior monitoring during soil boring indicated a potential for exposure.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Electrical shock	GFCI for all electrical hand tools.	Daily safety inspection.
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Soil Boring, Soil Sampling, and Monitoring Well Installation Using Air Rotary or Auger Drill Rig		
General safety hazards (rotating machinery, suspended loads, moving equipment, slips, falls)	Level D PPE: long pants, shirts with sleeves, safety glasses, work gloves for material handling plus hard hat (see Chapter 5.0 of FSHP). Buddy system. NO employees under lifted loads. At least two functional skill switches. Functional backup alarm. Drill rig manual on-site. Only experienced operators. Exclusion zone at least equal to mast height if there is any potential for unauthorized entry.	Daily site safety inspections. Weekly drill rig inspections.

Safety and Health Hazards	Controls	Monitoring Requirements
Noise	Hearing protection NRR 25 within 25 feet of rig unless rig-specific monitoring indicates noise exposure of less than 85 dBA.	Daily safety inspections.
Fire (vehicle fuels or subsurface contaminants)	Fuels stored in safety cans with flame arrestors. Bonding (metal to metal) and grounding during fuel transfers. Fuel storage areas marked with "no smoking or open flames" signs. Fire extinguishers in all fuel use areas.	Combustible gas indicator if buried organic material or other source of flammable gas is suspected.
Contact with unexploded ordnance	Downhole monitoring every 2 feet until cleared for continuous drilling by OE personnel. On-site training in ordnance recognition for all field personnel. Clearance of sites by OE personnel for intrusive work. Continuous escort by OE personnel in areas with a potential to encounter OE. Withdrawal of all non-OE personnel if ordnance or suspected ordnance is discovered.	Visual and instrument surveys by OE technicians.
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Stay upwind of any dust-generating activities. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	PID or other sampling as appropriate.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Electrical shock	Identification and clearance of overhead and underground utilities. GFCI required for electric hand tools.	Visual of all work areas.
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Soil Sampling Using Hand Augers or Scoops		
General safety hazards (manual lifting, slips, falls)	Level D PPE: long pants, shirts with sleeves, safety shoes or boots, safety glasses, and work gloves for manual work (see Chapter 5.0 of FSHP).	Daily site safety inspections.

Safety and Health Hazards	Controls	Monitoring Requirements
	Buddy system. Hazardous waste safety training.	
Contact with unexploded ordnance	On-site training in ordnance recognition for all field personnel. Clearance of sites by OE personnel for intrusive work. Continuous escort by OE personnel when in areas with potential to encounter OE. Withdrawal of all non-OE personnel if ordnance or suspected ordnance is discovered. Sampling of stations having known or suspected (i.e., red soil or raw product) explosives >10% (100,000 mg/kg) to be performed by OE technicians following applicable OE safety requirements.	Visual and instrument surveys by OE technicians.
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Stay upwind of any dust-generating activities. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	PID or other sampling as appropriate.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Surface Water and Sediment Sampling on Foot		
General safety hazards (moving equipment, slips, falls)	Level D PPE: long pants, shirts with sleeves, safety glasses, and safety shoes or boots (see Chapter 5.0 of FSHP). Hazardous waste safety training. Buddy system.	Daily site safety inspections.
Drowning	Coast Guard-approved personal flotation vests if working near (6 feet) or over water deeper than 4 feet.	Measure water depth.
Contact with unexploded ordnance	On-site training in ordnance recognition for all field personnel. Clearance of sites by OE personnel for intrusive work. Continuous escort by OE	Visual and instrument surveys by OE technicians.

Safety and Health Hazards	Controls	Monitoring Requirements
	personnel when in areas with potential for OE. Withdrawal of all non-OE personnel if ordnance or suspected ordnance is discovered. Sampling of washout sumps or sedimentation basins by OE technicians if OE is confirmed or suspected to be present.	
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	PID or other sampling as appropriate.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Vegetation Clearing with Chainsaws, Machetes, and Sling Blades		
General safety hazards (contact with sharp edges, slips, falls)	Level D PPE: long pants, shirts with sleeves, safety shoes or boots, safety glasses, plus heavy -duty work gloves and hard hat with face shield (see Chapter 5.0 of FSHP). Buddy system. Only experienced operators. Personnel operating brush clearing tools must maintain separation of at least 15 feet. Machetes equipped with lanyard and lanyard looped around wrist. Tools must be inspected daily and taken out of service if damaged. Exclusion zone if there is a potential for entry of unauthorized personnel.	Daily site safety inspections.
Chainsaw kickback and related hazards	Chainsaw chaps. Saws must have automatic chain brake or kickback device. Idle speed adjusted so chain does not move when idling. Saws must not be used to cut above shoulder height. Saws must be held with both hands when operating. Additional requirements at EM 385-1-1 Section 31, and 29 CFR 1910.266.	Daily inspection

Safety and Health Hazards	Controls	Monitoring Requirements
Noise (chainsaw)	Hearing protection NRR 25 within 25 feet of operating chainsaw unless specific monitoring indicates noise exposure of less than 85 dBA.	Daily safety inspections.
Fire (fuels)	Fuels stored in safety cans with flame arrestors. Bonding (metal to metal) and grounding during fuel transfers. Fuel storage areas marked with "no smoking or open flames" signs. Fire extinguishers in all fuel use areas. Gasoline-powered equipment turned off and allowed to cool for at least five minutes prior to fueling.	Daily safety inspection.
Contact with unexploded ordnance	On-site training in ordnance recognition for all field personnel. Clearance of sites by OE personnel for intrusive work. Escort by OE personnel when in areas with potential to encounter OE. Withdrawal of all non-OE personnel if ordnance or suspected ordnance is discovered.	Visual and instrument surveys by OE technicians.
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	PID or other sampling as appropriate.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP).	Visual survey.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Investigation-Derived Waste Handling		
General hazards (lifting equipment, manual lifting, slips)	Level D PPE: long pants, shirts with sleeves, safety glasses, safety shoes or boots, heavy-duty gloves for materials handling, and hard hat if overhead hazards are present (see Chapter 5.0 of FSHP). Buddy system.	Daily safety inspections of operations. Daily inspection of equipment - verify brakes and

Safety and Health Hazards	Controls	Monitoring Requirements
	Unnecessary personnel will stay well clear of operating equipment. Functional back-up alarm on fork trucks, Bobcats, trucks, etc. Documented forklift training for forklift operators. Only experienced operators will be allowed to operate equipment. No personnel allowed under lifted loads. Lifts of greater than 50 pounds will be made with two or more personnel or with lifting equipment. Hazardous waste safety training. Compliance with EM 385-1-1 Sections 14 and 16.	operating systems are in proper working condition.
Contact with unexploded ordnance	On-site training in ordnance recognition for all field personnel. Clearance of sites by OE personnel for intrusive work. Continuous escort by OE personnel if working in areas with potential for OE. Withdrawal of all non-OE personnel if ordnance or suspected ordnance is discovered.	Visual and instrument surveys by OE technicians.
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	PID or other sampling as appropriate.
Gunfire (deer hunting with shotguns loaded with slugs is allowed in some areas during hunting season)	Field work will not be conducted during hunt days. Office work, sample management, and analytical work may be conducted in the SpecPro office.	None
Fire (vehicle fuels and flammable contaminants)	Fuels stored in safety cans with flame arrestors. Bonding (metal to metal) and grounding during fuel transfers. Fuel storage areas marked with “no smoking or open flames” signs. Gasoline-powered equipment will be shut down and allowed to cool for 5 minutes before fueling. Fire extinguishers in all fuel use areas.	Daily safety inspection.
Noise	Hearing protection within 25 feet of any noisy drum moving equipment unless equipment-specific monitoring indicates exposures less than 85 dBA.	Daily safety inspections.
Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus)	PPE (boots, work clothes). Insect repellant on boots, pants, and elsewhere, as necessary to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Chapter 9.0 of FSHP). Avoidance of accumulations or bird or bat droppings (see Chapter 9.0 of FSHP)..	Visual survey.
Electric shock	Identification and clearance of overhead utilities. GFCI for all electrical hand tools.	Visual survey of all work areas.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or	Temperature measurements at

Safety and Health Hazards	Controls	Monitoring Requirements
	warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.
Equipment Decontamination (Hot Water Washing, Soap and Water Washing, HCl, and Methanol Rinse)		
General equipment decontamination hazards (hot water, slips, falls, equipment handling)	Level D PPE plus nitrile or PVC gloves (see Chapter 5.0 of FSHP). Face shield and Saranax or rain suit when operating steam washer. Hazardous waste safety training.	Daily safety inspections.
Noise (spray washer)	Hearing protection when washer is operating unless equipment-specific monitoring indicated that exposure is less than 85 dBA.	None.
Fire (decontamination solvents and gasoline)	Flammable material stored in original containers or in safety cans with flame arrestors. Fire extinguisher kept near decon area.	Daily safety inspection.
Exposure to chemicals	Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Minimal contact. Hazardous waste 40-hour certification training and medical clearance must be current. Site training must include hazards and controls for site contaminants and all chemicals used on-site. MSDSs for chemical tools on-site. Chemical containers labeled to indicate contents and hazard.	None.
Temperature extremes	Administrative controls (see Chapter 8.0 of FSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Chapter 8.0 of FSHP). Chilled drinks if temperature exceeds 70°F.	Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing.

CGI = Combustible Gas Indicator
EC&HS = Environmental Compliance and Health and Safety.
FSHP = Facility-wide Safety and Health Plan.
GFCI = Ground-fault circuit interrupter.
HAZWOPER = Hazardous Waste Site Operations.
MSDS = Material Safety Data Sheet.
NRR = Noise Reduction Rating.
OE = Ordnance and Explosives.
OSHA = Occupational Safety and Health Administration.
PID = Photoionization detector.
PPE = Personal protective equipment.
PVC = Polyvinyl chloride.
RVAAP = Ravenna Army Ammunition Plant.
SSHO = Site Safety and Health Officer.
SSHP = Site Safety and Health Plan.
USACE = U.S. Army Corps of Engineers.

Table 2-3. Potential Exposures

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]
Chromium	TLV/TWA: 0.5 mg/m^3,A4 IDLH: 25 mg/m^3	Eye irritation, sensitization	Solid; properties vary depending upon specific compound	Inhalation Ingestion Contact
DNT (dinitrotoluene)	TLV/TWA: 0.2 mg/m^3,A2 IDLH: Ca [50 mg/m^3]	Suspected human carcinogen, anorexia, cyanosis, reproductive effects	Orange-yellow solid, VP: 1 mm; FP 404°F	Inhalation Absorption Ingestion Contact
Gasoline (used for fuel)	TLV/TWA: 300 ppm IDLH: Ca	Potential carcinogen per NIOSH, dizziness, eye irritation, dermatitis	Liquid with aromatic odor; FP: -45°F; VP: 38-300 mm	Inhalation Ingestion Absorption Contact
Hydrochloric acid (potentially used for equipment decontamination)	TLV: 5 ppm ceiling IDLH: 50 ppm	Irritation of eyes, skin, respiratory system	Liquid; VP: fuming; IP: 12.74 eV; FP: none	Inhalation Ingestion Contact
Isopropyl alcohol (potentially used for equipment decontamination)	TLV/TWA: 400 ppm STEL: 500 ppm IDLH: 2000 ppm	Irritation of eyes, skin, respiratory system; drowsiness, headache	Colorless liquid with alcohol odor; VP: 33 mm; IP: 10.10 eV; FP: 53°F	Inhalation Ingestion Contact
Lead	TLV/TWA: 0.05 mg/m^3,A3 PEL/TWA: 0.05 mg/m^3 IDLH: 100 mg/m^3	Weakness, anorexia, abdominal pain, anemia	Solid metal; VP: 0 mm; FP: NA; IP: NA	Inhalation Ingestion Contact
Liquinox (used for decontamination)	TLV/TWA: None	Inhalation may cause local irritation to mucous membranes	Yellow odorless liquid (biodegradable cleaner); FP: NA	Inhalation Ingestion
Methanol (potentially used for equipment decontamination)	TLV/TWA: 200 ppm Skin notation IDLH: 6000 ppm	Irritation of eyes, skin, respiratory system; headache; optic nerve damage	Liquid: VP: 96 mm; IP: 10.84 eV; FP: 52°F	Inhalation Absorption Ingestion Contact

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]
HMX (octogen)	TLV/TWA: None established; toxicity assumed to be similar to RDX as compounds are very similar	Explosive; assumed irritation of eyes and skin, dizziness, weakness	Assumed similar to RDX FP: explodes VP: 0.0004 mm at 230°F	Assumed: Inhalation Absorption Ingestion Contact
RDX (cyclonite)	TLV/TWA: 0.5 mg/m^3, A4 Skin notation IDLH: none established	Explosive; irritation of eyes and skin, dizziness, weakness	White powder FP: explodes VP: 0.0004 mm at 230°F	Inhalation Absorption Ingestion Contact
TNT (2,4,6-trinitrotoluene)	TLV/TWA: 0.5 mg/m^3 Skin notation IDLH: 500 mg/m^3	Cluster headache; irritation of skin and mucous membranes, liver damage, kidney damage	Pale solid FP: explodes VP: 0.0002 mm	Inhalation Absorption Ingestion Contact
White Phosphorus	TLV/TWA: 0.1 mg/m^3 Skin notation IDLH: 5mg/m^3	Irritation of eyes, respiratory tract, skin; target organs: eyes, skin, respiratory system, liver, kidneys, jaw, teeth, blood.	White to yellow soft, waxy solid with acrid fumes in air. FP: Ignites spontaneously in moist air. VP: 0.03 mmHg	Inhalation Ingestion Contact

[a]The potential chemicals were obtained from the *Ravenna Army Ammunition Plant Phase I Remedial Investigation Report* (USACE 1998).
[b]From 1999 Threshold Limit Values, *NIOSH Pocket Guide to Chemical Hazards*.
[c]From 1997 *NIOSH Pocket Guide to Chemical Hazards, the Condensed Chemical Dictionary,* 10th ed.

A2 = Suspected human carcinogen.
A3 = Confirmed animal carcinogen with unknown Relevance to humans.
A4 = Not classifiable as a human carcinogen.
FP = Flash point.
IDLH = Immediately dangerous to life and health.
IP = Ionization potential.
NA = Not available.
NIOSH = National Institute for Occupational Safety and Health.
PEL = Permissible exposure limit.
STEL = Short-term exposure limit.
TLV = Threshold limit value.
TWA = Time-weighted average.
VP = Vapor pressure.

3.0 STAFF ORGANIZATION, QUALIFICATIONS,AND RESPONSIBILITIES

This section presents the personnel (and their associated telephone numbers) responsible for site safety and health and emergency response. Table 3-1 identifies the SpecPro and subcontractor staff who will fill key roles. See the FSHP for information on the roles and responsibilities of key positions.

Table 3-1. Staff Organization

Position	Name	Phone
Program Manager	Jim Wirth	(703) 339-6890
Health & Safety Manager	Gregg Rexroad, CEP	(321) 868-7800
Project Manager	Susan McCauslin	(330) 358-1753
Field Operations Manager	Susan McCauslin	(330) 358-1753
Site Safety and Health Officer	Chantelle Carroll	(330) 358-1753
Emergency Responder	Lou Kovarik	(330) 358-2920

CEP=Certified Environmental Professional

4.0 TRAINING

Training requirements are outlined in the FSHP and in Table 2-2 of this SSHP Addendum. In addition, at least one American Red Cross 43-hr Emergency Response certified person will be present during sampling activities at the site. All on-site personnel shall be first aid/CPR trained. In addition, all field personnel will be familiarized with the types of ordnance known to have been disposed of at this site, and also with those items found during the UXO removal project conducted at this site in 1999-2000.

5.0 PERSONAL PROTECTIVE EQUIPMENT

General guidelines for selection and use of PPE are presented in the FSHP. Specific PPE requirements for this work are presented in the hazard/risk analysis section (Chapter 2.0).

6.0 MEDICAL SURVEILLANCE

Medical surveillance requirements are presented in the FSHP and in Table 2-2 of this SSHP Addendum.

7.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Assessment of airborne chemical concentrations will be performed, as appropriate, to ensure that exposures do not exceed acceptable levels. Action levels, with appropriate responses, have been established for this monitoring. In addition to the specified monitoring, the SSHO may perform or require additional monitoring, such as organic vapor monitoring, in the equipment decontamination area, or personnel exposure monitoring for specific chemicals. The deployment of monitoring equipment will depend on the activities being conducted and the potential exposures. All personal exposure monitoring records will be maintained in accordance with 29 CFR 1910.120. The minimum monitoring requirements and action levels are presented in Table 7-1.

Most of the Phase II RI fieldwork is not expected to pose airborne exposure hazards for the following reasons:

- Work will be performed in open areas or abandoned buildings with natural ventilation.
- Prior site sampling indicated that contaminants are unlikely to pose an airborne hazard.
- The most probable contaminants (metals, explosives, and white phosphorus are materials with relatively low vapor pressures.

Air monitoring of the breathing zone using a photoionization detector or equivalent is planned during soil sampling, and groundwater monitoring well drilling. The SSHO will examine site conditions and will contact the Health and Safety Manager and initiate additional monitoring if there is any indication of potential airborne exposure.

Table 7-1. Monitoring Requirements and Action Limits

Hazard or Measured Parameter	Area	Interval	Limit	Action	Tasks
Airborne organics with PID or equivalent	Breathing zone [0.9 meters (3 feet) from source or 0.36 meters (14 inches)] in front of employee's shoulder	>From 1 to 3 feet below ground surface and if site conditions, such as discolored soil or chemical smells, indicate that monitoring is necessary	<5 ppm >5 ppm	Level D Withdraw and evaluate: • Need for PPE upgrade • Identify contaminants • Notify project manager and H&S manager	Drilling, hand augering, power augering, and other intrusive work.
Noise	All	During operation of power augers and any area where there is some doubt about noise levels	85 dBA and any area perceived as noisy	Require the use of hearing protection	Hearing protection will be worn within the exclusion zone, around power augers, or other motorized equipment
Visible contamination	All	Continuously	Visible contamination of skin or personal clothing	Upgrade PPE to preclude contact; may include disposable coveralls, boot covers, etc.	All
Visible airborne dust	All	Continuously	Visible dust generation	Stop work; use dust suppression techniques such as wetting surface	All

H&S = Health & Safety. PID = Photoionization detector. PPE = Personal protective equipment.

8.0 HEAT/COLD STRESS MONITORING

General requirements for heat/cold stress monitoring are contained in the FSHP.

9.0 STANDARD OPERATING SAFETY PROCEDURES

Standard operating safety procedures are described in the FSHP.

10.0 SITE CONTROL MEASURES

Site control measures are described in the FSHP. No formal site control is expected to be necessary for this work, as the work areas are somewhat remote and fenced, and bystanders are not anticipated. The RVAAP installation is not open to the public, and only authorized personnel are allowed in the project areas. If the SSHO determines that a potential exists for unauthorized personnel to approach within 25 feet of a work zone or otherwise be at risk due to proximity, then exclusion zones will be established as described in the FSHP.

11.0 PERSONNEL HYGIENE AND DECONTAMINATION

Personal hygiene and decontamination requirements are described in the FSHP and in Chapter 2.0 of this addendum.

12.0 EMERGENCY PROCEDURES AND EQUIPMENT

Emergency contacts, telephone numbers, directions to the nearest medical facility, and general procedures can be found in the FSHP. The SpecPro field operations manager will remain in charge of all SpecPro and subcontractor personnel during emergency activities. The SpecPro field office will serve as the assembly point if it becomes necessary to evacuate one or more sampling locations. During mobilization, the SSHO will verify that the emergency information in the FSHP is correct; in addition, directions and a map to the nearest medical facility (Robinson Memorial Hospital) will be posted in conspicuous places that are readily available to all on-site workers in case of emergency.

Each field team shall have a hand-held, two-way radio for communications purposes.

During field operations at Demolition Area 2, at least one American Red Cross 43-hour Emergency Response certified person shall be present, and all on-site personnel shall have CPR/first aid training.

13.0 LOGS, REPORTS, AND RECORD KEEPING

Logs, reports, and record keeping requirements are described in the FSHP.

14.0 REFERENCES

NIOSH (National Institute for Occupational Safety and Health) 1997. *NIOSH Pocket Guide to Chemical Hazards, the Condensed Chemical Dictionary,* 10th Edition.

USACE (U.S. Army Corps of Engineers) 1992. *Safety and Occupational Health Requirements for Radioactive Waste (HTRW) and Ordnance and Explosive Waste (OEW) Activities*. ER-385-1-92.

USACE 1996. *Safety and Health Manual*. EM-385-1-1-13, September.

USACE 1998. *Phase I Remedial Investigation of High-Priority Areas of Concern at the Ravenna Army Ammunition Plant, Ravenna, Ohio.* DACA69-94-D-0029, D.O.0010 and 0022, February.

USACE 2001. *Facility-Wide Safety and Health Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. DACA62-00-D-0001, D.O. CY02, March.

USAEHA 1992, *Geohydrologic Study No. 38-26-KF95-92, Soils, Ground Water, and Surface Water Characterization for the Open Burning and Open Detonation Areas, Ravenna Army Ammunition Plant, Ravenna, Ohio*, May.

US Army IOC 2000, *Report of Analytical Results, Demolition Area #2 CERCLA Sites, Ravenna Army Ammunition Plant, Ravenna, Ohio*, DAAA09-99-D-018, D.O. #0001, March.

Part II

Quality Assurance Project Plan Addendum for the Phase II Remedial Investigation of Demolition Area 2 at the Ravenna Army Ammunition Plant, Ravenna, Ohio

June 2002

Prepared for

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Prepared by

SpecPro, Inc.
8451 State Route 5
Ravenna, OH 44266

CONTENTS

TABLES

ABBREVIATIONS

A-E	Architect-Engineer
ASTM	American Society of Testing and Materials
COC	chain of custody
CX	Center of Expertise
DQO	data quality objective
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
GPL	GPL Laboratories, LLLP
HTRW	Hazardous, Toxic, and Radioactive Waste
ICP	inductively coupled plasma
LCS	laboratory control sample
MS	matrix spike
MSD	matrix spike duplicate
PCB	polychlorinated biphenyls
QA	quality assurance
QMP	Quality Management Plan
QAPP	Quality Assurance Project Plan
QC	quality control
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
TAL	Target Analyte List
TCL	Target Compound List
TNT	trinitrotoluene
TOC	total organic carbon
USACE	U.S. Army Corps of Engineers

INTRODUCTION

This Quality Assurance Project Plan (QAPP) addendum addresses supplemental project-specific information in relation to the revised Facility-wide QAPP for the Ravenna Army Ammunition Plant (RVAAP) (USACE 2001a). Each QAPP section is presented documenting adherence to the Facility-wide QAPP or stipulating project-specific addendum requirements.

Primary analytical direction for these projects will be obtained from the identified U.S. Environmental Protection Agency (EPA) SW-846 Methods, the U.S. Army Corps of Engineers (USACE) Shell Document for Analytical Chemistry Requirements (version 1.0, 2 Nov 98), and the USACE Louisville District Chemistry Guideline (USACE 2001b).

1.0 PROJECT DESCRIPTION

1.1 SITE HISTORY/BACKGROUND INFORMATION

This information is contained in Section 1.1 of the Field Sampling Plan (Part I) of this Demolition Area 2 Phase II RI Sampling and Analysis Plan (SAP) Addendum No. 1 (hereafter referred to as the FSP Addendum).

1.2 PAST DATA COLLECTION ACTIVITY/CURRENT STATUS

This information is contained in Section 1.2 of the FSP Addendum.

1.3 PROJECT OBJECTIVES AND SCOPE

This information is contained in Chapter 3.0 of the FSP Addendum.

1.4 SAMPLE NETWORK DESIGN AND RATIONALE

This information is contained in Chapter 4.0 of the FSP Addendum.

1.5 PARAMETERS TO BE TESTED AND FREQUENCY

Sample matrix types and analytical parameters are discussed in Chapter 4.0 of the FSP Addendum. These sampling and analysis requirements are summarized in Table 1-1 of this QAPP addendum in conjunction with anticipated sample numbers, quality assurance (QA) sample frequencies, and field quality control (QC) sample frequencies. Additional sample volumes for matrix spike (MS)/matrix spike duplicates (MSD) samples will be annotated in the field logbooks.

1.6 PROJECT SCHEDULE

The Demolition Area 2 Phase II RI project schedules are discussed in Chapter 2.0 of the FSP Addendum.

Table 1-1 Sampling and Analytical Requirements for the Demolition Area 2 Phase II RI

Parameter	Methods	Field Samples	Field Duplicate Samples	Rinseate Samples	Trip Blanks	Total A-E Samples	MS/MSD Samples	USACE QA Split Samples	USACE Trip Blanks
Soil and Sediment									
Volatile organics, TCL	SW-846, 5030/8260B	24	4	2	2	32	2	4	
Semivolatile organics, TCL	SW-846, 3540/8270C	24	4	2		30	2	4	
Pesticides, TCL	Sw-846, 3540/8081A	24	4	2		30	2	4	
PCBs, TCL	SW-846, 3540/8082	24	4	2		30	2	4	
Explosives	SW-846, 8330	150	15	2		165	8	15	
Propellants	SW-846, 8330/9056	24	4	2		30	2	4	
Metals, TAL	SW-846, 6010B/7471	150	15	2		165	8	15	
Cyanide	SW-846, 9011/9012A	24	4	2		30	2	4	
Sulfide	SW-846, 9030	24	4	2		30	2	4	
Nitrate/Nitrite	EPA 300.0A	24	4	2		30	2	4	
Hexavalent Chromium	SW-846, 3060A/7196A	24	4	2		30	2	4	
TOC	EPA 415.2	30	3			32	2	3	
Grain size (sieve)	ASTM D422	30				32			
Moisture content	ASTM D2216	20				20			
Atterberg Limits	ASTM D4318	20				20			
USCS Classification	N/A	20				20			
Bulk density	ASTM D2937	20				20			
Porosity	EM1110-2-1906	20				20			
Hydraulic cond.	ASTM D5084	20				20			
Specific gravity	ASTM D854	20				20			
pH	EPA 150.1	20				20			
Groundwater									
Volatile organics, TCL	SW-846, 5030/8260B	16	2	2	2	22	1	2	2
Semivolatile organics, TCL	SW-846, 3540/8270C	16	2	2		20	1	2	
Pesticides, TCL	Sw-846, 3540/8081A	16	2	2		20	1	2	

Parameter	Methods	Field Samples	Field Duplicate Samples	Rinseate Samples	Trip Blanks	Total A-E Samples	MS/MSD Samples	USACE QA Split Samples	USACE Trip Blanks
PCBs	SW-846, 3540/8082	16	2	2		20	1	2	
Explosives	SW-846, 8330	16	2	2		20	1	2	
Propellants	SW-846, 8330/9056	16	2	2		20	1	2	
Metals, TAL	SW-846, 6010B/7470A	16	2	2		20	1	2	
Cyanide	SW-846, 9011/9012A	16	2	2		20	1	2	
Sulfide	SW-846, 9030	16	2	2		20	1	2	
Nitrate/Nitrite	EPA 300.0A	16	2	2		20	1	2	
Hexavalent Chromium	SW-846, 7196A	16	2	2		20	1	2	
Surface Water									
Volatile organics, TCL	SW-846, 5030/8260B	12	2	1	1	16	1	2	1
Semivolatile organics, TCL	SW-846, 3540/8270C	12	2	1		15	1	2	
Pesticides, TCL	Sw-846, 3540/8081A	12	2	1		15	1	2	
PCBs	SW-846, 3540/8082	12	2	1		15	1	2	
Explosives	SW-846, 8330	12	2	1		15	1	2	
Propellants	SW-846, 8330/9056	12	2	1		15	1	1	
Metals (total), TAL	SW-846, 6010B/7470A	12	2	1		15	1	2	
Cyanide	SW-846, 9011/9012A	12	2	1		15	1	2	
Sulfide	SW-846, 9030	12	2	1		15	1	2	
Nitrate/Nitrite	EPA 300.0A	12	2	1		15	1	2	
Hexavalent Chromium	SW-846, 7196A	12	2	1		15	1	2	

A-E = Architect-Engineer.
ASTM = American Society of Testing and Materials.
EM = Engineering Manual (USACE).
EPA = U.S. Environmental Protection Agency.
MS/MSD = Matrix Spike/Matrix Spike Duplicate
PCB = Polychlorinated biphenyls.
RVAAP = Ravenna Army Ammunition Plant.
QA = Quality Assurance.
TAL = Target analyte list.
TCL = Target compound list.
TOC = Total organic carbon.
USACE = U.S. Army Corps of Engineers.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The functional project organization and responsibilities are described in Chapter 2.0 of the Facility-wide SAP and the FSP Addendum.

Analytical support for this work will be performed by GPL Laboratories, LLLP (GPL). GPL is validated by the USACE Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise (CX), Omaha, Nebraska. GPL's Laboratory Quality Management Plan (QMP) is available for review upon request. The laboratory's organizational structure, roles, and responsibilities are identified in their QMP. Addresses and telephone numbers for each analytical laboratory to be used as part of this project are as follows:

GPL Laboratories, LLLP - general analytical services.

202 Perry Parkway
Gaithersburg, MD 20877
Project Manager: Debbie Griffiths

Tel: (301) 926-6802
Fax: (301) 840-1209

J&L Laboratories, Inc. - soil and sediment geotechnical analyses.

Wadsworth, Ohio Facility
215 Rainbow Street
Wadsworth, OH 44281
Project Manager: Lance Cole

Tel: (330) 335-0606
Fax: (330) 335-0908

The QA laboratory, Severn Trent Laboratories (STL), will be contracted through the Louisville USACE. Comprehensive data validation will be independently performed by the Louisville USACE.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

3.1 DATA QUALITY OBJECTIVES

Data quality objective summaries for this investigation will follow Tables 3-1 and 3-2 in the Facility-wide QAPP. All QC parameters stated in the specific EPA SW-846 methods will be adhered to for each chemical listed. The SW-846 method references found in the Facility-wide QAPP have been revised to the Update III methods (i.e., 8260A is now 8260B, 8270B is now 8270C, etc.). Laboratories are required to comply with all methods as written; recommendations are considered requirements. Concurrence with the USACE Shell Document for Analytical Chemistry Requirements, version 1.0, November 2, 1998 (USACE 1998), and USACE Louisville District Chemistry Guideline (USACE 2001b) is expected.

3.2 LEVEL OF QUALITY CONTROL EFFORT

QC efforts will follow Section 3.2 of the Facility-wide QAPP. Field QC measurements will include field source water blanks, trip blanks, field duplicates, and equipment rinsate blanks. Laboratory QC measurements will include method blanks, laboratory control samples (LCSs), laboratory duplicates, MS/MSD samples, and surrogates, if applicable. LCS measurements will include the standard mid-level analyte concentration, plus a QC/Method Reporting Level (QC/MRL) low-level concentration per the USACE Louisville District Chemistry Guideline. It is recognized that the laboratory will routinely perform and monitor the QC/MRL; however, guidance check limits will be utilized as advisory and corrective action will not be required for individual analyte variances.

3.3 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

Program accuracy, precision, and sensitivity goals identified in Section 3.3 and Tables 3-1 through 3-9 of the Facility-wide QAPP will be imposed for this investigation. In addition, the USACE Louisville District Chemistry Guideline identifies analytical method quality objectives related to individual method QC protocol.

Program and project reporting levels are identified in Tables 3-1 through 3-9 of the Facility-wide QAPP. Laboratories will make all reasonable attempts to meet these levels for each individual sample analysis. When samples require dilution, both the minimum dilution and quantified dilution must be reported. GPL will screen all samples to determine optimum dilution ranges. Dilution runs will be performed to quantitate high target analyte concentrations within the upper half of the calibration range, thus reducing the degree of dilution as much as possible. In addition, a five times less diluted run will then be performed to report other target analyte reporting levels as low as possible without destroying analytical detectors and instrumentation. If there are matrix interferences, non-target analyte, or high target analyte concentrations that preclude analysis of an undiluted sample, the laboratory project manager will contact SpecPro and Louisville District, forward analytical and chromatographic information from diluted runs, and obtain direction on how to proceed.

3.4 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Completeness, representativeness, and comparability goals identified in Section 3.4 and Tables 3-1 and 3-2 of the Facility-wide QAPP will be imposed for this investigation.

4.0 SAMPLING PROCEDURES

Sampling procedures are discussed in Chapter 4.0 of the Facility-wide SAP and FSP Addendum.

Table 4-1 summarizes sample container, preservation, and holding time requirements for the soil, sediment, and water matrices for this investigation. The number of containers required is estimated in this table.

As noted in the Facility-wide QAPP, additional sample volumes will be provided, when necessary, for the express purpose of performing associated laboratory QC (MS/MSD). These laboratory QC samples will be designated in the field records (sample manager's logbook) and identified for the laboratory on respective chain-of-custody (COC) documentation.

Table 4-1 Container Requirements for Water, Soil, and Sediment Samples for the Demolition Area 2 Phase II RI at RVAAP

Analyte Group	Approx. No. of Containers Inc. Field QC	Container	Minimum Sample Size	Preservative	Holding Time
Gorundwater and Surface Water					
Volatile Organic compounds	38	Three 40-mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCL to pH <2 Cool, 4°C	14 d
Semivolatile organic compounds	35	Two 1-L amber glass bottles with Teflon®-lined lid	1,000 mL	Cool, 4°C	7d (extraction) 40 d (analysis)
Pesticide compounds	35	Two 1-L amber glass bottles with Teflon®-lined lid	1,000 mL	Cool, 4°C	7d (extraction) 40 d (analysis)
PCB compounds	35	Two 1-L amber glass bottles with Teflon®-lined lid	1,000 mL	Cool, 4°C	7d (extraction) 40 d (analysis)
Explosive compounds	35	Two 1-L amber glass bottles with Teflon®-lined lid	1,000 mL	Cool, 4°C	7d (extraction) 40 d (analysis)
Propellant compounds	35	Two 1-L amber glass bottles with Teflon®-lined lid	1,000 mL	Cool, 4°C	7d (extraction) 40 d (analysis)
Metals (total)	35	1-L Polybottle	500 mL	HNO_3 to pH<2 Cool, 4°C	180 d
Cyanide	35	1-L Polybottle	500 mL	NaOH to pH>12 Cool, 4°C	14 d
Sulfide	35	500-mL Polybottle	100 mL	NaOH to pH >12 Cool, 4°C	28 d
Nitrate/Nitrite	35	250-mL Polybottle	100 mL	H_2SO_4 to pH <2 Cool, 4°C	28 d
Hexavalent Chromium	35	500-mL Polybottle	100 mL	Cool, 4°C	1 d
Soil and Sediment					
Volatile Organic compounds	32	One 2-oz. glass jar with Teflon®-lined cap (no headspace)	20 grams	Cool, 4°C	14 d
Semivolatile organic compounds	30	One 8-oz. wide-mouth glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 d (extraction) 40 d (analysis

Pesticide compounds	30	One 8-oz. wide-mouth glass jar with Teflon®-lined cap or use same container as SVOC, where possible	100 grams	Cool, 4°C	14 d (extraction) 40 d (analysis
PCB compounds	30	One 8-oz. wide-mouth glass jar with Teflon®-lined cap or use same container as Metals where possible	100 grams	Cool, 4°C	14 d (extraction) 40 d (analysis
Explosive compounds	165	One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 d (extraction) 40 d (analysis
Propellant compounds	30	One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	14 d (extraction) 40 d (analysis
Metals	165	One 8-oz. wide-mouth glass jar with Teflon®-lined cap	50 grams	Cool, 4°C	180 d
Sulfide	30	One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	
Nitrate/Nitrite	30	One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	
Hexavalent Chromium	30	One 4-oz. glass jar with Teflon®-lined cap	100 grams	Cool, 4°C	
Cyanide	30	Use same container as metals	25 grams	Cool, 4°C	14 d
Total organic carbon	32	One 4-oz. glass jar with Teflon®-lined cap	10 grams	Cool, 4°C	28 d
Geotechnical parameters	33	Shelby tube or 32-ounce wide-mouth container	1,000 grams	None	None

[a]Additional sample will be collected on 5 percent of the samples for the completion of matrix spike (MS)/matrix spike duplicate (MSD).
PCB = Polychlorinated biphenyl.
QC = Quality control
SVOC = Semivolatile organic compound.

5.0 SAMPLE CUSTODY

5.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

Sample handling, packaging, and shipment procedures will follow those identified in Section 5.1 of the Facility-wide QAPP.

5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

Laboratory COC will follow handling and custody procedures identified in the GPL QMP.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

Custody of evidence files will follow those criteria defined in Section 5.3 of the Facility-wide QAPP.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.1 FIELD INSTRUMENTS/EQUIPMENT

Field instruments and equipment calibrations will follow those identified in Section 6.1 of the Facility-wide QAPP.

6.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will follow procedures identified in the GPL QMP, corporate, and facility-specific operating procedures.

7.0 ANALYTICAL PROCEDURES

7.1 LABORATORY ANALYSIS

Analytical methods, parameters and quantitation or detection limits are those listed in Tables 3-3 through 3-9 of the Facility-wide QAPP.

GPL's QMP will be followed during the analysis of these samples. The following laboratory Standard Operating Procedures (SOPs) will implement the defined EPA methods.

- Gas Chromatograph (GC)/Mass Spectrometer (MS) Volatile Organics Analysis Based on Methods 8240B and 8260B, SW-846, CORP-MS-0002, rev 2, 12/15/97.

- GC/MS Semivolatile Analysis Based on Methods 8270C, SW-846, CORP-MS-0001, Rev. 2, 12/15/97.

- GC Analysis Based on Methods 8000A, 8010B, 8020A, 8021A, 8080A, 8081, 8082, 8150B, and 8051, SW-846, CORP-GC-0001, Rev. 5.1, 3/30/99.

- Extraction and Cleanup of Organic Compounds from Water and Soil, Based on SW-846 3500 Series, 3600 Series, 8150, 8151, and 600 Series Methods, CORP-OP-0001, Rev. 3.4, 4/15/99.

- Analysis of Nitroaromatic and Nitramine Explosives by HPLC, KNOX-LC-0001, Rev. 1, 4/28/97.

- Total Organic Carbon and Total Inorganic Carbon, NC-WC-0017, Rev. 2, 2/15/99.

- Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, Methods 6010B and 200.7, CORP-MT-0001, Rev. 2, 12/15/97.

- Graphite Furnace Atomic Absorption Spectroscopy, SW-846 Methods 7000A and MCAWW 200 series methods, CORP-MT-0003, Rev. 1, 08/22/95.

- Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW-846 7470A and MCAWW 245.1, CORP-MT-0005NC, Rev. 1.1, 04/19/97.

- Mercury in Solid Samples by Cold Vapor Atomic Absorption, SW846 7471A and McAWW 245.5, CORP-MT-0005NC, Rev. 1.1, 04/19/97.

- Preparation and analysis of Nitrocellulose in Aqueous, Soil, and Sediments by Colorimetric Autoanalyzer, SAC-WC-0050, Rev. 0.

- Determination of Nitroaromatics, Nitramines, and Specialty Explosives in Water and Soil by High Performance Liquid Chromatography/Ultraviolet Detector (HPLC/UV) and Liquid Chromatography/ Thermospray/Mass Spectrometry (LC/TSP/MS), SAC-LC-0001, Rev. 5.0.

GPL facilities will at all times maintain a safe and contaminant-free environment for the analysis of samples. The laboratories will demonstrate, through instrument blanks, holding blanks, and analytical method blanks, that the laboratory environment and procedures will not and do not impact analytical results.

GPL facilities will also implement all reasonable procedures to maintain project reporting levels for all sample analyses. Where contaminant and sample matrix analytical interferences impact the laboratory's ability to obtain project reporting levels, the laboratory will institute sample clean-up processes, minimize dilutions, adjust instrument operational parameters, or propose alternative analytical methods or procedures. Elevated reporting levels will be kept to a minimum throughout the execution of this work. When samples require dilution, both the minimum dilution and quantified dilution must be reported. GPL will screen all samples to determine optimum dilution ranges. Dilution runs will be performed to quantitate high target analyte concentrations within the upper half of the calibration range, thus reducing the degree of dilution as much as possible. In addition, a five times less diluted run will then be performed to report other target analyte reporting levels as low as possible without destroying analytical detectors and instrumentation. If there are matrix interferences, non-target analyte, or high target analyte concentrations that preclude analysis of an undiluted sample, the laboratory project manager will contact SpecPro and Louisville District, forward analytical and chromatographic information from diluted runs, and obtain direction on how to proceed.

7.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field analysis are identified in Chapter 6.0 of the Facility-wide SAP and in Chapter 4.0 of the FSP Addendum. Only screening of samples for organic vapors using a photoionization detector will be conducted. Headspace analysis will not be conducted.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

Field QC sample types, numbers, and frequencies are identified in Chapters 4.0 and 5.0 of the FSP of this SAP Addendum. In general, field duplicates and QA samples will be collected at a frequency of 10 percent. MS/MSD samples will be collected at a frequency of 5 percent. Field equipment rinsates will be collected at a frequency of 10 percent for water samples, while two soil/sediment equipment rinsate samples will be collected per field cycle. This will constitute a process check for the effectiveness of the decontamination procedure. Two site source water samples (one potable water source and one deionized water source) will be collected for the combined field effort. Volatile organic trip blanks will accompany all coolers and all shipments containing volatile organic samples.

8.2 FIELD MEASUREMENT

Refer to Chapter 4.0 of the FSP of this SAP Addendum for details regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures will follow those identified in the referenced EPA methodologies. These will include method blanks, LCS, MS, MSD, laboratory duplicate analysis, calibration standards, internal standards, surrogate standards, and calibration check standards.

GPL facilities will conform to their QMP, facility-specific appendices, and implement their established SOPs to perform the various analytical methods required by the project. QC frequencies will follow those identified in Section 8.3 of the Facility-wide QAPP.

Analyses will also be consistent with direction provided by the USACE Shell Document for Analytical Chemistry Requirements (USACE 1998) and the USACE Louisville District Chemistry Guideline (USACE 2001b). The following are clarifications to this guidance relative to this project.

- The Corps Quality Control/Method Detection Limit (QC/MDL) check will be performed quarterly until criteria can be established.

- Analytical method blanks will be considered clean as long as analyte concentrations are below reporting levels. Corrective actions will be performed for any analyte detected above the established method reporting level. Any analytes detected between the method detection limit and the method reporting level will be flagged appropriately.

- Laboratory Control Standards will contain all project target compounds, however, for organic methods only the SW-846 subset of system monitoring compounds will be used to monitor method performance and to initiate analytical method corrective actions.

- For methods that have multi-responders (i.e., Aroclors and pesticides) within the same analytical process, the laboratory will not include all analytes within the matrix spiking mixture. A representative analyte will be employed for the MS evaluation.

- Inductively coupled plasma (ICP) method initial calibration curves will be confirmed through the analysis of a blank and three standards, and this documentation will be reported as part of the analytical data package.

- ICP serial dilution will be performed on a per batch basis. If the serial dilution falls outside acceptance criteria, a post-digestion spike analyses will be performed.

- Sediment samples having moisture levels that preclude soxlet extraction process will be extracted by sonication methods.

- When analyzing nitroglycerine by Method 8330, NG must be spiked in the associated LCS and MS/MSDs.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 DATA REDUCTION

Sample collection and field measurements will follow the established protocols defined in the Facility-wide QAPP, Facility-wide SAP, and the FSP Addendum. Laboratory data reduction will follow GPL's QMP guidance and conform to general direction provided by the Facility-wide QAPP, the USACE Shell Document (USACE 1998), and the USACE Louisville District Chemistry Guideline (USACE 2001b).

9.2 DATA VERIFICATION/VALIDATION

Project data verification and validation will follow direction provided in the Facility-wide QAPP, Section 9.2 and diagrammed in Figure 9-1.

All data will be reviewed and verified by SpecPro according to the Facility-wide QAPP.

Validation of 10 percent of the data will follow the direction provided in the Facility-wide QAPP and the USACE Louisville District Chemistry Guideline (USACE 2001b). Independent third pary data validation will be performed through the USACE Louisville District.

9.3 DATA REPORTING

Analytical data reports will follow the direction provided in the Facility-wide QAPP.

10.0 PERFORMANCE AND SYSTEM AUDITS

10.1 FIELD AUDITS

A minimum of one field surveillance for the investigation will be performed by the SpecPro QA Officer (or designee) and/or the SpecPro Field Operations Manager. This audit will encompass the sampling of groundwater, surface water, soil, and sediment from the wells, ditches, and land areas.

USACE, EPA Region 5, or Ohio EPA audits may be conducted at the discretion of the respective agency.

10.2 LABORATORY AUDITS

Routine USACE HTRW CX on-site laboratory audits may be conducted by the USACE, EPA Region 5, or Ohio EPA at the discretion of the respective agency.

Internal performance and systems audits will be conducted by GPL's QA staff as defined in the laboratory QMP.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

11.1 FIELD INSTRUMENTS AND EQUIPMENT

Maintenance of all field analytical and sampling equipment will follow direction provided in Section 11.1 of the Facility-wide QAPP.

11.2 LABORATORY INSTRUMENTS

Routine and preventive maintenance for all laboratory instruments and equipment will follow the direction of GPL's QMP.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 FIELD MEASUREMENTS DATA

Field data will be assessed as outlined in Section 12.1 of the Facility-wide QAPP.

12.2 LABORATORY DATA

Laboratory data will be assessed as outlined in Section 12.2 of the Facility-wide QAPP.

13.0 CORRECTIVE ACTIONS

13.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Field activity corrective action protocol will follow directions provided in Section 13.1 of the Facility-wide QAPP.

13.2 LABORATORY ANALYSES

Laboratory activity corrective action protocol will follow directions provided in Section 13.2 of the Facility-wide QAPP and GPL's QMP and the Louisville Chemistry Guideline (USACE 2001b).

14.0 QA REPORTS TO MANAGEMENT

Procedures and reports will follow the protocol identified in Section 14.0 of the Facility-wide QAPP and those directed by GPL's QMP.

15.0 REFERENCES

GPL Laboratories, LLLP, *Quality Management Plan*, 2001.

USACE (U.S. Army Corps of Engineers) 1998. *Shell Document for Analytical Chemistry Requirements,* Version 1.0, November.

USACE 2001a. *Facility-wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*, DACA62-00-D-0001, Delivery Order CY02, Final, March.

USACE 2001b. *Louisville Chemistry Guideline,* Samir A. Mansy, Environmental Chemistry Branch, Rev. 1, January.