APPENDIX I

PBA08 Remedial Investigation Summary

THIS PAGE INTENTIONALLY LEFT BLANK.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK.

ACRONYMS AND ABBREVIATIONS

ADR	Automated Data Review
AOC	Area of Concern
ASTM	American Society for Testing And Materials
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, And Liability Act
COC	Chemical of Concern
DoD	U.S. Department Of Defense
DPT	Direct Push Technology
DQO	Data Quality Objective
ELAP	Environmental Laboratory Accreditation Program
ERA	Ecological Risk Assessment
FCR	Field Change Request
FS	Feasibility Study
FWCUG	Facility-wide Cleanup Goal
FWHHRAM	Facility-wide Human Health Risk Assessors Manual
FWSAP	*Facility-Wide Sampling And Analysis Plan*
gal	gallon
GPS	Global Positioning System
HHRA	Human Health Risk Assessment
HQ	Hazard Quotient
IDW	Investigation-Derived Waste
ISM	Incremental Sampling Method
MDL	Method Detection Limit
Ohio EPA	Ohio Environmental Protection Agency
PAH	Polycyclic Aromatic Hydrocarbon
PBA08 RI	Performance-Based Acquisition 2008 Remedial Investigation
PBA08 SAP	Performance Based Acquisition 2008 Supplemental Investigation Sampling and Analysis Plan Addendum No. 1
PCB	Polychlorinated Biphenyl
QA	Quality Assurance
QC	Quality Control
RI	Remedial Investigation
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SVOC	Semi-volatile Organic Compound
TAL	Target Analyte List
TR	Target Risk
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOC	Volatile Organic Compound

THIS PAGE INTENTIONALLY LEFT BLANK.

I.0 REMEDIAL INVESTIGATION

This section presents the methods used for developing data quality objectives (DQOs), collecting field data, and managing analytical data and laboratory programs for the Performance-Based Acquisition 2008 Remedial Investigation (PBA08 RI) at Load Line 10. The PBA08 RI was implemented in accordance with the Performance Based Acquisition 2008 Supplemental Investigation Sampling and Analysis Plan Addendum No. 1 (PBA08 SAP) to supplement historical data and complete the remedial investigation (RI) phase of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. The results of the PBA08 RI sampling are combined with the results of 2004 and 2007 sampling events to evaluate the nature and extent of contamination, assess potential future impacts to groundwater, conduct human health risk assessments (HHRAs) and ecological risk assessments (ERAs), and evaluate the need for remedial alternatives.

As part of the PBA08 RI DQOs, an initial screening approach was used to help focus the investigation on specific chemicals and areas to be further evaluated by assessing the nature and extent of contamination observed in historical samples (Section 3.2.2 of the PBA08 SAP). The screening approach presented in the PBA08 SAP compared sample results from previous investigations at Load Line 10 to the most protective chemical-specific facility-wide cleanup goals (FWCUGs) at the 1E-06 cancer risk level and non-carcinogenic risk hazard quotient (HQ) of 0.1, as presented within the Ravenna Army Ammunition Plant (RVAAP) Facility-wide Human Health Risk Assessors Manual (USACE 2005)(FWHHRAM). The most protective FWCUGs are referred to as "screening criteria." Previous results were also compared to FWCUGs at the higher target risk (TR) of 1E-05 and HQ of 1.0 to facilitate identifying potential source areas that may require additional sampling to refine the extent of contamination. The decision rules for surface and subsurface soil sampling outlined in the PBA08 SAP are shown on Figures I-1 and I-2. Table I-1 lists the chemicals with detected concentrations that exceed screening criteria in historical soil samples.

Table I-1. Chemicals Detected at Concentrations above Screening Criteria in Previous Investigations

Surface Soil	Subsurface Soil
Aluminum Arsenic Chromium Cobalt Lead Benzo(a)pyrene	Medium not sampled

Representatives of RVAAP, Ohio Environmental Protection Agency (Ohio EPA), U.S. Army Corps of Engineers (USACE) Louisville, and Camp Ravenna reviewed and approved the PBA08 RI sample locations and rationale as part of the approval process for the PBA08 SAP in January 2010. The PBA08 RI, conducted from February through April 2010, included collecting surface water, sediment, surface soil, and subsurface soil using discrete sampling techniques. Additionally, surface soil was collected using incremental sampling method (ISM) techniques.

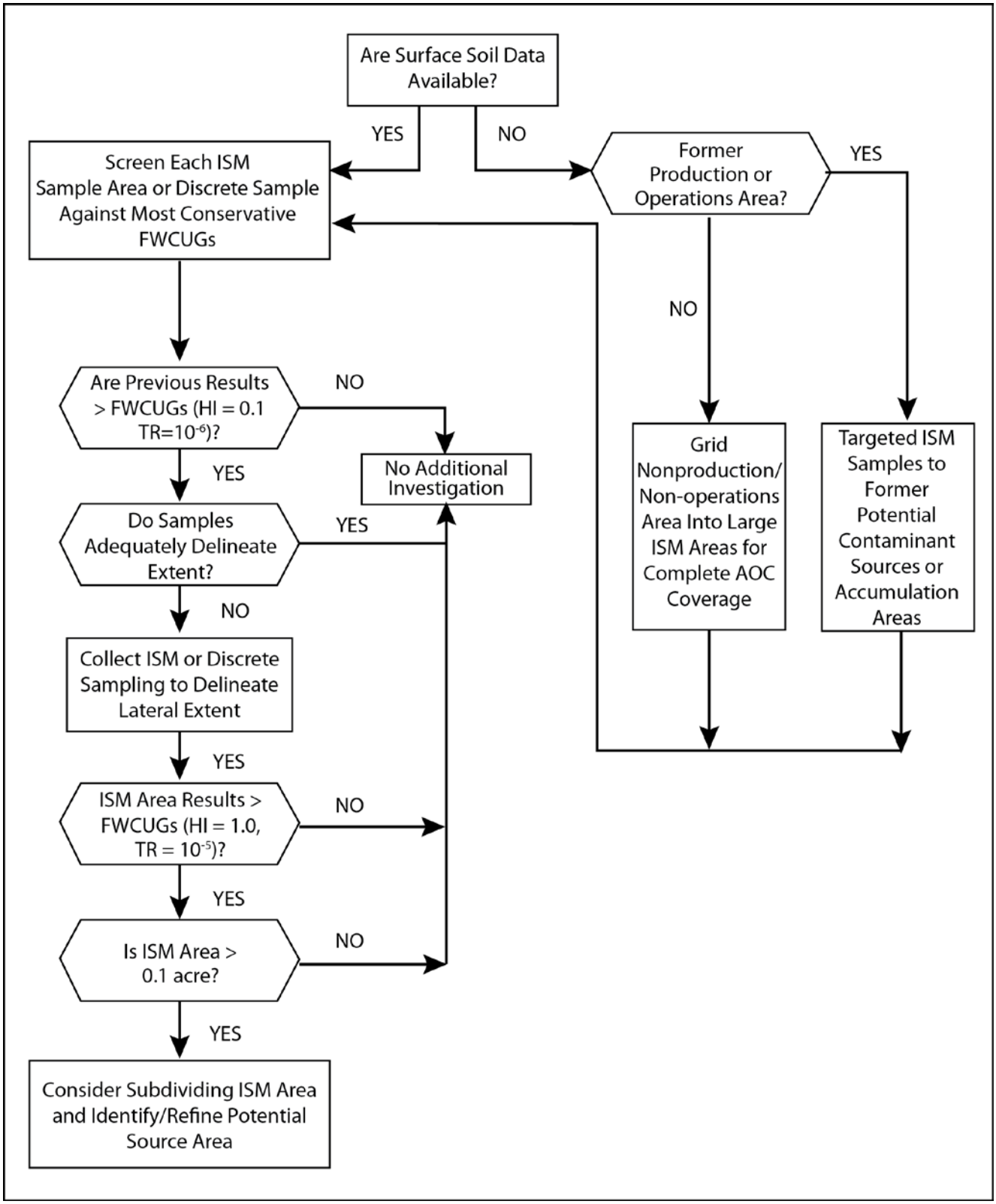

Figure I-1. PBA08 RI Surface Soil Sampling Decision Flowchart

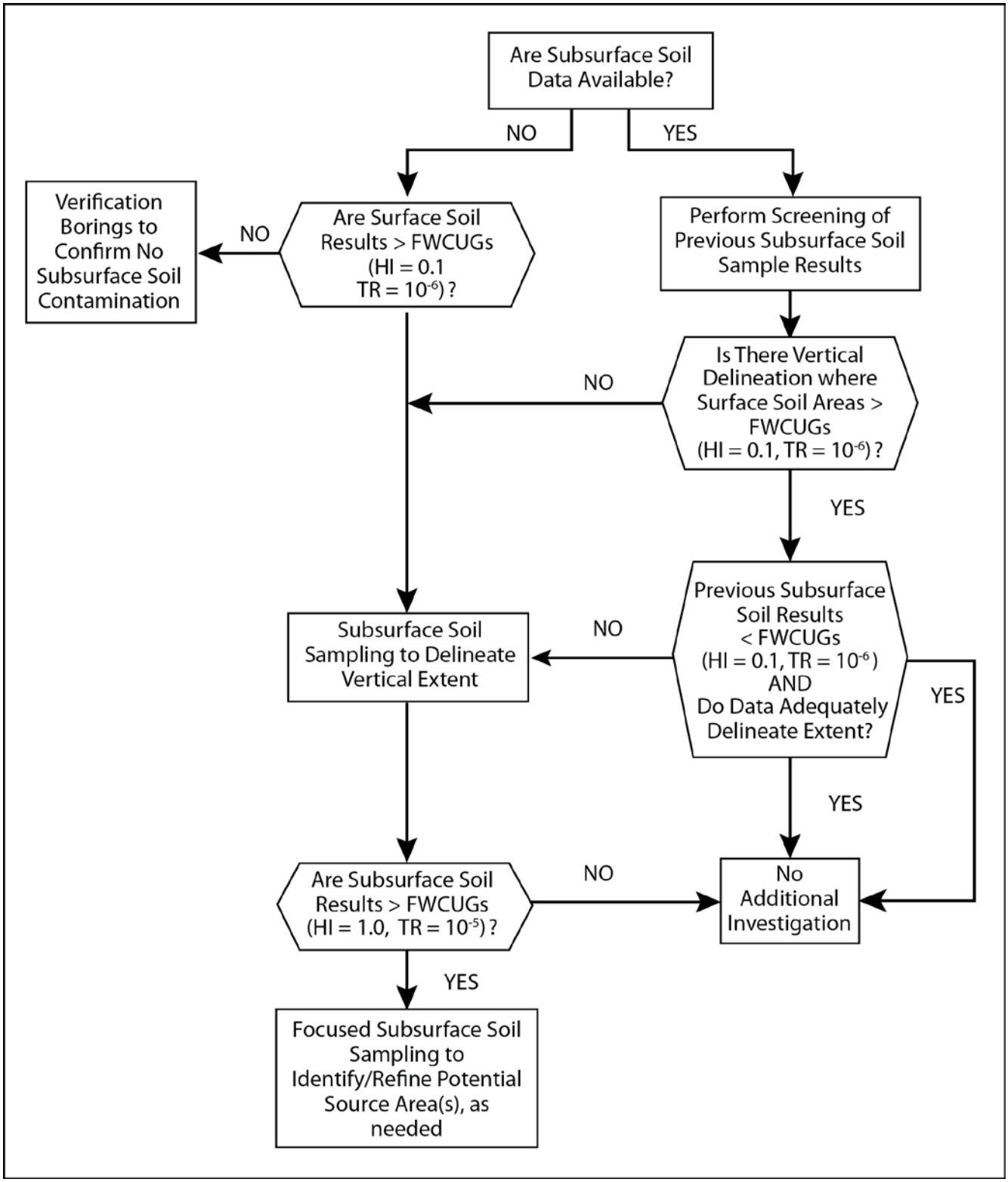

Figure I-2. PBA08 RI Subsurface Soil Sampling Decision Flowchart

No groundwater samples were collected during the PBA08 RI, as the current conditions of groundwater will be evaluated as an individual area of concern (AOC) for the entire facility (designated as RVAAP-66) and addressed in a separate RI/feasibility study (FS) report. The following sections describe the rationale and sample collection methods for each component of the PBA08 RI field investigation.

I.1 SOIL CHARACTERIZATION

Soil samples were collected during the PBA08 RI to assess contaminant occurrence and distribution in surface and subsurface soil. The decision-making matrices for the surface soil and subsurface soil sampling plans are presented in Figures I-1 and I-2, respectively.

I.1.1 Surface Soil Sampling Rationale and Methods

Since ISM was used for surface soil [0–1 ft below ground surface (bgs)] as part of the Characterization of 14 AOCs, ISM was also used for surface soil sampling during the PBA08 RI. The PBA08 RI sampled locations with the greatest likelihood of contamination (e.g., adjacent to production buildings or within sediment accumulation areas, such as ditches). Each ISM result was evaluated separately against the screening criteria for each chemical analyzed. Surface soil sampling to define the lateral extent of contamination was conducted according to the decision rules approved in the PBA08 SAP and is depicted in Figure I-1. All PBA08 RI surface soil samples were collected using ISM or discrete sampling techniques.

A total of 22 surface soil (19 ISM and 3 discrete) samples were collected at Load Line 10 during the PBA08 RI. Three ISM samples were collected around former ISM sample areas to delineate locations where chemicals were detected above FWCUGs and to further define the lateral extent of contamination (Figure I-3). A total of 14 multi-acre ISM samples, including quality assurance (QA)/quality control (QC) samples, were collected to complete characterization of the AOC. Multi-acre ISM sample locations ranged from 1.8-4.1 acres in extent, encompassing the entirety of the AOC as defined by the Load Line 10 fence line. Additionally, three discrete samples were collected to evaluate chromium speciation.

ISM samples were analyzed for target analyte list (TAL) metals, explosives, and polycyclic aromatic hydrocarbons (PAHs). Discrete samples for chromium speciation were analyzed for total and hexavalent chromium. Three ISM samples (15% of the total number of ISM samples collected) were analyzed for RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), semi-volatile organic compounds (SVOCs), volatile organic compound (VOCs), polychlorinated biphenyls (PCBs), and pesticides]. Nitroglycerin was analyzed under U.S. Environmental Protection Agency (USEPA) Method 8330 and was reported as an explosive chemical. Table I-2 presents the specific rationale for each surface soil sample collected for the PBA08 RI.

Table I-2. PBA08 RI Surface Soil Samples and Rationales

PBA08 RI Location	Targeted Area	Purpose	Analyses Performed				
			Metals	Explosives	VOCs	Pesticides/ PCBs	SVOC
L10ss-079M	L10ss-030M, and L10ss-011M (Northwest side of PE-4, PE-5 and PE-6)	Further refined previously identified chemical exceedances of arsenic, chromium.	Y	Y	N	N	PAH
L10ss-080M	L10ss-003M and L10ss-026M (Northeast side of PE-1)	Further refined previously identified chemical exceedances of chromium, lead and benzo(a)pyrene.	Y	Y	Y	Y	Y
L10ss-081M	L10ss-028M (Area northeast of PE-25)	Further refined previously identified chemical exceedances of arsenic, chromium.	Y	Y	N	N	PAH
L10ss-082M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-083M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-084M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-085M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-085M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-086M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-087M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-088M	Not applicable	Characterization of large areas at the site.	Y	Y	Y	Y	Y
L10ss-089M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-089M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-090M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-091M	Not applicable	Characterization of large areas at the site.	Y	Y	N	N	PAH
L10ss-092M	Not applicable	Characterization of large areas at the site.	Y	Y	Y	Y	Y
L10ss-093M	Not applicable	Characterization of ditch not previously investigated.	Y	Y	N	N	PAH

PAH = Polycyclic aromatic hydrocarbon.
PCB = Polychlorinated biphenyl.
SVOC = Semi-volatile organic compound.
VOC = Volatile organic compound.

For the PBA08 RI, the corners of each of the designated ISM sampling areas were located using a digital global positioning system (GPS) and were marked using wooden stakes. Sampling crews selected aliquot locations by walking over the entire ISM sampling area and marking the requisite number of points using flagging. At least 30 aliquots were collected for each ISM sample. Aliquot locations were randomly selected in the field and were not predetermined using a grid.

Approximately equal sample volume aliquots were collected from a depth of 0–1 ft bgs using a decontaminated ⅝-inch diameter push probe. A soil description was completed for each ISM sample and is included in Appendix A.

All aliquots collected from a given ISM sample area were combined in a labeled container for transport to the laboratory in accordance with the PBA08 SAP. At the laboratory, each sample was air-dried, sieved, and ground for specified non-volatile chemical analyses.

QC field duplicate and QA split samples were collected from the ISM sample areas at 10% frequency (two samples). The QC field duplicate samples were submitted to the laboratory as "blind" and were used to determine whether the field sampling technique was reproducible, and as an indicator of sample heterogeneity. The QA split samples were sent to a USACE QA laboratory for independent analysis and evaluation of analytical results obtained by the primary laboratory.

QA/QC samples were collected as replicate ISM samples requiring three separate ISM samples from the same sample area. The QA/QC samples were collected from a set of 30 aliquot locations that were positioned adjacent to the location used for the initial ISM sample. Aliquots for QA/QC samples were collected in separate stainless steel bowls and were placed into separate labeled containers.

ISM was not utilized for samples collected for VOC analysis because the air drying, mixing, and sieving of aliquots required by the method could result in the loss of VOCs from the sample. For ISM sample areas designated for VOC analysis, one discrete sample was collected from a depth of 0-1 ft bgs within the ISM sample area using the bucket hand auger method described in the PBA08 SAP. The specific location of the discrete sample was randomly chosen. Soil portions designated for VOC analyses were not homogenized in the field but were placed directly in the sample container and compacted to zero headspace.

In addition to the ISM surface soil samples, three discrete chromium speciation samples were collected to evaluate the potential contribution of hexavalent chromium to the total chromium concentrations in soil. Samples from 0–1 ft bgs were collected in accordance with the bucket hand auger method described in Section 4.5.2.1.1 of the *Facility-Wide Sampling and Analysis Plan* (USACE 2001) (herein referred to as the FWSAP). An updated version of the FWSAP was developed in February 2011 and approved by the Ohio EPA; however, the PBA08 RI was implemented prior to approval of this updated version. Two samples were collected from areas previously identified as having elevated total chromium concentrations, and one sample was collected from an area previously identified as having a total chromium concentration near background concentrations. Field duplicate samples were not collected for chromium speciation samples. A sample log including soil description was completed for each sample, and all logs are included in Appendix A.

After the discrete samples were collected, excess soil was designated as investigation-derived waste (IDW) and placed in lined, labeled 55-gal drums that were sealed after use and staged at Building 1036. IDW management practices for all media are discussed in Appendix F. Hand auger borings were backfilled to ground surface with dry bentonite chips while hydrating with the project-approved potable water.

I.1.2 Subsurface Soil Sampling Rationale and Methods

The PBA08 RI used discrete samples from soil borings to complete the characterization of subsurface soil. The subsurface soil decision rules are presented in Figure I-2 and were based upon prior surface soil sampling results to define the vertical extent of contamination. The subsurface soil was characterized by placing borings in various areas, including areas with previous results greater than the screening criteria, areas with previous results only slightly greater than the screening criteria, and areas not previously sampled. Subsurface soil sampling was conducted according to the decision rules approved in the PBA08 SAP.

In all cases, subsurface borings were biased toward areas where contamination from historic uses or site drainage was most likely. Soil samples from nine soil borings installed in ISM areas with historical screening criteria exceedances were collected to further delineate the vertical extent of contamination in subsurface soil at the AOC (Figure I-3). These included three samples in downgradient drainage ditches and six samples in previous ISM areas. Table I-3 presents the specific rationale for each subsurface soil sample collected for the PBA08 RI.

Table I-3. Subsurface Soil Rationale and Analyses

PBA08 RI Location	Comments/Rationale	Sample Type	Depth ft (bgs)	Analyses Performed				
				Metals	Explosives	VOCs	Pesticides/ PCBs	SVOC
L10sb-066	Delineated vertical extent of previously identified contamination in L10ss-003M (Northeast of PE-1).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		Discrete	7–12	Y	Y	N	N	PAH
L10sb-067	Delineated vertical extent of previously identified contamination in sample L10ss-027M (ditch).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		NS	7–13	N	N	N	N	N
L10sb-069	Delineated vertical extent of previously identified contamination in L10ss-004M (PE-15).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		NS	7–13	N	N	N	N	N
L10sb-070	Delineated vertical extent of previously identified contamination in L10ss-028M (PE-25).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		Discrete	7–13	Y	Y	N	N	PAH
	QA/QC	Discrete	4–7	Y	Y	N	N	PAH
L10sb-071	Delineated vertical extent of previously identified contamination in L10ss-015M (PE-7).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–6.5	Y	Y	N	N	PAH
		NS	7–13	N	N	N	N	N
L10sb-072	Confirmed absence of contamination in previously sampled area in L10ss-004M (PE-8).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		NS	7–13	N	N	N	N	N
	QA/QC	Discrete	0–1	Y	Y	N	N	PAH
L10sb-073	Delineated vertical extent of previously identified contamination in L10ss-011M and L10ss-030M (PE-5). Analyzed for RVAAP full-suite analytes.	Discrete	0–1	Y	Y	Y	Y	Y
		Discrete	1–4	Y	Y	Y	Y	Y
		Discrete	4–7	Y	Y	Y	Y	Y
		NS	7–13	N	N	N	N	N
	QA/QC	Discrete	0–1	Y	Y	Y	Y	Y

Table I–3. Subsurface Soil Rationale and Analyses (continued)

PBA08 RI Location	Comments/Rationale	Sample Type	Depth ft (bgs)	Analyses Performed	Explosives	VOCs	Pesticides / PCBs	SVOC
L10sb-074	Delineated vertical extent of previously identified contamination in L10ss-040M (ditch exiting the AOC to the southeast). Analyzed for RVAAP full-suite analytes.	Discrete	0–1	Y	Y	Y	Y	Y
		Discrete	1–4	Y	Y	Y	Y	Y
		Discrete	4–7	Y	Y	Y	Y	Y
		NS	7–13	N	N	N	N	N
L10sb-075	Confirmed absence of contamination in area not previously sampled near L10ss-036M (ditch on the east side of the AOC).	Discrete	0–1	Y	Y	N	N	PAH
		Discrete	1–4	Y	Y	N	N	PAH
		Discrete	4–7	Y	Y	N	N	PAH
		NS	7–13	N	N	N	N	N

Subsurface soil borings were completed by direct push technology (DPT) using a Geoprobe® and/or hand auger. DPT soil samples were collected in a single-use acetate liner at discrete sample locations and hand auger samples were collected in a chemically decontaminated 3-inch diameter stainless steel auger bucket. The sampling depth intervals were presented in the PBA08 SAP. Each soil boring was sampled at the following intervals: 0–1 ft bgs, 1–4 ft bgs, 4–7 ft bgs, and 7–13 ft bgs. Each interval was composited and homogenized in a stainless steel bowl, with the exception of VOC samples. The sample collected from the 7–13 ft bgs interval was archived on site, while the 4–7 ft bgs interval sample was analyzed under an expedited five day turnaround time. As specified in the PBA08 SAP, if there was one chemical concentration that exceeded screening criteria in the 4–7 ft bgs sample, the 7-13 ft bgs sample was analyzed. In addition, at least 10% of all subsurface samples from 7–13 ft bgs were submitted for laboratory analysis to ensure adequate characterization of the subsurface soil to 13 ft bgs. Two samples collected from the 7–13 ft bgs sample interval were submitted for laboratory analysis for Load Line 10.

All subsurface soil samples were analyzed for TAL metals, explosives, and PAHs. A total of 15% of samples (six) were analyzed for the RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, VOCs, PCBs, and pesticides]. Three QC field duplicate and three QA split samples were collected to satisfy the QA/QC sample requirements of 10% frequency for subsurface soil samples. A lithologic soil description was completed for each soil boring and is included in Appendix A.

One geotechnical sample was collected from boring location L10sb-068 to provide soil data for fate and transport modeling. A pilot boring was installed with a Geoprobe® to a depth of 20.0 ft bgs to allow lithologic characterization of the soil and determine the appropriate geotechnical sample intervals (Appendix A). The geotechnical sample location was offset from the pilot boring and drilled with hollow stem auger attachments. Geotechnical samples were collected from 4.0–4.8 ft bgs through the hollow stem augers directly into the Shelby tube. Several attempts were made to recover a second Shelby tube from 16–18 ft bgs directly above the only moist zones observed in the pilot boring, but were not successful due to poor recovery.

The undisturbed Shelby tube was sealed with wax, capped, and submitted for laboratory geotechnical analysis for porosity, bulk density, moisture content, total organic carbon, grain size fraction analysis, and permeability. Laboratory analytical results for geotechnical samples are presented in Appendix D. QA/QC samples were not collected for the geotechnical sample.

After the discrete samples were collected, excess soil was designated as IDW and placed in lined, labeled 55-gal drums that were sealed after use and staged at Building 1036. IDW management practices for all media are discussed in Appendix F. Hand auger borings were backfilled to ground surface with dry bentonite chips while hydrating with the project-approved potable water.

I.2 SURFACE WATER AND SEDIMENT CHARACTERIZATION

For the purposes of this report, the term "surface soil" includes dry sediment. Dry sediment refers to unconsolidated inorganic and organic material within conveyances, ditches, or low lying areas that occasionally may be covered with water, usually following a precipitation event or due to snowmelt. Dry sediment is not covered with water for extended periods and typically is dry within seven days of precipitation. Dry sediment does not function as a permanent habitat for aquatic organisms, although it may serve as a natural medium for the growth of terrestrial organisms. Dry sediment is addressed the same as surface soil (0–1 ft bgs) in terms of contaminant nature and extent, fate and transport, and risk exposure models. The term "sediment," as used in this report, refers to wet sediment within conveyances, ditches, wetlands, or water bodies that are inundated for extended periods of time. These definitions and terminology usage are consistent with the FWCUG Report.

Surface water and sediment samples were collected to characterize current conditions and assess potential entrance and exit pathways from the AOC (Figure I-3). One co-located surface water and sediment sample (L10sd/sw-094) was collected during the PBA08 RI from the drainage ditch exiting the AOC at the south end, and one facility-wide, co-located surface water and sediment sample (FWSsd/sw-102) was collected during the PBA08 RI from a stream that drains the Fuze and Booster Hill area.

I.2.1 Surface Water and Sediment Sampling Methods

The surface water grab samples were collected by the hand-held bottle method in accordance with Section 4.3 of the PBA08 SAP and analyzed for the RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, VOCs, PCBs, and pesticides]. Water quality parameters for temperature, pH, conductivity, dissolved oxygen, and turbidity were collected using calibrated water quality meters (Hanna Instrument Models 9828 and 98703). A surface water and sediment sample collection sheet was completed for each sample location and is included in Appendix A.

The sediment samples were collected in accordance with Section 4.2 of the PBA08 SAP. The samples consisted of a multi-aliquot composite with 10 aliquots selected randomly within a 5 ft radius of the identified sample location. Each aliquot was collected by a push probe to a maximum depth of 0.5 ft bgs. The aliquots were homogenized in a stainless steel bowl, transferred to the appropriate, labeled sample container, and analyzed for the RVAAP full-suite analytes [i.e., TAL metals, explosives, propellants (nitrocellulose and nitroguanidine), SVOCs, VOCs, PCBs, and pesticides]. For VOC analysis, one discrete sample collected from 0–0.5 ft bgs was collected within the 5 ft sampling radius and placed directly in the appropriate, labeled sample container.

I.2.2 Load Line 10 Surface Water and Sediment Sampling Rationale

During previous investigations, no surface water or sediment samples were collected for characterization purposes at Load Line 10. One co-located surface water and sediment sample was

collected during the PBA08 RI from the drainage ditch exiting the AOC at the south end. The sample was collected in accordance with the following decision rules approved in the PBA08 SAP:

- At AOCs where overland flow of contaminants could occur to nearby perennial streams, those streams will be sampled. The sample locations may be outside of the AOC boundaries but the samples represent the areas potentially impacted by the AOCs (Load Lines 5, 6, 7, 9, 10, and Wet Storage Area).
- At points where contamination may migrate out of the AOC area, such as a ditch or a stream near the AOC boundary, samples will be collected to characterize current conditions and determine whether contaminant migration may occur at surface water runoff exit points.

Table I-4 presents the specific rationale for the surface water and sediment samples collected for the PBA08 RI.

Table I-4. PBA08 RI Surface Water and Sediment Samples and Rationales

Sample Type	Depth (ft bgs)	Station	Sample	Date Sampled	Comments/Rationale
Composite Sediment	0–1	L10sd-094	L10SD-094-5531-SD	2/18/2010	Assessment of potential exit pathway of ditch draining to the southwest.
Grab Surface Water	NA	L10sw-094	L10SW-094-5535-SW	3/9/2010	

ft bgs = Feet below ground surface.
NA = Not Applicable.

I.2.3 Facility-wide Surface Water and Sediment Sampling Rationale

One facility-wide, co-located surface water and sediment sample was collected during the PBA08 RI from a stream that drains the Fuze and Booster Hill area. Table I-5 presents the specific rationale for the facility-wide surface water and sediment samples collected for the PBA08 RI.

Table I-5. Facility-wide Surface Water and Sediment Samples and Rationales

Sample Type	Depth (ft bgs)	Station	Sample	Date Sampled	Comments/Rationale
Grab Surface Water	NA	FWSsw-102	FWSsw-102-5010-SW	2/17/2010	Characterize current conditions and potential exit pathways from the Fuze and Booster Hill area, and provide data for the nature and extent.
Composite Sediment	0–0.5	FWSsd-102	FWSsd-102-5011-SD	2/17/2010	

ft bgs = Feet below ground surface.
NA = Not Applicable.

I.3 CHANGES FROM THE WORK PLAN

Changes to the PBA08 SAP are documented in the field change requests (FCRs) provided in Appendix B. Changes made in the field based on AOC-specific conditions are not documented on FCRs but on the field sampling logs (Appendix A). These changes are presented in Table I-6 and in the field sampling logs. Revised coordinates for all locations can be found on the field sampling logs.

I.4 ANALYTICAL PROGRAM OVERVIEW

The following sections describe the analytical program followed during the PBA08 RI.

I.4.1 Data Quality Objectives

Samples were collected and analyzed according to the FWSAP and the PBA08 SAP that were prepared in accordance with USACE and USEPA guidance. The FWSAP and PBA08 SAP outline the organization, objectives, intended data uses, and QA/QC activities to perform in order to achieve the desired DQOs for maintaining the defensibility of the data. Project DQOs were established in accordance with USEPA Region 5 guidance. Requirements for sample collection, handling, analysis criteria, target analytes, laboratory criteria, and data verification criteria for the RI are consistent with USEPA and U.S. Department of Defense (DoD) requirements. DQOs for this project include analytical precision, accuracy, representativeness, completeness, comparability, and sensitivity for the measurement data. Appendix C presents an assessment of the analytical program objectives.

Table I-6. Changes from the PBA08 Sampling and Analysis Plan

Station	Affected Sample	Date Sampled	Change/Rationale
L10sb-067	L10SB-067-5497-SO	3/17/2010	Original station location was on a hill; location was relocated to the bottom of the adjacent ditch.
	L10SB-067-5498-SO	3/17/2010	
	L10SB-067-5499-SO	3/17/2010	
	L10SB-067-5500-SO	3/17/2010	
L10sb-068	L10SB-068-5502-SO	NA	No recovery for 16–18 foot interval; only one geotechnical sample collected.
L10sb-074	L10SB-074-5523-SO	3/16/2010	Location was relocated to the bottom of a nearby ditch.
	L10SB-074-5524-SO	3/16/2010	
	L10SB-074-5525-SO	3/16/2010	
L10sb-075	L10SB-075-5527-SO	3/16/2010	Location was relocated to the bottom of a nearby ditch (former ISM area).
	L10SB-075-5528-SO	3/16/2010	
	L10SB-075-5529-SO	3/16/2010	
	L10SB-075-5530-SO	3/16/2010	
L10sw-094	L10SW-094-5535-SW	3/9/2010	No water present when sediment sample was collected; water sample was collected on a later date after snowmelt and rain.

ISM = Incremental Sampling Method.
NA = Not Applicable.

I.4.2 Quality Assurance and Quality Control

Samples were properly packaged for shipment and transferred by courier to the laboratory for analysis. A signed chain-of-custody record (included in Appendix D) with sample numbers and locations was enclosed with each shipment. When transferring the possession of samples, the individuals relinquishing and receiving the samples signed, dated, and noted the time on the record. All shipments were in compliance with applicable U.S. Department of Transportation regulations for environmental samples.

QA/QC samples for this project included field blanks, trip blanks, QC field duplicates, QA split samples, laboratory method blanks, laboratory control samples, laboratory duplicates, and matrix spike/matrix spike duplicate samples. Table I-7 presents a summary of QA/QC samples utilized during the PBA08 RI and how each sample type was used to support the quality of the analytical data. Evaluation of QA/QC samples and their contribution to documenting project data quality is provided in Appendix C.

I.4.3 Field Analyses

No field laboratory analyses (i.e., field explosives testing or ISM processing) were conducted for the PBA08 RI. However, water quality parameters were recorded using water quality meters (Hanna Instrument Models 9828 and 98703) that were calibrated daily. Additionally, field screening for organic vapors was not used to guide sampling or analytical efforts. Organic vapors were monitored in the breathing zone during drilling for health and safety purposes at each subsurface soil boring location.

Table I-7. Summary of PBA08 RI QA/QC Samples

Sample Type	Rationale
Field Blank	Analyzed to determine contamination in source material that may contribute to sample contamination.
Trip Blank	Analyzed to assess the potential for cross contamination of samples due to contaminant interference during sample shipment and storage.
Field Duplicate	Analyzed to determine sample heterogeneity and sampling methodology reproducibility.
Equipment Rinsate	Analyzed to assess the adequacy of the equipment decontamination processes for non-dedicated sampling equipment.
Laboratory Method Blanks	Analyzed to assess the contamination level in the laboratory preparation and analysis process.
Laboratory Duplicate Samples	Analyzed to assist in determining the analytical reproducibility and precision of the analysis for the samples of interest and provide information about the effect of the sample matrix on the measurement methodology.
Matrix Spike/Matrix Spike Duplicate	
Laboratory Control Sample	Analyzed to determine the accuracy and precision of the analytical method implemented by the laboratory and to monitor the laboratory's analytical process control.
QA Split	Analyzed to provide independent verification of the accuracy and precision of the principal analytical laboratory.

QA = Quality Assurance.

I.4.4 Laboratory Analyses

Samples collected during the PBA08 RI were analyzed by TestAmerica Laboratories, Inc. (herein referred to as TestAmerica) of North Canton, Ohio and West Sacramento, California, as a subcontractor to White Water Associates, Inc., of Amasa, Michigan. Collected QA split samples were analyzed by USACE's contracted QA laboratory, RTI Laboratories, Inc., of Livonia, Michigan. TestAmerica and RTI Laboratories, Inc. are accredited by the DoD Environmental Laboratory Accreditation Program (ELAP).

All analytical procedures were completed in accordance with applicable professional standards, USEPA requirements, government regulations and guidelines, DoD Quality Systems Manual Version 3, USACE Louisville District analytical QA guidelines, and specific project goals and requirements. In addition to these standards, the analytical laboratories were required to strictly adhere to the requirements set forth in the FWSAP and PBA08 SAP so that conditions adverse to data quality would not arise. Project quantitation level goals for analytical methods were listed in the Quality Assurance Project Plan. These levels were achieved or exceeded throughout the analytical process, with the exception of a few pesticide, PCB, and SVOC soil samples which were analyzed at diluted levels. These goals and exceptions are further discussed in Appendix C Data Quality Control Summary Report. Preparation and analyses for chemical parameters were performed according to the methods listed in Table I-8. Additionally, soil geotechnical analysis for porosity, bulk density, moisture content, grain size fraction, and permeability were performed in compliance with American Society for Testing and Materials (ASTM) test methods.

Table I-8. Summary of PBA08 RI Sample Preparation and Analytical Procedures

Parameter	Soil and Sediment		Surface Water	
	Preparation	Analysis	Preparation	Analysis
Inorganic chemicals	SW-846 3050B	SW-846 6020	SW-846 3005A	SW-846 6020
Mercury	--	SW-846 7471A	--	SW-846 7470A
Explosives	--	SW-846 8330B	--	SW-846 8330B
SVOCs and PAHs	SW-846 3540C	SW-846 8270C	SW-846 3520C	SW-846 8270C
Propellants: Nitrocellulose Nitroguanidine	 -- SW-846 3550A	 353.2 Modified SW-846 8330M	 -- SW-846 3535	 353.2 Modified SW-846 8330M
VOCs	SW-846 5030B	SW-846 8260B	SW-846 5030B	SW-846 8260B
Pesticides	SW-846 3540C	SW-846 8081A	SW-846 3520C	SW-846 8081A
PCBs	SW-846 3540C	SW-846 8082	SW-846 3520C	SW-846 8082
Hexavalent Chromium	SW-846 3060A	SW-846 7196A	--	SW-846 7196A

PAH = Polycyclic Aromatic Hydrocarbon.
PCB = Polychlorinated Biphenyl.
SVOC = Semi-volatile Organic Compound.
VOC = Volatile Organic Compound.
-- = Preparation steps included in analytical method.

Leidos is the custodian of the project files and will maintain the contents of the files for this investigation, including all relevant records, reports, logs, field notebooks, photographs, subcontractor reports, correspondence, and sample custody forms. These files will remain in a secure area under the custody of the Leidos project manager until they are transferred to USACE, Louisville District and the U.S. Army at the end of the PBA08 project.

Analytical data reports from the project laboratory were forwarded to the USACE Louisville District laboratory data validation contractor for validation, review, and QA comparison. White Water Associates, Inc. and TestAmerica will retain all original raw data (hard copy and electronic copy) in a secure area under the custody of the laboratory project manager for a minimum of seven years.

I.4.5 Data Review, Verification, and Quality Assessment

Data were produced, reviewed, and reported by the laboratory in accordance with specifications in the PBA08 SAP, the Louisville District analytical QA guidelines, and the laboratory's QA manual.

TestAmerica performed in-house analytical data reduction under the direction of the laboratory project manager and QA officer. These individuals were responsible for assessing data quality and informing Leidos and USACE of any data considered "unacceptable" or requiring caution by the data user in terms of its reliability.

Final reports were generated by the laboratory project manager. Data were then delivered to Leidos for verification. TestAmerica prepared and retained full analytical and QC documentation for the project in paper copy and electronic storage media (e.g., compact disk), as directed by the analytical methodologies employed. Laboratory reports included documentation verifying analytical holding time compliance.

Leidos performed a systematic process utilizing automated data review (ADR) software for data verification to ensure the precision and accuracy of the analytical data were adequate for their intended use. The ADR outlier reports are included as Attachment 1 to Appendix C. This verification also attempted to minimize the potential of using false-positive or false-negative results in the decision-making process (i.e., to ensure accurate identification of detected versus non-detected chemicals). This approach was consistent with the DQOs for the project and with the analytical methods used for determining chemicals of concern (COCs) and calculating risk. "Definitive Data" were reported consistent with the deliverables identified in the project sampling and analysis plan (SAP). These definitive data were then verified through the review process outlined in the project SAP and presented in Appendix C. A few inorganic chemical, SVOC, PAH, PCB, and pesticide samples required dilution due to elevated analyte concentrations or difficult matrices. All reporting limits and/or method detection limits (MDLs) for undetected analytes remained below FWCUGs, with the exception of n-nitrosodi-n-propylamine for soil sample L10SS-080M-5537-SO. Data that have been rejected were relegated to the non-detected antimony result in soil sample L10SB-070-5510-SO. Rejected data constituted 0.02% of the Load Line 10 data. Other results were qualified as estimated, indicating accuracy, precision, or sensitivity was less than desired but adequate for their intended use. The completeness goal for analytical data is 90%, as defined in Table 3-1 and 3-2 of the Facility-wide Quality Assurance Project Plan. The project achieved this goal by collecting all samples presented in the PBA08 SAP and producing usable results for 99.98% of all samples performed. In addition to the Leidos data review, USACE performed a 10% validation of all data to evaluate data usability. Results of USACE's validation are presented in Appendix C.

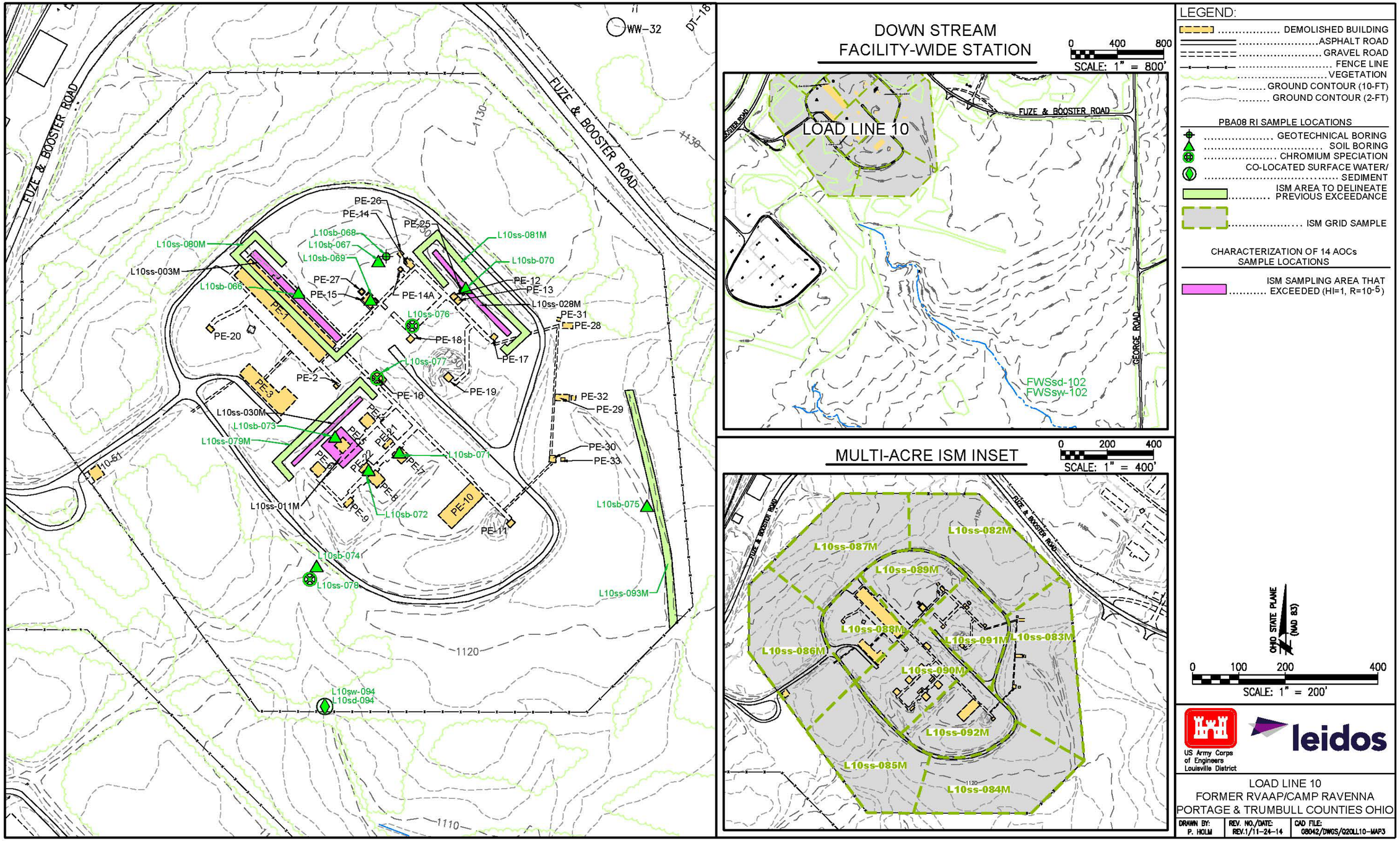

Figure I-3. Load Line 10 Map Showing Historical and PBA08 RI Sampling Locations - Former RVAAP/Camp Ravenna

THIS PAGE INTENTIONALLY LEFT BLANK.

REFERENCES

USACE 2001. *Facility-wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*. March 2001.

USACE 2005. *RVAAP Facility-Wide Human Health Risk Assessors Manual – Amendment 1*. December 2005.