FINAL

FACILITY-WIDE SAMPLING AND ANALYSIS PLAN

FOR

ENVIRONMENTAL INVESTIGATIONS

AT THE

RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO

Prepared for

US Army Corps of Engineers®

U.S. Army Corps of Engineers – Louisville District
Contract No. DACA 62-00-D-0001
Delivery Order CY02

March 2001

SAIC

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FIELD SAMPLING PLAN

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ACRONYMS

AOC	Area of Concern
ARAR	applicable or relevant and appropriate requirement
ASTM	American Society for Testing and Materials
bgs	below ground surface
CAR	Corrective Action Report
CCQC	Contractor Chemical Quality Control
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
COC	chain of custody
COPC	chemicals of potential concern
CQC	Contractor Quality Control
DCQCR	Daily Chemical Quality Control Report
DNT	dinitrotoluene
DOT	U.S. Department of Transportation
DQOs	Data Quality Objectives
DSMOA	Defense-State Memorandum of Agreement
EPA	Environmental Protection Agency
FCO	Field Change Order
FSA	Field Staging Area
FSAP	Facility-Wide Sampling and Analysis Plan
FSHP	Facility-Wide Safety and Health Plan
GOCO	Government-Owned, Contractor-Operated
GPD	gallons per day
GPM	gallons per minute
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HQ	Hazard Quotient
IDW	investigation-derived waste
IRA	Interim Removal Action
IRP	Installation Restoration Program
LCS	laboratory control sample
LIMS	Laboratory Information Management System
LPD	liters per day
LPM	liters per minute
MDL	method detection limit
MS	matrix spike
MSD	matrix spike duplicate
NCR	Nonconformance Report
NFA	no further action
NSF	National Sanitation Foundation
OAC	Ohio Administrative Code
OB/OD	Open Burning/Open Detonation
OE	ordnance explosive waste
Ohio EPA	Ohio Environmental Protection Agency
OSC	Operations Support Command
OSP	Ohio State Plane
PAS	Preliminary Assessment Screening
PCB	polychlorinated biphenyl

PPE	personal protective equipment
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RAI	Ravenna Arsenal Inc.
RCRA	Resource Conservation and Recovery Act
RDX	cyclonite
RFA	RCRA Facility Assessment
RMIS	Restoration Management Information System
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SAP	Sampling and Analysis Plan
SDWA	Safe Drinking Water Act
SHP	Safety and Health Plan
SHSO	Site Health and Safety Officer
SOP	Standard Operating Procedure
SSHP	Site Safety and Health Plan
SWMUs	Solid Waste Management Units
TCLP	Toxicity Characteristic Leaching Procedure
TNT	trinitrotoluene
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
USACE	U.S. Army Corps of Engineers
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAEHA	U.S. Army Environmental Hygiene Agency
USATHAMA	U.S. Army Toxic and Hazardous Materials Agency
UXO	unexploded ordnance
XRF	X-ray fluorescence

INTRODUCTION

This Facility-Wide Sampling and Analysis Plan (FSAP) for Environmental Investigations at Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio, has been prepared by Science Applications International Corporation (SAIC), under contract DACA 62-00-D-0001, Delivery Order #CY02, with the U.S. Army Corps of Engineers (USACE) Louisville District. The FSAP was developed in accordance with USACE and Ohio Environmental Protection Agency (Ohio EPA) guidance documents, to meet the requirements for the investigation of known or suspected contaminated sites regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), the Resource Conservation and Recovery Act (RCRA), and other federal or state regulations that govern environmental restoration activities at RVAAP.

This FSAP is intended to:

- establish standards for the performance of all environmental field sampling and data handling efforts that take place at RVAAP;
- incorporate improvements and modifications to the original facility-wide plans;
- serve as the master Standard Operation Procedure (SOP), with the realization that new information and new technologies may result in changes to these procedures; and
- be available to regulators, managers, and contracted firms in easily accessible electronic format.

The standards of performance are necessary to ensure consistency and defensibility of the large amounts of environmental data expected to be gathered at RVAAP, regardless of Area of Concern (AOC), funding source, U.S. Army project manager, or contracted firm performing the work. All environmental data will be archived in a central Environmental Information Management System, and must be consistent across all programs. The requirements for consistency among investigation programs include not only detailed procedures for sample collection and handling, but also for documentation, data validation, and quality assurance (QA)/quality control (QC). These protocols, along with the project organization presented here, have proven successful in the foregoing U.S. Department of Defense Installation Restoration Program (IRP) work administered by Operations Support Command (OSC) and USACE at RVAAP.

The original FSAP (USACE 1996) presumed that all environmental activities carried out at RVAAP would be administered by the OSC and USACE under the IRP, a process that parallels CERCLA (see Figure Intro-1). Indeed, the IRP/CERCLA model for ensuring the sufficiency, integrity, and defensibility of data on environmental contamination has been applied to the majority of environmental investigations conducted by the U.S. Army to date at RVAAP. USACE recognizes that not all environmental investigation activity is IRP-driven, and that the requirements under CERCLA may be more rigorous than required for some AOCs. However, the CERCLA model will continue to be used in this FSAP update for all environmental data collection and analysis at RVAAP, for all currently identified 51 AOCs at RVAAP (including the non-IRP sites; see Table Intro-1; see Figure Intro-2). This model provides consistency with all previous IRP data collected at RVAAP, and provides high-quality data on which to base cleanup decisions. The foundations set forth in this FSAP will apply to several possible types of IRP and non-IRP environmental investigations, e.g.:

Phase I and Phase II Remedial Investigations (CERCLA),
Feasibility Studies (CERCLA),
Groundwater Investigations (Ohio Solid Waste Regulations),
Confirmatory Sampling of Removal Actions (CERCLA),

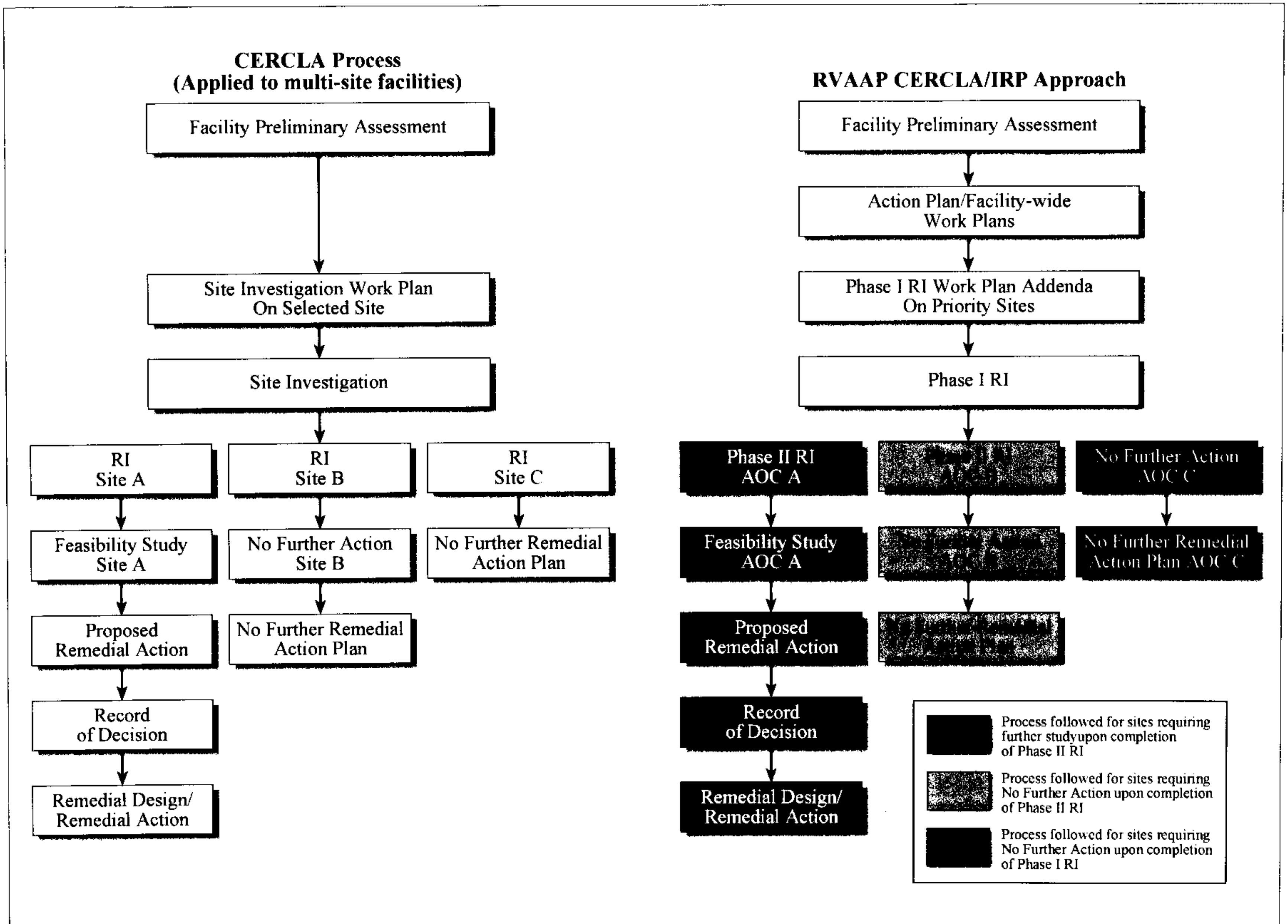
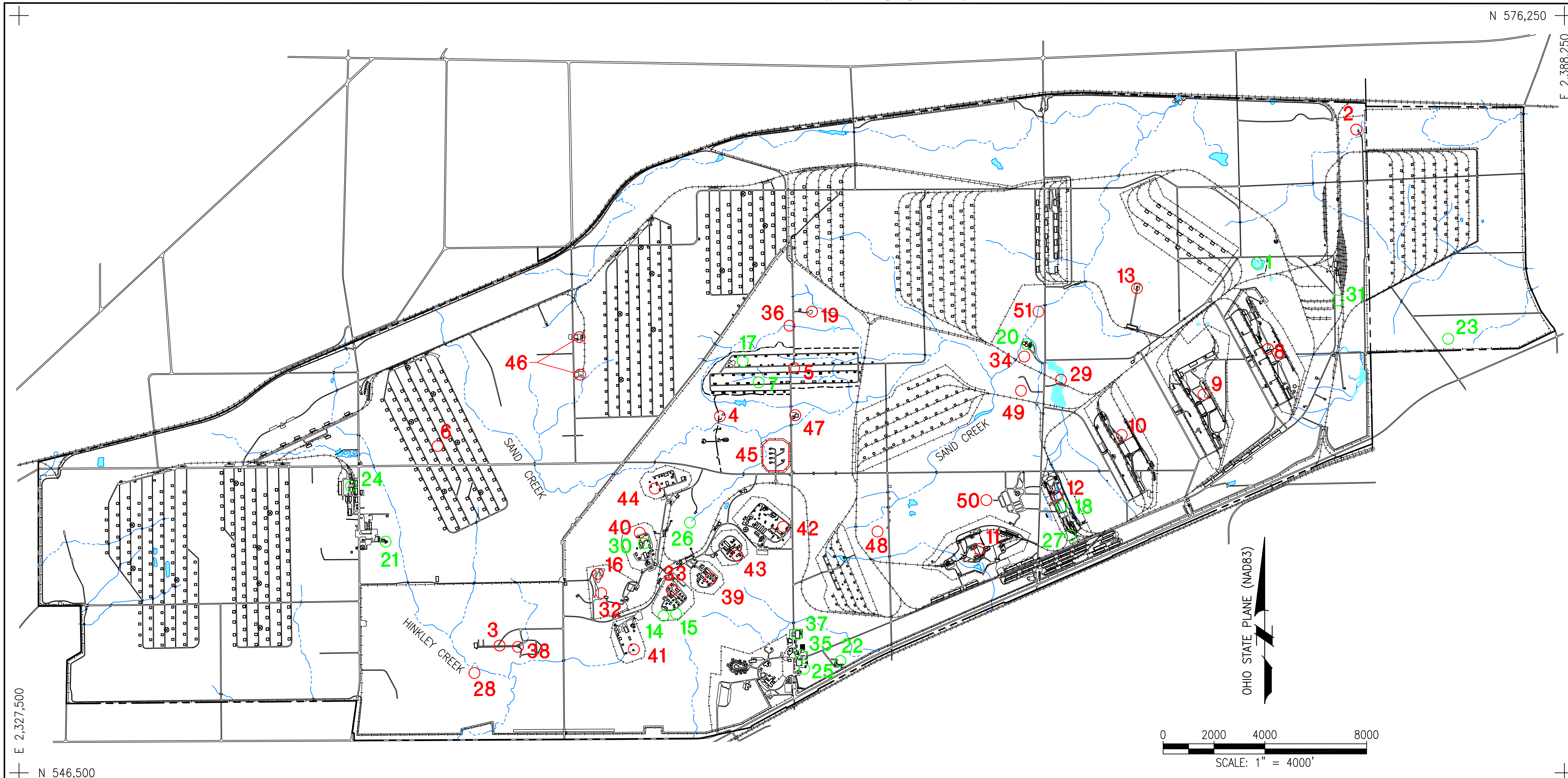


Figure Intro-1. CERCLA Approach at RVAAP



LEGEND OF SITES:

1 ...... RAMSDELL QUARRY LANDFILL
2 ...... ERIE BURNING GROUNDS
3 ...... DEMOLITION AREA 1
4 ...... DEMOLITION AREA 2
5 ...... WINKLEPECK BURNING GROUNDS
6 ...... C BLOCK QUARRY
7 ...... BLDG 1601 HAZARDOUS WASTE STORAGE
8 ...... LOAD LINE 1 AND DILUTION/SETTLING POND
9 ...... LOAD LINE 2 AND DILUTION/SETTLING POND
10 ...... LOAD LINE 3 AND DILUTION/SETTLING POND
11 ...... LOAD LINE 4 AND DILUTION/SETTLING POND
12 ...... LOAD LINE 12 AND DILUTION/SETTLING POND
13 ...... BLDG 1200 AND DILUTION/SETTLING POND
14 ...... LOAD LINE 6, EVAPORATION UNIT
15 ...... LOAD LINE 6, TREATMENT PLANT
16 ...... QUARRY LANDFILL/FORMER FUZE & BOOSTER BURNING PITS
17 ...... DEACTIVATION FURNACE
18 ...... LOAD LINE 12 PINK WASTE WATER TREATMENT
19 ...... LANDFILL NORTH OF WINKLEPECK BURNING GROUND
20 ...... SAND CREEK SEWAGE TREATMENT PLANT
21 ...... DEPOT SEWAGE TREATMENT PLANT
22 ...... GEORGE ROAD SEWAGE TREATMENT PLANT
23 ...... UNIT TRAINING SITE WASTE OIL TANK
24 ...... RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK
25 ...... BLDG 1034 MOTOR POOL WASTE OIL TANK
26 ...... FUZE BOOSTER AREA SETTLING TANKS
27 ...... BLDG 854-PCB STORAGE
28 ...... MUSTARD AGENT BURIAL SITE
29 ...... UPPER AND LOWER COBBS POND COMPLEX
30 ...... LOAD LINE 7 PINK WASTEWATER TREATMENT PLANT
31 ...... ORE PILE RETENTION POND
32 ...... 40- AND 60-MM FIRING RANGE
33 ...... FIRESTONE TEST FACILITY
34 ...... SAND CREEK DISPOSAL ROAD LANDFILL
35 ...... 1037 BUILDING-LAUNDRY WASTEWATER SUMP
36 ...... PISTOL RANGE
37 ...... PESTICIDE STORAGE BUILDING T-4452
38 ...... NACA TEST AREA
39 ...... LOAD LINE 5 / FUZE LINE 1
40 ...... LOAD LINE 7 / BOOSTER LINE 1
41 ...... LOAD LINE 8 / BOOSTER LINE 2
42 ...... LOAD LINE 9 / DETONATOR LINE
43 ...... LOAD LINE 10 / PERCUSSION ELEMENT
44 ...... LOAD LINE 11 / ARTILLERY PRIMER
45 ...... WET STORAGE AREA
46 ...... BUILDINGS F-15 AND F-16
47 ...... BUILDING T-5301 DECONTAMINATION
48 ...... ANCHOR TEST AREA
49 ...... CENTRAL BURN PITS
50 ...... ATLAS SCRAP YARD
51 ...... DUMP ALONG PARIS-WINDHAM ROAD

○ ...... CERCLA
○ ...... RCRA
○ ...... OTHER REGULATORY

US Army Corps of Engineers Louisville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
LOUISVILLE, KENTUCKY

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
FACILITY MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. 0 / 03-14-01	/99035/DWGS/L70RVAP1

Fig. Intro-2. RVAAP Installation Map

Table Intro-1. Areas of Concern at RVAAP

AOC Name		Regulations
1	Ramsdell Quarry Landfill	Other Regulations
2	Erie Burning Grounds	CERCLA
3	Demolition Area #1	CERCLA
4	Demolition Area #2	RCRA/CERCLA
5	Winklepeck Burning Grounds	CERCLA
6	C Block Quarry	CERCLA
7	Bldg 1601 Hazardous Waste Storage	RCRA
8	Load Line 1 and Dilution/Settling Pond	CERCLA
9	Load Line 2 and Dilution/Settling Pond	CERCLA
10	Load Line 3 and Dilution/Settling Pond	CERCLA
11	Load Line 4 and Dilution/Settling Pond	CERCLA
12	Load Line 12 and Dilution/Settling Pond	CERCLA
13	Bldg 1200 and Dilution/Settling Pond	CERCLA
14	Load Line 6, Evaporation Unit	Other Regulations
15	Load Line 6, Treatment Plant	Other Regulations
16	Quarry Landfill/Former Fuze & Booster Burning Pits	CERCLA
17	Deactivation Furnace	RCRA
18	Load Line 12 Pink Waste Water Treatment	Other Regulations
19	Landfill North of Winklepeck Burning Ground	CERCLA
20	Sand Creek Sewage Treatment Plant	Other Regulations
21	Depot Sewage Treatment Plant	Other Regulations
22	George Road Sewage Treatment Plant	Other Regulations
23	Unit Training Site Waste Oil Tank	Other Regulations
24	Reserve Unit Maintenance Area Waste Oil Tank	Other Regulations
25	Building 1034 Motor Pool Waste Oil Tank	Other Regulations
26	Fuze Booster Area Settling Tanks	Other Regulations
27	Bldg 854-PCB Storage	Other Regulations
28	Mustard Agent Burial Site	CERCLA
29	Upper and Lower Cobbs Pond Complex	CERCLA
30	Load Line 7 Pink Wastewater Treatment Plant	Other Regulations
31	ORE Pile Retention Pond	Other Regulations
32	40 and 60 MM Firing Range	CERCLA
33	Load Line 6	CERCLA
34	Sand Creek Disposal Road Landfill	CERCLA
35	1037 Building-Laundry Wastewater Sump	Other Regulations
36	Pistol Range	CERCLA
37	Pesticide Storage Building T-4452	Other Regulations
38	NACA Test Area	CERCLA
39	Load Line 5/Fuze Line 1	CERCLA
40	Load Line 7/Booster Line 1	CERCLA
41	Load Line 8/Booster Line 2	CERCLA
42	Load Line 9/Detonator Line	CERCLA
43	Load Line 10/Percussion Element	CERCLA
44	Load Line 11/Artillery Primer	CERCLA
45	Wet Storage Area	CERCLA
46	Buildings F-15 and F-16	CERCLA
47	Building T-5301 Decontamination	CERCLA
48	Anchor Test Area	CERCLA
49	Central Burn Pits	CERCLA
50	Atlas Scrap Yard	CERCLA
51	Dump along Paris-Windham Road	CERCLA

Confirmatory Sampling of RCRA Closures (RCRA),
Unexploded Ordnance/Ordnance Explosive Waste (UXO/OE) Removal Engineering Evaluation/Cost Analyses, and
Sampling of non-AOC Areas Before Placement of Clean Fill.

The characterization of AOCs at RVAAP will be accomplished using the facility-wide plans that can be customized with addenda for only those elements of the work that are project-specific. This approach reduces costs associated with creating redundant work plan information and accelerates the review of work plans for individual projects. The facility-wide plans address work elements that are expected to be integral to the investigations of all AOCs. The elements of the facility-wide plans are the following:

- **Sampling and Analysis Plan (SAP):** This document details the expected sampling methods, equipment, and procedures; sample custody/documentation requirements; sample packaging, shipping, and handling requirements; generic management of investigation-derived wastes; chemical QC requirements; field documentation; data reporting; and corrective actions. The SAP contains a generic request for authorization under Ohio Administrative Code (OAC) 3745-27-13 to conduct investigative activities necessary to characterize an AOC.

- **Safety and Health Plan (SHP):** This plan identifies the potential hazards and presents a risk analysis for each expected chemical, physical, and biological hazard expected at RVAAP during the performance of the common field tasks. The SHP defines provisions for personal protective equipment, hazard and emergency communication, training, and general safe work practices to be observed by field personnel at RVAAP during environmental investigations.

- **Quality Assurance Project Plan (QAPP):** The QAPP addresses analytical data quality objectives (DQOs) and specific QA/QC procedures to be used in the collection and analyses of anticipated samples. The document identifies the roles and responsibilities of each element of the QA/QC team for a project. The QAPP addresses sampling quality control procedures (e.g., preservation, handling, and custody); analytical holding times; calibration; preventive maintenance; laboratory QC; data quality assessment, data precision, accuracy completeness, sensitivity, representativeness, and compatibility requirements; and data reporting. Because the USACE will continue to fulfill the role of QA administrator for RVAAP, specific USACE guidance will be adopted for environmental investigations at RVAAP.

- The **Environmental Information Management Plan** addresses work elements that follow the field components of IRP and other environmental investigations.

The facility-wide plans cannot be implemented without the accompaniment of investigation-specific addenda (to the FSAP, QAPP, and FSHP, at a minimum). The addenda will contain specific project scope and objectives, sampling rationale and locations, analytical DQOs, analytical laboratory specifications, and the project schedule, as well as specific health and safety precautions and protocols. Sampling procedures not addressed in the FSAP will also be included as appropriate. The addenda will be tiered under the facility-wide plans and used in conjunction with them, to the extent practical. It should be noted that nothing in these facility-wide work plans prevents a user (such as a contracted consulting firm) from modifying specific procedures and standards, according to the goals of the specific investigation, in an RVAAP- and Ohio-EPA reviewed addendum to the FSAP, Facility-wide QAPP, or FSHP, etc.

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1.0 PROJECT DESCRIPTION

1.1 SITE HISTORY AND CONTAMINANTS

The Ravenna Army Ammunition Plant (RVAAP) is located in northeastern Ohio within Portage and Trumbull counties, approximately 4.8 km (3 miles) east–northeast of the town of Ravenna and approximately 1.6 km (1 mile) northwest of the town of Newton Falls. The installation consists of 8668.3 ha (21,419 acres) contained in a 17.7-km (11-mile)-long, 5.6-km (3.5-mile)-wide tract bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; State Route 534 on the east; Garrettsville and Berry Roads on the west; and the CONRAIL Railroad on the north. The land use surrounding the installation is primarily farmland with occasional private residences. The installation is surrounded by several local communities: Windham, which borders the installation to the north; Garrettsville, located 9.6 km (6 miles) to the northwest; Newton Falls, 1.6 km (1 mile) to the east; Charleston, bordering the southwest; and Wayland, 4.8 km (3 miles) to the southeast.

RVAAP was established on August 26, 1940 for the primary purpose of loading conventional medium- and large-caliber artillery ammunition; bombs; mines; fuzes and boosters; primers and percussion elements; and for the storage of finished ammunition components. Originally, the installation was divided into two separate units; one was designated the Portage Ordnance Depot with the primary mission of the depot's storage activity, and the other was designated as the Ravenna Ordnance Plant with the primary mission of the ammunition-loading activities.

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

RVAAP is a Government-Owned, Contractor-Operated (GOCO) U.S. Army Operations Support Command (OSC) facility. Currently, RVAAP is an inactive facility maintained by a contracted caretaker, Tol-Test, Inc. of Toledo, Ohio. The Atlas Powder Company was the original GOCO manager of the Ravenna Ordnance Depot and operated the plant from 1940 to 1945; the government operated the Portage Ordnance Depot. The last production for World War II was in August 1945. The government assumed operations of both areas from 1945 to 1951 when Ravenna Arsenal Inc. (RAI), a subsidiary of the Firestone Tire and Rubber Co., Akron, Ohio, was contracted to operate the entire facility. In 1982, Physics International Co., a subsidiary of Rockcor Inc., purchased RAI from Firestone. Rockcor Inc. was purchased by Olin Corporation in June 1985. In May 1999, the Ohio Army National Guard assumed administrative control over ~6,880 of the 8,903 ha (~17,000 of the ~22,000 acres) at RVAAP. However, the Areas of Concern (AOCs) and munitions storage areas remain under the control of the U.S. Army OSC.

A brief overview of the history of RVAAP is provided in chronological order to provide a summary of the site's history.

<u>Date</u>	<u>Description of Activity/Facility Status</u>
1940	10,117.5 ha (25,000 acres) purchased by United States Government. Began construction of the plant.
Sep 1940	Operated by Atlas Powder Company.

Dec 1941 to Jan 1942	Facility completed and began operations. Primary mission was depot storage and ammunition ammunition loading. Divided installation into two separate units: Portage Ordnance Depot – depot storage of munitions and components. Ravenna Ordnance Plant – loading ammunition.
Aug 1943	Redesignated as the Ravenna Ordnance Center.
Nov 1945	Redesignated as the Ravenna Arsenal.
1945	Turned over to Ordnance Department.
1946 to 1949	Silas Mason Co. operated the ammonium nitrate line for the production of ammonium nitrate fertilizer.
1950	Plant placed on standby status. Operations limited to renovation, demilitarization, and normal maintenance of equipment and stored ammunition and components.
Apr 1951	RAI contracted to run facility. Subsidiary of Firestone Tire and Rubber Co.
Jul 1954	Plum Brook Ordnance Works of Sandusky, Ohio, and the Keystone Ordnance Works of Meadville, Pennsylvania, were made satellites of Ravenna.
Aug 1957	All at-plant production ended.
Oct 1957	The installation was placed on standby status.
Mar 1958	Plum Brook Ordnance Works ceased to be under the jurisdiction of Ravenna.
Jul 1959	Keystone Ordnance Works was transferred to the General Services Administration.
Oct 1960	Began rehabilitation work to replace facilities in the ammonium nitrate line for the processing and explosive melt-out of bombs.
Jan 1961	Began operations of the processing and explosive melt-out of bombs. First operation of this type in the ammunition industry.
Jul 1961	Plant again deactivated.
Nov 1961	Installation was divided into the Ravenna Ordnance Plant and an industrial section. Entire facility was designated as the RVAAP.
May 1968	RVAAP reactivated in support of the Southeast Asian Conflict for loading, assembling, and packing munitions on three load lines and two component lines.
1971	Operations ceased at Load Lines 1, 2, 3, and 4.
Jun 1973 to Mar 1974	Deactivated major load lines and component line to demilitarization of the M71A1 90MM projectile.
Oct 1982	Physics International Company (a subsidiary of Rockcor Inc.) purchased Ravenna Arsenal Inc. from Firestone.

Jun 1985 Rockcor Inc. was purchased by Olin Corporation.

1992 The RVAAP mission was discontinued, placing the installation on the “Inactive Maintained” status.

Mar 1993 Transfer of RVAAP from “Inactive Maintained” to “Inactive Modified-Caretaker” Status.

Sep 1993 RVAAP was placed in “Modified-Caretaker” Status.

Sep 1993 A Report of Excess determined the load lines and associated real estate as excess to the U.S. Army. The excess area includes approximately 2006.0 ha (4957 acres) and 362 buildings in Load Lines 1 through 12 (excluding 7 and 11), Area 4, and Area 8.

Oct 1993 Mason & Hanger-Silas Mason Co., Inc. took over as the installation’s contractor modified caretaker.

Oct 1997 R+R International became the installation’s contractor modified caretaker.

1998 Salvage and demolition operations commenced at RVAAP. Removal of railroad ties and rails, copper wire, and excess metal for salvage was completed. Demolition of Load Lines 1, 2, and 12 commenced with the removal of all transite (friable asbestos and concrete) siding and roofing.

May 1999 Administrative control of 6,541 ha (16,164 acres) of RVAAP was transferred to the Ohio Army National Guard for use in training and related activities. Seventeen CERCLA AOCs were included in this transfer.

Feb 2000 Tol-Test, Inc. replaced R+R International as contractor-modified caretaker.

Although currently inactive, RVAAP has historically handled hazardous wastes and operated several waste management units in support of their operations (Figure Intro-2). Materials of potentially hazardous nature were stored, treated, deposited in landfills, or burned at the site.

The industrial operations at RVAAP consisted of 12 load lines. Load Lines 1 through 4 were used to melt and load trinitrotoluene (TNT) and Composition B into large-caliber shells and bombs. The operations on Load Lines 1 through 4 produced explosive dust, spills, and vapors that collected on the floor and walls of each building. Periodically, the floor and walls would be hosed down with water and steam. The liquid, containing TNT and Composition B constituents, would be collected in holding tanks, filtered, and pumped to one of four settling ponds. Load Lines 5 through 11 were used to assemble fuzes, primers, and boosters while Load Line 12 housed the ammonium nitrate plant. Potential contaminants in Lines 5 through 11 included lead azide, lead styphnate, black powder, TNT, mercury fulminate, perchlorate, and Composition B. Load Line 12 was operated to produce ammonium nitrate for explosives and fertilizers. According to plant documentation, all residual dusts and spills were washed into the storm drainage system. Demilitarization of munitions later took place at Lead Lines 1 and 12.

Landfills at RVAAP were used to bury waste from industrial operations and sanitary sources. In addition, other burial sites may be located on-site based on historical information. Potential contaminants from these areas include, but are not limited to, explosives, explosive wastes, mustard agent, metals, sodium chloride, and calcium chloride.

Settling and retention ponds at the site collected waste water from munitions washdown operations at various facilities. Potential contaminants associated with the settling and retention ponds include, but are not limited to, explosive compounds, aluminum chloride, and metals.

RVAAP had several areas associated with the burning, demolition, and testing of various munitions. These burning grounds and demolition areas consisted of large areas of land or abandoned quarries for these activities. Potential contaminants at these sites include, but are not limited to, explosives [cyclonite (RDX), HMX, Composition B, TNT, black powder] white phosphorous, antimony sulfide, lead azide, propellant, waste oils, metals, sludge from load lines, various laboratory chemicals, and sanitary waste.

RVAAP has various industrial operations that have been identified as potential sources of contaminants. These operations include sewage treatment, waste water treatment, vehicle maintenance, storage tanks, waste storage areas, equipment storage areas, furnaces, and evaporation units. Contaminants associated with these operations include, but are not limited to, explosives, lead azide, lead styphnate, metals, polychlorinated biphenyls (PCBs), waste oil, and petroleum.

1.2 ENVIRONMENTAL SETTING

1.2.1 Climatic Conditions

The general climate of the RVAAP area is continental and is characterized by moderately warm and humid summers, reasonably cold and cloudy winters, and wide variations in precipitation from year to year. The following climatological data were obtained from the National Weather Service Office (NWS 1995) at the Youngstown-Warren Regional Airport located in Trumbull County and are based on a 30-year average.

Total annual rainfall in the RVAAP area is approximately 93.25 cm (37.3 inches), with the highest monthly average occurring in July [10.2 cm (4.07 inches)] and the lowest monthly average occurring in February [5.0 cm (2.03 inches)]. Average annual snowfall totals approximately 140.5 cm (56.2 inches) with the highest monthly average occurring in January [32.2 cm (12.9 inches)]. It should be noted that due to the influence of lake-effect snowfall events associated with Lake Erie [located approximately 56.3 km (35 miles) to the northwest of RVAAP], snowfall totals vary widely throughout northeastern Ohio.

The average annual daily temperature in the RVAAP area is 48.3 ºF, with an average daily high temperature of 57.7 ºF and an average daily low temperature of 38.7 ºF. The record high temperature of 100 ºF occurred in July 1988, and the record low temperature of -22 ºF occurred in January 1994. The prevailing wind direction at RVAAP is from the southwest, with the highest average wind speed occurring in January [18.7 km (11.6 miles) per hour] and the lowest average wind speed occurring in August [11.9 km (7.4 miles) per hour].

Thunderstorms occur on approximately 35 days per year and are most abundant from April through August. The RVAAP area is susceptible to tornadoes; minor structural damage to several buildings on facility property occurred as the result of a tornado in 1985.

1.2.2 Geologic Setting

1.2.2.1 Unconsolidated deposits

Two glacial advances during the Wisconsin Age of the Pleistocene Epoch resulted in the deposition of glacial till over the entire RVAAP installation. The first glacial advance deposited the Lavery Till over the facility. The Lavery Till consists mostly of clay and silt with a few cobbles and sporadic boulders. The second glacial advance deposited the Hiram Till over the eastern two-thirds of the facility only. The Hiram Till consists of 12 percent sand, 41 percent silt, and 47 percent illite and chlorite clay minerals, and ranges in depth from 1.5 to 4.6 m (5 to 15 feet) below ground surface (bgs). The Hiram Till overlies thin beds of sandy outwash material in the far northeastern corner of the facility. Field observations indicate that overall till thickness is less than 0.6 m (2 feet) in some areas of the RVAAP facility. The reduced till thickness may be due to natural erosion or construction grading operations and is not necessarily the result of deposition.

A buried glacial valley, oriented in a southwest–northeast direction is suspected to occur in the central portion of the facility. This valley is filled with glacial outwash consisting of poorly sorted clay, till, gravel, and silty sand. Depths of unconsolidated sediments in the valley range from 30.5 to 61 m (from 100 to 200 feet) BGS. However, bedrock outcrops have been documented in the same area, so the existence of a buried valley in this location cannot be confirmed.

1.2.2.2 Bedrock

The bedrock geology of RVAAP consists of Carboniferous Age sedimentary rocks that lie stratigraphically beneath the glacial deposits of the Lavery and Hiram tills. The oldest bedrock within the facility is the Cuyahoga Formation of the Mississippian Age. Three members comprise this formation: (1) the Orangeville Shale, (2) the Sharpsville Sandstone, and (3) the Meadville Shale. The Cuyahoga outcrops in the far northeastern corner of the facility and generally consists of a blue-gray silty shale with interbedded sandstone. The regional dip of the Cuyahoga strata is between 1.5 and 3.0 m (5 and 10 feet) per mile to the south.

The remainder of the facility is underlain by bedrock associated with the Pottsville Formation of Pennsylvanian Age. The Pottsville Formation, which lies unconformably on an erosional surface of the Cuyahoga Formation, is divided into four members: (1) the Sharon, (2) the Connoquenessing Sandstone, (3) the Mercer, and (4) the Homewood Sandstone. The Sharon Member consists of two individual units: the Sharon Conglomerate and the Sharon Shale. The Sharon Conglomerate is a porous, coarse-grained, gray-white sandstone that often exhibits thin layers of milky white quartz pebbles. The Sharon Conglomerate also has locally occurring thin shale lenses in the upper portion of the unit. Due to the differences in lithology between the Sharon Conglomerate and the underlying shales of the Cuyahoga Formation, the contact between the Pottsville and Cuyahoga Formations usually is quite distinct. The Sharon Shale overlies the Sharon Conglomerate and consists of sandy, gray-black, fissile shale with some plant fragments and thin flagstone beds. Sharon sandstones are exposed on the ground surface at Load Line 1 and the former Ramsdell Quarry.

The Connoquenessing Sandstone member of the Pottsville Formation unconformably overlies the Sharon Member and is a medium- to coarse-grained, gray-white sandstone with more feldspar and clay than the Sharon Conglomerate. Thin interbeds and partings of sandy shale also are common in the Connoquenessing. The Mercer member of Pottsville Formation overlies the Connoquenessing and consists of silty to carbonaceous shale with abundant thin, discontinuous sandstone lenses in the upper portion. Regionally, the Mercer also has been noted to contain interbeds of coal. The Homewood Member of the Pottsville Formation unconformably overlies the Mercer member and consists of coarse-grained crossbedded sandstones that contain discontinuous shale lenses.

The Connoquenessing, Mercer, and Homewood members are present only in the western half of the RVAAP facility. The Sharon Conglomerate unit is the upper bedrock surface in most of the eastern half. The regional dip of the Pottsville Formation strata is between 1.5 and 3.5 m (5 and 10 feet) per 1.6 km (1.0 mile) to the south.

1.2.3 Hydrologic Setting

1.2.3.1 Unconsolidated sediments

The largest groundwater supplies within Portage County come from two buried valleys that underlie Franklin, Brimfield, and Suffield townships and Streetsboro, Shalersville, and Mantua townships, respectively. The sand and gravel within these buried valleys are favorably situated to receive recharge from surface streams and surface infiltration. The water-bearing characteristics for the sand and gravel aquifers in the vicinity of the RVAAP installation are poorly documented. Wells that penetrate these aquifers can yield up to 6,080 liters per minute (LPM) [1,600 gallons per minute (GPM)]. However, yields from wells penetrating silty or clay till materials are significantly lower. In general, the Lavery and Hiram tills are too thin and impermeable to produce useful quantities of water.

1.2.3.2 Bedrock

The most important bedrock sources of groundwater in the vicinity of the RVAAP facility are the sandstone/conglomerate members of the Pottsville Formation. These aquifers, together with two other deeper Mississippian/Devonian sandstone aquifers, represent the most important bedrock sources of groundwater in Northeastern Ohio.

The Sharon Conglomerate is the primary source of groundwater at RVAAP and maintains the most significant well yields of the Pottsville Formation members with hydraulic conductivity values of from 19 to 7,600 liters per day per meter (LPD/m) [from 5 to 2,000 gallons per day per foot (GPD/ft)]. Past studies of the Sharon Conglomerate indicate that the highest yields are associated with the true conglomerate phase (coarse-grained sandstone with abundant quartz pebbles) and with joints and fractures in the bedrock; however, there is no facility-specific information available regarding variations in aquifer properties due to these factors. Where present, the overlying Sharon Shale acts as a relatively impermeable confining layer for the Sharon Conglomerate. Several flowing artesian production wells have been noted at the facility.

The Connoquenessing Sandstone and the Homewood Sandstone are the remaining aquifers of the Pottsville Formation and exhibit hydraulic conductivities of from 19 to 1,140 LPD/m (from 5 to 300 GPD/ft) and from 19 to 760 LPD/m (from 5 to 200 GPD/ft), respectively. Well yields in the Connoquenessing and Homewood sandstones, although lower than the Sharon Conglomerate, are high enough to provide significant quantities of water. Several wells at the RVAAP facility have penetrated both the Sharon Conglomerate and the Connoquenessing Sandstone and reportedly produced water from both units.

In general, hydraulic conductivities in the shales of the Sharon and Mercer members of the Pottsville Formation are low and result in insignificant groundwater yields. The primary porosity of the shales is likely secondary, owing to joints and fractures in the bedrock; however, there is no facility-specific information available regarding the occurrence of joints and fractures in these units.

1.2.3.3 Surface water

The entire RVAAP facility is situated within the Mahoning River Basin, with the West Branch of the Mahoning River representing the major surface stream in the area. The West Branch flows adjacent to the west end of the facility, generally in a north to south direction, before flowing into the M.J. Kirwan Reservoir, which is located to the south of State Route 5. The West Branch flows out of the reservoir along the southern facility boundary before joining the Mahoning River east of RVAAP.

The western and northern portions of the RVAAP facility display low hills and a dendritic surface drainage pattern. The eastern and southern portions are characterized by an undulating to moderately level surface, with less dissection of the surface drainage. The facility is marked with marshy areas and flowing and intermittent streams whose headwaters are located in the facility's hills. Three primary water courses drain RVAAP: (1) the South Fork of Eagle Creek, (2) Sand Creek, and (3) Hinkley Creek (see Figure Intro-2). All of these water courses have many associated tributaries.

Sand Creek, with a drainage area of 36 km^2 (13.9 $miles^2$), flows generally in a northeast direction to its confluence with the South Fork of Eagle Creek. In turn, the South Fork of Eagle Creek then continues in a northerly direction for 4.3 km (2.7 miles) to its confluence with Eagle Creek. The drainage area of the South Fork of Eagle Creek is 67.8 km^2 (26.2 $miles^2$), including the area drained by Sand Creek. Hinkley Creek originates just southeast of the intersection between State Routes 88 and 303 to the north of the facility. Hinkley Creek, with a drainage area of 28.5 km^2 (11.0 $miles^2$), flows in a southerly direction through the installation to its confluence with the West Branch of the Mahoning River south of the facility.

Approximately 50 ponds are scattered throughout the installation. Many were built within natural drainageways to function as settling ponds or basins for process effluent and runoff. Others are natural in origin, resulting from glacial action or beaver activity. All water bodies at RVAAP support an abundance of aquatic vegetation and are well stocked with fish. None of the ponds within the installation is used as a water supply source.

Storm water runoff is controlled primarily by natural drainage except in facility operations areas where an extensive storm sewer network helps to direct runoff to drainage ditches and settling ponds. In addition, the storm sewer system was one of the primary drainage mechanism for process effluent during the period that production facilities were in operation.

1.2.3.4 Groundwater utilization

All groundwater utilized at the RVAAP facility during past operations was obtained from on-site production wells, with the majority of wells screened in the Sharon Conglomerate. Production wells scattered throughout the facility provided necessary sanitary and process water for RVAAP operations. All remaining process production wells were permanently abandoned in 1992. Currently, only two groundwater production wells remain in operation. These wells, located in the central portion of the facility, provide sanitary water to the remaining site personnel.

Residential groundwater use in the surrounding area is similar to that for RVAAP, with the Sharon Sandstone acting as the major producing aquifer in the area. The Connoquenessing Sandstone and the Homewood Sandstone also provide limited groundwater resources, primarily near the western half of the RVAAP facility. Many of the local residential wells surrounding RVAAP are completed in the unconsolidated glacial material.

The *Ground Water Pollution Potential of Portage County* published by the Ohio Department of Natural Resources (1991) provides additional insight into the groundwater characteristics of the RVAAP area. This map indicates the relative vulnerability of groundwater in a specific area to contamination from surface sources. Intended primarily as a groundwater resource management and planning tool, the Ground Water Pollution Potential Map presents index values based on several hydrogeologic criteria including depth to water, hydraulic conductivity, topography, and others. Resulting index values range from a low pollution potential (zero) to a high pollution potential (200+).

Based on this mapping system, the majority of the RVAAP facility has a moderate pollution potential that ranges between 100 and 159, depending on location. In addition, three general hydrogeologic settings are defined for RVAAP and include: (1) glacial till overlying bedded sedimentary rock, (2) glacial till overlying sandstone, (3) and alluvium overlying bedded sedimentary rock. In general, the highest pollution potential values at RVAAP occur in the areas where alluvium overlies bedded sedimentary rock (index range of from 140 to 159); these areas occur primarily in the northeast portion of the facility. The majority of RVAAP has pollution potential indices that range between 100 and 139.

1.2.3.5 Surface water utilization

Past and present surface water utilization at RVAAP generally was limited to use by wildlife and recreational users. Although some surface water may have been used intermittently for various facility operations, the vast majority of process water was provided by on-site groundwater production wells. There is no available documentation that indicates any past irrigation or other agricultural use of surface water sources on facility property. It is likely that some agricultural use of surface water was conducted in this area before facility construction due to the presence of homesteads and farms at that time. On-site recreational surface water use was limited to managed fishing programs conducted in the past. RVAAP has recently re-instituted a catch-and-release fishing program. Based on conversations with site personnel, it is likely that some recreational trespasser use of surface water does occur on a limited basis.

The major surface water drainages at RVAAP all exit facility property and eventually flow into the Mahoning River to the east. Surface water from Sand Creek, which flows to the northeast across the facility, joins the South Fork of Eagle Creek, which flows to the east inside the northern property boundary. The South Fork of Eagle Creek continues to the east until it eventually discharges to the Mahoning River. It is possible that limited agricultural and recreational use of the South Fork of Eagle Creek does occur off of facility property, although no data are available to allow a more detailed study. Hinkley Creek, which enters facility property from the north and flows to the south across the western portion of RVAAP, eventually discharges to the West Branch of the Mahoning River (and the West Branch Reservoir) south of State Route 5. It is doubtful that Hinkley Creek is used for any agricultural purposes, although limited recreational use may occur.

1.2.4 Air Quality for Surrounding Area

The RVAAP facility is located in a rural area and has air quality that generally can be described as good. Based on a southwesterly prevailing wind direction, the city of Akron [located 37 km (23 miles) to the south-southwest] is the nearest significant upwind urban area. Currently, there are no significant airborne emissions from RVAAP due to its inactive status. In addition, there is no operating air monitoring program in place at the facility at this time. There are no significant documented air pollution sources in close proximity to facility property that would affect air quality at RVAAP.

1.2.5 Ecological Setting

Available estimates indicate that approximately one-third of the RVAAP facility property meets the regulatory definition of a wetland, with the majority of the wetland areas located in the eastern portion of the facility. Wetland areas at RVAAP include seasonal wetlands, wet fields, and forested wetlands. Many of the wetland areas are the result of natural drainage or beaver activity; however, some wetland areas are associated with anthropogenic settling ponds and drainage areas. The potential for impacts on wetland areas at RVAAP is real due to the amount of process effluent discharged to settling ponds and the natural drainage of the area in the past.

The flora and fauna present at RVAAP are varied and widespread. A total of 18 plant communities have been identified on facility property, including marsh, swamp, and forest communities. Twelve plant types listed as State Potentially Threatened have been identified at RVAAP including:

- Gray Birch,
- Round-leaved Sundew,
- Closed Gentian,
- Butternut,
- Blunt Mountain-mint,
- Northern Rose Azalea,
- Large Cranberry,
- Hobblebush,
- Fox Grape,
- Woodland Horsetail,
- Long Beech Fern, and
- Eel Grass.

In addition to being listed as a State Potentially Threatened Plant species, the Butternut also is listed as a Federal Candidate (Category 2) species.

A large number of animal species have been identified on facility property, including 26 species of mammals, 143 species of birds, and 41 species of fish. Animal species listed as Ohio State Endangered (1993 inventory) include the Northern Harrier, the Common Barn Owl, the Yellow-bellied Sapsucker, the Mountain Brook Lamprey, and the Graceful Underwing. Several animal species present at RVAAP also are listed as Ohio State Special Concern:

- Woodland Jumping Mouse,
- Solitary Vireo,
- Sharp-shinned Hawk,
- Sora,
- Virginia Rail,
- Four-toed Salamander,
- Smooth Green Snake,
- River Otter,
- Pygmy Shrew,
- Star-Nosed Mole,
- Red-Shouldered Hawk,
- Henslow's Sparrow,
- Cerulean Warbler,
- Common Moorhen, and
- Eastern Box Turtle.

There is no documentation available to determine if any of the above animal or plant species have been affected by past facility operations. Future Installation Restoration Program (IRP) activities will require consideration of these species to ensure that detrimental effects on threatened or endangered RVAAP flora and fauna do not occur. There are no federal, state, or local parks or protected areas on RVAAP facility property.

1.3 SUMMARY OF EXISTING SITE DATA

During the last 30 years, multiple environmental-related investigations were conducted at RVAAP. A brief summary of these investigations is provided below.

Date	Description of Investigation
1978	U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an Installation Assessment of RVAAP and concluded that no migration of contamination to groundwater had occurred at the installation (USATHAMA 1978).
1982	Reassessment by USATHAMA also concluded that no migration of contamination to groundwater had occurred (USATHAMA 1982).
1988	The U.S. Army Environmental Hygiene Agency (USAEHA) conducted a groundwater contamination survey and an evaluation of Solid Waste Management Units (SWMUs). Twenty-nine potentially contaminated SWMUs were identified. Further investigation was recommended for 15 of the 29 SWMUs to determine if contaminants had migrated from these units.
1989	The U.S. Environmental Protection Agency (EPA) contracted Jacobs Engineering to perform a Resource Conservation and Recovery Act (RCRA) Facility Assessment (RFA) – Preliminary Review and Visual Site Inspection (USEPA 1989). The report identified 31 SWMUs, 13 of which were recommended for no further action (NFA). These 31 SWMUs are listed as sites in the Restoration Management Information System (RMIS).
1992	USAEHA conducted a hydrogeologic study of the Open Burning/Open Detonation (OB/OD) areas as part of a response to a Notice of Deficiency issued by Ohio EPA regarding the installation's RCRA Part B permit application. Minor amounts of contamination were reported at these areas.
1994	USAEHA performed a Preliminary Assessment Screening (PAS) of the Boundary Load Line areas at RVAAP and provided a Statement of Findings to support a Record of Environmental Considerations along with recommendations for additional activities at these sites.
1996	The U.S. Army Corps of Engineers (USACE) performed a facility-wide preliminary assessment covering all known environmental sites at RVAAP.
1996	USACE developed a Facility-wide Sampling and Analysis Plan (FSAP) and Facility-wide Safety and Health Plan (FSHP) for conducting investigations at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) AOCs at RVAAP.
1996	USACE conducted Phase I Remedial Investigations of 11 areas of concern. These AOCs were Load Lines 1–4, Load Line 12, Winklepeck Burning Grounds, Landfill North of Winklepeck Burning Grounds, Building 1200, Demolition Area #2, Upper and Lower Cobbs Ponds, and Load Line 12 Pink Wastewater Treatment Plant.
1997	USACE conducted a field investigation to support RCRA and other clean closures at the following SWMUs: Building 1601, Open Burning Area (Pad #37 at Winklepeck Burning Grounds), Open Detonation Area (in Demolition Area #2), Deactivation Furnace Area (Pad #45 at WBG), and the Pesticides Building S-4452.

1998 USACE conducted a Phase II Remedial Investigation at Winklepeck Burning Grounds, including baseline human health and ecological risk assessments.

1998 USACE performed a groundwater investigation at Ramsdell Quarry Landfill.

1998 USACHPPM performed Relative Risk Site Evaluations at several known or suspected former waste disposal sites. These included Erie Burning Grounds, NACA Test Area, and Demolition Area #1, among others, and resulted in the establishment of 13 additional AOCs.

1999 USACE performed Phase I Remedial Investigations at Erie Burning Grounds, NACA Test Area, and Demolition Area #1. They also completed the installation of monitoring wells for the Phase II RI at Load Line 1.

2000 U.S. Army OSC performed a Phase I Remedial Investigation and Interim Removal Action (IRA) at Load Line 11.

2000 U.S. Army OSC performed an Unexploded Ordnance (UXO) Removal and Site Restoration at a portion of Demolition Area #2.

2000 USACE performed Phase II Remedial Investigations at Load Line 12 and Load Line 1.

2000 USACE performed a biological assessment at Winklepeck Burning Grounds to support a feasibility study.

2000 An IRA of Building T-5301 was conducted, and the Pesticide Building was closed.

2000 USACE performed a field investigation to support the Feasibility Study at Winklepeck Burning Grounds.

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2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

This Facility-wide Field Sampling Plan (FSAP) presents project organization and responsibility from a generic perspective because of the global nature of the plan with respect to the anticipated multiple investigations that are expected to be performed under the FSAP at RVAAP. The project organization and responsibilities identified here are based on the generic functional roles necessary to implement the field activities described in the FSAP and do not include specific names of organizations or individuals. Project-specific organization and responsibilities will be included in each investigation-specific SAP addendum to identify individual responsibilities and any new roles that may be appropriate for a specific investigation. It is expected, however, that USACE Louisville District will continue to fulfill the role of laboratory data Quality Assurance Administrator for all environmental projects.

The organization chart shown in Figure 2-1 outlines the generic management structure that will be used to implement field investigations at RVAAP. The functional responsibilities of key personnel are described in the following parts of this section. Specific assignment of personnel to each of these positions will be made before each specific investigation and will be based on a combination of (1) experience in the type of work to be performed, (2) experience working with government personnel and procedures, (3) a demonstrated commitment to high quality, and (4) staff availability.

2.1 CONTRACTOR PROGRAM MANAGER

The Contractor Program Manager ensures the overall management and quality of all projects performed at RVAAP under the general contract. This individual will ensure that all project goals and objectives are met in a high-quality and timely manner. Quality assurance and nonconformance issues will be addressed by this individual, in coordination with the Project Manager, for corrective action.

2.2 CONTRACTOR PROJECT MANAGER

The Contractor Project Manager has direct responsibility for implementing a specific project, including all phases of work plan development, field activities, data management, and report preparation. This individual will also provide the overall management of the project, and serve as the technical lead and principal point of contact with the USACE Louisville District, RVAAP, or other U.S. Army Project Manager. These activities will involve coordinating all personnel working on the project, interfacing with U.S. Army project personnel, and tracking project budgets and schedules. The Contractor Project Manager will also develop, monitor, and fill project staffing needs, delegate specific responsibilities to project team members, and coordinate with administrative staff to maintain a coordinated and timely flow of all project activities. The Project Manager reports directly to the Program Manager.

2.3 CONTRACTOR QA/QC OFFICER

The Contractor Quality Assurance/Quality Control (QA/QC) Officer is responsible for the project QA/QC in accordance with the requirements of the Facility-wide Quality Assurance Project Plan (QAPP), the project-specific QAPP addendum, and appropriate management guidance. This individual, in coordination with the Contractor Field Contractor Quality Control (CQC) Officer, will be responsible for participating in the project field activity readiness review; approving variances before work proceeds; approving, evaluating, and documenting the disposition of Nonconformance Reports (NCRs); overseeing and

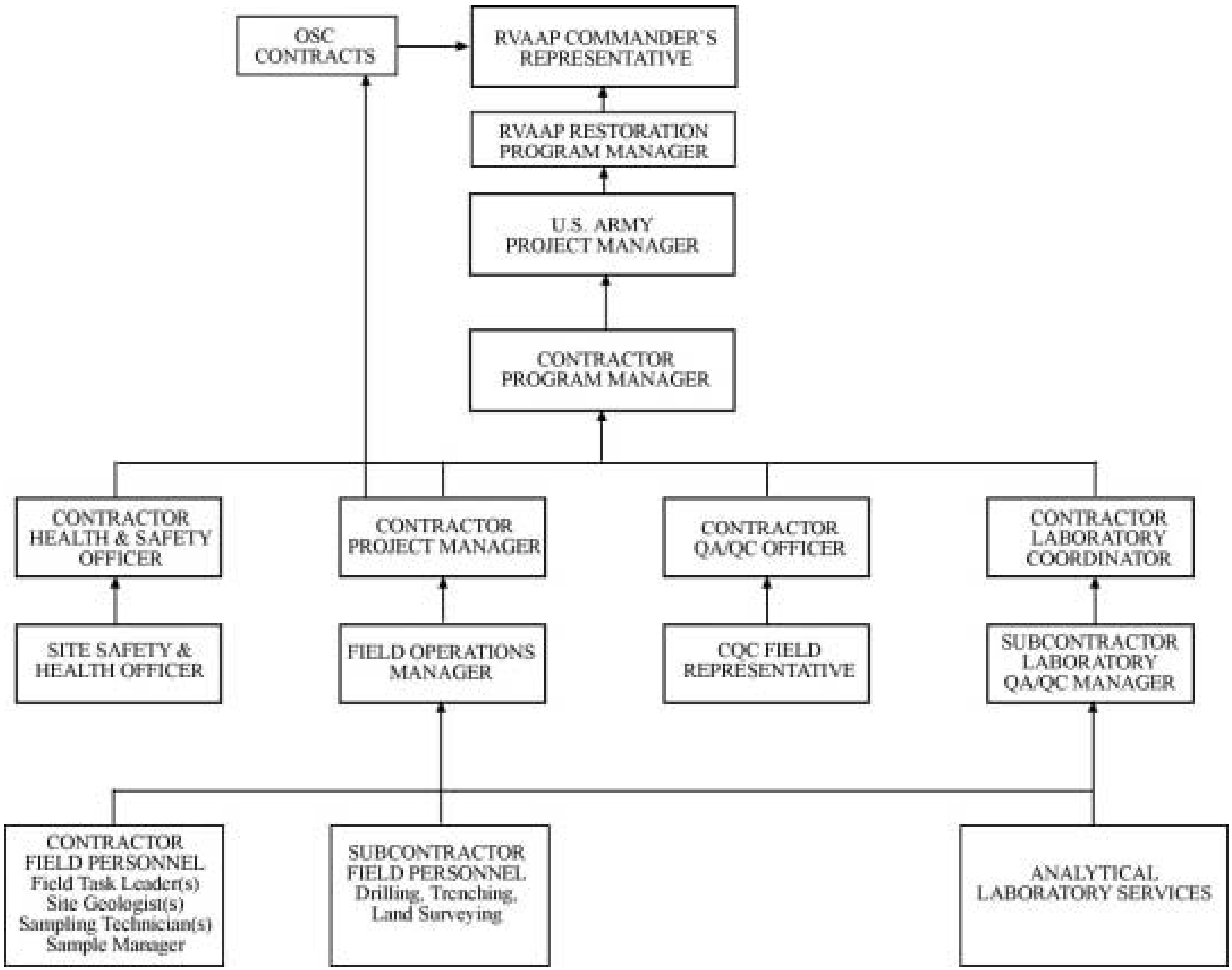

Figure 2-1. Generic Project Organization Chart for RVAAP AOC-Specific Investigations

approving any required project training; and designing audit and surveillance plans followed by supervision of these activities. This individual and the field CQC officer report directly to the Program Manager, but they will inform the Project Manager of all information and decisions reported.

2.4 CONTRACTOR HEALTH AND SAFETY OFFICER

The Contractor Health and Safety Officer (HSO) will ensure that health and safety procedures designed to protect personnel are maintained throughout all field activities conducted at RVAAP. This will be accomplished by strict adherence to the FSHP, which has been prepared as a companion document to this FSAP, and the project-specific Site Safety and Health Plan (SSHP), which has been prepared as an addendum to the FSHP for each investigation. This individual, in coordination with the Site Health and Safety Officer (SHSO), will have the authority to halt field work if health and/or safety issues arise that are not immediately resolvable in accordance with the FSHP and the project-specific SSHP addendum. This individual and the SHSO report directly to the Contractor Program Manager, but they will inform the Contractor Project Manager of all information and decisions reported.

2.5 SUBCONTRACTOR LABORATORY QA/QC MANAGER

Analytical laboratories will be subcontracted for each investigation to perform off-site chemical analysis for media sampled. All subcontract laboratory support shall be USACE Ohio River District validated. The subcontracted laboratory's QA/QC Manager is responsible for the laboratory QA/QC in accordance with the requirements of the Facility-wide QAPP and the project-specific addendum. In coordination with the Contractor Laboratory Coordinator, this individual will be responsible for handling and documenting samples received by the laboratory, ensuring that all samples are analyzed in accordance with required and approved methodologies, ensuring that instrument calibration is performed properly and documented, ensuring that field and internal laboratory QC samples are analyzed and documented, and ensuring that all analytical results for both field and QC samples are reported in the format required in the QAPP. The subcontracted laboratory QA/QC Manager is also responsible for ensuring that laboratory NCRs are processed in a timely manner and for making decisions regarding cost and schedule related to processing of NCRs and implementation of Corrective Action Report (CAR) recommendations and/or requirements. This individual reports directly to the Laboratory Coordinator, but he or she will inform the Project Manager of all information and decisions reported.

2.6 CONTRACTOR LABORATORY COORDINATOR

The Contractor Laboratory Coordinator is responsible for coordination of sample collection and subsequent laboratory analysis in accordance with the requirements of the FSAP and Facility-wide QAPP and their project-specific addenda. This individual will be responsible for obtaining required sample containers from the laboratory for use during field sample collection, resolving questions the laboratory may have regarding QAPP requirements and deliverables, and preparing a quality assessment report for sample data package deliverables received from the laboratory. This individual reports directly to the Contactor Program Manager, but he or she will inform the Contractor Project Manager of all information and decisions reported.

2.7 CONTRACTOR FIELD OPERATIONS MANAGER

The Contractor Field Operations Manager is responsible for implementing all field activities for a specific investigation in accordance with the FSAP and Facility-wide QAPP and their project-specific addenda. This individual will be responsible for ensuring technical performance of all field sampling activities; adherence to required sample custody and other related QA/QC field procedures; coordination of field subcontractor personnel activities; management of project investigation-derived wastes (IDW); QA checks of all field documentation; and preparation of Field Change Orders (FCOs), if required. This individual reports directly to the Contractor Project Manager except with regard to QA/QC matters that are reported directly to the Contractor QA/QC Officer.

2.8 CONTRACTOR FIELD PERSONNEL

In addition to the Field Operations Manager, other contractor field personnel participating in the implementation of field activities will be the Field Team Leader(s), Site Geologist(s), Sampling Technician(s), and Sample Manager. These individuals, in coordination with field subcontractor personnel, will be responsible for performing all field sampling activities in accordance with the FSAP and FSHP and their project-specific addenda. These individuals report directly to the Field Operations Manager.

2.9 SUBCONTRACTOR FIELD PERSONNEL

Contractors will subcontract various companies to provide field support services during the implementation of specific investigations at RVAAP. The primary support services anticipated will be drilling (soil borings and monitoring wells), trenching, and land surveying. Subcontractor field personnel, in coordination with contractor field personnel, will be responsible for performing their specific scope of services as identified in the project-specific SAP addenda. Field personnel assigned by the subcontractors to each project will be qualified and experienced to perform the scope of their work, and these personnel will be required to review and comply with both the FSAP and FSHP and their project-specific addenda. The scope of work to be performed by each subcontractor will be documented in the subcontract agreements with each organization along with equipment and material requirements and experience and qualifications of the assigned personnel. All subcontractor field personnel report directly to the Field Operations Manager, who will be responsible for ensuring that all subcontractor activities comply with project requirements.

3.0 SCOPE AND OBJECTIVES

3.1 FACILITY-WIDE SCOPE AND OBJECTIVES

The scope of the FSAP is to define, to the extent practical, generic methods and procedures for field sampling activities that are expected to be used during the investigation of all AOCs at RVAAP. Based on the similarity of the former waste-generating operations, the chemicals of potential concern (COPCs), and the media of concern expected at each AOC to be investigated, it is anticipated that several field sampling methodologies will be utilized repeatedly during the investigation of all AOCs. Consequently, these sampling activities are addressed in the FSAP and will be applied, as appropriate and with the use of project-specific SAP addenda, during the investigation of all AOCs. Based on the current understanding of AOCs at RVAAP, the primary media of concern will be soil (surface and subsurface) and sediment, groundwater, and surface water. The FSAP will address sampling methods and procedures for monitoring well installation and groundwater sampling (Section 4.3); subsurface soil sampling (Section 4.4); surface soil and sediment sampling (Section 4.5); and surface water sampling (Section 4.6). The FSAP also defines generic protocols for sample chain of custody/documentation (Section 5.0); sample packaging and shipping (Section 6.0); IDW (Section 7.0); contractor chemical quality control (Section 8.0); daily chemical quality control reports (Section 9.0); corrective actions (Section 10.0); and project schedule (Section 11.0), which can be applied to all investigations at RVAAP. The FSAP contains two supporting appendices: Appendix A, Data Standards for Corps Environmental Restoration; and Appendix B, Ohio Administrative Code (OAC) 3745-27-13 Generic Authorization Request.

This FSAP has been developed in accordance with requirements established in the USACE guidance documents *Requirements for the Preparation of Sampling Analysis Plans*, EM 200-1-3, September 1994, *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites*, EM 1110-1-4000, August 1994 (USACE 1994b; USACE 1994a), and Ohio EPA's *Technical Guidance Manual for Hydrogeologic Investigations and Groundwater Monitoring* (1995). Requirements for environmental sampling of various media are contained in EM 200-1-3, Appendices C, E, and F, and were used as general guidelines for developing sampling methods and procedures (environmental and field QC), sample handling (preparation and shipping), field and sample documentation, and equipment decontamination procedures. Requirements for monitoring well installation, including drilling, construction, development, purging/sampling, documentation, and abandonment, are contained in EM 1110-1-4000 and were used as general guidelines for developing these procedures.

The objective of the FSAP is to provide overall guidance for the performance of types of sampling activities identified herein; however, because of the generic nature of the FSAP, its use relative to a project-specific investigation must be accompanied by an investigation-specific FSP addendum to ensure the successful implementation of each project-specific work plan. The FSP addenda will be tiered under the FSAP and will address project-specific scope and objectives, sampling approach and rationale, data uses, project-specific sampling methods and procedures or deviations not covered in the FSAP, specific IDW requirements, and any project-specific details not included in the FSAP. Each project-specific SAP addendum will be developed following EM 200-1-3 and will be approved by the Ohio EPA and the U.S. Army before implementation. The Ohio EPA has review and comment authority on all documents submitted under the Defense-State Memorandum of Agreement (DSMOA).

The scope and objectives of each AOC-specific investigation will be developed based on EPA guidance for data quality objectives (DQOs) specified in *Data Quality Objectives Process For Superfund, Interim Final Guidance,* EPA/540/G-93/071, September, 1993 (USEPA 1993). The SAP addenda will define project-specific scope and objectives, sampling rationale and approach, and data quality needs to support decisions to be made using the data collected during each investigation. Project DQOs will be developed to tier under the Facility-wide DQOs presented in the following paragraphs.

3.2 FACILITY-WIDE DATA QUALITY OBJECTIVES

As part of the Facility-wide approach to environmental investigation activities at RVAAP, Facility-wide DQOs have been developed. The DQO process is a tool to guide investigations at CERCLA sites. Although not all AOCs at RVAAP are CERCLA sites, this model still has relevance for decision-makers. The DQOs serve two major purposes: (1) to present the facility-wide approach to sampling at the installation, and (2) to present the process that will be used to develop AOC-specific sampling and analysis plans. The stages of the DQO development process are:

- develop the conceptual site model,
- state the problem,
- identify decisions to be made,
- define the study boundaries,
- develop the decision rule (if/then),
- identify inputs to the decision (data uses and data needs),
- specify limits on uncertainty, and
- optimize the sample design.

3.2.1 Conceptual Site Model

A conceptual site model is the cornerstone for planning a field sampling effort. It reflects an understanding of the known or expected site conditions and serves as the basis for making decisions about sample locations, frequencies, and required analytes. A good conceptual model is inclusive of all available information, incorporating the hydrogeologic features and other characteristics of the site that combine to define the problem to be addressed (e.g., location of buried waste, primary contaminants and their properties, contaminant transport pathways, and potential human exposure scenarios, etc.).

A preliminary conceptual model for RVAAP has been developed using available information. Portions of the conceptual model are described in detail in other sections of this plan. Aspects of the conceptual model that are important for sampling design are noted below. Perhaps of more importance than what is known, are the uncertainties that must be addressed by the field sampling efforts. Available information indicates:

- Surface geology across the site is highly variable. Glacial overburden ranges in depth from approximately 1.5 m (5 feet) (Hiram Till in the eastern portion of the installation) to 12.2 m (40 feet) (Lavery Till in the western portion). Bedrock outcroppings have been noted in the southeastern portion of the site. The till is reported to be somewhat impermeable, with hydraulic conductivities thought to be greater than 10^{-6} cm/sec. Additional hydraulic conductivity testing is needed to evaluate the highly variable conditions of the surficial material.

- A burial glacial valley filled with sand and gravel potentially exists in the central portion of the installation, oriented in a southwest-northeast direction. The presumed depth of the valley ranges from 30.5 to 60.7 m (100 to 200 feet).

- The variable nature of the till combined with the topography of the site results in a complex surface water system on the installation.

- The South Fork of Eagle Creek and Sand Creek drain much of the installation. The creeks converge and exit the installation in the northeast. AOCs in the central portion of the site (e.g., Demolition Area #2) and upper and lower Cobbs Ponds likely feed this drainage system. This system flows east to the West Branch of the Mahoning River, which eventually flows south to the M.J. Kirwan Reservoir.

- Hinkley Creek in the western potion of the site drains due south. The AOC of greatest concern along Hinkley Creek is Demolition Area #1.

- Drainage from the main load lines appears to flow east and southeast. The southeastern portion of the site is swampy, even in the summer months. Drainages to the south flow into the M.J. Kirwan Reservoir.

- Approximately 50 ponds are scattered throughout the installation. Many of these ponds have acted as settling basins over the years. The ponds appear to support an abundance of wildlife and fish.

• Because of the somewhat impermeable nature of the till, it is suspected that a large percentage of rainfall exits the installation via the surface drainages.

• Information is sparse on the exact nature of the groundwater underlying the AOCs at the installation, with the exception of areas managed under RCRA [e.g., open detonation (OD) and former open burning (OB) Areas], Ohio Solid Waste Regulations (Ramsdell Quarry Landfill), AOCs with monitoring wells (Winklepeck Burning Grounds, Load Line 1), and the 14 background monitoring wells installed across the RVAAP facility. Groundwater as shallow as 0.61 m (2 feet) bgs has been detected in portions of the site. It is not known whether shallow groundwater is perched or continuous.

• The sand and gravel aquifers associated with the buried valleys are a major source of potable water in the local area and can yield up to 6,080 liters (1,600 gallons) per minute. Little is known about the precise connection between the AOCs at RVAAP and these valleys.

• Bedrock formations in the area are also a source of potable water, with the Pottsville Formation representing the largest bedrock aquifer. Hydraulic conductivities range from 19 to 760 LPD/m (5 to 2000 GPD/ft) in the bedrock aquifers. Sandstone of the Pottsville Formation is exposed at Ramsdell Quarry Landfill and Load Line 1, and underlies much of the eastern and northeastern portion of the facility.

• Major COPCs include explosive-related chemicals [TNT, dinitrotoluene (DNT), RDX], propellants (nitroglycerine, nitroguanidine, and nitrocellulose) and metals (arsenic, aluminum , barium, cadmium, chromium, lead, mercury, silver, selenium, and zinc). Additional chemicals have been identified at some AOCs, including PCBs and manganese. Most of the COPCs are relatively insoluble, tend to adsorb to soil particles rather than dissolve into water, and are relatively long-lived.

• Currently, the facility is not accessible to the public. The Ohio National Guard controls and regularly uses approximately 6,541 ha (16,164 acres) of the site for training exercises and are negotiating for the remaining acreage. The most likely pathway of exposure to off-site receptors is via chemical migration through the surface water and groundwater systems.

3.2.2 Define the Problem

The problem to be addressed at RVAAP is that hazardous contaminants from past waste disposal activities may be posing a current or future risk on-site via direct contact with environmental media; off-site receptors via contaminant migration to off-site receptors; and ecological receptors.

3.2.3 Remedial Action Objectives

A major goal of implementing the DQO process is to ensure that all data critical for decision making are collected as part of the field investigations. This should include data necessary for selecting and implementing a cost-effective remedial action if such an action is required. For example, if an impermeable cap is a probable remedial technology, data should be collected to characterize the potential for subsurface lateral groundwater flow. During the planning for investigation of each AOC, potential remedies will be identified. This will ensure that all data necessary for a Feasibility Study, should one be necessary, are available.

3.2.4 Identify Decisions

Table 3-1 presents key decisions that need to be made with regard to investigation data collection at RVAAP. Primary decisions are upper-tier decisions that drive subsequent field investigations. Secondary decisions are more specific to the RVAAP site. In planning for each AOC, specific decisions for that AOC will be identified.

Table 3-1. Key Decisions for RVAAP Investigations

Decision Number	Primary Decisions	Secondary Decisions
D1	Determine the Need for Additional Action at Ravenna	
	Do waste sources at Ravenna pose unacceptable human health or ecological risk (e.g., 10^{-6} to 10^{-4}) to: 1. Current on-site or off site receptors? 2. Future on-site or off-site receptors?	D1-1 What are the residual concentrations of contaminants at the sources? D1-2 Are wastes leaving the site via surface water/sediment? D1-3 Are wastes leaving the site via groundwater? D1-4 Are wastes posing a threat to ecological receptors? D1-5 Is there a risk to humans from consumption of ecological receptors (fish and deer)? D1-6 What is the current and future land use?
D2	Determine the Best Response Actions from a Facility-wide Perspective	
	What are effective ways of reducing risk to achieve threshold criteria as set by stakeholders?	D2-1 What are the priority sites for addressing off-site releases via surface water? groundwater? D2-2 What sites may need remediation to mitigate current and potential future on-site exposures? D2-3 What technologies are effective at reducing off-site risk, given the Facility-wide understanding of surface water/groundwater hydrologic conditions and potential future on-site exposures?

3.2.5 Define Study Boundaries

The spatial boundary for initial field work at an AOC is the fence line or other boundary (including railroad tracks, drainage divides, or other defined features) for each individual AOC. The potential for off-site migration will be addressed by sampling at the boundary (e.g., in drainages at the fence line), and as necessary and appropriate at selected locations beyond the boundary.

The spatial boundary for any follow-up field investigation work will be determined based on the results of initial field efforts. If warranted, the spatial boundary for follow-up work may extend beyond the facility boundary to include off-post sampling.

3.2.6 Identify Decision Rules

Decision rules guide the sampling effort, which in turn, defines the level of characterization necessary for decision making. For example, by specifying specific risk goals (e.g., 10^{-6}) in the decision rule, planners can identify the analytical levels needed for the sampling effort. The primary decision rules governing early work at RVAAP are:

- Initial phase: If levels of contamination detected in soils, sediment, surface water, or groundwater are greater than permissible risk-based [at a 10^{-6} risk level or Hazard Quotient (HQ) equals 1] or applicable or relevant and appropriate requirement (ARAR)-based concentrations, then perform additional sampling to characterize the risk; otherwise, no additional action is required.

- Follow-up phase: If contamination detected in soils, sediment, surface water, or groundwater results in an estimated current or future risk is less than 10^{-6} or toxic effects where HQ is less than 1, then no additional action is required.

- If contamination detected in soils, sediment, surface water or groundwater results in an estimated current risk is greater than 10^{-4} or toxic effects where HQ is greater than 1, then consider a removal action to address the risk.

- If contamination detected in soils, sediment, surface water or groundwater results in an estimated current risk of 10^{-6} to 10^{-4} (i.e., the risk management range) or toxic effects where HQ is greater than 1, then weigh the cost benefit and other factors before implementing an action (e.g., perform a Feasibility Study).

3.2.7 Identify Inputs to the Decision

"Inputs to the decision" include results of the field investigation and data analysis, modeling, and risk estimates, etc. The data needed to provide decision inputs vary from site to site, depending on the waste type, site setting, and other AOC-specific factors, and the data needs will be defined on an AOC-specific basis.

3.2.8 Specify Limits on Decision Error

Remedial action decisions may eventually need to be made for RVAAP AOCs based on the results of the data assessment and baseline risk assessment. Controlling the potential for making a wrong decision begins in the DQO process by identifying what types of errors may be introduced during sample collection and data assessment and attempting to limit those errors. Although DQO guidance provides some methods for attempting to limit error by designing statistically based sampling plans (USEPA 1993; USEPA 1994), most practitioners have found the methods generally account for only single factors (e.g., how a single contaminant is distributed in a single medium), when, in fact, response action decisions are based on understanding multiple factors (multi-media distribution and partitioning, multiple chemicals of varying degrees of toxicity, and risk modeling output and the various parameter required for that effort).

EPA specifies two types of decision error that should be addressed during DQOs: sampling errors and measurement errors (USEPA 1993). A third type of error, modeling error, is an important consideration when interpreting risk assessment results. Provided below is a summary of errors that may contribute to decision error and ways to minimize the potential for error during sample collection and reporting.

3.2.8.1 Sampling errors

Most sampling plans attempt to avoid the potential of a false positive error (e.g., avoid concluding that wastes do not pose a risk when they actually do). During the planning for each AOC, sample locations and frequencies will be identified using the knowledge of the AOC (conceptual model) and the requirements of the risk assessment. For example, if the conceptual model suggests that surface water is the major contaminant migration pathway for the AOC, more sampling resources will be directed toward characterizing this potential for the pathway to pose a current or future risk. Screening tools (e.g., geophysical surveys, geoprobe sampling, etc.) may also be used to determine optimum sampling locations where analytical data can be collected using definitive sampling methods to define the nature and extent of contamination. Screening tools cannot be used to define the nature and extent of contamination, but their use can be effective in reducing the number of confirmatory samples collected to characterize an AOC.

3.2.8.2 Measurement errors

Measurement errors in laboratory data can be minimized through proper planning, implementation of applicable laboratory QC, and programmatic data verification and validation procedures. Proposed processes and procedures are provided in the Facility-Wide QAPP. A primary focus of the review, verification, and validation process will be to avoid the potential for false positive errors (e.g., avoiding the potential of finding no risk when a risk actually exists). Analytical project-reporting levels established to meet the needs of risk assessment are presented in the Facility-Wide QAPP, Tables 3-3 through 3-9. Associated risk level concentrations for the major COPCs are presented in this FSAP in Table 3-2.

Analytical data will be generated using EPA SW-846 Methods, EPA Water and Wastewater Methods, and American Society for Testing and Materials (ASTM) Methods. Alternate or supplemental methods may be added as the need arises through specification in an approved addendum to the FSAP. Analytical data will receive its initial review by the laboratory generating the information prior to the results being reported as definitive data as identified in the Facility-Wide QAPP.

Verification of the analytical data will be performed independently of the analytical laboratory by the Contractor. This verification will ensure that precision, accuracy, sensitivity, and completeness of the analytical data are adequate for their intended use. Because the greatest uncertainty in a measurement is often a result of the sampling process, the inherent variability of the matrix, or the environmental population, verification will focus at a level necessary to minimize the potential of using false positive or false negative concentrations in the decision-making process (i.e., first priority will be to assure accurate identification of detected versus non-detected analytes).

Additionally, 10 percent of the project data will undergo comprehensive data validation through an organization independent of both the laboratory and the Contractor. This review combined with the U.S. Army QA split sample analyses and documentation will form the basis for an overall data quality assessment by the U.S. Army.

Table 3-2. Required Detection Limits for Performing the Baseline Risk Assessment for Primary Chemicals of Potential Concern at RVAAP

Chemical	Detection Limit Requirements[a]	
	Soil (mg/kg)	Water (mg/L)
Primary Chemicals of Potential Concern		
Dinitrotoluene-2,4 (DNT)	0.9 (1)	0.0001 (3)
Dinitrotoluene-2,6	0.9 (1)	0.0001 (3)
Trinitrotoluene-2,4,6 (TNT)	21 (1)	0.003 (3)
RDX	5.8 (1)	0.0008 (3)
Composition B (RDX+TNT)	see limits for individual constituents	
HMX	3900 (2)	2 (4)
Nitrocellulose	best available[d]	best available
Nitroglycerine	best available	best available
Nitroguanidine	7800 (2)	4 (4)
Aluminum	best available	best available
Arsenic	0.4 (1)	0.0001 (3)
Barium	5500 (2)	2 (5)
Cadmium	78 (2)	0.005 (5)
Chromium	230 (2)	0.1 (4)
Lead	400 [b]	0.015 [c]
Mercury	23 (2)	0.002 (5)
Selenium	390 (2)	0.05 (5)
Silver	390 (2)	0.2 (4)
Zinc	24000 (2)	11 (4)
Other COPCs		
1,3,5-Trinitrobenzene	2300 (2)	1 (4)
1,3-Dinitrobenzene	7.8 (2)	0.004 (4)
Nitrobenzene	39 (2)	0.02 (4)
o-Nitrotoluene	780 (2)	0.4 (4)
n-Nitrotoluene	780 (2)	0.4 (4)
p-Nitrotoluene	780 (2)	0.4 (4)
Manganese	3600 (2)	2 (5)
VOCs		
SVOCs		
PCBs	0.3 (1)	0.00004 (3)

[a]Basis for requirement: achieve a concentration at least equivalent to (1) 10^{-6} risk goal assuming soil ingestion by children and adults, (2) HQ=1 assuming child soil ingestion, (3) 10^{-6} risk goal assuming adult drinking water ingestion, (4) HQ=1 assuming adult drinking water ingestion, (5) Federal Maximum Contaminant Level (MCL) for drinking water.
[b]Proposed soil action level for lead (USEPA 1994)
[c]Proposed technology action level for lead in drinking water (USEPA, 1993).
[d]Compounds considered not to be toxic at environmental levels.

Verification and validation will be accomplished by comparing the contents of the data packages and QA/QC results to requirements contained in the requested analytical methods. In general, verification and validation support staff will conduct a systematic review of data for compliance with the established QC criteria based on the following categories:

- holding times,
- blanks,
- laboratory control samples (LCSs),
- calibration,
- surrogate recovery (organic methods),
- internal standards (primarily organic methods),
- matrix spike/matrix spike duplicate (MS/MSD) and duplicate results,
- sample reanalysis,
- secondary dilutions, and
- laboratory case narrative.

The protocol for analyte data verification and validation is presented in:

- Shell Analytical Chemistry Requirements, version 1.0, 2 November 1998;
- Environmental Data Assurance Guideline, USACE Louisville, May 2000;
- EPA National Functional Guidelines for Organic Data Review (EPA 1994b); and
- EPA National Functional Guidelines for Inorganic Data Review (EPA 1994c).

Consistent with the data quality requirements as defined in the DQOs, all project data and associated QC will be evaluated and qualified as per the outcome of the review.

3.2.9 Optimize Sample Design

3.2.9.1 Purposes of sampling

Sampling and analysis for the RVAAP field investigations will focus on the following:

- determination of the presence of contamination,
- determination of the nature and extent of contamination,
- identification of the connections between contaminant sources and pathway media, and
- thorough characterization of an AOC using a comprehensive sampling methodology.

3.2.9.2 Selection of sample locations

In order to accomplish the purposes described above, biased sampling will be used. That is, process history, topography, geology, and other information specific to an individual AOC will be used to identify locations where residual contamination would most probably remain Field screen for explosives on composited soil samples and allow 100 percent of all detects and 15 percent of all non-detects to have corresponding laboratory analyses performed. In addition, 10 percent of all the samples will be subjected to the full suite of analyses (this standard also applies to all random-grid sampling). Given the non-uniform horizontal distributions of contaminated areas on ammunition plants such as RVAAP (e.g., former burning pads separated by apparently unused, uncontaminated land), the investigation of a given AOC may require characterization of the spaces between contaminated areas as well. For this purpose, non-biased, or random grid, sampling will be used to acquire representative information on areas between known or suspected sources within individual AOCs.

Random grid sampling will be conducted as follows:

- Select a representative area or exposure unit that most reflects the future land use (e.g., a 300 × 300-foot plot).
- Use the Gilbert (1987) statistical approach to determine an appropriate triangular grid spacing (e.g., 60-foot spacing).
- Lay out exposure units outside or beyond the areas of biased sampling, and label each grid sampling location with a grid sampling number.
- At each exposure unit, randomly select a grid sampling number.

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4.0 FIELD ACTIVITIES

All CERCLA AOCs regulated under the Ohio Administrative Code (OAC) 3745-27-13 (Authorization to Engage in Filling, Grading, Excavating, Building, Drilling, or Mining on Land Where a Hazardous Waste Facility or Solid Waste Was Operated) must have a written request for authorization from Ohio EPA to conduct invasive environmental investigations. The request for authorization under the OAC statute (hereinafter referred to as Rule 13) addresses measures required to ensure that investigative activities necessary to characterize individual AOCs under CERCLA are protective of human health and the environment.

A generic request for authorization under Rule 13 for RVAAP is provided in Appendix B of this FSAP, and it addresses the general requirements for planned activities, e.g., drilling, trenching, monitoring well installation, surface water and sediment sampling, excavation, etc. Should it be determined by Ohio EPA and RVAAP that additional safeguards are necessary for specific activities at individual AOCs, a supplemental request must be submitted for those AOCs.

4.1 GEOPHYSICS

Geophysical analysis is not anticipated to be routinely necessary for the AOC-specific investigations. In the event that geophysical analysis is required, the rationale and procedures for this activity will be presented in the AOC-specific investigation addendum to the FSAP.

4.2 SOIL GAS SURVEY

Soil gas surveys are not anticipated to be routinely necessary for AOC-specific investigations. In the event that a soil gas survey is required, the rationale and procedures for this activity will be presented in the AOC-specific investigation addendum to the FSAP.

4.3 GROUNDWATER

4.3.1 Rationales

As defined in Section 3.0 of this FSAP, AOC-specific investigation addenda to the FSAP will be developed for the purpose of identifying unique elements of each investigation not addressed in the FSAP. Therefore, the rationales related to monitoring well locations and installation, sample collection, field and laboratory analyses, determination of background values, and QA/QC sample collection and frequency will be addressed within each of the AOC investigation-specific addenda as appropriate.

4.3.2 Monitoring Well Installation

4.3.2.1 Drilling methods and equipment

4.3.2.1.1 Equipment condition and cleaning

All drilling and support equipment used for monitoring well installation during each AOC-specific investigation will be in operable condition and free of leaks in the hydraulic, lubrication, fuel, and other fluid systems where fluid leakage would or could be detrimental to the project effort. All switches (including two functioning safety switches); gages; and other electrical, mechanical, pneumatic, and hydraulic systems will be in a safe and operable condition before arrival and during operation. The Drill Rig Operational Checklist presented in Figure 4-1 will be completed before commencement of drilling at each monitoring well borehole location, typically once per week.

All drilling equipment will be cleaned with steam or pressurized hot water before arriving for each AOC-specific investigation. After arrival, but before commencement of drilling activities, all drilling equipment [including the rig, support vehicles, water tanks (interior and exterior), augers, drill casings, rods, samplers, and tools] will be cleaned with steam or pressurized hot water using approved water at a decontamination pad. Sampling devices will also be decontaminated in accordance with Section 4.4.2.8.

Similar decontamination of drilling and sampling equipment will be conducted upon completion of each monitoring well borehole. However, only the equipment used or soiled during the drilling and sampling activities at each borehole location will undergo decontamination. All drilling and sampling equipment used during the course of each AOC-specific investigation will be decontaminated.

The temporary decontamination pad to be used for equipment cleaning will be located, to the greatest extent possible, in an area surficially crossgradient or downgradient from the monitoring well borehole locations. The pad will be constructed in such a manner to allow for containment and collection of decontamination solid and liquid wastes and to minimize loss of overspray water during decontamination activities. Solid and liquid wastes generated from the decontamination process [investigation-derived waste (IDW)] will be managed in accordance with the procedures defined in Section 7.0 of this FSAP.

4.3.2.1.2 Drilling methods

Two different types of drilling methods are anticipated to be used for installation of groundwater monitoring wells during the AOC-specific investigations, based on the assumption that monitoring wells for the initial AOC-specific investigations are anticipated to be installed for the purpose of subsurface contaminant characterization. The two methods are hollow stem auger drilling and air rotary drilling. These methods, when used during investigations, will be implemented as dry drilling methods.

Either the hollow stem auger or air rotary method will be used to drill soil portions of monitoring well boreholes, provided that collection of soil samples for physical and/or chemical analyses is not required. In the event that collection of environmental soil samples is required, only the hollow stem auger method will be utilized. Regardless of the drilling method, lithologic samples will be collected from the surface to total depth in each borehole. Information regarding the methods and equipment to be used for collection of subsurface soil samples from boreholes drilled using the hollow stem auger method is presented in Sections 4.4.2.4 and 4.4.2.5 of this FSAP. Drilling of bedrock portions of monitoring well boreholes will be accomplished using the air rotary method. In the event that collection of bedrock cores is required as part of the borehole drilling, information regarding the methods and equipment for this procedure is presented in Section 4.3.2.3.2 of this FSAP.

Soil drilling using the hollow stem auger method will be accomplished using a truck-mounted auger rig of sufficient size and power to advance augers to the required drilling depth. Soil and bedrock drilling using the air rotary method will be accomplished using a truck-mounted air rotary rig, which will advance a tricone roller bit to the required drilling depth. The total depth of each monitoring well borehole will be dictated by the depth of local groundwater and will be contingent upon the constraints of the maximum drilling depth for boreholes defined by the U.S. Army for each AOC-specific investigation. A discussion of these constraints and the decision criteria associated with installation of monitoring wells in boreholes will be presented in the AOC-specific investigation addenda to the RVAAP FSAP.

DRILL RIG OPERATIONAL CHECKLIST

Site Name:____________________________

Rig
Model: ______________________________ Manufacturer:____

Serial Number: ________________________ Rig Owner: ____

Inspection Performed
by: ____
(Driller's Signature) (Date)

Checklist Reviewed and
Emergency Shutdown Observed
by: ____
(Signature) (Date)

Place an X in each appropriate ( )

1.0 GENERAL

1.1 Check all safety devices which are part of drill rig and which can be verified (see note).
Is (are all) device(s) intact and operating as designed?

Emergency Interrupt System

A.	Kill Switch 1	Yes ( ) No ( ) NA ( )
B.	Kill Switch 2	Yes ( ) No ( ) NA ( )
C.	Kill Switch 3	Yes ( ) No ( ) NA ( )
D.	Kill Switch 4	Yes ( ) No ( ) NA ( )
E.	Kill Switch 5	Yes ( ) No ( ) NA ( )
F.	Other ________________________________	Yes ( ) No ( ) NA ( )
G.	Other ________________________________	Yes ( ) No ( ) NA ( )
H.	Other ________________________________	Yes ( ) No ( ) NA ( )

Note: All safety devices (not otherwise listed in this checklist) should be identified for each drill rig at the beginning of each project and subsequently checked at each inspection. Testing of all safety devices must be observed by health and safety personnel. List only safety devices which can be checked without disassembly or without rendering the device ineffective. This checklist does not cover United States Department of Transportation requirements.

Figure 4-1. Drill Rig Operational Checklist for RVAAP AOC-Specific Investigations

1.2	Is the proper type and capacity of fire extinguisher(s) present, properly charged, and inspected?	Yes ( ) No ( ) NA ( )
1.3	Is rig properly grounded?	Yes ( ) No ( ) NA ( )
1.4	Are rig and mast a safe distance from electrical lines?	Yes ( ) No ( ) NA ( )
1.5	Can mast be raised without encountering overhead obstructions?	Yes ( ) No ( ) NA ( )
1.6	Have spill prevention materials been placed under rig (i.e., plastic sheeting)?	Yes ( ) No ( ) NA ( )
1.7	Is a spill kit present?	Yes ( ) No ( ) NA ( )
1.8	Is the safe operating zone/exclusion zone posted (minimum radius at least equal to height of raised drill mast)?	Yes ( ) No ( ) NA ( )
1.9	Do all modifications made to the drill rig permit it to operate in a safe manner and allow the drill to operate within the manufacturer's specifications?	Yes ( ) No ( ) NA ( )
1.10	Are moving parts (excluding cathead and other moving parts normally used during operations) properly guarded?	Yes ( ) No ( ) NA ( )
1.11	Are all exhaust pipes, which would come in contact with personnel during normal operation properly guarded?	Yes ( ) No ( ) NA ( )
1.12	Are tank(s) and lines free of leakage?	Yes ( ) No ( ) NA ( )
1.13	Are all normal or manufacturer-recommended maintenance activities or schedules performed at the required frequency?	Yes ( ) No ( ) NA ( )
1.14	Are walking and standing surfaces, steps, rungs, etc., free of excess grease, oil, or mud which could create a hazard?	Yes ( ) No ( ) NA ( )

2.0 CONTROL MECHANISMS

Are all control mechanisms and gauges on the drill rig functional and free of oil, grease, and ice (checked while running)?	Yes ( ) No ( ) NA ( )

3.0 HYDRAULICS AND PNEUMATICS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

3.1	Do all hydraulic reservoirs exhibit proper fluid levels?	Yes ( ) No ( ) NA ( )
3.2	Are hydraulic and/or pneumatic systems in good condition and functioning correctly (checked while running)?	Yes ( ) No ( ) NA ( )

Figure 4-1 (continued)

4.0 LIFTING MECHANISMS

Note: The mast should be lowered during the completion of this section to allow inspection of portions of the lifting mechanisms normally out of reach during operation.

4.1	Have all wires, ropes, cables, and lines that are kinked, worn, corroded, cracked, bent, crushed, frayed, stretched, birdcaged, or otherwise damaged been replaced and the defective equipment removed from the site?	Yes ( ) No ( ) NA ( )
4.2	Have all wires, ropes, cables, and lines been wrapped around winch drums without excessive pinching or binding?	Yes ( ) No ( ) NA ( )
4.3	Are all pulleys undamaged and functional?	Yes ( ) No ( ) NA ( )
4.4	Are all clips, clamps, clevises, hooks, and other hardware used to rig wires, ropes, cables, or lines undamaged and attached properly?	Yes ( ) No ( ) NA ( )
4.5	Do all eyes formed in wires, ropes, cables, or lines attached to the rig use a thimble to retain the shape of the eye?	Yes ( ) No ( ) NA ( )
4.6	Do all hooks having functioning safety gates/latches?	Yes ( ) No ( ) NA ( )

5.0 NONCONFORMING ITEMS

5.1 When did the last operation checklist inspection take place for this drill rig at this site?

Date: ____________________________

5.2 Have any nonconforming items been carried over from the last inspection? List any such items and dates or original nonconformance.

A. ____

Date: ____________________________

B. ____

Date: ____________________________

C. ____

Date: ____________________________

D. ____

Date: ____________________________

Figure 4-1 (continued)

Any nonconforming items must be documented in the following remarks section and reported to the field operations manager for the project prior to operating the drill ring. Reference all remarks to the item numbers noted above.

Remarks:

Figure 4-1 (continued)

With regard to the air rotary method, soil and bedrock cuttings will be removed from the borehole during drilling using high-pressure air, and they will be directed to the surface through the borehole annulus or through a borehole casing (if installed) in bedrock sections. Drill cuttings traveling up to the ground surface will be directed into a diverter sealed to the top of the borehole or the borehole casing. The drill cuttings will then exit from the diverter through a discharge vent and will be directed into a container located next to the borehole. Using this procedure, field personnel will be protected from any adverse effects caused by site contaminants in the returned air and blown particles.

The air compressor used for the air rotary method will be equipped with an air-line oil filter. This oil filter will be changed in accordance with manufacturer's recommendations; however, if oil is visibly detected in the filtered air, the filter will be changed more frequently. The air filter will be examined daily for breakthrough. Sufficient samples of the air compressor initial reservoir oil will be collected and retained until completion of the AOC investigation. These samples will be evaluated in the event that oil from the unit is suspected to have contributed to contamination detected in samples collected for chemical analysis. Logs completed for each borehole will be used to record the following information regarding air usage:

- equipment description,
- manufacturer and model,
- air pressure used,
- frequency of oil filter change,
- evaluation of system performance, and
- record of any oil loss from the unit.

Information regarding procedures to be used for mitigation of adverse subsurface effects resulting from the implementation of the air rotary method and procedures to be used for management of IDW generated at borehole locations during hollow stem auger or air rotary drilling will be presented in the AOC-specific investigation addenda to the FSAP.

Various drilling scenarios for the completion of monitoring well boreholes may be implemented during the course of the AOC investigations due to specific site conditions. Therefore, the type of drilling method required (i.e., hollow stem auger or air rotary) and size(s) of augers or tricone roller bits will be dictated by the scenario that is applicable for a particular AOC investigation. Details regarding the drilling method, approach, and rationale for each investigation will be presented in the AOC-specific investigation addenda to the FSAP. Several monitoring well borehole drilling scenarios that may be implemented during the AOC investigations are discussed in Section 4.3.2.1.3 of this FSAP.

4.3.2.1.3 Drilling scenarios

Based on the assumption that monitoring wells for the initial AOC-specific investigations are anticipated to be installed for the purpose of subsurface contaminant characterization, it is assumed that a majority of these wells will be installed using 5.0-cm (2.0-inch)-diameter well screen and casing. Furthermore, it is assumed that some monitoring wells for the investigations will be drilled to relatively shallow depths and completed in overlying soil material, while other monitoring wells will be drilled to greater depths and completed in the upper 3.0 to 6.0 m (10.0 to 20.0 feet) of the underlying bedrock. Based on these assumptions, four different drilling scenarios may be used for completion of the boreholes for these monitoring wells.

In circumstances where wells are to be completed in bedrock, coring may be necessary to determine lithologies and degree and nature of weathering and fracturing in bedrock. N-series coring shall be performed in the bedrock interval prior to 15.2-cm (6.0-inch)-diameter air-rotary overdrilling to install the monitoring well.

The first drilling scenario would be implemented for monitoring well boreholes required to be drilled through overlying soil material known to be contaminated and into the underlying bedrock. For this scenario, the well borehole would initially be drilled down to the soil-bedrock interface using either the hollow stem auger method if soil sampling is required, or the air rotary method if soil sampling is not required. The borehole will then be additionally advanced into the top of the bedrock approximately 0.9 to 1.5 m (3 to 5 feet). A hole-opening device may be utilized to increase the diameter of the borehole soil section to the required size if the standard-sized auger lead or tricone roller bits are not adequate. Next, steel surface casing extending from the ground surface to the bottom of the borehole would be installed and the annulus between the casing and borehole grouted. After curing of the grout for at least 12 hours, drilling of the bedrock portion of the borehole would be completed using the air rotary method. The surface casing used for this scenario would not be removed during subsequent installation of the monitoring well.

The second drilling scenario would be implemented for monitoring well boreholes required to be drilled through overlying soil material not requiring isolation but known to be unstable (i.e., prone to caving) and into the underlying bedrock. For this scenario, initial drilling of the well borehole would be conducted in the same manner as described for the first drilling scenario. Immediately after installation of the surface casing, drilling of the bedrock portion of the borehole would be completed using the air rotary method. Monitoring wells installed within boreholes drilled using this scenario would be constructed inside the surface casing that would be removed during grouting of the well.

The third drilling scenario would be implemented for monitoring well boreholes required to be drilled into overlying soil material not requiring isolation and known to be stable, or required to be drilled through this material and into the underlying bedrock. For this scenario, drilling of the soil portion of the borehole would be conducted in the same manner as described for the initial drilling in the first drilling scenario. If required, drilling of the bedrock portion of the borehole would be completed using the air rotary method. No surface casing would be used during implementation of this drilling scenario.

The fourth drilling scenario would be implemented for monitoring well boreholes required to be drilled into overlying soil material not requiring isolation and known to be unstable. For this scenario, borehole drilling using the hollow stem auger method would be accomplished by advancing the augers to the required depth. Monitoring wells installed within boreholes drilled using this method would be constructed inside the augers that would be removed during grouting of the well. Borehole drilling using the air rotary method would be accomplished by advancing the tricone roller bit to the required depth. A hole opening device would be utilized to increase the diameter of the borehole soil section to the required size if the standard-sized tricone roller bits are not adequate. Following completion of the borehole, temporary surface casing would be installed. Monitoring wells installed within boreholes drilled using this method would be constructed inside the surface casing that would be removed during grouting of the well.

In each of these drilling scenarios, the need may exist to isolate overlying soil material if heaving sands are encountered. In these instances, steel surface casing would be installed from the surface to within the confining interval immediately above the heaving sand. The annulus between the casing and borehole would be grouted. After curing the grout for at least 12 hours, a closed-end (temporarily plugged) auger would be used to drill the heaving sand interval. The temporary plug would then be knocked and drilling continue or the well completed, as outlined in the above drilling scenarios.

A summary of the four drilling scenarios described above and the types of standard hollow stem augers, tricone roller bits, and surface casings that may be used during implementation of these scenarios is presented in Table 4-1.

4.3.2.2 Materials

The following discussion regarding materials to be used for construction of monitoring wells during the AOC-specific investigations is based upon the assumption that the wells will be installed for the purpose of subsurface contaminant characterization and thus will be 5.0 cm (2.0 inches) in diameter. Furthermore, it is anticipated that two different types of monitoring wells may be constructed during the investigations, above-grade installations and flush-mounted installations.

Details regarding the installation of monitoring wells are presented in Section 4.3.2.3 of this FSAP. Information regarding the materials to be used for installation of monitoring wells within investigation boreholes, and the type of well to be constructed (i.e., above-grade or flush-mounted) will be presented in the AOC-specific investigation addenda to the FSAP.

4.3.2.2.1 Casing/screen

The casing, screen, and fitting materials to be used for construction of monitoring wells during the AOC-specific investigations will be composed of new, precleaned, 5.0-cm (2.0-inch) Schedule 40 polyvinyl chloride (PVC). Screen sections will be commercially fabricated and slotted with openings equal to 0.025 cm (0.010 inches). Screen and casing sections will be flush threaded, and thermal or solvent welded couplings will not be used. Gaskets, pop rivets, and screws will also not be used during monitoring well construction. Pre-packed screens will be used for intervals that cannot be filter packed conventionally.

All materials used for monitoring well construction will be as chemically inert as technically practical with respect to the site environment. All PVC screens, casings, and fittings will conform to National Sanitation Foundation (NSF) Standard 14 (NSF 1994) for potable water usage or Annual Book of ASTM Standards: Volume 08.04; F 480 (ASTM 1995) and will bear the appropriate rating logo.

The well caps and centralizers to be used for construction of monitoring wells will be composed of new, precleaned PVC. The tops of all monitoring well casings associated with above-grade well installations will be covered with slip-joint type well caps. The tops of all monitoring well casings associated with flush-mounted well installations will be covered with water-tight expandable-flange locking well caps. Both types of caps will be fitted to the casings and will be designed to preclude binding to the casing resulting from tightness of fit, unclean surface, or frost and to allow for equilibration between hydrostatic and atmospheric pressures. The caps will also be designed to fit securely enough to preclude debris and insects from entering the monitoring well.

Well centralizers will be used for construction of all monitoring wells that are installed within open boreholes exceeding approximately 6.1 m (20.0 feet) in depth. They will be attached to the well casing at regular intervals by means of stainless steel fasteners or strapping. The placement of centralizers will be determined in the field at the time of monitoring well installation based on the total depth of each well. Centralizers will not be attached to well screens or to that part of well casings exposed to the granular filter pack or bentonite seal. Centralizers will also be oriented to allow for the unrestricted passage of tremie pipes used for placement of monitoring well construction materials within the annular space between the well and the borehole wall.

4.3.2.2.2 Filter pack, bentonite, and grout

Granular filter pack material used during the AOC-specific investigations for monitoring well installation will be approved by the U.S. Army Project Manager before commencement of field activities

Table 4-1. Summary of Drilling Scenarios for RVAAP AOC-Specific Investigations

Scenario Summary	Soil Drilling	Surface Casing Placement	Bedrock Drilling	Monitoring Well Size	Protective Casing Size
Borehole through overlying contaminated soil and into underlying bedrock	Hollow Stem Auger Method 12.0-inch OD augers; borehole diameter increased to 14.0 inches using hole opening device	10.0-inch ID casing grouted in place	Air Rotary Method 6.5-inch tricone bit Bedrock Coring N-series core	2.0-inch ID PVC screen and casing	6.0-inch ID iron or steel casing
	Air Rotary Method 10.75-inch tricone bit; borehole diameter increased to 14.0 inches using hole opening device	10.0-inch ID casing grouted in place			
Borehole through overlying unstable soil and into underlying bedrock	Hollow Stem Auger Method 8.0- to 8.5-inch OD augers; borehole diameter increased to 9.5 inches using hole opening device	8.0-inch ID casing	Air Rotary Method 6.5-inch tricone bit Bedrock Coring N-series core	2.0-inch ID PVC screen and casing	6.0-inch ID iron or steel casing
	Air Rotary Method 9.62-inch tricone bit	8.0-inch ID casing			
Borehole into overlying stable soil and into underlying bedrock	Hollow Stem Auger Method 6.0-to 6.5-inch OD augers	Not required	Air Rotary Method 6.5-inch tricone bit Bedrock Coring N-series core	2.0-inch ID PVC screen and casing	6.0-inch ID iron or steel casing
	Air Rotary Method 6.5-inch tricone bit	Not Required			
Borehole into overlying unstable soil	Hollow Stem Auger Method 8.0- to 8.5-inch OD augers	Not Required	Not Required	2.0-inch ID PVC screen and casing	6.0-inch ID iron or steel casing
	Air Rotary Method 6.5-inch tricone bit; borehole diameter increased to 7.0 inches using hole opening device	6.0-inch ID casing grouted in place			

(Figure 4-2). A 500-cm^3 (1-pint) representative sample of the granular filter pack material proposed for use will be submitted to the USACE-Louisville District, RVAAP, or other U.S. Army Project Manager for approval, if requested. Based on the screen slot size of 0.025 cm (0.010 inches) to be used for monitoring well construction, the granular filter pack material used will generally be Global Supply No. 7 [size equals 0.047 cm (0.0188 inches)] sand. Global Supply No. 5 may alternately be used with prior approval from the Army Project Manager and Ohio EPA if conditions warrant.

The granular filter pack material will be visually clean (as seen through a 10-power hand lens), free of material that would pass through a No. 200 sieve, inert, siliceous, and composed of rounded grains. The filter material will be packaged in bags or buckets by the supplier and delivered therein to the site. Filter pack material in pre-packed screens will also meet these criteria.

Bentonite will be used during the AOC-specific investigations for one or more of the following purposes:

- creation of an annular seal during monitoring well construction between the lower granular filter pack and upper grout seal,

- additive in grout mixture used for creation of upper grout seal during monitoring well construction, and/or

- additive in grout mixture used for abandonment of boreholes not converted into monitoring wells.

Bentonite material used during the investigations for monitoring well installation will be approved by the U.S. Army Project Manager before commencement of field activities (Figure 4-3). A 500-cm^3 (1-pint) representative sample of each type of bentonite material proposed for use will be submitted to the U.S. Army Project Manager for approval, if requested. Compressed powdered bentonite pellets or chips, generally measuring 0.63 cm (0.25 inches) in size, will be used for annular seal applications. Powdered bentonite will be used for grout additive applications.

Grout used during AOC-specific investigations for monitoring well installation or borehole abandonment will be composed of Type I portland cement, approximately 6 pounds dry weight bentonite per 42.6-kilogram (94-pound) sack of dry cement, and a maximum of 0.02 to 0.03 m^3 (6 to 7 gallons) of approved water per sack of cement. The amount of water used to prepare grout mixtures will be minimized to the greatest extent possible.

All grout materials will be combined in an above-ground rigid container or mixer and mechanically blended onsite to produce a thick, lump-free mixture throughout the mixing vessel. The grout will be placed using a tremie pipe of rigid construction for vertical control of pipe placement. The tremie pipe will be equipped with side discharge holes rather than an open end to help maintain the integrity of the underlying material onto which the grout is placed.

4.3.2.2.3 Surface completion

The well protection assembly to be used for construction of monitoring wells during AOC-specific investigations will be composed of new iron/steel protective casing. All monitoring wells should be constructed as above-grade installations, where possible (see Section 4.3.2.3). Protective casings associated with above-grade well installations will be equipped with locking iron/steel covers, while those associated with flush-mounted installations will be equipped with flush (not threaded) manhole-type iron/steel covers. Covers on the protective casings will be such that the possibility of water leakage is minimized. Protective casings installed as flush-mounts or above grade will be surrounded by a minimum of three new iron/steel guard posts to help in location and avoidance

GRANULAR FILTER PACK APPROVAL

Project for intended use:

1. Filter Material Brand Name:
2. Lithology:
3. Grain Size Distribution:
4. Source:
   Company that made product:
   Location of pit/quarry origin:
5. Processing method:
6. Slot Size of Intended Screen:

SUBMITTED BY:

Company:

Person:

Telephone Number:

Date

FOA APPROVAL (A)/DISAPPROVAL (D)	(check one)	
Project Officer/Date	A	D
Project Geologist/Date:	A	D

Figure 4-2. Granular Filter Pack Description and Approval Form

BENTONITE APPROVAL

Project for intended use:

1. Bentonite Material Brand Name:

   Annular seal:

   Grout additive:

2. Manufacturer:

   Annular seal:

   Grout additive:

3. Manufacturer's Address and Telephone Number(s):

   Annular seal:

   Grout additive:

4. Product Description:

   Annular seal:

   Grout additive:

5. Intended Use of Product:

   Annular seal:

   Grout additive:

6. Potential Effects on Subsequent Chemical Analyses:

   Annular seal:

   Grout additive:

SUBMITTED BY:

Company:

Person:

Telephone Number:

Date

FOA APPROVAL (A)/DISAPPROVAL (D)	(check one)	
Project Officer/Date	A	D
Project Geologist/Date:	A	D

Figure 4-3. Bentonite Description and Approval Form

All locks on protective casings installed during each investigation will be opened by a single key and, if possible, will match the locks present on existing monitoring wells within the AOC. If this is not possible, the locks on the existing wells may be replaced with the type used for the new monitoring wells installed during the investigation. Currently all wells installed and sampled under the IRP, as well as those at Ramsdell Quarry Landfill, have a common key. All well locks will be issued by RVAAP.

The diameter of all protective casings will be 15.2 cm (6.0 inches). The length of protective casing used for above-grade well installations will be 2.4 m (8.0 feet), approximately 1.5 m (5.0 feet) of which will extend below the ground surface. The length of protective casing used for flush-mounted well installations will be 1.5 m (5.0 feet), the entire length of which will extend below the ground surface. The guard posts installed around above-grade protective casings will be at least 7.6 cm (3.0 inches) in diameter and the top of each post modified to preclude the entry of water. The guard post length will be 1.8 m (6.0 feet), approximately 0.6 m (2.0 feet) of which will extend below the ground surface.

4.3.2.2.4 Water Source

Water will be used during the AOC-specific investigations for the following purposes:

- preparation of grout mixture used for monitoring well installation or borehole abandonment,
- preparation of cement mixture used for construction of monitoring well surface completions, and
- decontamination of drilling and sampling equipment.

Evaluation of the water source used for each investigation will be accomplished by collecting a sample from each potable source used before starting field activities. Procedures for the collection, preservation, shipping, and documentation of this sample and other related requirements, are defined in the subsequent sections of this FSAP and in Appendix C, Section C-4, of USACE Procedure EM 200-1-3. One QC trip blank will placed into the cooler used for transport of the sample from the field to the contracted laboratory. The water sample will be submitted to the contracted laboratory for analysis of the contaminants to be evaluated during the investigation. The water source will only be used if analytical results indicate that the source is free of contaminants.

In the event an approved water supply is available and analytical data document its suitability, this water source may be used without additional analyses.

The water source used for the project will also comply with other requirements defined in Section 3-9, Subsection b, Item #1a through #1f of USACE Procedure EM 1110-1-4000 (August 31, 1994) and will be approved by the U.S. Army Project Manager before use (Figure 4-4). Field personnel will be responsible for transport and storage of the approved water required for investigation needs in a manner to avoid the chemical contamination or degradation of the approved water once obtained.

4.3.2.2.5 Delivery, storage, and handling of materials

All monitoring well construction materials will be supplied and delivered to the AOC investigation sites by the subcontracted drilling company retained for each AOC-specific investigation. Upon delivery to the site, the Field Operations Manager will inspect all of the materials to ensure that the required types of materials have been delivered and that the materials have not been damaged or contaminated during transport to the site. During this inspection, the Field Operations Manager will collect and file any material certification documentation attached to or accompanying the materials. All material certification documentation will be maintained on site until completion of the project, at which time the documentation will be transferred to the project evidence file. All materials will be stored in a dry and secure location until used for monitoring well construction.

WATER APPROVAL

Project for intended use:

1. Water Source:

   Owner:

   Address:

   Telephone Number

2. Water tap location:

   Operator:

   Address:

3. Type of source:

   Aquifer:

   Well depth:

   Static water level from ground surface:

   Date measured:

4. Type of treatment prior to tap:
5. Type of access:
6. Cost per cubic gallon charged for use:
7. Results and dates of chemical analyses for past 2 years:
8. Results and dates of chemical analyses for project analytes:

SUBMITTED BY:

Company:

Person:

Figure 4-4. Water Description and Approval Form

All well screens and well casings used for monitoring well construction will be free of foreign matter (e.g., adhesive tape, labels, soil, grease, etc.) and will be washed with approved water before use. However, if the materials have been packaged by the manufacturer and have their packaging intact up to the time of installation, no prewashing will be conducted. Pipe nomenclature stamped or stenciled directly on well screens and/or solid casing to be located within and below the bentonite seal will be removed by sanding, unless removable by approved water washing. Washed screens and casing will be stored in plastic sheeting until immediately before insertion into the borehole. All well screens and casings used for construction will be free of unsecured couplings, ruptures, and other physical breakage and/or defects.

All protective casing materials will be steam cleaned before placement; free of extraneous openings; and devoid of any asphaltic, bituminous, encrusting, and/or coating materials (with the exception of black paint or primer applied by the manufacturer). Washed protective casing materials will be stored in plastic sheeting until immediately before placement around monitoring well casings.

4.3.2.3 Installation

Monitoring wells installed as part of the AOC-specific investigations are anticipated to be constructed above-grade installations. Flush-mounted installations may be preferable in some circumstances. Furthermore, boreholes for both types of installation may be completed in either overlying soil material or the underlying bedrock. The criteria that will guide the type of construction will be the depth of local groundwater encountered at each monitoring well borehole location and the type of area (i.e., remote area versus traffic area) where each well is to be installed. All wells installed at RVAAP should be constructed as above-grade installations, where possible. Figures 4-5 and 4-6 conceptually illustrate two types of monitoring well construction that may be completed during the AOC investigations. A discussion of the monitoring well installation process to be used is presented below.

4.3.2.3.1 Test holes

In the event that test holes are required to be drilled before the installation of monitoring wells during the AOC-specific investigations, these holes will be drilled in accordance with the procedures defined in Section 4.3.2.1.2 of this FSAP.

4.3.2.3.2 Soil sampling and rock coring during drilling

Collection of soil samples for physical, geotechnical, and/or chemical analyses during monitoring well installation activities conducted during AOC-specific investigations will be performed in accordance with the procedures defined in Sections 4.4.2.4 and 4.4.2.5 of this FSAP.

All rock coring will be conducted in a manner to obtain maximum intact recovery of bedrock. The minimum core size will be an “N” series, which is 50.0 millimeter (2.0 inches) in diameter.

To the extent possible, bedrock coring will be accomplished without the addition of potable water. However, coring in unsaturated bedrock may require the addition of potable water to the formation to cool the cutting surface and facilitate the extension of the borehole. Circulation of this water may be lost to surrounding formation if it is porous and permeable. If the monitoring well installed in this borehole is a low-yield well, the potable water volume lost is generally not recoverable during well development. During the course of bedrock coring to advance a monitoring well boring, the Field Operations Manager will contact the U.S. Army Project Manager and the Ohio EPA Division of Drinking and Ground Waters in the event that drilling and coring conditions result in a loss of circulation of potable water.

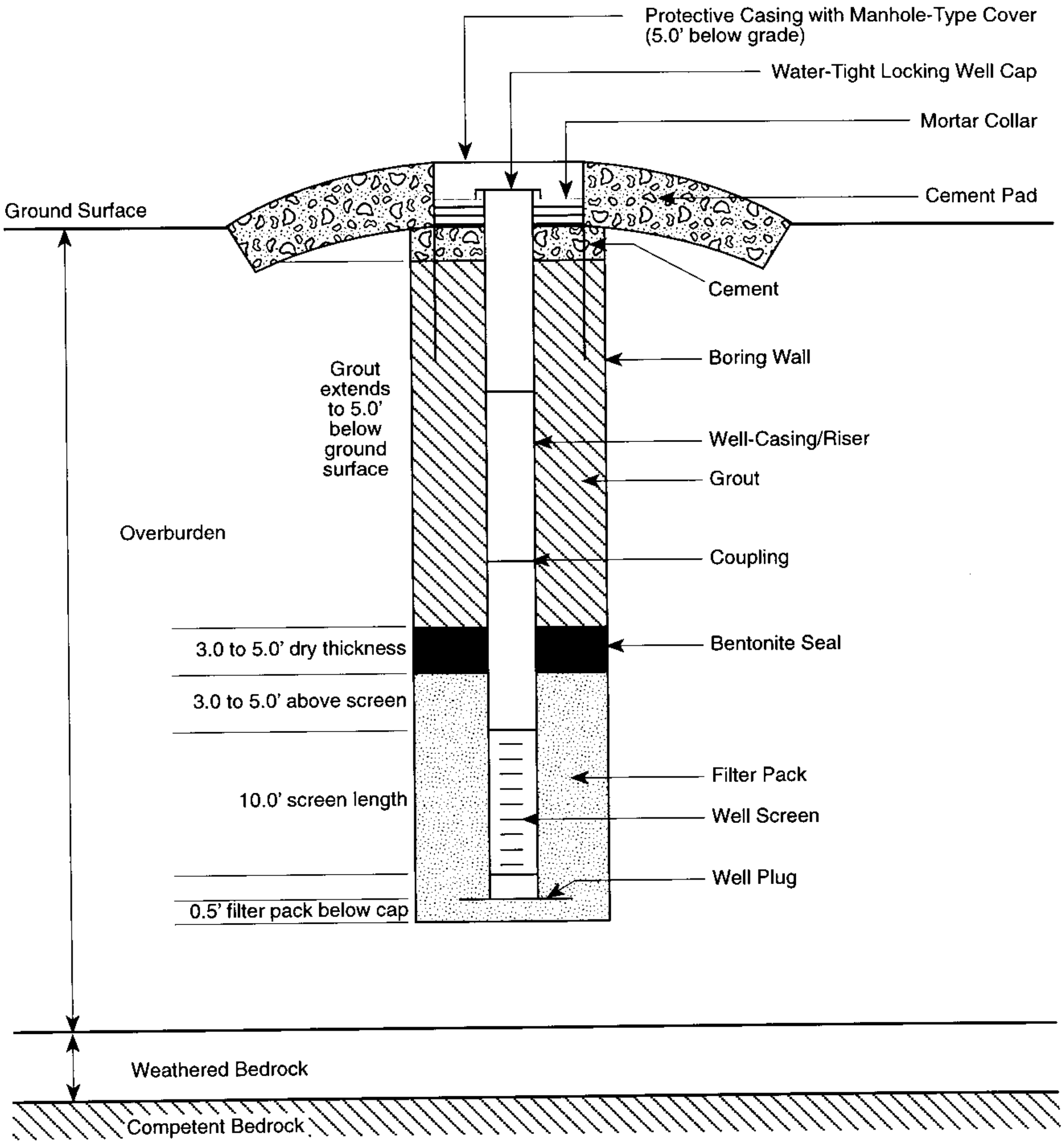

Figure 4-5. Example of a Monitoring Well Completed in Overlying Unstable Soil (Overburden) with a Flush-mount Installation

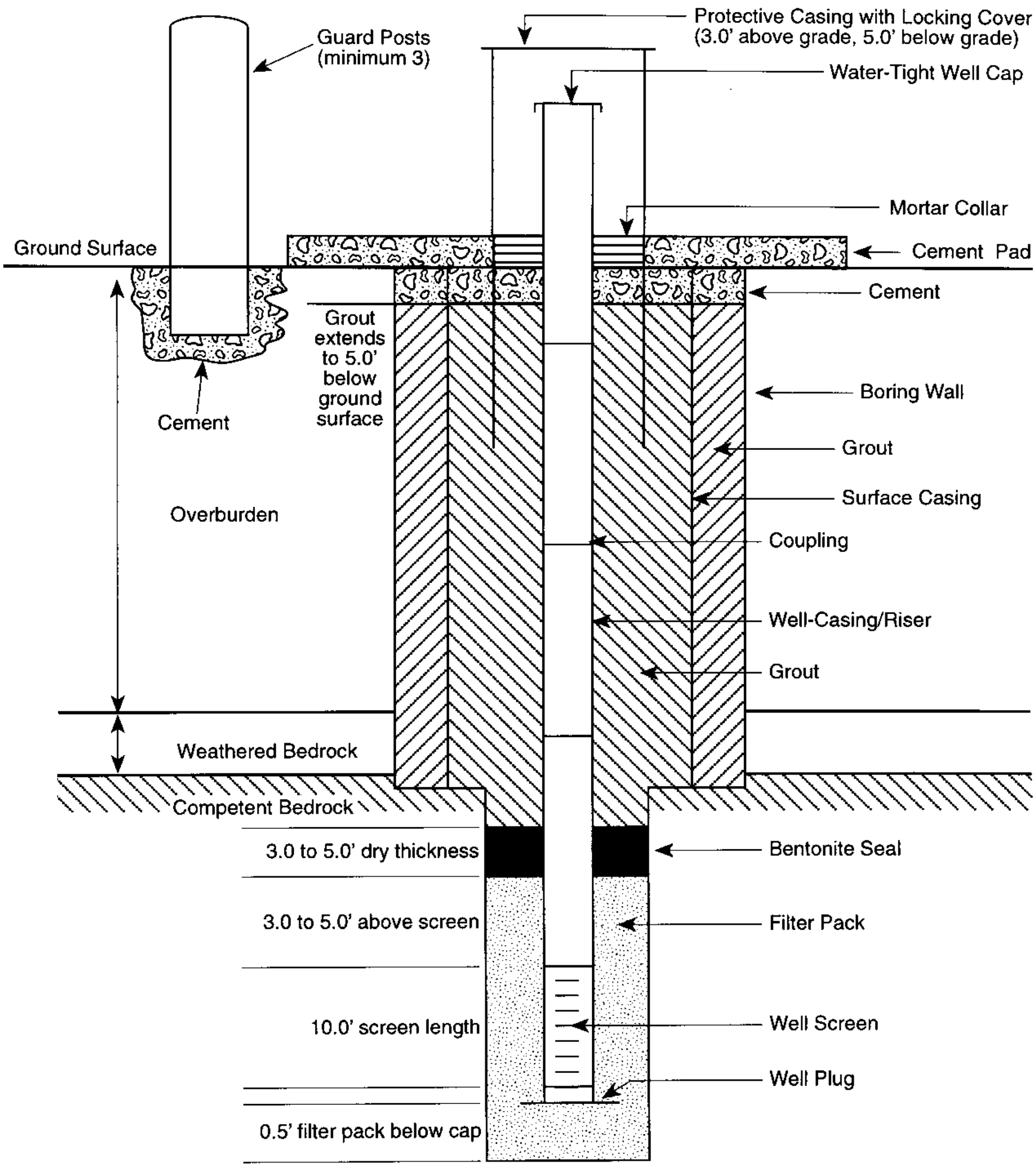

Figure 4-6. Example of a Monitoring Well Completed in Underlying Bedrock with an Above-grade Installation. Overlying Unstable Soil (Overburden) is Contaminated

Rock cores will be stored in covered core boxes to preserve their relative position by depth. Intervals of lost core will be noted in the core sequence. Boxes will be marked on the cover (both inside and outside) and on the ends to provide project name, borehole number, cored interval, and box number in cases of multiple boxes. Any core box known or suspected to contain contaminated core material will be appropriately marked on the borehole log and the core box cover and ends. The weight of each fully loaded box will not exceed 34.0 kilograms (75.0 pounds).

The core within each completed box will be photographed after the core surface has been cleaned and wetted. Each core box will be photographed close-up with a 35-millimeter camera loaded with color print film and will contain a legible scale for reference. Each core box will be oriented so that the top of the core is at the top of the photograph. These photographs, minimally 12.7 by 17.8 cm (5 by 7 inches) in size and annotated on the back with project name, well/borehole number, core box number, cored depths illustrated, and photograph date, will be provided to the U.S. Army Project Manager after coring activities have been completed. The film negatives or data disks will also be provided to the U.S. Army Project Manager after receipt of the photograph prints.

After the core boxes have been photographed, the samples will be disposed of in the same manner as other solid IDW generated during the investigation, except for those designated for laboratory analyses. Details regarding the disposal of rock cores and the storage, packaging, and method of shipment for core samples designated for laboratory analyses will be defined in the AOC-specific investigation addenda to the FSAP. Currently all IRP and other rock cores are in temporary storage at RVAAP. Rock cores will not be disposed of without RVAAP and USACE approval.

4.3.2.3.3 Borehole diameter and depth

It is anticipated that monitoring wells installed for the purpose of contaminant characterization during the AOC-specific investigations will be constructed using 5.0-cm (2.0-inch) PVC casing and screen. For monitoring wells of this size, the borehole drilled will be of sufficient diameter to permit at least 5.0 cm (2.0 inches) of annular space between the borehole wall and all sides of the well (centered screen and casing). Additional information regarding borehole drilling scenarios that may be implemented during the AOC investigations are discussed in Section 4.3.2.1.3 of this FSAP.

The anticipated depths of boreholes for monitoring wells will be defined in the AOC-specific investigation addenda to the FSAP. However, the monitoring well boreholes to be drilled for the initial AOC-specific investigations to be conducted at the RVAAP are currently estimated to be from approximately 6.0 to 12.1 m (from 20.0 to 40.0 feet) in depth.

Each borehole will be advanced through the overlying soil material, and into the underlying bedrock if required, until groundwater is encountered. Drilling will be terminated at a depth of from 1.5 to 2.1 m (from 5.0 to 7.0 feet) below the groundwater table. If sufficient groundwater to support a functional monitoring well is found to be present in the borehole, a monitoring well will be constructed. However, if insufficient groundwater is found to present, the borehole will be abandoned unless additional drilling is authorized by the U.S. Army Project Manager.

4.3.2.3.4 Screen and well casing placement

All screens used for monitoring well construction will be installed such that the bottom of each well screen is placed no more than 0.9 m (3.0 feet) above the bottom of the drilled borehole. The screen bottom will be securely fitted with a threaded PVC cap or plug. The cap/plug will be within 15.2 cm (6.0 inches) of the open portion of the screen. The standard length of screen to be used for all monitoring wells will be 3.0 m (10.0 feet). The casing used for construction of above-grade monitoring well installations will be of sufficient length to allow for 0.7 m (2.5 feet) of the casing to extend above the ground surface. The casing used for construction of flush-mounted monitoring well installations will be of sufficient length to allow for location of the casing top 5.0 cm (2.0 inches) bgs. The top of each installed monitoring well casing will be level so that the difference in elevation between the highest and lowest points on the top of the well casing is less than or equal to 0.6 cm (0.2 inches).

4.3.2.3.5 Filter pack placement

Granular filter pack material used for monitoring well construction will be placed within the annular space around the monitoring well screen using a tremie pipe. If approved water is used to place the filter pack, the amount of this water will be recorded and added to the volume of water to be removed during well development. The filter pack will extend from the bottom of the borehole to 0.9 to 1.5 m (3.0 to 5.0 feet) above the top of the well screen. In addition, 15.2 cm (6.0 inches) of filter pack will be placed under the bottom of the well screen to provide a firm footing. The final depth to the top of the filter pack will be measured directly with a weighted tape and recorded.

4.3.2.3.6 Bentonite Seal

The type of bentonite material to be used for construction of monitoring well seals will be composed of commercially available pellets or chips. Bentonite seals will be from 0.9 to 1.5 m (from 3.0 to 5.0 feet) thick as measured immediately after placement, without allowance for swelling. A tremie pipe will be used for placement of the pellets to prevent bridging. In addition, a weighted tape will be used to prevent bridging and to measure the placement of bentonite. After placement of the bentonite pellets, a small volume of approved water will be used to hydrate the pellets, and the hydration time for the pellets will be a minimum of 1 hour. The final depth to the top of the bentonite seal will be measured directly with a weighted tape and recorded.

4.3.2.3.7 Cement/bentonite grout placement

All prescribed portions of grout material to be used for monitoring well construction will be combined in an above-ground rigid container and mechanically blended to produce a thick, lump-free mixture throughout the mixing vessel. The grout will be placed from within a rigid grout pipe initially located just over the top of the bentonite seal in such a manner as to minimize disturbance of the seal.

Before exposing any portion of the borehole above the seal by removal of any surface casing (to include hollow-stem augers), the annulus between the surface casing and well casing will be filled with sufficient grout to allow for planned surface casing removal. If all surface casing is to be removed in one operation, the grout will be pumped through the grout pipe until undiluted grout flows from the annulus at the ground surface. During the surface casing removal, the grout pipe will be periodically reinserted as needed for additional grouting.

If the surface casing is to be incrementally removed with intermittent grout addition, the grout will be pumped through the grout pipe until it reaches a level that will permit at least 3.0 m (10.0 feet) of grout to remain in the annulus after removing the selected length of surface casing. Using this method, the grout pipe will only be reinserted to the base of the casing yet to be removed before repeating the process. After grouting has been completed to within approximately 3.0 m (10.0 feet) of the ground surface, the remaining surface casing will be removed from the borehole and the remaining annulus will be grouted to 1.5 m (5 feet) below the ground surface.

Grout for monitoring wells to be completed both as above-grade well installations and flush-mounted well installations will be added until it is present at 1.5 m (5 feet) below the ground surface.

Upon initiation of the grouting operation, the process will be conducted continuously until all of the surface casing or hollow stem augers, if present, have been removed and all annular spaces are grouted to the required levels as noted above. After 24 hours, the site will be checked for grout settlement and more grout will be added at that time to fill any depression. This process will be repeated until firm grout remains within 1.5 m (5 feet) of the ground surface. Incremental quantities of grout added in this manner will be recorded on the well construction diagram.

4.3.2.3.8 Concrete/gravel pad placement

Information regarding the placement of concrete pads around monitoring wells is presented in Section 4.3.2.3.9 of this FSAP.

4.3.2.3.9 Protective cover placement

Protective iron/steel casing will be installed around each monitoring well the same day as initial grout placement around the well. The protective casing's exterior will be pre-primed before being brought to RVAAP. The protective casing used for above-grade well installations will be set approximately 1.5 m (5 feet) below grade and will extend approximately 0.9 m (3 feet) above the ground surface. The protective casing used for flush-mounted well installations will be set approximately 1.5 m (5 feet) bgs with the top of the casing flush to grade. All protective casings will be installed so that the distance between the top of the protective casing and the top of the well casing is no more than 6.0 cm (2.4 inches).

For monitoring wells constructed as flush-mounted well installations, the remaining annulus formed between the outside of the protective casing and borehole, or permanent surface casing if present, will be filled to the ground surface with concrete on the day that firm grout is found to be present in the borehole. A sloping concrete pad measuring approximately 0.76 by 0.76 m square (30 by 30 inches square) will be poured around the exterior of the protective flush mount casing. Concurrently, an internal mortar collar will be poured within the annulus between the protective casing and well casing from the top of the firm grout to approximately 2.5 cm (1.0 inch) below the top of the well casing. The mortar mix will be (by weight) one part cement to two parts sand, with minimal approved water for placement.

For monitoring wells constructed as above-grade well installations, the mortar collar will be poured on the day firm grout is found in the borehole. The mortar collar will be poured within the annulus between the protective casing and well casing from the ground surface to approximately 15.2 cm (6.0 inches) above the ground surface. After the placement of the mortar collar, the remaining annulus formed between the outside of the protective casing and borehole, or permanent casing, if present, will be filled with concrete to the ground surface and extending onto the apron around the well head to form a square-cornered concrete pad measuring approximately 0.76 by 0.76 m square (30 by 30 inches square). For flush-mounted installations, the pad will be sloped away from the casing and recessed into the ground approximately 12 cm (0.5 ft). For both types of installations, the thickness of each concrete pad will be uniform and no less than 10.2 cm (4.0 inches). Following placement and curing of the concrete pad, a drainage port measuring approximately 0.6 cm (0.25 inches) in diameter will be drilled into the protective casing 0.3 cm (0.12 inches) above the top of the internal mortar collar.

Upon completion of protective cover placement for above-grade well installations, a minimum of three and preferably four steel guard posts will be radially located 1.2 m (4.0 feet) around each monitoring well. The guard post length will be 1.8 m (6.0 feet), approximately 0.6 m (2.0 feet) of which will be set in cement below ground level. All of the guard posts, as well as the protective casing including the hinges and cover/cap, will be painted orange with a paint brush and will be completely dry before sampling of the well.

4.3.2.3.10 Well identification

For each monitoring well installed during the AOC-specific investigations, the well designation number will be painted, using white paint, on the outside of the protective casing (after application and drying of the orange paint), and/or a metal tag bearing the designation will be attached to the protective casing or well casing depending upon the type of installation (i.e., above-grade or flush-mounted).

At AOC sites where no existing monitoring wells are present, wells installed during the investigations will be numbered consecutively beginning with the designation XXXmw-001 (XXX = AOC Designator). At sites where existing monitoring wells are present, wells installed during the investigations will be numbered consecutively beginning with the next highest unused number (for example, if four existing wells designated as XXXmw-001 through XXXmw-004 are present, numbering of the new investigation wells would begin with XXXmw-005). Boreholes drilled for purpose of monitoring well installation, but subsequently abandoned, will also be numbered consecutively beginning with the designation XXXSB-001. In the event that boreholes have been previously drilled at the site, numbering will again begin with the next highest unused number. The well identification system will be consistent with the location/sample identification naming convention specified in Section 5.3 of the FSAP.

4.3.2.3.11 Well development

The development of monitoring wells installed at the AOC will be initiated not sooner than 48 hours after nor longer than 7 days beyond internal mortar collar placement or the final grouting of the wells. If it is necessary to develop existing monitoring wells at one AOC, the integrity of the well will be checked prior to development. In the event that the integrity of the well is questionable, the well will not be developed. The integrity of the well will be checked by visual inspection of the surface casing and riser pipe, and by performing an alignment test in accordance with Section 4.3.2.3.13, of the FSAP.

4.3.2.3.11.1 Pump and bailer usage

Development of monitoring wells will be accomplished using one of the following nondedicated devices: a bottom discharge/filling Teflon or stainless steel bailer, a submersible pump, or a peristaltic pump. During development operations utilizing a bailer, the bailer will be rapidly surged up and down within the screen section of the well to agitate and mobilize particulates around the well screen during removal of groundwater from the well. During development operations utilizing a pump, the pump will be alternately started and stopped during groundwater removal, allowing the well to equilibrate and creating a surging action. In situations where a high percentage of fine material is suspended in the groundwater, a surge block may be used in coordination with the noted devices to mobilize particulates drawn into the granular filter pack.

4.3.2.3.11.2 Development criteria

Development of each monitoring well will proceed until each of the following criteria are achieved.

- A turbidity reading of 5 NTU or less is achieved using a turbidity meter, or the water is clear to the unaided eye.
- The sediment thickness remaining within the well is less than 3.0 cm (0.1 foot).
- A minimum removal of five times the standing water volume in the well (to include the well screen and casing plus saturated annulus, assuming 30% annular porosity) has been achieved.

- Indicator parameters (pH, specific conductivity, temperature, e.g.) have stabilized to within 10 percent on three consecutive readings.

- In addition to the “five times the standing water volume” criteria, five times the amount of any water unrecovered from the well during installation will also be removed. Under specific circumstances, such as bedrock coring in dry rock, potable water may be introduced to the formation.

During the course of well development, the U.S. Army Project Manager will be contacted for guidance if well recharge is so slow that the required volume of water cannot be removed during 48 consecutive hours of development, if persistent water discoloration is observed after completion of the required volume removal, or if excessive sediment remains after completion of the required volume removal.

4.3.2.3.11.3 Development water sample

For each monitoring well developed at an AOC site, a 500-cm^3 (1-pint) sample of the last water to be removed during development will be placed into a clear glass jar and labeled with the well number and date. Each sample will be individually agitated and immediately photographed close up with a 35-millimeter camera loaded with color print film, using a back-lit setup to show water clarity. These photographs, minimally 12.7 by 17.8 cm (5 by 7 inches) in size and individually identified with project name, well number, and photograph date, will be provided to the U.S. Army Project Manager after development of all AOC wells. The film negatives or data disks will also be provided to the U.S. Army Project Manager after receipt of the photograph prints. After the development water samples have been photographed, the samples will be disposed of in the same manner as the other water removed from the monitoring wells during the development operation. All well development water must be containerized, characterized, stored, and disposed of in accordance with Section 7.0 of the FSAP.

4.3.2.3.11.4 Monitoring well washing

As part of each monitoring well development operation, the entire well cap and the interior of the well casing between the water table and the ground surface will be washed using water from the well. The purpose of this activity will be to remove extraneous materials (grout, bentonite, sand, etc.) from the interior of the well. The monitoring well washing activity will be conducted during the overall development operation.

4.3.2.3.12 Well survey

A topographic survey of the horizontal and vertical locations of all groundwater monitoring wells at the AOC sites will be conducted after completion of well installation. The topographic survey will be lead/conducted by an individual licensed in an appropriate classification within the State of Ohio for the specific work anticipated to be conducted. This license will be current and active throughout the term of performance during the project.

4.3.2.3.12.1 Horizontal control

Each required survey element will be topographically surveyed to determine its map coordinates referenced to the Ohio State Plane (OSP) Coordinate System . The survey will be connected to the OSP by third-order, Class II control surveys in accordance with the Standards and Specifications for Geodetic Control Networks (Federal Geodetic Control Committee 1984). All elements surveyed will have an accuracy of at least 0.3 m (1.0 foot) within the chosen system. Specific projects may require greater accuracy. Locations of monitoring wells will be measured at the rim of the uncapped well casing (not the protective casing).

4.3.2.3.12.2 Vertical control

Each required survey element will be topographically surveyed at the notched point on the solid well casing (not the protective casing). The ground surface elevation (not the pad surface) adjacent to each well will also be measured. The location of the ground surface point surveyed will be marked using a driven hub with a nail and flagging affixed. The survey will be connected by third-order leveling to the National Geodetic Vertical Datum of 1929 in accordance with the Standards and Specifications for Geodetic Control Networks (Federal Geodetic Control Committee 1984). All elements surveyed will have an accuracy of at least 0.3 cm (0.01 foot). Specific projects may require greater accuracy.

4.3.2.3.12.3 Field data

The topographic survey will be completed as near as possible to the time when the last monitoring well is installed at the AOC site. Survey field data (as corrected), to include loop closures and other statistical data in accordance with the standards and specifications referenced above, will be provided to the U.S. Army Project Manager. Closure will be within the horizontal and vertical limits referenced above. The following data will be clearly listed in tabular form: coordinates (and system) and elevation (ground surface and top of well) as appropriate, for all boreholes, wells, and reference marks. All permanent and semipermanent reference marks used for horizontal and vertical control (i.e., benchmarks, caps, plates, chiseled cuts, rail spikes, etc.) will be described in terms of their name, character, physical location, and reference value.

4.3.2.3.13 Alignment testing

Alignment tests will be conducted on each monitoring well installed during the AOC-specific investigations. This testing will be conducted to ensure that deformation and/or bending of the PVC well casing and screen is minimal. The testing will be performed using a pump or bailer with a diameter no less than 2.5 cm (1.0 inch) smaller than the well casing and screen diameter. A nylon rope will be attached to the pump/bailer, and the unit will be lowered to the bottom of the well and retrieved. The alignment test will be considered successful if the pump/bailer can be lowered and retrieved without bridging within the well. If a monitoring well fails an alignment test as described, the well will be abandoned in accordance with Section 4.3.2.5 of the FSAP.

4.3.2.4 Documentation

4.3.2.4.1 Logs and well installation diagrams

4.3.2.4.1.1 Boring logs

Each borehole log generated during the AOC-specific investigations will fully describe the subsurface environment and the procedures used to gain that description. All borehole data will be recorded in the field by the site geologist on Engineer Form 5056-R and 5056A-R (Figure 4-7). A scale of 2.5 cm (1.0-inch) on the log equaling 0.3 m (1.0 foot) of borehole will be used during borehole log preparation. Each original borehole log will be submitted to the U.S. Army Project Manager, along with the corresponding original well construction diagram, as soon as the field effort has been completed. Original borehole logs and well construction diagrams will be of sufficient legibility and contrast so as to provide comparable quality in reproduction and will be recorded directly in the field without transcribing from a field book or other document.

HTRW DRILLING LOG	DISTRICT		HOLE NUMBER
1. COMPANY NAME	2. DRILL SUBCONTRACTOR		SHEET OF SHEETS
3. PROJECT		4. LOCATION	
5. NAME OF DRILLER		6. MANUFACTURER'S DESIGNATION OF DRILL	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT		8. HOLE LOCATION	
		9. SURFACE ELEVATION	
		10. DATE STARTED	11. DATE COMPLETED
12. OVERBURDEN THICKNESS		15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK		16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE		17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES			
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR		

LOCATION SKETCH/COMMENTS SCALE:

PROJECT	HOLE NO.

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

Figure 4-7. Engineer Forms 5056-R and 5056A-R for Borehole Logging

HTRW DRILLING LOG

HOLE NUMBER
PROJECT	INSPECTOR	SHEET OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)

PROJECT

HOLE NO.

Figure 4-7 (continued)

All borehole logs generated during the AOC-specific investigations will routinely contain the following information:

- Unique borehole/monitoring well number and location denoted on a sketch map as part of the log.

- Depths or heights recorded in feet and decimal fractions thereof (tenths of feet).

- Field estimates of soil classification (USCS) in accordance with the Annual Book of ASTM Standards, Volume 04.08, D 2488 (ASTM 1995) prepared in the field at the time of sampling by the site geologist.

- Full description of each soil sample collected, including the parameters noted in Table 4-2.

Table 4-2. Soil and Rock Parameters to be Recorded on Borehole Logs

Soil Parameters	Rock Parameters
USCS Classification	Rock type
Depositional environment and formation, if known	Formation
ASTM D 2488 group symbol	Modifier denoting variety
Secondary components and estimated percentages	Bedding/banding characteristics
Color (using Munsell Soil or GSA Rock Color Chart). Give both narrative and numerical description and note which chart was used.	Color (same as for soil)
	Hardness
	Degree of cementation
Plasticity	Texture
Consistency (cohesive soil; very soft, soft, medium stiff, stiff, very stiff, hard)	Structure of orientation
Density (noncohesive soil, loose, medium dense, dense, very dense)	Degree of weathering
Moisture content in relative terms: Dry – crumbly Damp – between crumbly and plastic limit Moist – between plastic limit and liquid limit Wet – greater than liquid limit Saturated – runny, all voids filled with water	Solution or void conditions
Structure and orientation	Primary and secondary permeability, include estimates and rationale
Grain angularity	Lost core interval and reason for loss

ASTM = American Society for Testing and Materials.
GSA = Geological Society of America.

- Visual numeric estimates of secondary soil constituents and quantitative definitions of description terms (i.e., trace, some, several, etc.) recorded on the log.

- Full description, to the greatest extent practical, of bedrock material encountered, including the parameters noted in Table 4-2.

- Description of disturbed samples (if used to supplement subsurface description) in terms of the appropriate soil/rock parameter, to the extent practical. At a minimum, classification along with a description of drill action for the corresponding depth will be recorded. Notations will be made on the log that these descriptions are based on observations of disturbed material rather than intact samples.

- Description of drilling equipment, including such information as auger size (inner and outer diameter), bit types, compressor type, rig manufacturer, and model.

- Sequence of drilling activities.

- Any special problems encountered during drilling and their resolution.

- Dates and times for the start and completion of the borehole along with notation by depth for drill crew shifts and individual days.

- Each sequential boundary between various soil types and individual lithologies.

- The depth of first-encountered free water along with the method of determination and any subsequent distinct water level(s) encountered thereafter. Before proceeding, the first encountered water will be allowed to partially stabilize (from 5 to 10 minutes) and recorded along with the time between measurements.

- Interval by depth for each sample collected, including the length of sampled interval, length of sample recovery, and the sampler type and size (diameter and length).

- Total depth of drilling and sampling.

- Results of soil core organic vapor scan readings and soil sample organic vapor headspace readings. Notation will include interval sampled, corresponding vapor readings, and key to the specific instrument used to obtain readings. A general note will be made on the log indicating the manufacturer, model, serial number, and calibration information for each instrument used.

- Definition of any special abbreviations used at the first occurrence of their usage.

In addition to the original borehole logs prepared for each AOC-specific investigation, the contractor will also create an electronic geological database. Information will be entered into this database in accordance with the USACE-Louisville District Data Standards for Environmental Restoration Sites (Appendix A). Information required to complete the database that is not recorded on original borehole logs will be recorded in the project logbook. The geological database will be submitted to the U.S. Army Project Manager in ASCII format.

4.3.2.4.1.2 Well construction diagrams

Each monitoring well installed during the AOC-specific investigations will be depicted in an as-built well construction diagram (Figure 4.8). Each diagram will be attached to the original borehole log for that installation and will graphically denote, by depth from the ground surface, the following information:

- location of the borehole bottom and borehole diameter(s);
- location of the well screen;
- location of any joints;
- location of the granular filter pack;
- location of the bentonite seal;
- location of grout;
- location of centralizers;
- height of riser (stickup), without cap/plug, above the ground surface;

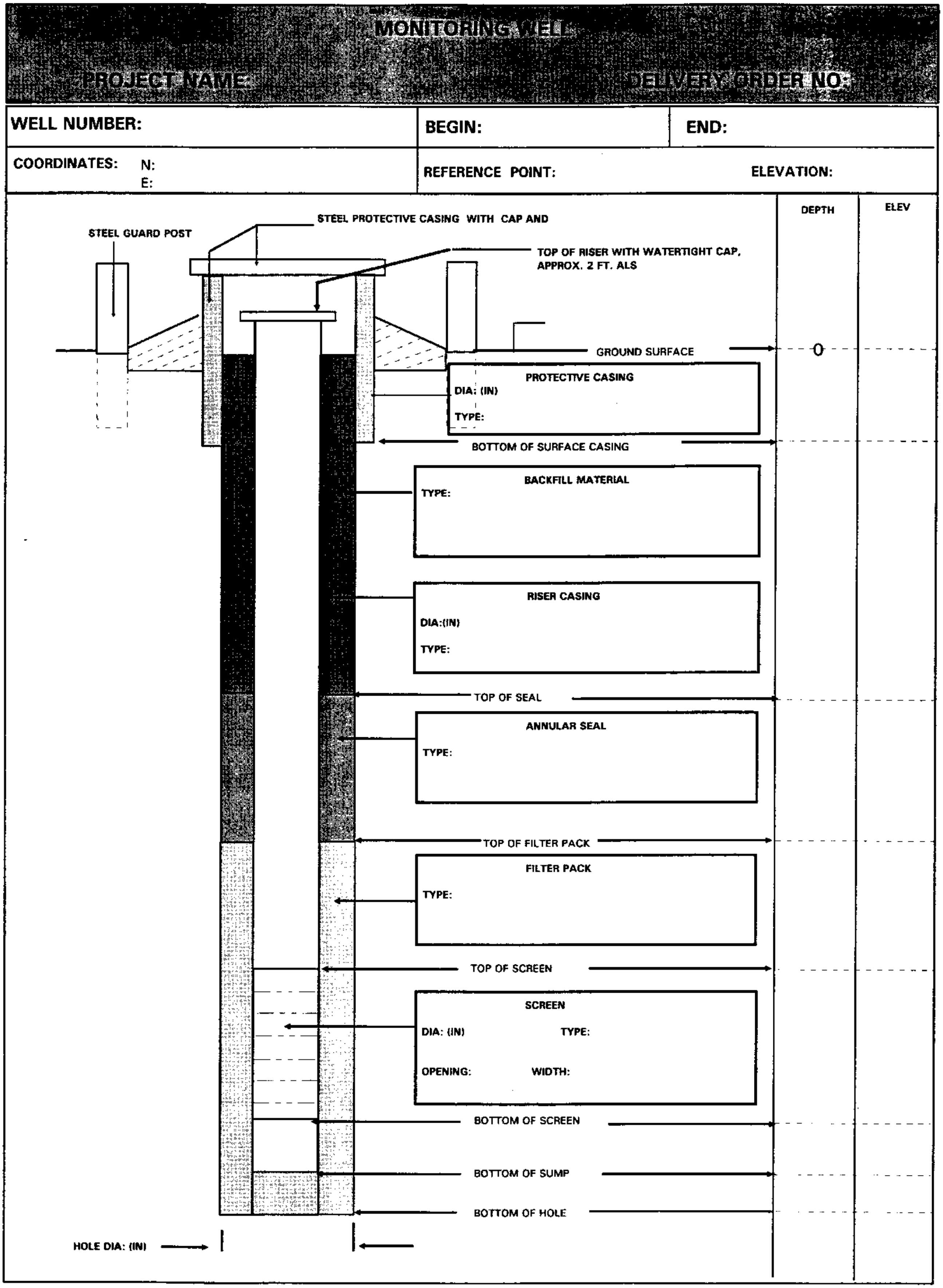

Figure 4.8. Example of Well Construction Diagram Used in Logbooks

- height of the protective casing, without cap/cover, above the ground surface;
- depth of protective casing base below the ground surface;
- location and size of drainage port;
- location of the internal mortar collar;
- sloped concrete pad height and diameter;
- protective post configuration; and
- water level 24 hours after completion of installation with date and time of measurement.

Additional information to be described on each as-built well construction diagram will include the following:

- actual quantity and composition of the grout, bentonite seal, and granular filter pack used for construction of the monitoring well;

- the screen slot size in inches, slot configuration, total open area per foot of screen, outside diameter; nominal inside diameter, schedule/thickness, composition, and manufacturer;

- type of material located between the bottom of the borehole and the bottom of the screen;

- the outside diameter, nominal inside diameter, schedule/thickness, composition, and manufacturer of the well casing;

- the joint design and composition;

- the design and composition and centralizers;

- depth and description of any permanent pump or sampling device installed within the monitoring well;

- the composition and nominal inside diameter of protective casing;

- any special problems encountered during well construction and their resolution;

- dates and times for the start and completion of monitoring well installation; and

- definition of any special abbreviations used at the first occurrence of their usage.

Each original well construction diagram will be submitted to the U.S. Army Project Manager as soon as the field effort has been completed. Each diagram will be attached to the corresponding original borehole log for that location. In addition to the original well construction diagrams prepared for each AOC-specific investigation, the Contractor will also enter well information into the electronic geological database in accordance with the USACE-Louisville District Data Standards for Environmental Restoration Sites (Appendix A). Information required to complete the database that is not recorded on original well construction diagrams will be recorded in the project logbook.

4.3.2.4.2 Development record

For each monitoring well developed during the AOC-specific investigations, a record will be prepared to include the following information:

- project name and location;

- well designation and location;
- date(s) and time(s) of monitoring well installation;
- date(s) and time(s) of monitoring well development;
- static water level from top of well casing before and 24 hours after completion of well development with dates and times of measurements;
- quantity of water lost during drilling, removed before well insertion, and added during granular filter placement;
- quantity of standing water contained with the well, and contained within the saturated annulus (assuming 30 percent porosity), before well development;
- field readings of pH, conductivity, turbidity, and temperature measured before, twice during, and after completion of well development using an appropriate device and method in accordance with EPA Procedure 600/4-79-020 (see Section 4.3.3 of this FSP for description of instrument and procedure to the utilized for field measurements);
- depth from top of well casing to bottom of well;
- length of the well screen;
- depth from top of the well casing to the top of sediment inside the well, both before and after development, as measured directly at the time of development;
- physical character of the removed water, including changes during development in clarity, color, particulates, and any noted odor;
- type and size/capacity of the bailer or pump used for development;
- description of the surge technique used during development;
- height of the well casing above ground surface as measured directly at the time of development;
- estimated recharge rate into the well at the time of development; and
- quantity of water removed from the well during the development operation and the time for removal, present as both incremental and total values).

4.3.2.4.3 Photographs

For each photograph taken during the AOC-specific investigations, the following items will be noted in the field logbook:

- date and time,
- photographer (name and signature),
- name of the AOC site,

- general direction faced and description of the subject taken, and
- sequential number of the photograph and the roll number.

Photographs taken to document sampling points will include two or more permanent reference points within the photograph to facilitate relocating the point at a later date. In addition to the information recorded in the field logbook, one or more site photograph reference maps will be prepared as required. An example of this map type is presented in Figure 4-9.

4.3.2.5 Well abandonment

Abandonment of monitoring wells and soil boreholes during the AOC-specific investigations will be conducted in a manner precluding any current or subsequent fluid media from entering or migrating within the subsurface environment along the axis or from the endpoint of the well/borehole. Abandonment will be accomplished by filling the entire volume of the well/borehole with grout composed of Type I portland cement, 6 pounds dry bentonite per 42.6-kilogram (94-pound) sack of dry cement, and a maximum of 0.02 to 0.03 m^3 (6 to 7 gallons) of approved water per sack of cement.

The abandonment of each well/borehole will follow field procedures outlined in Chapter 9 of Ohio EPA's *Technical Guidance Manual for Hydrogeologic Investigations and Ground Water Monitoring* (Ohio EPA 1995). Well abandonment will include removal of casing and screen, overdrilling of the well borehole, and grouting to the surface.

For each abandoned well/borehole, a record will be prepared and submitted to U.S. Army Project Manager including the following information:

- project and well/borehole designation;
- location with respect to the replacement well or borehole (if any);
- open depth of well/borehole before grouting;
- casing or items left in borehole by depth, description, composition, and size (if applicable);
- copy of the borehole log;
- copy of construction diagram for abandoned well (if applicable);
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting;
- water or mud level prior to grouting and date measured; and
- remaining casing above ground surface: type (well, drill, protective), height above ground, size, and composition of each (if applicable).

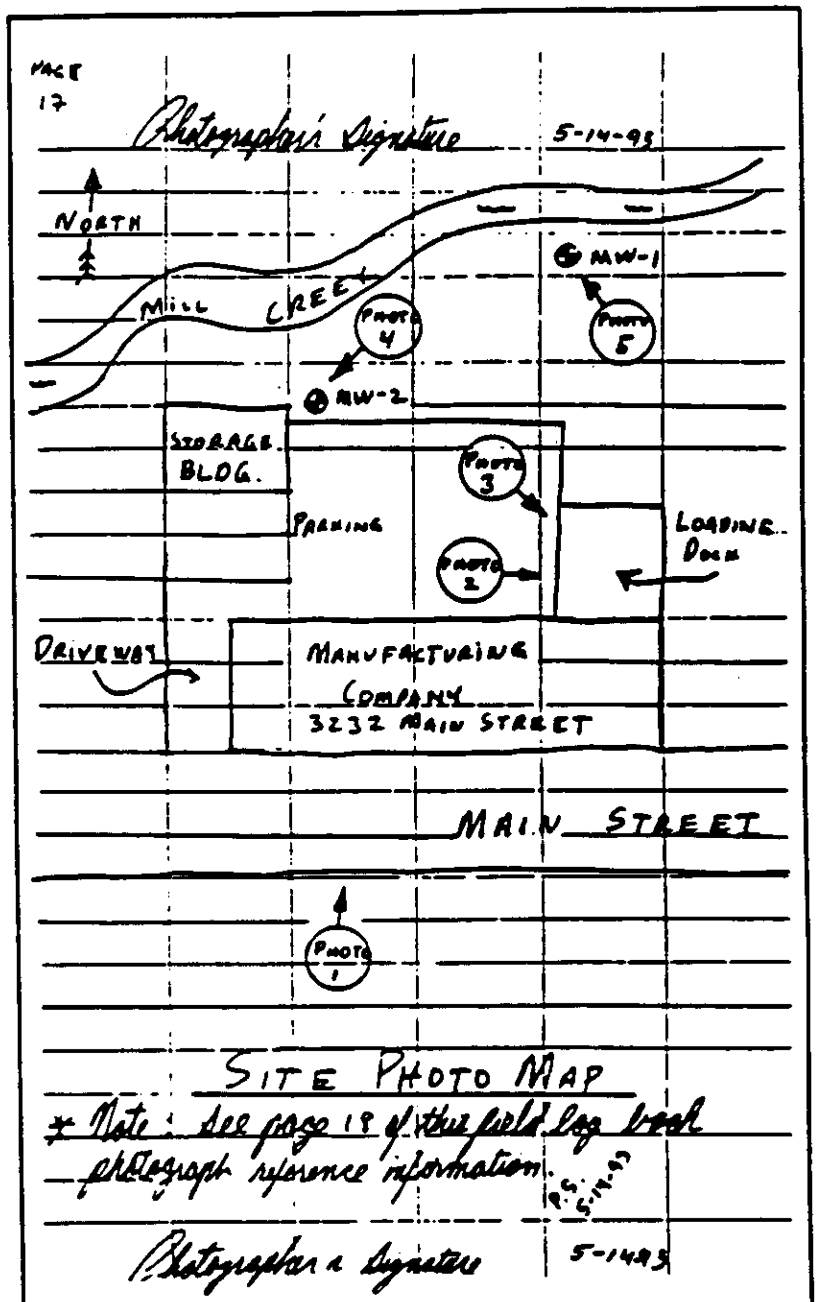

Figure 4-9. Example of the Photograph Map to be Recorded in Field Logbooks

All depths reported in the borehole abandonment record will be designated in feet from ground surface. Original borehole abandonment records will be submitted to the U.S. Army Project Manager. Any replacement wells/boreholes installed during the AOC-specific investigations will be offset at least 6.0 m (20.0 feet) from any abandoned site in a presumed upgradient or cross-gradient groundwater direction.

4.3.2.6 Water level measurement

Measurement of one complete set of initial static groundwater levels within all monitoring wells located at any given AOC site will be made over a single, consecutive 10 to 12-hour period at least 24 hours after development and sampling of the monitoring wells. The depth to groundwater will be measured and recorded to the nearest 0.3 cm (0.01 foot). Measurements will be made from a notch filed into the solid well casing and will not be referenced to the rim of the protective casing. The point on the well casing will be surveyed for vertical control. All measured groundwater level data will be presented in subsequent reports in tabular form, which will include: (1) well location; (2) total depth; (3) top of casing elevation; (4) measure water depth; and (5) groundwater elevation. Groundwater elevation data will be contoured to denote flow directions and gradients provided that sufficient data points exist.

4.3.3 Field Measurement Procedures and Criteria

Groundwater field measurements to be performed during the AOC-specific investigations will include determination of static water level, pH, conductivity, dissolved oxygen concentration, and temperature. A description of each field instrument and associated calibration requirements and performance checks to be used for field measurements is presented in Table 4-3. A summary of the procedures and criteria to be used for field measurements is presented below.

Table 4-3. Summary of Field Instruments and Calibration/Performance Requirements for RVAAP AOC-Specific Investigations

Instrument and Use	Calibration	Performance
Solinst Water Level Meter, used for determination of static water level	Calibrated by manufacturer	± 0.01 feet
HyDAC Conductivity – Temp.-pH Tester, used for determination of groundwater pH	2 points using pH 4.0 and 7.0 standard solutions on a daily basis	± 0.1 units
HyDAC Conductivity – Temp. – pH Tester, used for determination of groundwater conductivity	1 point using 0.01 m KCL standard solution on a daily basis	± µmhos/cm
Mercury thermometer, used for determination of groundwater temperature	Calibration by manufacturer	± 1°C
HNu HW-101 PID, used for determination of organic vapor concentrations emitted from subsurface soil material	1 point using 100 ppm isobutylene calibration gas on a daily basis	± 0.1 ppm

KCL = potassium chloride (solution)
PID = photoionization detector
ppm = parts per million

4.3.3.1 Static water level

Static water level measurements will be made using an electronic water level indicator. Initially, the indicator probe will be lowered into each monitoring well without touching the probe to the well casing until the alarm sounds and/or the indicator light illuminates. The probe will then be withdrawn several feet and slowly lowered again until the groundwater surface is contacted as noted by the alarm and/or indicator light. All probe cords used for measurement will be incrementally marked at 0.006-meter

(0.02-feet) intervals. Water level measurements will be estimated to the nearest 0.003 m (0.01 feet) based on the difference between the nearest probe cord mark to the top of the well casing.

The distance between the top of casing and the groundwater surface will be recorded to within 0.3 cm (0.01 foot). The static water level measurement procedure will be repeated two or three times to ensure that the water level measurements are consistent (± 0.3 cm or 0.01 foot). If this is the case, then the first measured level will be recorded as the depth to groundwater. If this is not the case, the procedure will be repeated until consistent readings are obtained from three consecutive measurements.

4.3.3.2 pH, conductivity, dissolved oxygen, and temperature

pH, conductivity, dissolved oxygen, and temperature measurements will be made using a combination meter designed to measure these parameters. A groundwater sample will be retrieved from each monitoring well and immediately poured into a clean container placed onto a stable surface at the well. With the combination meter set in the appropriate mode, the meter electrode will be swirled at a slow constant rate within the sample until the meter reading reaches equilibrium.

Sample pH will be recorded to the nearest 0.1 pH unit. The pH measurement is considered stable when 3 consecutive readings produce less than 0.2 pH units variation. All recorded conductivity values will be converted to conductance at 25 ºC. Sample conductivity will be recorded to the nearest 10 μmhos/cm, and the temperature to the nearest 0.1 ºC, with stable measurements consisting of less than 10 percent variation for conductance and less than 0.5 ºC variation for temperature. Dissolved oxygen content will be recorded to the nearest 0.01 mg/L. Dissolved oxygen readings will be considered stable when three consecutive readings produce less than 10 percent variation.

4.3.4 Sampling Methods for Groundwater – General

USACE guidance in EM-1110-1-4000 (USACE 1994) recommends that well development be completed at least 14 days prior to sampling. This hiatus theoretically allows time for the chemical equilibrium between the aquifer and the filter pack to be established. However, this rule of thumb is unsubstantiated by scientific data. If a different duration is proposed, based on technical data or overall project considerations, it should be used as deemed appropriate, and such proposal should be included in the site-specific addendum to this FSAP.

Collection of groundwater samples from monitoring wells during the AOC-specific investigations will involve three general steps: (1) measurement of field parameters, (2) well purging, and (3) groundwater sample collection. All of the activities would normally be accomplished within a 2- to 4-hour period per monitoring well. Procedures and criteria for the measurement of field parameter were previously discussed in Section 4.3.3 of this FSAP. Purging and sampling of monitoring wells will be accomplished using either a Teflon® or stainless steel bailer or a bladder or peristaltic pump. If it is necessary to sample an existing monitoring well, the integrity of the well will be checked prior to purging. Alignment testing is recommended to ensure that the well has not been obstructed or otherwise damaged since the previous sampling event. The integrity of the well will be checked by visual inspection of the surface casing and riser pipe, and by performing an alignment test in accordance with Section 4.3.2.3.13 of the FSAP. In the event that the monitoring well is questionable, the well will not be purged and sampled. If required, a new well will be installed as directed by the U.S. Army Project Manager.

4.3.4.1 Conventional well purging

After initial measurement of field parameters, purging of each monitoring well will commence until pH, conductivity, dissolved oxygen concentration, and temperature have reached equilibrium as described in

Section 4.3.3.2. Equilibrium will be established by three consecutive readings, where one well casing volume is purged between each reading. However, purging will be terminated before establishment of equilibrium if one of the following conditions is met: (1) five well volumes, including the saturated filter pack assuming a porosity of 30%, have been removed from the well; or (2) the well is purged to dryness. Each bailer used for purging/sampling will be equipped with a nylon retrieval cord that will be properly discarded upon completion of the purging and sampling activities. Each bladder pump used for purging/sampling will be equipped with a Teflon®-coated retrieval wire that will be decontaminated upon completion of the purging and sampling activities.

If a monitoring well is purged to dryness, sampling will be delayed for a time period of up to 24 hours to allow for recharge. During the delay period, the atmosphere of the well will be isolated to the greatest extent possible from the surface atmosphere. Upon sufficient recharge of groundwater into the well, i.e., if the well recharges to 90% of its initial water level within 4 hours, a sample will be collected without additional well purging. If sufficient well recharge does not occur within 24 hours after the initial purging, the U.S. Army Project Manager will be contacted for guidance.

4.3.4.2 Micro-purging

In order to minimize the quantity of liquid IDW generated as a result of well purging, wells will be micro-purged where conditions permit, in accordance with Ohio EPA technical guidance (1995), as follows:

- A bladder or submersible pump will be used for purging;
- The purge rate will not exceed 100 mL/minute unless it can be shown that higher rates will not disturb the stagnant water column above the well screen (i.e., will not result in drawdown);
- The volume purged will be either two pump and tubing volumes or a volume established through in-line monitoring and stabilization of water quality parameters such as dissolved oxygen and specific conductance; and
- Sample collection shall occur immediately after micro-purging.

When micro-purging cannot be accomplished for any reason, then purging of all monitoring wells in the AOC will be conducted in accordance with the procedures for conventional purging described above.

Sampling of the monitoring well will begin immediately after purging. When a bailer is used, the device will be lowered slowly until it contacts the groundwater surface, allowed to sink and fill with a minimum of surface disturbance, and raised slowly to the surface. The sample will then be transferred to appropriate sample bottles by tipping the bailer so that a slow discharge of sample from the bailer top flows gently down the side of the sample bottle with minimum entry disturbance. Bottles designated for volatile organic analysis will be filled first and in a manner so that no headspace remains. Immediately after collection of each sample and completion of bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed in an ice-filled cooler to ensure preservation.

When a bladder pump is used, the device will be lowered slowly until it contacts the groundwater surface, and then will continue to be lowered until the pump intake is located at the midpoint of the monitoring well screen. The pump will then be activated and allowed to operate until a steady flow of groundwater is expelled from the Teflon® return line at the ground surface. The discharge line will not be allowed to touch any part of the interior of the sample container or the sample matrix within the container. The sample will be collected and preserved in the same manner as described above. Details regarding the general groundwater sampling methods to be used for investigations will be presented in the AOC-specific investigation addenda to the FSAP.

4.3.5 Sampling Methods for Groundwater – Filtration

The method used for collection of filtered groundwater samples from monitoring wells will depend on whether a bailer or bladder pump is used for the sample collection. Regardless of which of the two sampling devices is used, the measurement of field parameters and purging of the well will be conducted in the same manner as described in Section 4.3.4 of this FSAP.

When a bailer is used for groundwater sampling, the device will be lowered into the monitoring well, filled with groundwater, and raised to the surface. The collected sample will then be slowly poured into a decontaminated holding vessel. The groundwater sample will be filtered using a hand-operated pump equipped with Teflon® intake and discharge tubing. A disposable, pre-sterilized 0.45-μm pore size filter assembly will be attached to the end of the Teflon® discharge tubing. The Teflon® intake tubing will be placed into the holding vessel and the groundwater sample will be pumped through the tubing and disposable filter. Sample bottles will be filled with discharge exiting the disposable filter. Filters will be replaced as they become restricted by solids buildup, and between sample collection sites. Immediately after collection of the sample and completion of bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed in an ice-filled cooler to ensure preservation.

When a bladder pump is used for groundwater sampling, a disposable, pre-sterilized 0.45-μm pore size filter will be attached to the end of the pump's Teflon® return line. After the pump has been placed into the monitoring well, groundwater will be pumped through the tubing and disposable filter. During this flushing operation, the pumping rate will be adjusted as necessary to minimize turbulence. After flushing of the system has been completed, sample bottles will be filled with discharge exiting the disposable filter. The sample bottles will be packaged and preserved in the same manner as described above. The disposable filters used for collection of filtered groundwater samples will be discarded after each use.

4.3.6 Sample Containers and Preservation Techniques

Information regarding sample containers and preservation techniques for groundwater samples collected for chemical analyses during the AOC-specific investigations is presented in Section 4.0 of the QAPP portion of this FSAP. All sample containers will be provided by contracted laboratories, who will place into the containers or provide separately the required types and quantities of chemical preservatives. With regard to temperature preservation, all groundwater sample containers will be stored at 4 °C (± 2°C) immediately after sample collection and will be maintained at this temperature until the samples are received at the contracted laboratory.

4.3.7 Field Quality Control Sampling Procedures

Generally, three different types of QA/QC samples will be collected during performance of the AOC-specific investigation groundwater sampling activities. These sample types will be duplicates, equipment rinsate blanks, and trip blanks. QC samples collected will be sent to the contracted laboratory to provide data for use in determining the quality of the analytical results reported for the associated environmental samples. QA samples collected will be sent to a U.S. Army QA laboratory for independent analysis and evaluation of analytical results reported by the contracted laboratory.

A duplicate sample is collected along with a field sample at the same sampling location and is placed into a separate container labeled with a unique sample number. The duplicate is submitted as "blind" to the laboratory and is used to determine whether the field sampling technique is reproducible and to check the accuracy of reported laboratory results. Duplicate groundwater samples will be collected during the AOC-specific investigations using the same procedures defined for field groundwater samples as discussed in Sections 4.3.4 and 4.3.5 of this FSAP. Information regarding the total number, collection frequency, and analytical parameter for duplicate samples will be defined in the AOC-specific addenda to the FSAP. However, it is anticipated that the number of duplicate samples will represent 10% of the total number of field samples collected for each AOC-specific investigation. This applies also to matrix spike/matrix spike duplicates (MS/MSDs), as discussed in Section 8.0 of the Facility-wide QAPP.

An equipment rinsate blank is collected in the field from the final decontamination water rinse of field sampling equipment. The rinsate blank is used to determine the effectiveness of the decontamination process in avoiding carryover of contamination from one sampling location to the next. A rinsate blank will be collected from the device used to collect groundwater samples from monitoring wells after it has undergone decontamination. Upon completion of the decontamination procedure, ASTM Type I or equivalent water will be poured over and through the device and collected directly into appropriate sample containers. Information regarding the total number, collection frequency, and analytical parameter for equipment rinsate blanks will be defined in the AOC-specific addenda to the FSAP. Typically, rinsate blanks are collected at a frequency of 10 percent or one per day per matrix. When dedicated sampling equipment is used, equipment rinstate blanks are not required. AOC-specific addenda to the QAPP will list any equipment rinsates to be collected.

A trip blank consists of a sealed container of ASTM Type I or equivalent water that travels from the field to the laboratory with field samples to be analyzed for volatile organic compounds. The trip blank receives the same treatment as field sample containers and is used to identify contamination that may have been contributed to the field samples during transport. Trip blanks will be prepared by the contracted laboratory and shipped with sample bottles to be used for collection of field, duplicate, and rinsate samples. Therefore, no sampling procedures are applicable to these blanks. One trip blank will be placed into each cooler used to transport groundwater samples designated for volatile organic compound analysis. Information regarding the total number and analytical parameter for trip blanks will be defined in the AOC-specific addenda to the QAPP. Typically, one trip blank is collected per day per matrix, when volatile organic compounds are analyzed (the AOC-specific addendum will specify exceptions).

4.3.8 Decontamination Procedures

Decontamination of nondedicated equipment used for static water level measurement and for the development and purging of monitoring wells and collection of groundwater samples during the AOC-specific investigations will be conducted within a temporary decontamination pad to be constructed at each decontamination site. The decontamination pad will be designed so that all decontamination liquids are contained from the surrounding environment and can be recovered for disposal as IDW. Nondedicated equipment will be decontaminated after the development of each well and again after purging and sampling of each well. The procedure for decontamination of equipment will be as follows:

1. Wash with approved water and phosphate-free detergent using various types of brushes required to remove particulate matter and surface films.

2. Rinse thoroughly with approved potable water.

3. Rinse thoroughly with ASTM Type I or equivalent water.

4. Rinse thoroughly with methanol.

5. Rinse thoroughly with ASTM Type I or equivalent water.

6. Rinse thoroughly with hydrochloric acid (2% solution).

7. Rinse thoroughly with ASTM Type I or equivalent water.

8. Allow equipment to air dry as long as possible.

9. Place equipment on clean plastic if immediate use is anticipated or wrap in aluminum foil to prevent contamination if longer-term storage is required.

In addition to the well development and sampling equipment, field measurement instruments will also be decontaminated between monitoring well locations. Only those portions of each instrument that come into contact with potentially contaminated environmental media will be decontaminated. Due to the delicate nature of these instruments, the decontamination procedure will only involve initial rinsing of the instruments with approved water, followed by a final rinse using ASTM Type I or equivalent water. Decontamination of non-dedicated bladder pumps and other equipment with stainless steel components will be accomplished using only steps 1 through 4 above.

4.4 SUBSURFACE SOIL

4.4.1 Rationales

As defined in Section 3.0 of this FSAP, AOC-specific investigation addenda to the FSAP will be developed for the purpose of identifying unique elements of each investigation not addressed in the FSAP. Therefore, rationales related to soil borehole locations, discrete or composite soil sampling requirements, sample collection, field and laboratory analyses, determination of background values, and QA/QC sample collection and frequency will be addressed within each of the AOC investigation addenda as appropriate.

4.4.2 Procedures

4.4.2.1 Drilling Methods

4.4.2.1.1 Equipment condition and cleaning

The condition of all drilling, trenching, sampling, and support equipment used for subsurface soil sampling associated with each AOC-specific investigation and the equipment cleaning procedures will be the same as defined in Section 4.3.2.1.1 of this FSAP. Additional information regarding the decontamination of drilling and sampling equipment used for soil sample collection is presented in Section 4.4.2.8 of this FSAP.

4.4.2.1.2 Hollow stem auger drilling method

The hollow stem auger drilling method is to be used during the AOC-specific investigations for drilling of subsurface soil boreholes from which soil samples are to be collected for physical and/or chemical analyses. This method will be implemented as a dry drilling method for the investigations. The standard equipment used for borehole drilling will be 15.2 to 16.5 cm (6.0 to 6.5 inches) in outside diameter hollow stem auger. Information regarding the methods and equipment to be used for collection of subsurface soil samples from boreholes drilled using the hollow stem auger method is presented in Sections 4.4.2.4 and 4.4.2.5 of this FSAP.

Soil drilling using the hollow stem auger method will be accomplished using a truck-mounted auger rig of sufficient size and power to advance augers to the required drilling depth. The total depth of each subsurface borehole will be dictated by the target depth(s) for sampling and will be contingent upon the constraints of the maximum drilling depth for boreholes defined by the U.S. Army for each AOC-specific investigation. A discussion of these constraints will be presented in the AOC-specific investigation addenda to the FSAP.

4.4.2.1.3 Trenching method

The trenching method is anticipated to be used to collect subsurface soil samples and examine buried waste materials to characterize landfills during AOC-specific investigations. Authorization under OAC 3745-27-13 (Rule 13), as presented in Appendix B of the FSAP, must be granted by the Ohio EPA prior to commencement of any trenching activities. Further, it must be determined, to the extent practical, prior to trenching that no potential exists for unexploded ordnance and that adequate provisions for worker health and safety are addressed in the AOC-specific SSHP. Groundwater elevation must be known, and concurrence from Ohio EPA must be obtained before trenching begins.

The depth interval over which material will be collected using this method is expected to be limited to the interval located from the land surface (after removal of surface debris) to a depth of 4.5 m (15.0 feet) bgs. However, trenches will not be excavated below the local groundwater table to avoid the potential for contaminating groundwater and the hazard of collapse caused by digging into saturated material. Trenching will be stopped at the first indication of groundwater, and the trench will be immediately backfilled with at least 0.6 m (2 feet) of material. In the event that subsurface soil samples are required to be collected at depths greater than 4.5 m (15.0 feet), or below the local groundwater table, these samples will be obtained using the hollow stem auger drilling method.

Trenches will be excavated using a backhoe or other type of excavation equipment (i.e., clam shell, trench excavator, etc.). Soil material in each trench will be removed in layers measuring approximately 0.6 to 0.9 m (2.0 to 3.0 feet) in thickness. Soil will be removed in this fashion until the trench has been excavated to the required depth designated for the sampling location. The total depth of each trench will be dictated by the target depth(s) for sampling and will be contingent upon the depth of groundwater constraints of the maximum excavation depth for trenches defined by the U.S. Army for each AOC-specific investigation.

Under no circumstances will project personnel enter trenches deeper than 1.22 m (4 feet) unless sloping and/or benching is provided as discussed in the FSHP.

All soil and solid waste removed from trenches will be placed beside each trench on plastic sheeting and segregated by the layers in which it was excavated, if necessary, so that potentially hazardous materials are not commingled with non-hazardous materials. Segregation of the materials by layers will also allow for placement of the material back into the trench in the position that it was excavated. All soil and buried materials, except for materials determined to be hazardous, will be returned to the excavation of its origin immediately after each trench is completed. Any hazardous material encountered will not be placed back into the excavation, but will be containerized for treatment, storage, and disposal in accordance with Section 7 of the FSAP and the AOC-specific investigation SAP addendum. If as a result of trenching operations a release of contamination occurs, corrective measures will be initiated immediately to abate the release.

A discussion of these constraints and the equipment to be used for trench excavation will be presented in the AOC-specific investigation addenda to the FSAP.

4.4.2.1.4 Bucket hand auger method

The bucket hand auger method is a third method to be used during the AOC-specific investigations for collection of subsurface soil samples. This method will be implemented in the same manner as described in Section 4.5.2.1.1 of this FSAP.

4.4.2.1.5 Hydraulic direct-push method

Subsurface soil samples may also be collected by means of hydraulic direct-push samplers (e.g., Geoprobe). The hydraulic device may be used where continuous shallow-subsurface lithologic and stratigraphic information is needed in order to characterize an AOC. It may be used to advance Shelby tubes for the collection of undisturbed geotechnical samples. In some circumstances, it may be used to collect discrete or composite samples for chemical analyses. The standard equipment for subsurface sample collection will be a 5-cm (2-inch) outside-diameter macro-core sampling device, advanced using 2.54-cm (1-inch)-diameter steel rods attached to the hydraulic device. Each macro-core section is approximately 1.22 m (4 feet) long. The borehole is advanced by attaching additional lengths of extension rod to the macro-core barrel and pushing the entire pipe string downward. The macro-core sampler may be fitted with a clear acetate sleeve for ease of retrieving samples.

Hydraulic-push borings will be created using a truck-mounted hydraulic system of sufficient size and power to advance the macro-core to the required depth. The total depth of each borehole will be determined by the target depth(s) for sampling for each AOC. These parameters will be discussed in the AOC-specific addendum to this FSAP.

4.4.2.2 Boring logs

Information regarding the preparation and contents of borehole logs for the AOC-specific investigations is presented in Section 4.3.2.4.1.1 of this FSAP.

4.4.2.3 Field Measurement Procedures and Criteria

Field measurements to be performed on subsurface soil samples during the AOC-specific investigations may include determination of volatile organic headspace gas concentrations, field screening for the presence of TNT and other explosives, and field determinations of metals concentrations.

A description of the field instrument and associated calibration requirements and performance checks to be used for headspace gas measurements is presented in Table 4-3. Headspace gas concentration measurements will be made using a field organic vapor analyzer. Each soil sample collected from an investigation borehole will be placed into a glass jar, leaving some air space, and the jar will be covered with plastic cling wrap or aluminum foil to create an air-tight seal. The sample will then be immediately placed into an empty cooler and allowed to volatilize for a minimum of 15 minutes. The sealed jar will then be punctured with the organic vapor analyzer probe and headspace gas will be drawn until the meter reading is stable. The concentration of the headspace gas will be recorded to the nearest 0.1 part per million. All soil samples utilized for field measurements will be allowed to volatilize for an equal period of time before screening.

Field screening for explosives will be performed using RVAAP's Standard Operating Procedure (SOP) for Field Colorimetry Determination of Explosives in Soils. Field screening for metals will be conducted with the X-ray fluorescence (XRF) method detailed in RVAAP's SOP for XRF Determination of Metals Concentrations in Soils.

4.4.2.4 Sampling for physical/geotechnical analyses

4.4.2.4.1 Hollow stem auger drilling method

Soil samples designated for physical and geotechnical analyses will be collected from AOC investigation boreholes using a thin-walled (Shelby) tube sampler device. Samples will be collected using this device as part of hollow stem auger drilling of boreholes. The size (both diameter and length) of the Shelby tube sampler to be used, and the intervals over which soil samples will be collected will be defined in the AOC-specific investigation addenda to the FSAP.

During the drilling of investigation boreholes, the lead hollow stem auger will be advanced to the top of the soil interval to be sampled. The Shelby tube sampler will then be inserted into the auger string and hydraulically pushed to the bottom of the soil interval to be sampled. Upon retrieval of the sampler, the percentage of recovery will be recorded and the ends of the sampler will be sealed with wax or rubber packers to preserve moisture content. The preparation of Shelby tube samplers for shipment will be conducted in accordance with ASTM Method K1587-83.

4.4.2.4.2 Trenching and bucket hand auger methods

Subsurface soil samples collected using the trenching or bucket hand auger methods would be classified as disturbed sample types. Therefore, physical and geotechnical analyses of samples collected using these methods would be limited to those analyses for disturbed samples (i.e., grain size, Atterberg limits, moisture content, etc.). Samples collected using these methods would not be utilized for the determination of in-situ permeability values.

A sample will be collected from the required depth using either trench excavation equipment or a bucket hand auger as described in Section 4.4.2.1.3 or 4.5.2.1.1 of this FSAP. When trench excavation equipment is used, the sample will be placed onto polyethylene sheeting located at least 1.22 m (4.0 feet) from the edge of the collection trench. When a bucket hand auger is used, the sample will be placed into a decontaminated stainless steel bowl at the sampling location. The quantity of the sample required for physical and geotechnical analyses will be collected from the soil stockpile or stainless steel bowl using a stainless steel spoon and placed into sample containers.

4.4.2.5 Sampling for chemical analyses

4.4.2.5.1 Hollow stem auger drilling method

Subsurface soil samples designated for chemical analyses will be collected from AOC investigation boreholes using either split-spoon or split-barrel sampling devices. Samples will be collected using these devices as part of hollow stem auger drilling of boreholes. The size (both diameter and length) of the split-spoon or split-barrel device to be used and the intervals over which soil samples will be collected using one or both of these devices will be defined in the AOC-specific investigation addenda to the FSAP.

During the drilling of investigation boreholes, the lead hollow stem auger will be advanced to the top of the soil interval to be sampled. The selected soil sampling device will then be inserted into the auger string and advanced to the bottom of the soil interval. When using a split-spoon sampler, this device will be advanced to the required depth using a 63.5 kilogram (140-pound) hammer or continuously advanced with the auger string. When using a split-barrel sampler, this device will be hydraulically pushed to the required depth. A clean sampling device will be used to collect soil core from each sampled interval of the investigation boreholes.

Upon retrieval of the sampling device, the percentage of recovery will be recorded and the contained soil core will be split in half lengthwise using a stainless steel knife. Samples designated for laboratory analysis will be collected from the core using a stainless steel scoop. The scoop will either be used to retrieve an isolated section(s) of the soil core or will be run lengthwise down the core to collect a sample representative of the entire core interval. The portion of the sample designated for volatile organic analyses will be placed into laboratory sample containers first, followed by placement of the remaining portion of the sample into containers designated for other types of chemical analyses. Sample containers designated for volatile organic analyses will be filled so that minimal headspace in present in the containers. No portion of the soil core that was in contact with the sampling device wall will be included in the sample collected for laboratory analysis.

In the event that composite subsurface soil samples are to be collected as part of an AOC investigation, the first step of the compositing process will involve assembly of the bottles containing the discrete samples as collected above to be composited. At this point, samples for volatile organic analysis have been previously collected. No samples for volatile organic analysis will be collected from composited or homogenized sample volumes. Next, an equal quantity of each discrete sample will be placed into a decontaminated stainless steel bowl. The total quantity of the discrete samples selected for compositing will be sufficient to perform all required laboratory analyses. The soil placed into the bowl will initially be split into quarters, and each quarter will be mixed thoroughly in the center in the bowl using a stainless steel spoon. All four quarters will then be mixed together until the single composite sample has a consistent physical appearance. Upon completion of the compositing process, the sample will be divided in half and containers filled by scooping sample material alternately from each half.

Immediately after collection of discrete or composite samples and completion of bottle label information, each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

4.4.2.5.2 Trenching and bucket hand auger methods

Subsurface soil samples designated for chemical analyses will be collected using either trenching equipment or bucket hand augers in the same manner as described in Section 4.4.2.4.2 of this FSAP. When subsurface samples are collected at a location where a composite surface soil sample was collected (for explosives and propellants), the subsurface sample location will be in the approximate center of the three surface soil composite samples. All VOC samples will be collected as discrete aliquots from the middle of the subsurface interval without homogenization, using a stainless steel spoon. All remaining samples will be collected from homogenized soil from the bucket hand auger over the depth interval. No portion of the sample that was in contact with the sampling equipment or device will be included in the sample collected for laboratory analysis.

Immediately after collection of discrete or composite samples and completion of bottle label information each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

4.4.2.6 Sample containers and preservation techniques

Information regarding sample containers and preservation techniques for subsurface soil samples collected for chemical analyses during the AOC-specific investigations is presented in Section 4.0 of the QAPP portion of this FSAP. All sample containers will be provided by contracted laboratories. With regard to temperature preservation, all sample containers will be stored at 4 ºC (±2ºC) immediately after collection and will be maintained at this temperature until the samples are received at the contracted laboratory.

4.4.2.7 Field quality control sampling procedures

Duplicate QC samples will be collected in association with the collection of subsurface soil samples during the AOC-specific investigations. Duplicate subsurface soil samples will be collected during the investigations using the same procedures defined for field subsurface soil samples in Section 4.4.2.5 of this FSAP. Information regarding the total number, collection frequency, and analytical parameters for duplicate samples will be defined in the AOC-specific investigation addenda to the FSAP and in Section 8.0 of the QAPP.

4.4.2.8 Decontamination procedures

Decontamination of equipment used for the drilling of boreholes and collection of subsurface soil samples during the AOC-specific investigations will be conducted within a temporary decontamination pad to be constructed at the site. The decontamination pad will be designed so that all decontamination liquids are contained from the surrounding environment and can be recovered for disposal as IDW. Drilling equipment will be decontaminated after completion of each borehole. The procedure for decontamination of drilling equipment will be as follows:

1. Remove caked soil material from the exterior of augers and cutting heads using a rod and/or brush.

2. Steam clean interior and exterior of equipment using approved water, using a brush where steam cleaning is not sufficient to remove all soil material.

3. Rinse thoroughly with approved potable water.

4. Allow equipment to air dry as long as possible.

5. Place equipment on clean plastic if immediate use is anticipated, or wrap in plastic to prevent contamination if longer-term storage is required.

Nondedicated sampling equipment will be decontaminated after each use during borehole interval sampling. The procedure for decontamination of sampling equipment will be as follows:

1. Steam clean (hollow-stem auger equipment only) and wash with approved water and phosphate-free detergent using various types of brushes required to remove particulate matter and surface films.

2. Rinse thoroughly with approved potable water.

3. Rinse thoroughly with ASTM Type I or equivalent water.

4. Rinse thoroughly with methanol.

5. Rinse thoroughly with ASTM Type I or equivalent water.

6. Rinse thoroughly with hydrochloric acid (2% solution).

7. Rinse thoroughly with ASTM Type I or equivalent water.

8. Allow equipment to air dry as long as possible.

9. Place equipment on clean plastic if immediate use is anticipated, or wrap in aluminum foil to prevent contamination if longer-term storage is required.

4.5 SURFACE SOIL AND SEDIMENT

4.5.1 Rationales

As defined in Section 3.0 of this FSAP, AOC-specific investigation addenda to the FSAP will be developed for the purpose of identifying unique elements of each investigation not addressed in the FSAP. Therefore, rationales related to surface soil and sediment sample locations, discrete or composite sampling requirements, sample collection, field and laboratory analyses, determination of background values, and QA/QC sample collection and frequency will be addressed within each of the AOC investigation addenda as appropriate.

4.5.2 Procedures

4.5.2.1 Sampling methods for surface soil/dry sediments

4.5.2.1.1 Bucket hand auger method

The bucket hand auger method is anticipated to be one method used during the AOC-specific investigations for collection of surface soil and sediment samples. Surface soil samples will be collected from the ground surface to a depth of 30.5 cm (12 inches), unless otherwise specified in the project-specific addenda.

The bucket hand auger collection method will be accomplished using a stainless steel bucket auger head attached to an extension rod and T-shaped bar. The auger will be advanced continuously over 10.1- to 15.2-cm (4.0- to 6.0-inch) intervals into the soil to the required depth designated for the sampling location. Material collected in the bucket cylinder in each interval will be removed to the greatest extent possible using a stainless steel spoon.

Where explosives and propellants samples are to be collected from surface soils, a specific augering procedure must be used to collect representative samples. All surface soil [0 to 0.3-m (0- to 1-ft)] samples collected for explosives and propellants analyses will be composited and homogenized from three subsamples collected with the hand auger about 0.9 m (3 ft) from one another in a roughly equilateral triangle pattern. Equal portions of soil from each of the three subsamples will be homogenized in a stainless steel bowl. Remaining surface soil samples (e.g., metals, semi-volatile organics, and others) will be collected with the hand auger from a point located in the approximate center of the triangle. Discrete samples for VOC analyses will be taken from the middle of the sample interval from the center of the triangle without being homogenized.

The bucket auger will be decontaminated after completion of augering at each sampling location; however, the auger will not be decontaminated after removal of material from each interval augered at a location unless multiple discrete samples are collected from a single location at different depth intervals.

The diameter of the bucket hand auger to be used for the investigations will depend upon the quantity of soil or sediment sample required to be collected from each sampling location to fulfill chemical analyses requirements. Therefore, the specifications for the bucket hand auger to be used for surface soil and sediment sampling will be presented in the AOC-specific investigation addenda to the FSAP. Additional information regarding methods to be used for collection of surface soil and sediment samples using the bucket hand auger method is presented in Sections 4.5.2.4 and 4.5.2.5 of this FSAP.

4.5.2.1.2 Trowel/spoon method

The trowel/spoon method is anticipated to be a second method used for collection of surface soil and sediment samples during the AOC-specific investigations. The depth interval over which material will be collected using this method will be limited to the interval located from the land surface (after removal of surface debris) to a depth of 15.2 cm (6.0 inches) below ground level.

The trowel collection method will be accomplished using a stainless steel trowel or spoon. This instrument will be used to manually dig into the subsurface material to the required depth designated for the sampling location. The trowel may be necessary to collect composite samples as described in Section 4.5.2.1.1. The trowel will be decontaminated after completion of digging at each sampling location. Additional information regarding methods to be used for collection of surface soil and sediment samples using the trowel method is presented in Sections 4.5.2.4 and 4.5.2.5 of this FSAP.

4.5.2.2 Sampling methods for underwater sediments from ponds, lakes, streams, and lagoons

4.5.2.2.1 Trowel/spoon method

The trowel/spoon method is anticipated to be one method used during the AOC-specific investigations for collection of sediment samples located underwater. This method will be used in situations where the water depth is less than 15.2 cm (6.0 inches), and it will be implemented in the same manner as described in Section 4.5.2.1.2 of this FSAP. Sediment samples will be collected from the sediment-water interface to a depth of 15 cm (6 inches), unless otherwise specified in the project-specific addenda.

4.5.2.2.2 Hand core sampler method

The hand core sampler method is anticipated to be a second method used for collection of sediment samples located underwater during the AOC-specific investigations. This method will be used in situations where the water depth is greater than 15.2 cm (6.0 inches) but less than 3.0 m (10.0 feet) in depth. In the event that a particular AOC investigation requires sediment sampling to be conducted where water depths are greater than 3.0 m (10.0 feet), the method to be implemented to accomplish this sampling will be presented in the addendum to the FSAP for that investigation.

Hand core sediment samplers will consist of a stainless steel sample barrel with either an auger bit or core tip mounted on the leading end of the device. In either configuration, a self-closing valve and/or core catcher will be installed to retain the sample obtained with the device. Extension rods will be attached to the core sampler and used to lower the device through the body of water to the sample point. Upon reaching the top of the sediment, the core sampler will be pushed or augered into the sediment to the required depth designated for the sampling location. The core sampler and extension rods will be decontaminated after completion of coring at each sampling location.

The diameter of the core sampler to be used for the investigations will depend upon the quantity of sediment sample required to be collected from each sampling location to fulfill chemical analyses requirements. Therefore, the specifications for the core sampler to be used for sediment sampling will be presented in the AOC-specific investigation addenda to the FSAP. Additional information regarding methods to be used for collection of sediment samples using the hand core sampler method is presented in Sections 4.5.2.4 and 4.5.2.5 of this FSAP.

4.5.2.3 Field measurement procedures and criteria

Field measurements to be performed on surface soil and dry sediment samples during the AOC-specific investigations may include determination of volatile organic headspace gas concentrations, field screening for the presence of TNT and other explosives, and field determinations of metals concentrations.

Headspace measurements will be performed in the same manner as described in Section 4.4.2.3 of this FSAP. Field measurement of volatile organic headspace gas concentrations will not be performed on sediment samples collected at underwater locations due to interferences resulting from the saturated condition of these samples.

Field screening for explosives will be performed using RVAAP's SOP for Field Colorimetry Determination of Explosives in Soils. Field screening for metals will be conducted with the XRF method detailed in RVAAP's SOP for XRF Determination of Metals Concentrations in Soils.

4.5.2.4 Sampling for physical/geotechnical analyses

4.5.2.4.1 Bucket hand auger and trowel methods

Surface soil and sediment samples collected using the bucket hand auger or trowel/spoon methods are classified as disturbed samples. Therefore, physical and geotechnical analyses would be limited to those analyses for disturbed samples (i.e., grain size, Atterburg limits, moisture content, etc.). Samples collected using these methods would not be utilized for the determination of in-situ permeability values.

A sample will be collected from the required depth using either a bucket hand auger or trowel as described in Section 4.5.2.1.1 or 4.5.2.1.2 of this FSAP. The sample will then be placed into a decontaminated stainless steel bowl, and the quantity of the sample required for physical and geotechnical analyses will be placed into sample containers using a stainless steel spoon.

4.5.2.4.2 Hand core sampler method

Sediment samples collected using the hand core sampler are classified as undisturbed samples. Physical and geotechnical analyses would include those for disturbed samples (i.e., grain size, Atterberg limits, moisture content, etc.) and analyses for undisturbed samples (i.e., in situ permeability).

A stainless steel retaining liner will be placed into the core sampler device. Next, the device will be pushed rapidly into the sediment material to a depth sufficient to completely fill the retaining liner. The device will then be rotated to shear off the sample at the leading edge of the sampler and retrieved from the sampling location. Upon retrieval, the retaining liner will be removed from the sampler device, and the ends of the liner sealed with wax or rubber packers to preserve moisture content. The preparation of liners for shipment will be conducted in accordance with ASTM Method K1587-83.

4.5.2.5 Sampling for chemical analyses

Surface soil and sediment samples designated for chemical analyses will be collected using either bucket hand auger, trowel, or hand core sampler devices in the same manner as described in Section 4.5.2.1.1 of this FSAP.

Where explosives and propellants samples are to be collected from surface soils, a specific augering procedure must be used to collect representative samples. All surface soil [0 to 0.3-m (0- to 1-feet)] samples collected for explosives and propellants analyses will be composited and homogenized from three subsamples collected with the hand auger about 0.9 m (3 feet) from one another in a roughly equilateral triangle pattern. Equal portions of soil from each of the three subsamples will be homogenized in a stainless steel bowl. Remaining surface soil samples (e.g., metals, semi-volatile organics, and others) will be collected from a point located in the approximate center of the triangle. Discrete samples for VOC analyses will be taken from the middle of the sample interval from the center of the triangle without being homogenized. Sample containers designated for volatile organic analyses will be filled so that minimal headspace is present in the containers. No portion of the sample that is in contact with the sampling device will be included in the sample collected for laboratory analysis.

Immediately after collection of discrete or composite samples and completion of bottle label information each sample container will be placed into a sealable plastic bag and then into an ice-filled cooler to ensure preservation.

4.5.2.6 Sample containers and preservation techniques

Information regarding sample containers and preservation techniques for surface soil and sediment samples collected for chemical analyses during the AOC-specific investigations is presented in Section 4 of the QAPP portion of this FSAP. All chemical sample containers will be provided by contracted laboratories. With regard to temperature preservation, all sample containers will be stored at 4ºC (±2ºC) immediately after collection and will be maintained at this temperature until the samples are received at the contracted laboratory.

4.5.2.7 Field quality control sampling procedures

Duplicate QC samples will be collected in association with the collection of surface soil and sediment samples during the AOC-specific investigations. Duplicate surface soil and sediment samples will be collected during the investigations using the same procedures defined for field surface soil and sediment samples in Section 4.5.2.5 of this FSAP and in Section 8.0 of the Facility-wide QAPP. Information regarding the total number, collection frequency, and analytical parameter for surface soil and sediment duplicate samples will be defined in the AOC-specific investigation addenda to the FSAP.

4.5.2.8 Decontamination procedures

Decontamination of equipment used for collection of surface soil and sediment samples during the AOC-specific investigations will be conducted in the same manner as described for nondedicated sampling equipment in Section 4.4.2.8 of this FSAP. This equipment will be decontaminated after completion of sampling activities at each surface soil or sediment sampling location.

4.6 SURFACE WATER

4.6.1 Rationales

As defined in Section 3.0 of this FSAP, AOC-specific investigation addenda to the FSAP will be developed for the purpose of identifying unique elements of each investigation not addressed in the FSAP. Therefore, rationales related to surface water sample locations, discrete or composite sampling requirements, sample collection, field and laboratory analyses, determination of upgradient sample locations, and QA/QC sample collection and frequency will be addressed within each of the AOC-specific investigation addenda as appropriate.

4.6.2 Procedures

4.6.2.1 Sampling methods for surface water – general

4.6.2.1.1 Hand-held bottle method

Directly filling a sample container is one of the most efficient methods of surface water collection. It is the preferred method if the samples are being collected for volatile organic analyses. Collection of surface water samples using the hand-held bottle method will be accomplished by submerging the appropriate sample container with the cap in place into the body of water. The container will then be slowly and continuously filled using the cap to regulate the rate of sample entry into the container. The sample container should be filled such that a minimum of bubbling (and volatilization) occurs. The sample container will be retrieved from the water body with minimal disturbance to the sample. Immediately after collection of the sample and completion of bottle label information each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

4.6.2.1.2 Dipper and pond sampler method

Dipper and pond samplers perform similar functions and vary only in the length of the handle attached to the sampling vessel (usually a beaker). Before beginning sampling, a handle of appropriate length is attached to the dipper or pond sampler. Collection of surface water samples using the dipper or pond sampler method will then be accomplished by slowly submerging the device into the water so that the open end of the device is facing upstream. The sampler device will be retrieved from the water body with minimal disturbance to the sample, which will then be transferred into appropriate sample containers. Immediately after collection of the sample and completion of bottle label information each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

4.6.2.1.3 Kemmerer sampler method

The Kemmerer sampler is a messenger-activated water sampling device that is used to sample water from a specific depth. Figure 4-10 illustrates a standard Kemmerer sampler assembly. Collection of surface water samples using the Kemmerer sampler method will be accomplished by removing the upper and lower stoppers and lowering the sampler to the designated sampling depth. Upon reaching this depth, the messenger will be used to close the lower stopper and the sampler will be retrieved. Upon recovery of the sampler, the water sample will be transferred into appropriate sample containers using the lower stopper drain. Immediately after collection of the sample and completion of bottle label information each sample container will be placed into a sealable plastic bag and then will be placed into an ice-filled cooler to ensure preservation.

4.6.2.2 Sampling methods for surface water – filtration

The equipment used for collection of filtered surface water samples will be a hand-operated pump and disposable 0.45-μm barrel filters described in Section 4.3.5 of this FSAP. Immediately after collection of the sample and completion of bottle label information, each sample container will be placed into a sealable plastic bag and then into an ice-filled cooler to ensure preservation.

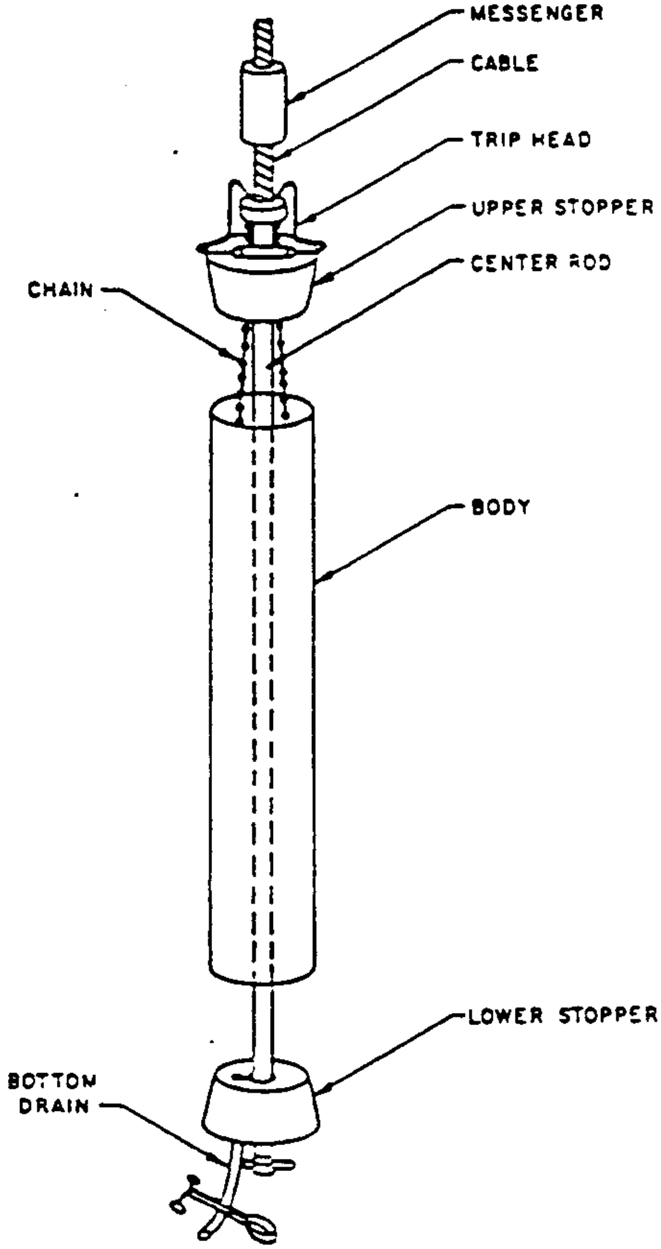

Figure 4-10. Illustration of the Kemmerer Sampler Device

4.6.2.3 Field Measurement Procedures and Criteria

Surface water field measurements to be performed during the AOC-specific investigations will include determination of pH, conductivity, dissolved oxygen, turbidity, and temperature. These measurements will be performed in the same manner as described in Section 4.3.3 of this FSAP.

4.6.2.4 Sample Containers and Preservation Techniques

Information regarding sample containers and preservation techniques for surface water samples collected for chemical analyses during the AOC-specific investigations is presented in Section 4.0 of the QAPP portion of this FSAP. All sample containers will be provided by contracted laboratories that will place into the containers or provide separately the required types and quantities of chemical preservatives. With regard to temperature preservation, all sample containers will be stored at 4° C (±2° C) immediately after collection and will be maintained at this temperature until the samples are received at the contracted laboratory.

4.6.2.5 Field Quality Control Sampling Procedures

Three types of field QC samples will be collected or used during in association with the collection of surface water samples during the AOC-specific investigations. The three types of field QC samples are (1) duplicates, (2) equipment rinsate blanks, and (3) trip blanks. Duplicate surface water samples will be collected during the investigations using the same procedures defined for field surface water samples in Section 4.6.2.1 of this FSAP. Equipment rinsate blanks will be collected and trip blanks used in the same manner as described in Section 4.3.7 of this FSAP and in Section 8.0 of the Facility-wide QAPP. Information regarding the total number, collection frequency, and analytical parameter for surface water QC samples will be defined in the AOC-specific investigation addenda to the FSAP.

4.6.2.6 Decontamination Procedures

Decontamination of equipment used for collection of surface water samples during the AOC-specific investigations will be conducted in the same manner as described for nondedicated sampling equipment in Section 4.3.8 of this FSAP. This equipment will be decontaminated after completion of sampling activities at each surface water sampling location.

In addition to the surface water sampling equipment, field measurement instruments will also be decontaminated between sampling locations. Only those portions of each instrument which come into contact with potentially contaminated environmental media will be decontaminated.

4.7 OTHER MATRICES

Sampling of other matrices not addressed in this FSAP is not anticipated to be routinely included within the scopes of work for the AOC-specific investigations. If sampling of other matrices is required, rationales and procedures for these activities will be presented in the AOC-specific investigation addenda to the FSAP.

4.8 OE ANOMALY AVOIDANCE

Contractors will employ fully qualified unexploded ordnance (UXO) subcontractors approved by the USACE Huntsville OE MCX for investigations in areas potentially contaminated with ordnance explosive waste (OE). The UXO specialists will employ Schonstedt Models GA-52 and GA-72 (or equivalent) magnetometers for surface anomaly surveys and Schonstedt Model MG-220 magnetic gradiometers for any downhole surveys. UXO technician support will be present during all field operations. The UXO Team Leader will train all field personnel to recognize and stay away from propellants and OE. Safety briefings for OE avoidance will also be provided to all site personnel and site visitors. All sample locations and access routes into soil sampling locations will be cleared for potential OE and clearly defined prior to entry, using visual and magnetometer surveys. Access routes will be at least twice as wide as the widest vehicle using the route. The UXO technician 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 will be clearly marked, and the area will be avoided. Any identified magnetic anomaly will also be clearly marked, and the anomaly will be avoided. The cleared approach paths will be the only ingress/egress routes to a particular sampling location.

Contractor sampling personnel must be escorted by UXO personnel at all times in areas potentially contaminated with OE until the UXO team has completed access surveys and the cleared areas are marked. Escorted sampling personnel will follow behind the UXO technician. If anomalies or OE are detected, the UXO technician will halt escorted personnel in place, select a course around the item, and instruct escorted personnel to follow.

Downhole magnetometer surveys will be performed at 2-foot intervals to a depth of 2 feet below the top of native, undisturbed material. Should OE be discovered, the UXO team will not be tasked with the mission of recovery and disposal. In the event of UXO or bulk explosives discovery, the Field Operations Manager will contact the RVAAP Environmental Coordinator, who will initiate the appropriate response actions. More specific requirements for anomaly avoidance will be provided, as required, in the site-specific addenda to this FSAP.

OE technical staff are responsible for decontaminating all non-dedicated downhole equipment or for providing disposable covers for downhole equipment. Specific requirements for minimizing the potential for cross-contamination via non-dedicated anomaly avoidance equipment will be provided in the site-specific addenda to this FSAP.

5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

5.1 FIELD LOGBOOK

All information pertinent to drilling and sampling activities, including field instrument calibration data, will be recorded in field logbooks. The logbooks will be bound and the pages will be consecutively numbered. Entries in the logbooks will be made in black waterproof ink and will include, at a minimum, a description of all activities, individuals involved in drilling and sampling activities, data and time of drilling and sampling, weather conditions, any problems encountered, and all field measurements. Lot numbers, manufacturer name, and expiration dates of standard solutions used for field instrument calibration will be recorded in the field logbooks. A summary of each day's activities will also be recorded in the logbooks.

Sufficient information will be recorded in the logbooks to permit reconstruction of all drilling and sampling activities conducted. Information recorded on other project documents (e.g., boring logs, well construction diagrams, well development records, etc.) will not be repeated in the logbooks except in summary form where determined necessary. All field logbooks will be kept in the possession of field personnel responsible for completing the logbooks, or in a secure place when not being used during field work. Upon completion of the field activities, all logbooks will become part of the project evidence file. The title page of each logbook will be labeled with the following information:

- logbook title,
- project name,
- USACE-Louisville District/other Army contract number and project delivery order number,
- start date for field activities, and
- end date for field activities.

Entries recorded in logbooks will include, but not be limited to, the following information:

- name and title of author, date, and times of arrival at and departure from the work site;
- purpose of the drilling and/or sampling activity;
- name and address of the field contact;
- names and responsibilities of field crew members;
- names and titles of any site visitors;
- type, matrix, and containerization method for IDW generated;
- sample collection method;
- number and volume of sample(s) collected;
- location, description, and log of sampling point photographs;
- references for all maps and photographs of the sampling site(s);

- information regarding sampling changes, scheduling modifications, and change orders;
- information regarding drilling decisions, not recorded on the boring log;
- information regarding access agreements, if applicable;
- details of the sampling location, including a sketch map illustrating the sampling location;
- date and time of sample collection, and name of collector;
- field observations;
- types of field instruments used and purpose of use, including calibration methods and results;
- any field measurements made (e.g., pH, conductivity, temperature, and static water level);
- sample identification number(s);
- information from containers, labels of reagents used, deionized and organic-free water used, etc.;
- sampling type and methodology, including distinction between grab and composite samples;
- sample preservation methods;
- sample distribution and transportation (e.g., name and address of the laboratory and courier);
- name and address of the government QA laboratory for the project and the associated project Laboratory Information Management System (LIMS) number, where applicable;
- sample documentation information, including:
  - chain-of-custody (COC) record numbers;
  - description of the number of shipping containers packaged (including contained COC records) and the shipping method employed (noting applicable tracking numbers);
- decontamination procedures;
- IDW documentation information, including:
  - types of containers/drums;
  - contents, type, and approximate volume of waste;
  - type of contamination and predicted level of contamination based on available information;
- summary of daily task (including costs where appropriate) and documentation on any cost or scope or work changes required by field conditions.; and
- signature and date entered by personnel responsible for observations recorded.

5.2 PHOTOGRAPHS

Information regarding the documentation of photographs for the AOC-specific investigations is presented in Section 4.3.2.4.3 of this FSAP.

5.3 SAMPLE NUMBERING SYSTEM

A unique sample numbering scheme will be used to identify each sample designated for laboratory analysis. The purpose of this numbering scheme is to provide a tracking system for the retrieval of analytical and field data on each sample. Sample identification numbers will be used on all sample labels or tags, field data sheets and/or logbooks, COC records, and all other applicable documentation used during the AOC-specific investigations. A listing of all sample identification numbers will be maintained in the field logbook.

The sample numbering scheme used for field samples will also be used for duplicate samples so that these type of samples will not be discernible by the laboratory. However, other types of field QC samples (i.e., equipment rinsate, trip blank, etc.) will be numbered so that they can be readily identified from other sample types. The USACE-Louisville District location/sample identification naming conventions will be used for all AOC-specific investigations. A summary of these naming conventions is presented in Figure 5-1. The sample number scheme used for each project will be presented in the AOC-specific investigation addenda to the FSAP. Follow-up sampling at a given AOC will begin with sample numbers that follow the last number in the sequence from the initial phase of work.

5.4 SAMPLE DOCUMENTATION

5.4.1 Sample Labels and/or Tags

All sample containers provided by the contracted analytical laboratory for use during the AOC-specific investigations will be shipped with sample labels pre-affixed to the containers, or the labels will be affixed to the bottles upon delivery to the investigation site (Figure 5-2). Information will be recorded on each sample container label at the time of sample collection. However, if preprinted labels are used, only field-specific information not already on the labels will be recorded at the time of sample collection. The information to be recorded on the labels will be as follows:

- contractor name,
- sample identification number,
- sample type (discrete or composite),
- site name and sampling station number,
- analysis to be performed,
- type of chemical preservative present in container,
- date and time of sample collection, and
- sampler's name and initials.

Sampling Location Identification: XXXmm-NNN(n)					
XXX	=	Area Designator	<u>Examples</u>		
			TNT	-	TNT Manufacturing Area
			P11	-	Pond #11
mm	=	Sample Location Type	<u>Examples</u>		
			MW	-	Groundwater Monitoring Well
			SB	-	Soil Boring
			SW	-	Surface Water Location
			SD	-	Sediment Sample Location
			SS	-	Surface Soil Location
			TR	-	Trench Location
			SP	-	Seep Sample
			WP	-	Groundwater Well Point
NNN(n)	=	Sequential Sample Location Number	<u>Examples</u>		
[must be unique for each designator]			004		
			012		
			099		
(n) can be used as a special identifier and is optional. For example: Use a D to identify the well as an adjacent deep zone/aquifer well (004D) Use a B to identify the well as a background location (012B) Use an A to identify an abandoned well (099A)					
Sample Identification: XXXmm-NNN(n)-####-tt					
###	=	Sequential Sample Number	<u>Examples</u>		
[must be unique for entire project site]			0001		
			0002		
			0003		
tt	=	Sample Type	<u>Examples</u>		
			GW	-	Groundwater Sample (unfiltered)
			GF	-	Groundwater Sample (filtered)
			SO	-	Soil Sample
			SW	-	Surface Water Sample
			SD	-	Sediment Sample
			PR	-	Free Product Sample
			SP	-	Seep Sample
			TB	-	Trip Blank
			FB	-	Field Blank
			ER	-	Equipment Rinsate

Figure 5-1. USACE-Louisville District Location/Sample Identification Naming Conventions

Sample Label

Title

SAMPLE ID:________________________
LAB:_________________________________

(*Barcode goes here)* **Project No:_____________**

Media:_________________
Sample Type:___________

Analysis:____
Preservative:__________________ Container Size:____ ______
Location:____
Sample Date:_________________ Container:________________
Sample Time:_________________ Station:__________________
Collected By:_________________ Depth:___________________
Comments:____
Submitted By:

Figure 5-2. Example of a Sample Container Label

5.4.2 Sample Analysis Request Form

A separate sample analysis request form will not be utilized. Sample analysis request information will be recorded on a single combination analysis request and COC form, which is discussed in Section 5.4.3 of this FSAP.

5.4.3 Chain-of-Custody Records

RVAAP will utilize EPA Region 5 COC protocols for the AOC-specific investigations, as described in EPA Procedure 330/9-78DDI-R "NEIC Policies and Procedures" (USEPA 1985). COC procedures implemented for the investigations will provide documentation of the handling of each sample from the time of collection until completion of laboratory analysis. The COC form serves as a legal record of possession of the sample. A sample is considered to be under custody if one or more of the following criteria are met:

1. The sample is in the sampler's possession.

2. This sample is in the sampler's view after being in possession.

3. The sample was in the sampler's possession and then was placed into a locked area to prevent tampering.

4. The sample is in a designated secure area.

Custody will be documented throughout the AOC-specific investigation field sampling activities by the COC form initiated for each day during which samples are collected. This record will accompany the samples from the site to the laboratory and will be returned to the Contractor Laboratory Coordinator with the final analytical report. All personnel with sample custody responsibilities will be required to sign, date, and note the time on the COC form when relinquishing samples from their immediate custody (except in the cases where samples are placed into designated secure areas for temporary storage before shipment). Bills of lading or airbills will be used as custody documentation during times when the samples are being shipped from the site to the laboratory, and they will be retained as part of the permanent sample custody documentation.

COC forms will be used to document the integrity of all samples collected. To maintain a record of sample collection, transfer between personnel, shipment, and receipt by the laboratory, COC forms will be filled out for sample sets as determined appropriate during the course of field work. An example of the COC form to be used for the AOC-specific investigations is illustrated in Figure 5-3. The following information will be recorded on all COC forms:

- sample number (for each sample in shipment);
- collection date and time (for each sample in shipment);
- number of containers for each sample;
- sample description (i.e., environmental medium);
- sample type (discrete or composite);
- analyses required for each sample;
- sample preservation technique(s);
- COC or shipment number;
- USACE LIMS number (only on COC records for government QA sample shipments);
- shipping address of the laboratory;

Laboratory Chain of Custody Record

COC No.:
Page 1 of 1 Date: mo/day/year

Name: *[Contractor Name]*
Address: *[Contractor Street Address, City/State, ZIP]*
Phone Number: *[Contractor Contact Number]*
Project Manager: *[Contractor Project Manager]*
Project Name: *[Name of Sampling Effort, e.g. LL11 Phase II RI]*
Job/P.O. #: *[Contract Number]*

Sampler (Signature) (Printed Name)

Laboratory: [name of laboratory]
Address: [street address, city/state, ZIP]
POC: [lab project manager]
Phone:

Site ID	Field Sample #	Site Type	Depth	Date	Time	Matrix	Requested Parameters														NO. OF CONTAINERS	OBSERVATIONS, COMMENTS SPECIAL INSTRUCTIONS
																					0	

Relinquished by	Date	Received by	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	
Relinquished by	Date	Received by	Date
Signature		Signature	
Printed Name	Time	Printed Name	Time
Company		Company	

Total Number of Containers (this page):

Notes:
A. Cool 4°C
B. HCl to pH<2, Cool 4°C
C. HNO3 to pH<2, Cool 4°C
D. H2SO4 to pH<2, Cool 4°C

Methods: [examples]
1. SW-846 6010B
2. SW-846 6010B/7470
3. EPA 300.0
4. EPA 350.1 (mod)
5. SW-846 8260B
6. SW-846 8270C
7. EPA 300.0/310.1
8. EPA 350.1 (mod)/353.1
9. EPA 160.1/160.2
10. SW-846 8015B (mod)

Total # of containers:
Total # of coolers:
FedEx airbill #(s):

Contractor Location
Street Address
City/State/ZIP
phone number

White: Laboratory *Yellow: Project Manager*

Figure 5-3. Example of a Chain-of-Custody Form

- date, time, method of shipment, courier, and airbill number; and
- spaces to be signed as custody is transferred between individuals.

The individual responsible for shipping the samples from the field to the laboratory will be responsible for completing the COC form and noting the date and time of shipment. This individual will also inspect the form for completeness and accuracy. In addition, this individual is responsible for determining the shipping classification for samples under U.S. Department of Transportation (DOT) HM126F. After the form has been inspected and determined to be satisfactorily complete, the responsible individual will sign, date, and note the time of transfer to the approved shipping company on the form. In the event that samples are shipped to a laboratory in the local area, samples just collected and stored on ice may not have sufficient time to cool to the required temperature of 4° C (± 2° C). The responsible individual will make note of this on the COC form. The COC form will then be placed in a sealable plastic bag and placed inside the cooler used for sample transport after the field copy of the form has been detached. If local courier service is used, the documentation can be given to the courier directly. The field copy of the form will be appropriately filed and kept at the site for the duration of the site activities.

In addition to the COC form, custody seals will also be placed on each cooler used for sample transport. These seals will consist of a tamper-proof adhesive material placed across the lid and body of the coolers in such a manner that if the cooler is opened, the seals will be broken. The custody seals will be used to ensure that no sample tampering occurs between the time the samples are placed into the coolers and the time the coolers are opened for analysis at the laboratory. Cooler custody seals will be signed and dated by the individual responsible for completing the COC form contained within the cooler. The signature and date will be written on both the cooler lid and cooler body portions of the seals.

5.4.4 Receipt of Sample Forms

The contracted laboratory will document the receipt of environmental samples by accepting custody of the samples from the approved shipping company. In addition, the contracted laboratory will document the condition of the environmental samples upon receipt as outlined in Section 6.0 of this FSAP. For samples sent to a U.S. Army QA laboratory that are suspected or known to be hazardous, a sample characterization form (Section 6.0) will be included with other required laboratory paperwork.

5.5 DOCUMENTATION PROCEDURES

The tracking procedure to be utilized for documentation of all samples collected during the AOC-specific investigations will involve the following series of steps:

1. Collection and placement of samples into laboratory sample containers as defined in Section 4 of this FSAP.

2. Completion of sample container label information as defined in Section 5.4.1 of this FSAP.

3. Placement of sample containers into an ice-filled cooler.

4. Completion of sample documentation information in the field logbook as defined in Section 5.1 of this FSAP.

5. Completion of project and sampling information sections of the COC form(s) as defined in Section 5.4.3 of this FSAP for all samples to be transported in a single cooler.

6. Completion of the airbill for the cooler to be shipped (if necessary).

7. Performance of a completeness and accuracy check of the COC form(s).

8. Completion of the sample relinquishment section of the COC form(s) as defined in Section 5.4.3 of this FSAP and placement of the form(s) into the cooler.

9. Placement of COC seals on the exterior of the cooler as defined in Section 5.4.3 of this FSAP.

10. Packaging and shipment of the cooler to the laboratory as defined in Section 6.0 of this FSAP.

11. Receipt of cooler at the laboratory, inspection of contents, and transmittal via fax of contained COC form(s) and cooler receipt form(s) as defined in Sections 5.4.4 and 6.0 of this FSAP. Each cooler must have a separate cooler receipt form.

12. Transmittal of original COC form(s) with final analytical results from laboratory.

5.6 CORRECTIONS TO DOCUMENTATION

All original information and data in field logbooks, on sample labels, on COC forms, and on any other project-related documentation will be recorded in black waterproof ink and in a completely legible manner. Errors made on any accountable document will be corrected by crossing out the error and entering the correct information or data. Any error discovered on a document will be corrected in the field by the individual responsible for the entry. Erroneous information or data will be corrected in a manner which will not obliterate the original entry, and all corrections will be initialed and dated by the individual responsible for the entry.

5.7 MONTHLY REPORTS

Monthly reports will be submitted during implementation of field investigations at AOCs as contracts require. The Monthly Reports will focus on the progress to date of an AOC-specific investigation and will be submitted directly to the U.S. Army Project Manager by the 10th day of the month following the reporting period. Copies of the Monthly Report will subsequently be submitted to the Ohio EPA-Northeast District Site Coordinator. The Monthly Reports will contain the following information: (1) site identification and activities; (2) status, (3) percent complete; (4) data collected to date (excluding analytical results); (5) difficulties encountered; (6) corrective actions; and (7) planned activities.

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6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample containers must be packaged according to requirements for preservation in transit to laboratories. Samples requiring cooling will be packaged thermally insulated rigid-body coolers. Samples not requiring cooling (i.e., geotechnical soil samples) will be packaged in heavy cardboard shipping boxes. Sample packaging and shipping will be conducted in accordance with applicable DOT specifications. Packaging and shipping procedures to be utilized for environmental samples collected during the AOC-specific investigations will include the following:

- Sample containers will be adequately identified with sample labels placed onto each container.
- All bottles, except those containing samples designated for volatile organic analyses, will be taped shut with electrical tape.
- All glass sample bottles will be placed in bubble wrap sleeves or styrofoam forms.
- Each sample bottle will be placed into a separate plastic bag that will then be sealed. For groundwater samples, each the vials for an individual sample will be placed into the same plastic bag. Trip blank containers will be wrapped and placed in the bag with the volatile organic analyte vials. As much air as possible will be squeezed from the sample container bags before sealing.
- All of the sample containers will be placed upright in the shipping coolers along with ice, which will be placed around, among, and on top of the sample containers. Before initial placement of samples into a rigid-body cooler, the cooler drain plug will be taped shut from both the inside and outside, and the cooler will be lined with a large plastic bag.
- Additional inert packing material will be placed into the cooler, if required, to prevent shifting of the sample containers during transport.
- All required laboratory paperwork, including the COC form(s) will be placed inside a plastic bag and taped to the inside of the cooler lid.
- Upon completion of the packing process, the cooler lid will be closed and two signed/dated custody seals will be placed on the cooler, one across the front and one across the side.
- Rigid-body coolers will be sealed by applying strapping tape directly to the cooler body.
- The airbill, if required for the shipment, will be completed and attached to the top of the shipping box/cooler, which will then be transferred to the courier for delivery to the laboratory.

Packaging and shipping procedures to be utilized for hazardous samples collected during the AOC-specific investigations will include the following:

- Sample containers will be adequately identified with sample labels placed onto each container.
- All bottles, except those containing samples designated for volatile organic analyses, will be taped shut with electrical tape.
- Each sample bottle will be placed into a separate plastic bag that will then be sealed. For liquid samples, volatile organic vials for an individual sample will be placed into the same plastic bag. Trip

blank containers will be wrapped and placed in the bag with the volatile organic analyte vials. As much air as possible will be squeezed from the sample container bags before sealing.

- Each bagged sample bottle will be placed upright into a separate paint-type can, the can filled with vermiculite or a similar packing material, and the lid secured to the can. The lid will be sealed with metal clips or with strapping tape.

- Arrows will be placed on each can indicating which end is up.

- The outside of each can will be labeled with the proper DOT shipping name and identification number for the sample. This information will be recorded on a sticker affixed to the can, or it will be printed legibly directly on the can.

- The cans containing samples will be placed upright in a rigid-body cooler that has had its drain plug taped shut inside and out and has been lined with a large plastic bag. Vermiculite or a similar packing material will be placed into the bottom of the cooler.

- All hazardous samples will be shipped to the laboratory on ice, which will be contained in double plastic bags placed around, among, and on top of the sample container cans.

- Additional inert packing material will be placed around and on top of cans in the cooler to prevent shifting during transport. Following the placement of this material, the plastic liner inside the cooler will be taped shut.

- All required laboratory paperwork, including the COC form(s) and sample characterization information, will be placed inside a plastic bag and taped to the inside of the cooler lid.

- Upon completion of the packing process, the cooler lid will be closed and two signed/dated custody seals will be placed on the cooler, one across the front and one across the side.

- Rigid-body coolers will be sealed by applying strapping tape directly to the cooler body.

- The following markings will be placed on the top of the cooler:

  - proper shipping name,
  - DOT identification number,
  - shipper’s or consignee’s name and address, and
  - “This End Up” legibly written if shipment contains hazardous liquid materials.

- The following labels will be placed on the top of the cooler:

  - appropriate hazard class label (placed next to the proper shipping name), and
  - “Cargo Aircraft Only,” if applicable.

- The airbill, if necessary for the shipment, will be completed and attached to the top of the cooler, which will then be transferred to the courier for delivery to the laboratory. Restricted-article airbills will be used for the shipment, and the “Shipper Certification for Restricted Articles” section of the airbills will be completed in accordance with instruction defined in Appendix F of USACE Procedure EM 200-1-3 (September 1994).

The checklist presented in Figure 6-1 will be used by the individual responsible for packaging environmental samples to verify completeness of sample shipment preparations. In addition, the contracted laboratory will document the condition of the environmental samples upon receipt at the laboratory. This documentation will be accomplished using the cooler receipt checklist presented in Figure 6-2. For samples sent to a USACE QA laboratory that are suspected or known to be hazardous, a sample characterization form will be included with other required laboratory paperwork. An example of this form is presented in Figure 6-3.

The contracted analytical laboratory name and address and laboratory point of contact to be used for each project will be identified in the AOC-specific investigation addenda to the FSAP. If QA samples are collected as part of an investigation, the addendum for that AOC-specific investigation will also identify the name, address, and point of contact for the USACE QA laboratory to be used for the investigation.

All environmental, QA, and QC samples collected during the project will be shipped no later than 48 hours after the time of collection. During the time period between collection and shipment, all samples will be stored in ice-filled coolers or refrigerators and maintained in a secure area. All coolers containing investigation samples will be shipped overnight to the laboratory by Federal Express or a similar courier.

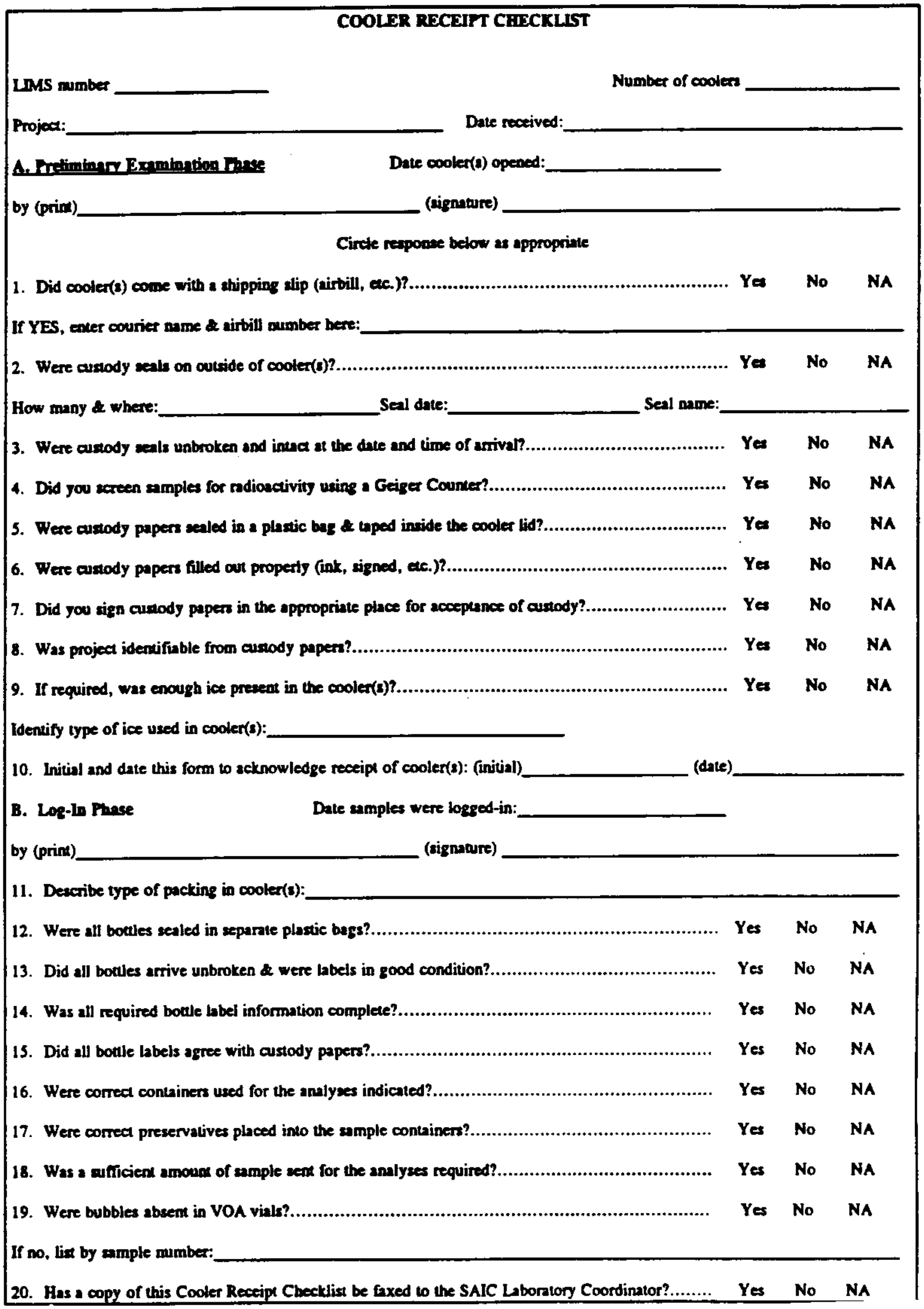
Each cooler containing environmental samples for organic analysis will contain a trip blank from the time those environmental samples are placed in the cooler for storage and/or shipment. The contracted analytical laboratory will analyze this trip blank for volatile organics upon receipt and compare results to analyses of corresponding environmental samples.

SAMPLE PACKAGING CHECKLIST

ATTN: Failure to properly handle or document the project samples could jeopardize the useability of the sample results and ultimately the project objectives. Prior to sending this cooler to the analytical laboratory at the address indicated on the chain-of-custody form, please check the following items:

* Is the project clearly identified on the chain-of-custody form (including the USACE delivery order number)?
* Are all enclosed sample containers clearly labelled with waterproof (permanent) ink?
* Are the required analyses indicated on the bottle labels and chain-of-custody form, and are the metals to be analyzed individually noted on the chain-of-custody form?
* Does the information on the chain-of-custody form match the information on the sample container labels?
* Has the chain-of-custody form been placed into a plastic bag and attached to the inside of the cooler lid?
* Have the samples been properly preserved (acid or base and cooling to 4°C)?
* Is the client information, including point of contact and telephone number, complete on the chain-of-custody form?
* Is there sufficient ice (double bagged in sealable plastic bags) in the cooler to ensure preservation of the samples during shipment?

Figure 6-1. Checklist for Sample Packaging



COOLER RECEIPT CHECKLIST

LIMS number ______________ Number of coolers ______________

Project: ______________________________ Date received: ______________________________

A. Preliminary Examination Phase Date cooler(s) opened: ______________

by (print) ______________________________ (signature) ______________________________

Circle response below as appropriate

1. Did cooler(s) come with a shipping slip (airbill, etc.)?........ Yes No NA

If YES, enter courier name & airbill number here: ______________________________

2. Were custody seals on outside of cooler(s)?........ Yes No NA

How many & where: ______________ Seal date: ______________ Seal name: ______________

3. Were custody seals unbroken and intact at the date and time of arrival?........ Yes No NA
4. Did you screen samples for radioactivity using a Geiger Counter?........ Yes No NA
5. Were custody papers sealed in a plastic bag & taped inside the cooler lid?........ Yes No NA
6. Were custody papers filled out properly (ink, signed, etc.)?........ Yes No NA
7. Did you sign custody papers in the appropriate place for acceptance of custody?........ Yes No NA
8. Was project identifiable from custody papers?........ Yes No NA
9. If required, was enough ice present in the cooler(s)?........ Yes No NA

Identify type of ice used in cooler(s): ______________

10. Initial and date this form to acknowledge receipt of cooler(s): (initial) ______________ (date) ______________

B. Log-In Phase Date samples were logged-in: ______________

by (print) ______________________________ (signature) ______________________________

11. Describe type of packing in cooler(s): ______________________________
12. Were all bottles sealed in separate plastic bags?........ Yes No NA
13. Did all bottles arrive unbroken & were labels in good condition?........ Yes No NA
14. Was all required bottle label information complete?........ Yes No NA
15. Did all bottle labels agree with custody papers?........ Yes No NA
16. Were correct containers used for the analyses indicated?........ Yes No NA
17. Were correct preservatives placed into the sample containers?........ Yes No NA
18. Was a sufficient amount of sample sent for the analyses required?........ Yes No NA
19. Were bubbles absent in VOA vials?........ Yes No NA

If no, list by sample number: ______________________________

20. Has a copy of this Cooler Receipt Checklist be faxed to the SAIC Laboratory Coordinator?........ Yes No NA

Figure 6-2. Example of a Cooler Receipt Checklist

Characterization of Hazardous Samples for Disposal

In order to properly dispose of samples, Federal and State Hazardous Waste Regulations require that the generator determine whether or not the sample is a hazardous waste. To assist the laboratory in making this determination, you are requested to answer the following questions concerning the site and respective contamination.

Instructions: Do not guess or hypothesize. Only provide answers that you can reasonably ascertain are accurate. If you do not know the answer, indicate in the blank that you do not know the answer by answering "Unknown". Please respond to all questions.

Site Name: ______________________________

Address of Site: ______________________________
____

Sampling Date: ______________________________

Sample Identification Number: __________ __________

__________ __________ __________ __________
__________ __________ __________ __________
__________ __________ __________ __________
__________ __________ __________ __________

1. Indicate by sample identification number which samples are background samples (if none, write none): __________

   __________ __________ __________ __________
   __________ __________ __________ __________

2. Were unopened containers of chemicals found on site? __________
   Were unopened chemicals known to have been stored on site? ___
   Is the contamination from this storage area? __________
   List unused, unopened chemicals found at the storage site:

   ____________________ ____________________
   ____________________ ____________________
   ____________________ ____________________
   ____________________ ____________________

3. Is the site a manufacturing facility? __________
   If yes, identify the industry: __________

Figure 6-3. Example of Characterization Form for Hazardous Sample Disposal

Characterization of Hazardous Samples for Disposal
(Continued)

4. Is the contamination at the site from the use of solvents? ___
If yes, identify the solvents: ______________________________

5. Is a process such as parts degreasing, electroplatin- etc. the suspected cause of the contamination? ______________
If yes, identify the process: ______________________________

6. Do you suspect the sample to have any of the following contaminants? Circle all that you suspect.

Asbestos PCBs Jet Fuel POL

7. What other contaminants do you expect to find in this sample?

______________________ ______________________
______________________ ______________________
______________________ ______________________

8. Briefly describe how this site was contaminated: __________

____
____
____
____
____
____
____
____

9. Your Name: ____________________ Telephone: __________

Thank You!

Figure 6-3 (continued)

Explanation of Characterization Questionnaire

Site Name: Indicate the name of the site where the samples were taken. For example, Fire Training Pit FTP 001, Landfill #10 Ft. Dix, etc.

Site Address: Write the address of the site.

Sampling Date: Indicate the date these samples were taken at the site.

Sample Identification Number: Identify each sample. This number in most cases should be the same as the identification number on the chain of custody form. Each sample should have a unique number. Be sure to identify each sample.

Question number 1 will assist us in segregating potentially clean samples - the background samples from the contaminated samples.

Question number 2 has been asked to determine whether the sample would be P or U-listed. If the sample is contaminated with a commercial chemical product or an off-specification chemical, the chemical itself would be P-listed or U-listed. This chemical would have to be a virgin chemical, i.e. a chemical that was manufactured, however it had not yet been used for its intended purpose. For example, if the just manufactured chemicals were all stored on a particular concrete pad, and analysis of the pad showed trace amounts of that chemical, then the pad would be considered a P or U-listed waste. Once the listed waste contaminated the soil or water, the entire mixture would also become P or U-listed.

Question number 3 will help us to identify whether the waste is K-listed. If the manufacturing process can be defined, the sample may be considered to be waste from a process listed on the K-list. If for example you are investigating a landfill and you know that the waste in the landfill came from a certain manufacturing process, that waste may also be K-listed as well as the contaminated soil and water.

Question number 4 will assist us in determining if the sample contains a F-listed waste.

Question number 5 will assist us in determining if the sample contains a K or F-listed waste. If the answer to the question is yes, then we will check to see if that process has been identified on the K or F-list.

Question number 6 will assist us in identifying any other contaminants that may require that special handling provisions be employed during disposal.

Figure 6-3 (continued)

Explanation of Characterization Questionnaire
(Continued)

Question number 7 requests that you identify any contaminants you may expect to find in the sample that would impact the characterization of the sample as a RCRA hazardous waste.

Question number 8 asks you to describe how t... site was contaminated. Identify any processes or procedures which led to the resultant contamination.

Question number 9 asks for your name and telephone number. If we have questions concerning the information on this form, we will contact you.

Figure 6-3 (continued)

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7.0 INVESTIGATION-DERIVED WASTE

IDW includes all materials generated during performance of an investigation that cannot be effectively reused, recycled, or decontaminated in the field. IDW consists of materials that could potentially pose a risk to human health and the environment (e.g., sampling and decontamination wastes) as well as materials that have little potential to pose risk to human health and the environment (e.g., sanitary solid wastes). Two types of IDW will be generated during the implementation of field activities: indigenous and non-indigenous. Indigenous IDW expected to be generated during the investigations of AOCs at RVAAP includes soil and bedrock drill cuttings; residual soil samples; soil and buried waste materials from trenching; residual sediment samples; and groundwater from well point installation, monitoring well development, and purging. Non-indigenous IDW is expected to consist of decontamination rinse fluids and compactible and miscellaneous trash. Procedures to be utilized for managing IDW are described below. The FSAP addresses generic waste collection, characterization, storage, and disposal procedures to be used to implement multiple investigations at RVAAP; however, it will be necessary to address project-specific waste management practices in each investigation-specific SAP addendum tiered under the FSAP.

All hazardous wastes generated during environmental investigations at RVAAP must be managed in accordance with federal and state of Ohio large-quantity generator requirements as discussed in the following subsections. All hazardous waste activities must comply with RVAAP's Installation Hazardous Waste Management Plan, now in preparation.

7.1 IDW COLLECTION AND CONTAINERIZATION

All indigenous solid IDW (soil and rock cuttings) generated from borehole installations >1.8 m (6 feet) in depth will be collected and segregated by borehole location. Additionally, all unsaturated soils will be segregated from saturated soils within each borehole. The segregation of unsaturated and saturated soils is expected only to be necessary in boreholes that are drilled below the water table for completion as monitoring wells because all boreholes drilled for soil characterization are expected to be terminated at or above the water table. All indigenous solid IDW (soil and sediment) from borehole installations <1.8 m (6 feet) will be collected and segregated by the AOC from which they were generated. Segregation by AOC from shallow boreholes/sediment sampling stations is necessary because of the small volume of soil and sediment expected to be generated from individual locations. The segregation of unsaturated from saturated soils in shallow boreholes <1.8 m (6 feet) and sediment sampling stations is not anticipated because it is expected that none of the shallow boreholes will encounter the water table and sediment sampling stations will yield either totally saturated or unsaturated solid IDW. All indigenous solid IDW will be contained in labeled DOT approved open-top 55-gallon drums equipped with plastic drum liners and sealed with bung-top lids.

All indigenous solid IDW (soil and waste material) generated from trenching operations will be segregated by trench location and staged temporarily on plastic sheeting (minimum 6-mil thickness) at the trenching site until the trench is completed. The temporary staging of trench IDW will be in a manner that is protective of human health and the environment. All potentially hazardous solid IDW recovered from a trench will be segregated from potentially non-hazardous IDW and will be contained immediately in labeled DOT approved open-top 55-gallon drums equipped with plastic drum liners and sealed with bung-top lids. Potentially hazardous solid IDW from trenching will be identified in the field on the basis of visual inspection of the soil and waste materials (i.e., heavy discoloration, oil saturated, etc.), the types of waste materials unearthed (i.e., drum containers, paint or aerosol cans, munitions wastes, etc.), and screening using field instruments (e.g., organic vapor analyzer). All non-hazardous solid (soil and buried material) IDW will be immediately returned to the trench upon completion in the order that the material was excavated.

All liquid indigenous (groundwater) IDW generated from well point and monitoring well installation, development, and purging will be segregated by sample station. All liquid indigenous IDW will be collected in either labeled DOT approved 55-gallon closed-top drums or in labeled polyethylene storage tanks.

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 labeled DOT approved open-top 55-gallon drums equipped with plastic drum liners and sealed with bung-top lids. 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 either labeled DOT approved 55-gallon closed-top drums or in approved polyethylene storage tanks. All known potentially hazardous liquid non-indigenous IDW streams, such as methanol, hydrochloric acid rinses, and acetone waste from field laboratories, will be contained separately in labeled DOT approved closed top 55-gallon drums.

As an alternative to off-site disposal following field activities, temporary storage of non-hazardous soils may be permitted on site, with the prior approval of Ohio EPA. Storage of soils within their AOC of origin represents a lower-cost option for non-hazardous waste disposal, compared to containerizing and off-site disposal. Such storage requires placement of soil materials known to be non-hazardous (i.e., chemical analyses already complete) on polyethylene sheeting, inside the AOC where it originated. The soil pile must be stabilized and its boundary marked with flagging or other visible labels. The final disposition of any such soil will take place after site-specific cleanup levels are established. If contaminant concentrations in the soils are below cleanup levels, the soil may be spread and seeded (using RVAAP-approved seed mixes) or used for fill at the AOC after remediation. If the contaminant concentrations are generally higher than cleanup levels, the soils will be removed from the site with any soil excavated during the cleanup.

The method(s) used to containerize each waste stream during each investigation will be identified in the investigation-specific SAP addenda based on the appropriate waste containment option, as defined above, to meet the investigation-specific criteria. Section 7.2 of this FSAP addresses container labeling requirements, Section 7.3 describes IDW field staging, and Section 7.4 addresses IDW characterization.

7.2 WASTE CONTAINER LABELING

All waste storage containers (drums and poly-tanks) will be labeled immediately before and continuously during their use to ensure proper management of the contained wastes. An example of the waste storage container labels that will be used is shown in Figure 7-1. The following procedure will be used for waste container labeling:

- Weather-resistant commercial hazardous or non-hazardous labels will be affixed and located on the top and two sides on the upper one-third of each storage container. Additional label information may be recorded directly on a clean, dry drum surface using an indelible white or silver paint marker. All containers, including empty ones, must be labeled.

DRUM NUMBER LL1mw85-001

CONTENTS unsaturated soil cuttings; 2/3 full

SOURCE OF WASTE LL1 Phase II RI Groundwater

SOURCE LOCATION LL1mw-085 (monitoring well)

GENERATION DATE(S) 8/17/ to 8/18/99

COMMENTS____________________________________

Figure 7-1. Example Waste Storage Container Label

- Each label will be placed on a smooth part of the container and will not be affixed across drum bungs, seams, ridges, or dents.

- Information to be recorded on each label will include the following:

  – container number,
  – contents,
  – source of waste,
  – source location,
  – project name and site identification,
  – physical characteristic of the waste, and
  – generation date(s).

- All information documented on container labels will be recorded with a permanent marker or paint pen and recorded in the field logbook.

- All container labels will be protected in a manner to prevent damage or degradation of the recorded information.

7.3 IDW FIELD STAGING

Subject to the review and approval of RVAAP staff before the start of a project, each Contractor Field Operations Manager will designate a Field Staging Area (FSA) for each project. The FSA will be established within each AOC during investigations to store IDW generated from each AOC pending characterization and disposal. If a centralized decontamination area is utilized (outside of an AOC) to support the investigation of multiple AOCs, an FSA will also be established and co-located with the decontamination facility to store non-indigenous liquid and solid IDW resulting from decontamination activities. All indigenous (solid and liquid) IDW will be stored at the point of generation within the AOC or in the FSA until such time that the IDW is characterized for disposal in accordance with Section 7.4. After characterization of the IDW, the wastes will be disposed of according to Section 7.5 or moved to the appropriate FSA and stored pending disposal.

All non-indigenous (decontamination rinse and expendable material) IDW will be stored in the appropriate (AOC or central decontamination area) FSA until such time that it is characterized for disposal in accordance with Section 7.4. After characterization of the non-indigenous IDW, the wastes will be disposed of according to Section 7.5 or moved to the appropriate FSA and stored pending disposal. All non-contaminated, non-indigenous IDW will be staged in a sanitary trash container (dumpster) pending disposal.

Each FSA will be visibly marked and all waste containers (drums and polyethylene tanks) will be placed on top of plastic sheeting or pallets and covered. Because of the large number of vacant buildings at many of the AOCs at RVAAP, FSAs will be established, where possible based on availability and approval of the facility, adjacent to or inside designated, currently unused buildings to protect the waste containers from the weather and safeguard the integrity of the stored wastes over time. All IDW will be segregated by location and type (e.g., soil and rock cuttings, decontamination water, alcohol and acid decontamination rinses, well development and purge water, etc.) so that all IDW generated can be identified with a given location or operation. All waste containers will be stored in a manner to accommodate inspection and sampling, if necessary, and to facilitate safe handling of the containers. All RCRA hazardous wastes will be managed in accordance with the appropriate technical requirements establish in the Ohio Administrative Code, Chapter 3745-55, Management of Hazardous Waste [40 Code of Federal Regulations (CFR) 264, Subparts I (containers) and J (tanks)]. If RCRA wastes are suspected at an AOC, they will be identified in the investigation-specific SAP addenda.

Hazardous and non-hazardous IDWs staged and stored at RVAAP are subject to the requirements of RVAAP's Installation Hazardous Waste Management Plan, now in preparation. All contractors conducting environmental investigations at the facility must comply with the following minimum requirements of that plan:

- No 90-day hazardous waste storage areas will be permitted within an AOC. Hazardous waste will be stored at a centralized 90-day storage area designated by the RVAAP Environmental Coordinator.

- Satellite accumulation areas may be used for hazardous waste storage, but all state and federal management rules must be followed. An inventory and a location map of the waste must be given to RVAAP staff as soon as waste is generated; this information must be updated on a daily basis if changes occur.

- Any containers in a satellite accumulation area must be moved to the designated 90-day storage area within 72 hours of the decision to dispose of them.

- Both hazardous and non-hazardous waste (except for municipal waste) must be manifested.

- All contractors must obtain an RVAAP tracking number from the RVAAP operating contractor when shipping waste and write it on the top of the front page of the manifest.

- The source of the waste (project name, activity, area within the AOC, etc.) and the weight must be written on the manifest.

- The contractor must give the state's copy of the manifest to the RVAAP operating contractor, who will submit it on behalf of the installation.

- All non-hazardous containerized waste not transported off-post within 30 days following project completion must be consolidated at an RVAAP-approved storage area near Post 1. Any non-hazardous liquid waste will require secondary containment at this time.

- All liquid hazardous waste must have secondary containment.

- All contractors must confirm that the disposal facility has received the hazardous waste shipment within the required time frames. This will be accomplished by contacting the RVAAP operating contractor to verify that the disposal facility signed and returned a copy of the manifest to RVAAP. If the copy has not been returned within 35 days of the pickup date, the contractor must immediately notify the RVAAP Environmental Coordinator and begin corrective actions.

7.4 IDW CHARACTERIZATION AND CLASSIFICATION FOR DISPOSAL

All indigenous IDW (soil, rock cuttings, and groundwater) will be characterized for disposal on the basis of analytical results from environmental samples or from direct analysis of composite IDW samples. Because all indigenous IDW will be segregated by sample station for boreholes >1.8 m (6 feet) in depth, trenches, and monitoring wells, the results of environmental samples collected from each sampling station can be used to determine the chemical composition of the wastes generated from that station and used to characterize the waste for disposal. In boreholes where it is necessary to segregate unsaturated and saturated solid indigenous (soil and rock cuttings) IDW (i.e., boreholes drilled below the water table for completion as monitoring wells), the results from environmental soil samples will be used to characterize the unsaturated soil and rock cuttings, and samples of saturated soil or rock from each borehole will be used to characterize the saturated soil and rock cuttings. Where it is necessary to segregate solid indigenous (soil) IDW by AOC [i.e., boreholes <1.8 m (6 feet) in depth], the results of environmental soil samples from all boreholes where wastes are commingled will be used to characterize the waste in each container.

Non-indigenous IDW, except for personal protective equipment (PPE) and expendable sampling equipment, will be characterized for disposal on the basis of composite samples collected from segregated waste stream storage containers. Composite waste samples will be submitted for laboratory analysis to characterize each waste stream for disposal. Procedures for composite waste sampling are presented in Sections 7.4.1 and 7.4.2 of this FSAP. PPE and expendable sampling equipment will be visually inspected and screened for contaminants on site using available field screening instruments after each use to determine if residual levels of contamination exist that may exceed contaminant action levels. PPE and expendable sampling equipment will be segregated by sampling stations as clean or potentially contaminated trash based on the results of field screening and visual inspection. Potentially contaminated PPE and expendable sampling equipment will be containerized in accordance with Section 7.1 and characterized based on the results of environmental samples collected from the sample station with which the wastes are associated.

Upon receipt of analytical results from the subcontracted laboratory (approximately 30 days after submission of sample delivery groups), the analytical results will be reviewed to determine if any potentially hazardous wastes exist. This review will include a comparison of the analytical results against the Toxicity Characteristic Leaching Procedure (TCLP) criteria for liquids, and a 20-fold TCLP dilution factor for soils. Table 7-1 presents the maximum concentration of contaminants for toxicity characterization of hazardous wastes as specified in 40 CFR 261.24. After all analytical results have been received for each investigation and prior to the disposal of any potentially contaminated or hazardous waste, an IDW Characterization and Disposal Plan will be prepared and submitted to RVAAP, the Army, and Ohio EPA. The IDW Characterization and Disposal Plan will present an inventory of all stored IDW, document the analytical results and IDW characterization, and make recommendations for the disposal of all IDW based on Facility-wide ARARs [Ohio EPA regulatory criteria, RCRA, Toxic Substances Control Act (TSCA), and Safe Drinking Water Act (SDWA)] and contaminant risk-based action levels. The recommendations for IDW disposal presented in the IDW Characterization and Disposal Plan will be submitted to the Army, the Ohio EPA Division of Emergency and Remedial Response and Division of Solid and Infectious Waste Management, and upon approval, implemented.

7.4.1 Solid IDW Composite Sampling Procedure

All solid IDW will be characterized on the basis of analytical results from correlative environmental samples; however, should it become necessary to characterize soil IDW by composite sampling, the following procedure will be used.

Composite sampling of solid IDW (soil and rock cuttings) for disposal characterization will be performed using a composite grab sampling technique. The equipment used in solid IDW sampling will consist of stainless steel bowls and mixing instruments (e.g., knives and spoons) and decontaminated following the procedure presented in Section 4.4.2.8 of this FSP. The handling, storage and shipping of IDW composite grab samples will follow the procedures for soil samples described in Section 4.4.2.6 and Section 5.0 of this FSAP. Composite grab sample collection will be performed as follows:

Table 7-1. Maximum Concentration of Contaminants for the Toxicity Characteristic (40 CFR 261.24)

EPA HW No.[a]	Contaminant	CAS No.[b]	Regulatory Level (mg/L)
D004	Arsenic	7440-38-2	5.0
D005	Barium	7440-39-3	100.0
D018	Benzene	71-43-9	0.5
D006	Cadmium	7440-43-2	1.0
D019	Carbon tetrachloride	56-23-5	0.5
D020	Chlordane	57-74-9	0.03
D021	Chlorobenzene	108-90-7	100.0
D022	Chloroform	67-66-3	6.0
D007	Chromium	7440-47-3	5.0
D023	o-Cresol	95-48-7	200.0[d]
D024	m-Cresol	108-39-4	200.0[d]
D025	p-Cresol	106-44-5	200.0[d]
D026	Cresol	--	200.0[d]
D016	2,4-D	94-75-7	10.0
D027	1,4-Dichlorobenzene	106-46-7	7.5
D028	1,2-Dichloroethane	107-06-2	0.5
D029	1,1-Dichloroethylene	75-35-4	0.7
D030	2,4-Dinitrotoluene	121-14-2	0.13[c]
D012	Endrin	72-20-8	0.02
D031	Heptachlor (and its epoxide)	76-44-8	0.008
D032	Hexachlorobenzene	118-74-1	0.13[c]
D033	Hexachlorobutadiene	87-68-3	0.5
D034	Hexachloroethane	67-72-1	3.0
D008	Lead	7439-92-1	5.0
D013	Lindane	58-89-9	0.4
D009	Mercury	7439-97-6	0.2
D014	Methoxychlor	72-43-5	10.0
D035	Methyl ethyl ketone	78-93-3	200.0
D036	Nitrobenzene	98-95-3	2.0
D037	Pentrachlorophenol	87-86-5	100.0
D038	Pyridine	110-86-1	5.0[c]
D010	Selenium	7782-49-2	1.0
D011	Silver	7440-22-4	5.0
D039	Tetrachloroethylene	127-18-4	0.7
D015	Toxaphene	8001-35-2	0.5
D040	Trichloroethylene	79-01-6	0.5
D041	2,4,5-Trichlorophenol	95-95-4	400.0
D042	2,4,6-Trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	Vinyl chloride	75-01-4	0.2

[a] Hazardous waste number.
[b] Chemical abstracts service number.
[c] Quantitation limit is greater than the calculated regulatory level. The quantitation limit therefore becomes the regulatory level.
[d] If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200 mg/L.

1. Collect discrete grab samples from each segregated IDW waste container. Each discrete grab sample should be collected in an identical fashion.

   a. For volatile organic characterization, grab samples of equal proportions will be transferred directly from each IDW waste container to the sample container with minimum head space for laboratory analysis.

   b. For all analyses other than volatile organic compounds, individual grab samples will be transferred into a sample bowl for homogenizing.

2. Homogenize individual grab samples using a sampling bowl and mixing instrument by stirring and turning over the sample until the mixture is adequately homogenized. The mixture is then divided by half and equal portions from each half will be used to fill sample containers.

3. Assemble the sample containers that contain the homogenized grab samples that will make up a specific composite sample.

4. Remove an aliquot of sample from each sample container and place it in a decontaminated stainless steel mixing bowl. Each aliquot amount is to be as identical as possible to facilitate representativeness.

5. Homogenize the aliquots as described in Step (2).

6. Remove sample amounts from the homogenized composite sample and place them into the proper containers for shipment to the laboratory.

7.4.2 Liquid IDW Composite Sampling Procedure

Sampling of liquid IDW (groundwater and decontamination water) for disposal characterization will be performed using a composite grab sampling technique. The equipment used in liquid IDW sampling will consist of sample containers and pipets. The handling, storage, and shipping of IDW samples will follow procedures for water samples described in Section 5.0 of this FSAP. Liquid IDW (i.e., groundwater and decontamination rinse water) will be sampled and analyzed separately. Composite grab sample collection will be performed as follows:

1. Collect discrete grab samples in a sample container from each segregated IDW waste container. Each discrete grab sample should be collected in identical fashion.

2. Shake or stir the individual grab sample containers to homogenize.

3. Using a clean pipet, deliver aliquots of the homogenized grab samples directly into a sample container to be sent to the laboratory. Correlate the number of grab samples and sample volume required by the laboratory to determine the volume needed to provide equal amounts of aliquot from each grab sample at the recommended sample volume (e.g., five 20-ml pipettings from five discrete grab samples to generate a 100-ml composite sample).

4. Seal the sample container and shake well to mix. Prepare container for shipment to the laboratory.

7.5 IDW DISPOSAL

Table 7-2 identifies the disposal options for all expected waste streams from environmental investigations at RVAAP, based on past efforts. All indigenous and non-indigenous wastes generated are subject to disposal protocols outlined Ohio EPA guidance (Ohio EPA November 1997). Waste disposal options recommended in the Contractor’s IDW Characterization and Disposal Plan are subject to the approval of the RVAAP Environmental Coordinator, the U.S. Army, and Ohio EPA. The RVAAP Environmental Coordinator will sign all waste manifests and other shipping documents, and oversee the disposition of all IDW at RVAAP. Transportation of all IDW for storage and/or disposal will be in accordance with applicable State of Ohio and Federal regulations.

There is no means for disposal of contaminated IDW at RVAAP. All IDW determined to be a hazardous waste will be disposed according to applicable State of Ohio and Federal regulations at an approved off-site hazardous waste facility. Non-hazardous, contaminated waste contains contaminants but does not meet the criteria for hazardous waste. This waste will either be stored in the FSA pending remediation of the AOC where it originated, or will be disposed off site. Non-hazardous, non-contaminated waste contains contaminants at concentrations at or below acceptable criteria (e.g., background concentrations), and may be disposed on site with prior approval from the RVAAP Environmental Coordinator, the Ohio EPA, and the U.S. Army.

Any contaminated or potentially contaminated liquid IDW or saturated-soil IDW that is stored in an FSA during winter months will require special management to prevent accidental releases due to freezing. The Contractor’s foremost responsibility is to manage IDW so that, if possible, disposal can be completed before freezing conditions arise. If disposal cannot be executed before the onset of such conditions, or if long-term storage of liquids is anticipated, secondary containment is required. Secondary containment is the responsibility of the Contractor and is subject to the requirements of RCRA.

Table 7-2. IDW Disposal Options for Potential Waste Streams in RVAAP Environmental Investigations

Waste Stream	Non-Hazardous, Non-Contaminated	Non-Hazardous, Contaminated	Hazardous, Contaminated
Solid (soil, rock cuttings)	Spread, seed, and mulch at designated area within the AOC (RVAAP-approved seed mix)	Dispose off site at permitted waste facility	Dispose off-site at permitted hazardous-waste facility
		Store in field staging area until remediation of contaminated media in the AOC	
Liquid (groundwater, decontamination fluids, laboratory reagents and residues)	Discharge on ground surface at designated area	Dispose off-site at permitted waste facility (most likely scenario for these wastes)	Dispose off-site at permitted hazardous-waste facility
		Store in field staging area until remediation of contaminated media in the AOC (**Requires Secondary Containment**)	
Expendable sampling equipment and trash	Dispose as sanitary trash	Dispose off site at permitted facility	Dispose off-site at permitted hazardous-waste facility

All non-indigenous solid (expendable sampling equipment and trash) IDW will be disposed of as either sanitary trash or, if determined to be potentially contaminated, stored in an FSA located within the AOC boundary and maintained there in accordance with Section 7.3 until such time that it can be disposed at an approved facility. All expendable sampling equipment determined to be potentially contaminated will be decontaminated according to Section 4.3.8 and then disposed of as sanitary trash.

All treatment, storage, and disposal facilities (TSDFs) must be in good standing with environmental regulatory agencies. The RVAAP Environmental Coordinator must be notified in advance of waste disposal which disposal facility is to be used. The Environmental Coordinator has the authority to refuse use of a particular disposal facility based on his/her review of their ability to protect the interests of OSC.

8.0 CONTRACTOR CHEMICAL QUALITY CONTROL

The Contractor Chemical Quality Control (CCQC) program to be utilized for the AOC-specific investigations will consist of three phases. The three CCQC phases will be the preparatory phase, the initial phase, and the follow-up phase, all of which will be performed by contractors whether or not an U.S. Army representative is present. The CCQC representative responsible for implementation and documentation of the CCQC program and definable features of work that will comprise the CCQC program will be identified in the AOC-specific investigation addenda to the FSAP.

The preparatory phase of the CCQC program will be conducted by the CCQC representative before beginning each definable feature of work. A summary of all activities performed during each preparatory phase meeting will be documented by the CCQC representative in a meeting minutes record. Each preparatory phase meeting will address the following:

- Review of all pertinent sections of the FSAP and SAP addendum in order to ensure that all field personnel are cognizant of the overall project DQOs, specific project activities to be accomplished, and specific sampling and analysis requirements.

- Actual calibration of all instruments to be used for measurement of field parameter using certified calibration standards, gases, etc.

- Physical examination of all materials and equipment required to accomplish the specific project activities.

- Demonstration of equipment decontamination procedures in accordance with FSAP and SAP addendum requirements.

- Demonstration of how each sample type is to be collected, containerized, documented, and packaged.

- Demonstration of proper IDW management and documentation.

- Demonstration of the procedure for completing all required information to be recorded on sample custody forms and discussion of the project sample numbering system. Completed examples of a COC form, sample container label, and IDW drum label will be provided to the field personnel for reference.

- Demonstration/discussion of any other activities to be performed as deemed necessary by the CCQC representative.

- Examination of the work area(s) to ascertain if all preliminary work is complete.

- Review of preparatory phase field equipment and support materials checklists. The contents of the field equipment checklist and supporting materials checklist will be presented in the AOC-specific investigation addenda. An example of the QA table that will be used to match up primary and QC samples is presented in Figure 8-1.

	Contractor Laboratory					Government Laboratory				Requested Laboratory Analyses					
Sample Location	Sample Type	Sample Number	Associated QC Duplicate Number	Associated QC Rinsate Number	Associated QC Trip Blank Number	Sample Number	Associated QA Duplicate Number	Associated QA Rinsate Number	Associated QA Trip Blank Number	VOCs	SVOCs	RCRA Metals	TPH, Oil, and Grease	Ignitability, Corrosivity, RCRA Metals	TCLP VOAs TCLP Metals

Figure 8-1. Example of the QA Table to be Used for the RVAAP AOC-Specific Investigations

In addition to the activities noted above, the CCQC representative will ensure that the USACE QA laboratory has been contacted to schedule receipt and analysis of the government QA samples. This will be accomplished by review of the telephone log used to document the laboratory contact.

The initial phase of the CCQC program will be conducted by the CCQC representative and will include the following:

- oversight of drilling, monitoring well installation construction and development, and/or sampling activities and review of this work to ensure compliance with delivery order requirements;

- inspection of individual sample labels and COC forms for accuracy, completeness, and consistency;

- inspection of sample packaging and shipping activities;

- observation, verification, and documentation of initial and ongoing field instrument calibration;

- inspection of field logbooks and other field records/sketches to ensure that all pertinent data are recorded in accordance with delivery order requirements; and

- inspection of the QA sample match-up table to ensure that all samples collected during each day are documented properly.

The follow-up phase of the CCQC program will be conducted by the CCQC representative and will involve performing the various activities noted for the initial phase on a daily basis until completion of the particular definable feature of work.

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9.0 DAILY CHEMICAL QUALITY CONTROL REPORTS

During the field activities preformed for the AOC-specific investigations, Daily Chemical Quality Control Reports (DCQCRs) will be prepared, signed, and dated by the Contractor CQC representative. An example of the DCQCR format to be used is illustrated in Figure 9-1. These reports will be submitted to the U.S. Army Project Manager on a weekly basis. The contents of each DCQCR will include a summary of activities performed at the project site, weather information at the time of sampling, results of measurements made with field instruments, results of CCQC activities performed including field instrument calibrations, departures from the approved FSAP and/or AOC-specific SAP addendum, problems encountered during field activities, and any instructions received from government personnel. Any deviations that may affect the project DQOs will be immediately conveyed to the U.S. Army Project Manager. The following will be attached to each DCQCR submittal, as appropriate:

- the QA sample table that matches up primary and QC samples collected,
- a summary of field-generated analytical results,
- any other project-related forms utilized, and
- a copy of the CCQC preparatory phase meeting minutes (unless bound in a logbook).

A copy of the COC form(s) is sent to the Contractor Laboratory Coordinator weekly.

DATE________________

DAY

S	M	T	W	T	F	S

DAILY QUALITY CONTROL REPORT

COE PROJECT MANAGER____________________

PROJECT________________________________

JOB NO.________________________________

CONTRACT NO.___________________________

WEATHER	Bright Sun	Clear	Over-cast	Rain	Snow
TEMP	To 32	32-50	50-70	70-85	85 up
WIND	Still	Moder.	High	Report No.	
HUMIDITY	Dry	Moder.	Humid		

SUB-CONTRACTORS ON SITE:

EQUIUPMENT ON SITE:

WORK PERFORMED (INCLUDING SAMPLING):

Figure 9-1. Example of the Daily Chemical Quality Control Report to be Used for the RVAAP AOC-Specific Investigations

PROJECT____________________ REPORT NO.____________________

JOB NO.____________________ DATE:____________________

QUALITY CONTROL ACTIVITIES (INCLUDING FIELD CALIBRATIONS):

HEALTH AND SAFETY LEVELS AND ACTIVITIES:

PROBLEMS ENCOUNTERED/CORRECTIVE ACTION TAKEN:

SPECIAL NOTES:

TOMORROW'S EXPECTATIONS:

By:____________________
(Signature and date)

QA Check by:____________________
(Signature and date)

Figure 9-1 (continued)

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10.0 CORRECTIVE ACTIONS

10.1 SAMPLE COLLECTION AND FIELD MEASUREMENTS

Corrective actions will be implemented in the event that a discrepancy is discovered by field personnel, laboratory personnel, and/or during a field or desk audit. The initial responsibility for monitoring the quality of field activities and measurements lies with the field personnel. These personnel are responsible for following QA procedures, while the CCQC representative is responsible for verifying that the these procedures are being followed. This verification requires that the CCQC representative assess the correctness of the field methods and the ability of the field team to meet the QA objectives and to make a subjective assessment of the impact that a procedure has on the field objective and resulting data quality.

If a field problem occurs that might jeopardize the integrity of the project, cause a QA objective not to be met, or affect data quality, the first action taken will be an assessment of the severity of the problem by the CCQC representative. If the problem is determined to be minor, the CCQC representative will initiate an appropriate corrective action, which will be recorded in the field logbook. If the problem is determined to be significant or subject to reoccurrence, the CQC representative will initiate an NCR that will be submitted to the Contractor QA/QC Officer. An example of the NCR to be used for the AOC-specific investigations is illustrated in Figure 10-1. The Contractor QA/QC Officer will then propose and implement an appropriate corrective action as documented on the NCR.

The Contractor QA/QC Officer will be responsible for ensuring that corrective action for nonconformances are initiated by:

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- determining disposition or action to be taken,
- maintaining a log of nonconformances,
- reviewing nonconformance reports and corrective actions taken, and
- ensuring that nonconformance reports are included in the project evidence file.

If appropriate, the Contractor CQC representative or QA/QC Officer will ensure that no additional work that depends on the nonconforming activity is performed until corrective actions are implemented, and the nonconforming activity is corrected. Corrective actions for field measurements may include the following:

- repeat measurement to check errors,
- check proper instrument adjustments for ambient conditions such as temperature,
- check battery charge and connections,
- check instrument calibration and recalibrate as necessary,
- replace instrument or measurement devices, and
- stop work (if necessary).

10.2 LABORATORY ANALYSES

In the event that a laboratory problem occurs that might jeopardize the integrity of the project analytical results, cause a QA objective not to be met, or affect data quality, the first action taken will be an assessment of the severity of the problem by the Contractor Laboratory Coordinator. If the problem is

NONCONFORMANCE REPORT	DATE OF NCR	NCR NUMBER
	LOCATION OF NONCONFORMANCE	PAGE____OF ____
INITIATOR (NAME/ORGANIZATION/PHONE	FOUND BY	DATE FOUND
RESPONSIBLE ORGANIZATION / INDIVIDUAL		PROGRAM
		PROJECT

DESCRIPTION OF NONCONFORMANCE

CATEGORY __ __ __ __ __

A INITIATOR: DATE | QA/QC OFFICER DATE | CAR REQ'D YES ☐ NO ☐

DISPOSITION:

PROBABLE CAUSE:

ACTIONS TAKEN TO PREVENT RECURRENCE:

B PROPOSED BY: NAME DATE

JUSTIFICATION FOR ACCEPTANCE

C INITIATOR: NAME DATE

VERIFICATION OF DISPOSITION AND CLOSURE APPROVAL

REINSPECTION/RETEST REQUIRED YES ☐ NO ☐ IF YES; DATE RESULT

D QUALITY ASSURANCE: NAME DATE

Figure 10-1. Example of the Nonconformance Report to be Used for the RVAAP AOC-Specific Investigations

determined to be minor, the Contractor Laboratory Coordinator will initiate an appropriate corrective action, which will be recorded in a memorandum submitted to the Contractor Project Manager. The Contractor Project Manager will then relate the corrective action to be implemented to the Contractor CQC representative and/or Contractor QA/QC Officer if the problem is associated with activities being performed in the field. If the problem is determined to be significant, the Contractor Laboratory Coordinator will initiate an Analytical Data Package Nonconformance Report, illustrated in Figure 10-2, which will be submitted to the Contractor QA/QC Officer and addressed in the same manner as described in Section 10.1 of this FSP. Analytical nonconformance reports will be copied to the U.S. Army Project Manager.

Laboratory personnel will be 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 relative percent differences between duplicates.
- Unusual changes in detection limits are encountered.
- Deficiencies are detected during internal or external audits or from the results of performance evaluation samples.
- Inquiries concerning data quality are received.

ANALYTICAL DATA PACKAGE NONCONFORMANCE REPORT	DATE OF ADNCR	ADNCR NUMBER
	ANALYSIS TYPE ☐ ORGANIC ☐ INORGANIC ☐ RAD. ____ OTHER (SPECIFY)	PAGE _____ OF _____

INITIATOR (Name/Organization/Phone)	FOUND BY	DATE FOUND
RESPONSIBLE LABORATORY/INDIVIDUAL	PROGRAM	SDG/BATCH #
	PROJECT	CASE/ORDER #

DESCRIPTION OF NONCONFORMANCE

YES NO

A INITIATOR DATE QA/QC OFFICER DATE CAR REQ'D ☐ ☐

DISPOSITION, PROBABLE CAUSE, AND ACTIONS TAKEN TO PREVENT RECURRENCE:

PROPOSED BY: ______________________ ______________________

NAME DATE APPROVED BY DATE

B

VERIFICATION OF DISPOSITION

☐ ACCEPTABLE ☐ NOT ACCEPTABLE

C INITIATOR DATE INITIATOR DATE

DATA BASE ADMINISTRATOR APPROVAL

☐ NOT APPLICABLE ☐ NOT ACCEPTABLE ☐ ACCEPTABLE

— NO CHANGES REQUIRED

— CHANGES MADE

D DATA BASE ADMINISTRATOR DATE DATA BASE ADMINISTRATOR DATE

CLOSURE APPROVAL ☐ ACCEPTABLE ☐ NOT ACCEPTABLE

E QA/QC OFFICER DATE

REVISION 0

Figure 10-2. Example of the Analytical Data Package Nonconformance Report to be Used for the RVAAP AOC-Specific Investigations

11.0 PROJECT SCHEDULE

Because of the generic nature of the FSAP, the inclusion of a schedule is not practical. Project schedules will be developed for each AOC-specific investigation and included in the AOC-specific investigation SAP addenda.

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12.0 REFERENCES

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Ohio EPA 1995. Technical Guidance Manual for Hydrogeologic Investigations and Groundwater Monitoring.

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USEPA 2000. Data Quality Objectives Process for Hazardous Waste Site Investigations. EPA/600/R-00/007.

APPENDIX A

ELECTRONIC DATA DELIVERABLE FILE SPECIFICATIONS

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General Guidelines

All data collected to characterize the environmental conditions at RVAAP must be submitted to the RVAAP Environmental Site Coordinator at the conclusion of the project or at regular intervals specified by the site manager for ongoing monitoring projects.

Information that that is best presented as drawings (such as boring logs and well construction logs) or on maps (such as geophysical data or UXO locations) should be submitted to RVAAP Environmental Site Coordinator in electronic format. Drawings should be submitted in PDF format. Maps should be submitted in an ArcView compatible format. Map formats such as ESRI shape files, ArcInfo coverages, or AutoCad drawings (.DWG files) are acceptable. Electronic files containing the maps or drawings should be submitted on 3.5 inch diskettes or CDs.

Field and laboratory measurements of discrete media such as soil, sediment, surface water, groundwater, air, building materials, biological tissues, etc. must be submitted in a standardized electronic format described below. A standardized electronic format facilitates the storage, retrieval and exchange of information.

Data must be submitted in tabular format (rows and columns). Each column is called a field. The name of each field and a description of its contents may be found in the tables below. Some fields are required and some are optional as indicated. If the field is marked as required ("Y"), then the field must have a valid value. Fields marked as Y* are required conditionally as indicated in the field description. Fields that do not have values should be left blank.

Entries in each field should be limited to the maximum length indicated. Numeric fields indicated with an 'N' after the length should contain only numeric entries. Data qualifier fields and comment fields are available for annotation of results. Dates should be written in mm/dd/yyyy format. Time is represented in HH:MM format. Coded fields should include entries chosen from codes tables provided by the RVAAP Environmental Site Coordinator. New codes may be added with the approval of RVAAP Environmental Site Coordinator.

Tables should include a header line with the name of each field. Tables should be submitted on 3.5 inch diskettes or CDs in tab-delimited ASCII format.

Four different table formats are available for data submittal. The Station Table contains information that describes each location that was sampled. The Well Construction Table includes information on the location, depth and type of well developed. The Sample Table includes measurements made on discrete samples. The Field Measurement Table includes information about measurements made directly in the environment. Data should be submitted using the appropriate table or tables.

The tables are related to each other by common fields indicated in bold type in the table formats. Entries for the common fields must match exactly for related records. For example, the STATION field relates the Station Table to the Well Construction, Sample, and Field Measurement Tables. The Station Table must have an entry for each station that was included in one of the other tables.

Station Table

Field #/ Column	Field Name	Maximum Width/ Type	Definition/Comments	Required
Link to Well Construction, Sample, and Field Measurement Tables				
1 A	Station	**50**	**The station name should be unique within a project, although it may be shared between projects. See Figure 5-1 in the Facility-wide Sampling and Analysis Plan for naming conventions.**	**Y**
Sampling Station Information				
2 B	**Project Name**	**50**	**Name to describe sampling effort associated with establishing the station**	**Y**
3 C	**Functional Area**	**50**	**A name that describes the general area where the station is located. (For example: building number, stream name, pad number, etc.)**	
4 D	**Easting**	**14N**	**The numeric horizontal plane coordinate. *Required for any location that can be mapped at the RVAAP site.**	**Y***
5 E	**Northing**	**14N**	**The numeric vertical plane coordinate. *Required for any location that can be mapped at the RVAAP site.**	**Y***
6 F	**Grid Units**	**3**	**The measurement units for the coordinates (e.g., ft, m, yd). *Must be present if coordinates are present.**	**Y***
7 G	**Grid System**	**15**	**Identifier for grid system. Geographic data should be in Ohio State Plane NAD83 meters.**	
8 H	**Coord Method**	**15**	**Method identifying how the coordinates were obtained (e.g., Global Positioning System, survey, estimated)**	
9 I	**Coord Accuracy**	**10N**	**Estimation of the accuracy of the coordinates in the units reported**	
10 J	**Elevation**	**10N**	**The ground surface elevation for the station.**	
11 K	**Elevation units**	**2**	**Units for measuring elevation (FT, M, etc.). Must be present if the elevation is present.**	**Y***
12 L	**Elevation Method**	**10**	**The method identifying how the elevation was determined (e.g., survey, estimate, contours).**	
13 M	**Elevation Accuracy**	**10N**	**Estimation of the elevation accuracy in the units reported.**	
14 N	**Station Type**	**20**	**The station type: well, borehole, surface, etc.**	
15 O	**Station Description**	**50**	**Additional information about the station.**	
16 P	**Comments**	**254**	**Any desired comments.**	

Well Construction Table

Field #/ Column	Field Name	Maximum Width/ Type	Definition/Comments	Required
			Link To Station Table	
1 A	**Station**	**50**	**The station name should be unique within a project, although it may be shared between projects. This is the name that will be used to identify the well. This entry must exactly match an entry in the Station Table which contains the location information.**	**Y**
			Well Construction Information	
2 B	**Project Name**	**50**	**Name to describe sampling effort associated the well development**	**Y**
3 C	**Functional Area**	**50**	**A name that describes the general area where the station in located. (For example: building number, stream name, pad number, etc.)**	
4 D	**Well Type**	**20**	**The well type: monitoring well, piezometer, recovery well, etc.**	**Y**
5 E	**Vertical RP**	**20**	**Vertical reference point (RP) for vertical measurements. For example, top of well casing, top of pad, ground surface, etc. *Required for monitoring wells.**	**Y***
6 F	**RP Elevation**	**10N**	**Elevation of vertical reference point (RP). *Required for monitoring wells.**	**Y***
7 G	**Elevation units**	**5**	**Units for measuring elevation (FT, M, etc.). *Must be present if the elevation is present.**	**Y***
8 H	**Elevation Method**	**10**	**The method identifying how the elevation was determined (e.g., survey, estimate, contours).**	
9 I	**Protective Casing Height**	**10N**	**Distance of highest point of well protective casing (outer casing) below RP. (Value is negative if above RP.)**	
10 J	**Well Casing Height**	**10N**	**Distance of highest point of well casing (inner casing) below RP. (Value is negative if above RP.)**	
11 K	**Total Depth**	**10**	**Distance from RP to bottom of well. *Required for monitoring wells.**	**Y***
12 L	**Depth Units**	**5**	**Units for measurement of vertical distance (FT, M). *Required if depth or heights are reported.**	**Y***
13 M	**Screen Top**	**10N**	**Distance from RP to screen top. *Required for screened monitoring wells.**	**Y***
14 N	**Screen Bottom**	**10N**	**Distance from RP to screen bottom. *Required for screened monitoring wells.**	**Y***
15 O	**Screen Material**	**20**	**Material of which screen is constructed (stainless steel, PVC, etc.) *Required for screened monitoring wells.**	**Y***
16 P	**Diameter Units**	**5**	**Units for diameter measurements (IN, CM, FT, etc.).**	**Y**
17 Q	**Screen Diameter**	**10N**	**Inside diameter of screen. *Required for screened monitoring wells. . (Use units from Diameter Units field.)**	**Y***
18 R	**Screen Opening Size**	**10N**	**Screen slot size or opening size. (Use units from Diameter Units field.)**	**Y**
19 S	**Well Casing Material**	**20**	**The inner well casing/riser material (stainless steel, PVC, etc). *Required for monitoring wells.**	**Y***

Field #/ Column	Field Name	Maximum Width/ Type	Definition/Comments	Required
20 T	Well Casing Diameter	10N	Inside diameter of the inner well casing/riser. . (Use units from Diameter Units field.)	Y
21 U	Protective Casing Material	20	Material of which the protective (outer) casing is constructed (stainless steel, PVC, etc.)	
22 V	Protective Casing Diameter	10N	Inside diameter of protective casing.	
23 W	Borehole Diameter	10N	Diameter of well boring. (Use units from Diameter Units field.)	
24 X	Completion Date	10	Date of completion of the well (mm/dd/yyyy).	Y
25 Y	Date Abandoned	10	Date that well was plugged and abandoned (mm/dd/yyyy). *Required if well is plugged.	Y*
26 Z	Aquifer Zone	20	Name used to describe aquifer intercepted by screened interval. *Required for monitoring wells.	Y*
27 AA	Comments	254	Any desired comments.	

Sample Table

This format is used to transfer information from sample analyses. It is meant to capture as much information as possible, however, it is recognized that not all fields may be relevant or available. Therefore, only a limited number of the fields are required. It is recognized that files in this format may be significantly empty. The format specification has been broken into subsections relating to the basic types of information.

The file should not contain laboratory quality control (QC) samples (e.g., method blanks, surrogates). It may contain field QC data such as field duplicates, results from split samples, trip blanks and equipment rinsates.

Field names marked with an asterisk are coded fields. Codes for these fields should be chosen from the attached codes table. Codes may be added with the approval of the RVAAP Data Manager.

Field #/ Column	Field Name	Maximum Width	Definition/Comments	Required
		Link to Station Table		
1 A	Station	**50**	**The station name should be unique within a project, although it may be shared between projects. This entry must exactly match an entry in the Station Table.**	**Y**
		Link to Field Measurement Table		
2 B	Client Sample ID	**22**	**The client's sample identification number. See Figure 5-1 in the Facility-wide Sampling and Analysis Plan for naming conventions.**	**Y**
		Field Sample Information		
3 C	**Alternate Sample ID**	**15**	**A shorter sample ID used if needed to facilitate field recording and processing by laboratory information management systems.**	
4 D	**Project Name**	**50**	**Identifies sampling effort associated with the data.**	**Y**
5 E	**Sample Group**	**50**	**A name used to group samples into related subsets. For example: 'LL-x Random Grid Samples', 'Waste Characterization Samples', 'Bldg. x Exposure Characterization'.**	
6 F	**Date Collected**	**10**	**The date the sample was collected. Should be reported as MM/DD/YYYY. If reported as MM/DD/YY, the year will be interpreted as 20YY.**	
7 G	**Time Collected**	**5**	**The time the sample was collected in HH:MM format.**	
8 H	**Field Sample Type***	**10**	**The sample type: regular, field duplicate, trip blank, split, source blank, etc.**	**Y**
9 I	**Sampling Method***	**20**	**The sampling method: grab, grab composite, flow composite, etc.**	
10 J	**Starting Depth**	**8N**	**The beginning depth (smaller number) for the sampling interval. For soil samples this is the depth below ground surface. For groundwater samples this may be used to indicate the top of the screened interval.**	

Field #/ Column	Field Name	Maximum Width	Definition/Comments	Required
11 K	Ending Depth	8N	The ending depth (larger number) for the sampling interval. For soil samples this is the depth below ground surface. For groundwater samples this may be used to indicate the bottom of the screened interval.	
12 L	Depth Units*	5	The measurement units for the sampling interval. Must be present if depth interval is specified.	Y*
13 M	Media*	15	The medium from which the sample was collected (e.g., soil, groundwater).	Y
14 N	Sampling Device*	20	The sampling device used to collect the sample (e.g., auger, bailer, bucket, split spoon).	
15 O	Comment	50	Short comment about the sample.	
Laboratory Method				
16 P	Laboratory	50	The laboratory performing the analysis.	
17 Q	Matrix*	10	Code for the analytical matrix. Valid values are solid, water, biota, air.	
18 R	Analysis Type*	20	Code or description for the type of analysis (organic, inorganic, rad, pesticide, TCLP).	
19 S	Method*	21	Analysis method identification reported as the method number from the statement of work (e.g., SW846-6010).	
20 T	SDG Number	15	The sample delivery group number assigned by the laboratory.	
21 U	Lab Sample ID	15	The laboratory sample ID.	
22 V	Date Received	10	The date the sample was received by the laboratory. Format as MM/DD/YYYY. If formatted as MM/DD/YY, the year will be interpreted as 20YY.	
23 W	Date Extracted	10	The date the sample was extracted or prepared by the laboratory. Format as MM/DD/YYYY. If formatted as MM/DD/YY, the year will be interpreted as 20YY.	
24 X	Date Analyzed	10	The date the sample was analyzed by the laboratory. Format as MM/DD/YYYY. If formatted as MM/DD/YY, the year will be interpreted as 20YY.	
25 Y	Percent Solids	8N	The percent solids for the sample. Represented as a percentage (25% = 25, not 0.25).	
26 Z	Sample Weight or Volume	8N	The sample weight for solid samples or volume for liquid samples.	
27 AA	Weight Units	5	The units associated with the sample weight. *Must be present if weight or volume is present.	Y*
28 AB	Reported Basis*	5	A flag indicating basis of reported concentration: “DRY”=concentration corrected to dry weight; “WET”=concentration reported on an “as received” reporting basis.”	
29 AC	Analysis Level	4	EPA–specified analysis level (e.g. ‘LOW”, ‘MED’).	
Analytical Results				

Field #/ Column	Field Name	Maximum Width	Definition/Comments	Required
30 AD	Result Type*	5	Flag to indicate if a result is a regular sample (REG) or a secondary or QC result.	Y
31 AE	CAS Number	15	The CAS number for the analyte. Leave blank if unknown or uncertain.	
32 AF	Chemical	50	The chemical or analyte name.	Y
33 AG	Result	15N	Reportable numeric result for the analyte.	Y
34 AH	Units	15	Units for the result.	Y
35 AI	MDL	15N	Method detection limit for chemicals or minimum detectable activity for radionuclides reported in the same units as the result.	
36 AJ	SQL	15	Sample quantitation limit reported in the same units as the result.	
37 AK	Counting Error	15N	The 2 sigma counting error for radionuclide analyses reported in the same units as the result. *Required for when radionuclide results are reported.	Y*
38 AL	Dilution	8N	The overall dilution of the sample aliquot as a factor of the initial sample size. A value of 1 should correspond to nominal conditions for the method. Values less than 1 correspond to concentrations. Blank will be interpreted as 1.	
39 AM	Lab Qualifier	6	The laboratory qualifier originally assigned to the result by laboratory. *Blank is a valid value; hence, the data should contain laboratory qualifiers, but the field may correctly be blank.	Y*
40 AN	Data Qualifier	6	The qualifier assigned based on data validation. This qualifier should be one of the following: J, UJ, U, R, =. The "=" indicates that the sample was detected at the concentration reported.	
41 AO	Validated	1	Flag indicating if the data were validated ("Y/N"). Blank means "N."	
42 AP	Val Code	20	List of codes identifying why data qualifiers were applied. Separate documentation should contain definitions of codes.	
43 AQ	Filtered/Unfiltered	1	*F = Sample filtered in the field or at the laboratory. U or blank means sample was not filtered.	Y*
44 AR	TCLP	1	*T=TCLP (Toxicity Characteristic Leaching Procedure) or extractable/reactivity analysis. Blank means sample is not a TCLP/reactivity analysis. Used to differentiate between analyses that may have been performed with the same method.	Y*
45 AS	TIC Retention Time	10	Any value present indicates the analyte is a TIC (tentatively identified compound). Value may be numeral or character.	Y*

Field Measurement Table

Field #/ Column	Field Name	Maximum Width	Definition/Comments	Required
Link to Station Table				
1 A	Station	50	The station name should be unique within a project, although it may be shared between projects. This entry must exactly match an entry in the Station Table.	Y
Link to Sample Table (if applicable)				
2 B	Client Sample ID	22	*If the measurement is associated with the collection of a sample, this should refer to the related sample ID from the Sample Table.	Y*
Field Measurement Information				
3 C	Field Measurement ID	15	ID used if needed to facilitate field recording and processing by field information management systems.	
4 D	Project Name	50	Identifies sampling effort associated with the data..	Y
5 E	Date Collected	10	Date the measurement was collected formatted as MM/DD/YYYY. If formatted as MM/DD/YY, the year will be interpreted as 20YY.	Y
6 F	Time Collected	5	The time the measurement was made in HH:MM format.	
7 G	Measurement Name	50	The measurement that was performed (e.g., turbidity, conductivity, depth to water)	Y
8 H	CAS Number	15	CAS number if the measurement is a chemical concentration.	
9 I	Result	15N	The numeric value for the measurement.	Y
10 J	Units	15	The units for the measurement.	Y
11 K	Detection Limit	15N	Detection limit reported in the same units as the result.	
12 L	Result Qualifier	6	Indicates qualifications on the result such as less than detection limit or off scale. *Blank is a valid entry indicating no qualification.	Y*
13 M	Validation Qualifier	6	Indicates qualification of result based on QC review.	
14 N	Method	21	The method number or instrument name used for making the measurement.	
15 O	Comment	50	Comment on measurement.	

APPENDIX B

OAC RULE 13 AUTHORIZATION
RAVENNA ARMY AMMUNITION PLANT

US Army Corps of Engineers
Louisville District

OAC Rule 13 Authorization

Ravenna Army Ammunition Plant
Ravenna, Ohio

Prepared by:
U.S. Army Corps of Engineers

July 2000

1. INTRODUCTION

This is a generic request for authorization from the Ohio Environmental Protection Agency (Ohio EPA) to conduct investigative activities at known and to-be-discovered Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Areas of Concern (AOCs) at Ravenna Army Ammunition Plant (RVAAP) that are regulated under the Ohio Administrative Code (OAC) 3745-27-13 (Authorization to Engage in Filling, Grading, Excavating, Building, Drilling, or Mining on Land Where a Hazardous Waste Facility or Solid Waste Facility Was Operated), hereinafter referred to as OAC Rule 13. An agreement between RVAAP and the Ohio EPA Northeast District, dated January 4, 1996, stipulates that a generic OAC Rule 13 authorization request be developed according to the requirements of the rule and presented in the Facility-wide Sampling and Analysis Plan (SAP). The original Facility-wide SAP (USACE 1996a) contained a request for authorization for only four AOCs. This document supercedes the 1996 request with more current site knowledge and more generalized requirements for conducting investigations at RVAAP.

Investigation activities at RVAAP commonly include processes such as those named in the OAC statute, i.e., filling, grading, excavating, and drilling. The request for authorization under OAC Rule 13 addresses measures required to ensure that investigative activities necessary to characterize individual AOCs under the Comprehensive Enviromental Response, Compensation, and Liability Act (CERCLA) are protective of human health and the environment.

This generic request for OAC Rule 13 authorization applies only to AOCs being addressed under CERCLA at RVAAP. Where there is no reasonable expectation that solid or hazardous wastes have been deposited, AOCs will not require OAC Rule 13 authorization. At this writing, there are 36 known CERCLA AOCs at RVAAP. It is possible that several more remain to be identified Should it be determined by Ohio EPA and RVAAP that additional AOCs require Rule 13 authorization, a formal request for authorization under this generic request will be submitted to the Ohio EPA. Additional safeguards, if necessary, will be addressed in the supplemental request for an individual AOC. The status, plans, and schedules for current characterization and removal activities at RVAAP AOCs are presented in the Installation Action Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio (Operations Support Command [OSC], March 2000). The Action Plan is revised annually to reflect current, planned, and completed environmental activities at RVAAP.

Table 1-1 lists all the current CERCLA AOCs at RVAAP. It is possible that several more remain to be identified.

The following sections provide the information required under OAC Rule 13. Much of the information required under the provisions of OAC Rule 13 is contained in existing facility documents and CERCLA work plans. Therefore, references to existing documentation are used where appropriate to meet the requirements of the rule.

2. OAC 3745-27-13(C)(1) – LOCATION AND DESCRIPTION

The location of RVAAP on a 7.5-minute USGS topographic quadrangle map is provided in the Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio (USACE 1996b). The locations, descriptions, and operating histories of individual AOCs are also included in the Preliminary Assessment.

RVAAP is located in northeastern Ohio, within Portage and Trumbull Counties. The facility lies 4.8km (3 mi) east-northeast of the Town of Ravenna and approximately 1.61 km (1 mi) northwest of the Town of Newton Falls. The installation consists of 8,668 ha (21,419 acres) bounded by State Route 5 and the CSX System Railroad on the south; State Route 534 on the east; Garrettsville and Berry Roads on the west; and the CONRAIL Railroad on the north. The Michael J. Kirwan Reservoir is located immediately south of the facility. Land use surrounding the installation is primarily agricultural, open space, and residential.

TABLE 1-1. CERCLA AOCs at RVAAP

RVAAP-02 Erie Burning Grounds	RVAAP-34 Sand Creek Disposal Road Landfill
RVAAP-03 Demolition Area #1	RVAAP-36 Pistol Range
RVAAP-04 Demolition Area #2	RVAAP-38 NACA Test Area
RVAAP-05 Winklepeck Burning Grounds	RVAAP-39 Load Line 5 Fuze Line 1
RVAAP-06 C Block Quarry	RVAAP-40 Load Line 7 Booster Line 1
RVAAP-08 Load Line 1 and Settling Pond	RVAAP-41 Load Line 8 Booster Line 2
RVAAP-09 Load Line 2 and Settling Pond	RVAAP-42 Load Line 9 Detonator Line
RVAAP-10 Load Line 3 and Settling Pond	RVAAP-43 Load Line 10 Percussion Element
RVAAP-11 Load Line 4 and Settling Pond	RVAAP-44 Load Line 11 Artillery Primer
RVAAP-12 Load Line 12 and Settling Pond	RVAAP-45 Wet Storage Area
RVAAP-13 Building 1200 and Settling Pond	RVAAP-46 Buildings F-15 and F-16
RVAAP-16 Quarry Landfill	RVAAP-47 Building T-5301
RVAAP-19 Landfill North of Winklepeck	RVAAP-48 Anchor Test Area
RVAAP-28 Mustard Agent Burial Site	RVAAP-49 Central Burn Pits
RVAAP-29 Upper and Lower Cobbs Ponds	RVAAP-50 Atlas Scrap Yard
RVAAP-32 40- and 60-mm Firing Range	RVAAP-51 Dump Along Paris-Windham Road
RVAAP-33 Load Line 6	

RVAAP is a government-owned, contractor-operated U.S. Army Operations Support Command (OSC) facility. Currently, RVAAP is an inactive facility maintained by a contracted caretaker, TolTest, Inc. Table 2-1 provides the RVAAP Command Organization, Department of Defense (DoD) Installation Restoration Program (IRP) executing agency, and lead regulatory agencies.

TABLE 2-1 RVAAP Organizational Responsibilities

Command Organization
Major Command: U.S. Army Materiel Command Major Subordinate Command: U.S. Army OSC Installation: RVAAP, Commander's Representative Installation Contractor: TolTest, Inc.
Installation Restoration Program Executing Agency
U.S. Army Corps of Engineers, Louisville District U.S. Army Operations Support Command
Regulatory Agencies
Ohio Environmental Protection Agency, Northeast District U.S. Environmental Protection Agency, Region 5

RVAAP had the capabilities to load, assemble, and pack military ammunition. These operations have been inactive since 1992. As part of RVAAP's mission, the inactive facilities were maintained in standby status for a number of years, by keeping equipment in a condition sufficient to permit resumption of production. Over the years, RVAAP also handled and stored strategic and critical materials for various government agencies. The facility also received, stored, maintained, transported, and demilitarized military ammunition and explosive items. The only activities still being carried out are the storage of bulk explosives and the infrequent demolition of unexploded ordnance (UXO) and ordnance explosive waste (OE) found at the installation. The Army is also overseeing the reclamation of railroad track, telephone line, and steel for reuse or recycling. The Army has begun the demolition of excess buildings at Load Lines 1, 2, and 12, which includes the removal of friable and non-friable asbestos.

In 1998, much of the land at RVAAP was transferred from the Army to the National Guard Bureau. Roughly 6,544 ha (16,164 acres) of land is now under the administrative control of the Ohio Army National Guard (OHARNG). The Guard uses RVAAP land and facilities for training, maintenance, and storage of heavy equipment.

3. OAC 3745-27-13(C)(2) – INVESTIGATION ACTIVITIES

The planned investigation activities for which authorization is requested are as follows:

- Drilling
- Trenching
- Monitoring well installation
- Piezometer and well point installation
- Surface water and sediment sampling
- Excavation
- Surgical removal/other removal of UXO and suspected UXO
- Grading
- Placement of clean fill material.

These activities are necessary to characterize the AOCs under CERCLA and effect their restoration under the IRP. The approach to implementing CERCLA under the IRP is described in Section 1 of the Facility-wide SAP (USACE 2000a) and in the Installation Action Plan. The characterization of the AOCs under this generic authorization request is expected to include investigations to evaluate the nature of buried solid waste materials and the potential impact from leaching of contaminants on adjacent soils, groundwater, surface water, and sediment. The specific investigation activities for each AOC will be defined in an investigation-specific addendum to the Facility-wide SAP. The addendum will be submitted in draft form for Ohio EPA review and comment, and as a final document for Ohio EPA review, prior to the commencement of any investigative activities at an AOC.

Table 2-2 presents the descriptions of the planned investigation activities listed above.

TABLE 2-2. Descriptions of Planned Investigation Activities for AOCs at RVAAP

ACTVITY	DESCRIPTION
Drilling	Soil borings may be drilled in and adjacent to former disposal areas in order to collect surface and subsurface soil samples for laboratory analysis to characterize potential contaminants, or to characterize lithology.
Monitoring well installation	Boreholes may be drilled to install monitoring wells in and adjacent to an AOC to collect groundwater samples for characterization of contaminants and subsurface geology.
Piezometer and well point installation	Piezometer and well points may be installed to determine the depth to shallow groundwater and the potentiometric surface at an AOC, and to collect screening groundwater samples. This information will be used to locate monitoring wells in the correct orientation to monitor downgradient water quality and flow. It may also be used to determine the maximum allowable depths of trenches and other excavations so that the water table is not penetrated during these operations. This will mitigate the potential for cross-media contamination and creation of preferential flow paths.
Trenching	Trenches may be excavated in some disposal areas to evaluate the nature of buried waste in former landfills for which records are limited or unavailable. Samples of waste materials and adjacent subsurface soils may be collected for laboratory analysis to characterize potential source materials and any contamination resulting from leaching. Trenches will not penetrate groundwater zones (perched or water table).
Surface water and sediment sampling	Samples may be collected from streams and other drainage features (culverts, ponds, sumps, and pits) adjacent to former disposal areas and submitted for laboratory analysis to characterize the potential impact of disposal practices on these media.
Excavation and removal of UXO and suspected UXO	Interim and emergency removals of hazardous or solid waste materials (including UXO and OE) in soils may require the excavation and disposal of contaminated soils and associated materials. UXO and suspected UXO may represent a significant safety hazard requiring surgical removals as well.
Placement of clean fill	Removals of contaminated soils and/or UXO may require the placement of clean soil (fill) in order to restore the site.
Grading	Removal of contaminated soils during interim or emergency actions will require the proper grading of the ground surface.

4. OAC 3745-27-13(C)(3) – PREVIOUS AND EXISTING PERMITS, APPROVALS, AND ORDERS

There are no previous or existing permits, approvals, or orders pertaining to the CERCLA AOCs at RVAAP for which authorization under this rule is being requested. The regulatory history of RVAAP is presented in the Preliminary Assessment; additionally, the Installation Action Plan contains information on the installation's regulatory history.

5. OAC 3745-27-13(C)(4) – LETTERS OF ACKNOWLEDGEMENT

All parcels of land to which this generic request for authorization pertains are owned by the U.S. Army. Because of the interior locations of the CERCLA AOCs within the boundaries of the facility, all adjacent parcels are similarly the property of the Army. Consequently, no letters of acknowledgement are included in this request for authorization under OAC Rule 13.

6. OAC 3745-27-13(C)(5) – LETTERS OF NOTICE

Letters of notice of this generic request for authorization are required, under the provisions of OAC Rule 13, to be sent to the board of health for the health district and the local zoning authority for the area where the facility is located. The Departments of Health for both Trumbull and Portage Counties, Ohio, were notified in 1996 and 1998. Additional notification of these agencies will be required for this generic request for authorization. Because the federal government owns RVAAP, local zoning authorities do not have jurisdiction over the facility. Therefore, notices of this revised request were not sent to these agencies. The Boards of Health for Trumbull and Portage Counties will be notified of this generic request.

7. OAC 3745-27-13(C)(6) – HISTORY OF HAZARDOUS WASTE OR SOLID WASTE TREATMENT, STORAGE, OR DISPOSAL OPERATIONS

A summary of all known hazardous and solid waste treatment, storage, and disposal facilities at RVAAP was presented in the Preliminary Assessment in 1996. Since that time, several additional CERCLA AOCs have been added to the original list of 23, resulting in a total of 36 CERCLA AOCs. The additional 13 AOCs and their histories are described in the Installation Action Plan or the Relative Risk Site Evaluation (RRSE) Report (USACHPPM 1998).

8. OAC 3745-27-13(C)(7) – CLOSURE ACTIVITIES

Hazardous waste and solid waste TSD operations have ceased at all AOCs at RVAAP. Formal closure activities have been conducted at selected AOCs in conjunction with RCRA-regulated portions of the AOCs. Section 1 of the Facility-wide SAP (USACE 2000) shows that the investigation of potential contamination is the first step in the remediation process, which leads to eventual closure. A summary of all known previous closure activities for AOCs at RVAAP is presented in the Preliminary Assessment, with additional information in the Annual Installation Action Plan for RVAAP.

9. OAC 3745-27-13(C)(8) – INVESTIGATION METHODS AND PROCEDURES

The investigation of CERCLA AOCs at RVAAP will be conducted in accordance with the Facility-wide SAP, HASP, and QAPP, as well as the investigation-specific SAP addenda developed to meet the CERCLA requirements. These plans contain detailed methods and procedures for performing the described investigation activities. The intent of the facility-wide documents is to guide the investigation activities, to the extent practical, expected to be common to the investigation of all CERCLA AOCs at RVAAP. For each AOC-specific investigation, addenda to the facility-wide plans will be developed that will contain additional project-specific information regarding activities, methods, and procedures. The investigation of an AOC cannot be implemented without the Facility-wide SAP, HASP, and investigation-specific addenda. The contents and relationship of the facility-wide plans and investigation-specific addenda are addressed in greater detail in Section 1 of the Facility-wide SAP. The facility-wide plans and their addenda will be reviewed and commented on by the Ohio EPA before the commencement of field activities.

Detailed procedures describing the investigative methods are contained in the Sampling and Analysis Plan (SAP) portion of either the Facility-wide SAP, or the investigation-specific addenda for drilling, monitoring well installation, piezometer and well point installation, trenching, surface water and sediment sampling, excavating, UXO removal, placing clean fill, and grading.

10. OAC 3745-27-13(C)(9) – ENVIRONMENTAL PROTECTION

As previously described in Section 9 of this generic request for authorization, the investigation of CERCLA AOCs at RVAAP will be conducted in accordance with facility-wide work plans and investigation-specific work plan addenda developed to meet the requirements developed by the Ohio EPA and the Army, under CERCLA. These plans contain detailed methods and procedures for performing the described work. The primary focus of these documents is to produce legally defensible investigation results and ensure protection of human health and the environment in the process. Consequently, the investigation methods and procedures cited in Section 9 are in compliance with applicable state and federal rules, laws, and regulations for conducting CERCLA investigations. These procedures contain provisions for protection of the environment during and as a consequence of field activities. In addition, the Facility-wide SAP and its addenda contain provisions (Section 7, Facility-wide SAP) for the management of Investigation-Derived Waste (IDW) in accordance with applicable state and federal rules, laws, and regulations. Provisions are included for the temporary storage or disposal of IDW in accordance with rules, laws, and regulations.

11. OAC 3745-27-13(C)(10) – REMOVAL OF SOLID OR HAZARDOUS WASTE, OR POTENTIALLY CONTAMINATED SOILS

During the investigation of CERCLA AOCs at RVAAP, it is expected that IDW will be generated as a result of characterization activities. Excess soil and drill cuttings from soil borings, purged groundwater, and equipment decontamination water could be removed from an individual AOC. These materials may be hazardous, contaminated but non-hazardous, or not contaminated. Section 7 of the Facility-wide SAP and the investigation-specific addenda contain provisions for representative sampling and analysis of IDW in accordance with applicable state and federal rules, laws, and regulations. The Facility-wide SAP also requires submittal of a copy of a letter of acceptance from a permitted disposal facility to the Ohio EPA prior to removal of IDW from an AOC for off-site disposal. IDW management is accomplished in conjunction with the RVAAP Environmental Coordinator.

12. OAC 3745-27-13(C)(11) – CLOSURE PROCEDURES

The formal process for completing regulatory closure of AOCs at RVAAP regulated under CERCLA is described in Section 1 of the Facility-wide SAP, and additional information is provided in the Installation Action Plan (OSC, March 2000). Because the CERCLA process is iterative and therefore requires a considerable amount of time in which to implement a remediation, the Facility-wide SAP and investigation-specific addenda contain provisions for reestablishing AOC conditions following completion of characterization activities. This is done in order to mitigate the impact on human health and the environment from these activities until such time as the AOC can be remediated (if necessary) under the CERCLA process. These reestablishment measures are described for each investigative activity presented in the Facility-wide SAP and investigation-specific addenda.

13. OAC 3745-27-13(C)(12) – GENERIC AUTHORIZATION REQUEST SIGNATURES

The statements and assertions of fact made in this application are true and complete to my knowledge and comply fully with the applicable state requirements as stated in OAC Rule 3745-27-13

John A. Cicero, Jr.
Commander's Representative
Ravenna Army Ammunition Plant

Notary Public

REFERENCES

Operations Support Command, March 2000. Installation Action Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio.

USACE 1996a. Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio.

USACE 1996b. Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio.

USACHPPM 1998. Relative Risk Site Evaluation Report, Ravenna Army Ammunition Plant, Ravenna, Ohio.

USACE 2000. Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio (in prep.).

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QUALITY ASSURANCE PROJECT PLAN FOR ENVIRONMENTAL INVESTIGATIONS AT THE RAVENNA ARMY AMMUNITION PLANT RAVENNA, OHIO

March 2001

Quality Assurance Project Plan
for Environmental Investigations
at the
Ravenna Army Ammunition Plant
Ravenna, Ohio

March 2001

____
(U.S. Army Project Manager)

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(U.S. Army Project Chemist)

QUALITY ASSURANCE PROJECT PLAN
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LIST OF FIGURES

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ACRONYMS

AOC	Area of Concern
ASTM	American Society of Testing and Materials
CFR	*Code of Federal Regulations*
CDQR	Chemical Data Quality Assurance Report
COC	chain of custody
CQAR	Chemical Quality Assurance Report
CX	Center of Expertise
DQO	data quality objective
EDD	electronic data deliverable
EPA	U.S. Environmental Protection Agency
FCR	field change request
FID	flame ionization detector
FSAP	Facility-Wide Sampling and Analysis Plan
FSP	Field Sampling Plan
GC/MS	gas chromatograph/mass spectrometer
HTRW	Hazardous, Toxic, and Radioactive Waste
ICP	inductively coupled plasma
IDW	investigation-derived waste
LCS	laboratory control sample
MDL	Method Detection Limits
MS	matrix spike
MSD	matrix spike duplicate
M&TE	Material and Testing Equipment
NCR	Nonconformance Report
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standards and Testing
Ohio EPA	Ohio Environmental Protection Agency
PAH	polycylic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCSR	Quality Control Summary Report
RPD	relative percent difference
RVAAP	Ravenna Army Ammunition Plant
SOP	standard operating procedure
SVOC	semivolatile organic compound
USACE	U.S. Army Corps of Engineers
VOC	volatile organic compound

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INTRODUCTION

It is expected that the U.S. Army Corps of Engineers (USACE) will continue to fulfill the role of laboratory data Quality Assurance Administrator for all environmental projects at the Ravenna Army Ammunition Plant (RVAAP). The USACE and the U.S. Environmental Protection Agency (EPA) require that all environmental monitoring and measurement efforts mandated or supported by these organizations participate in a centrally managed quality assurance (QA) program.

Any party generating data under this program has the responsibility to implement minimum procedures to ensure that the precision, accuracy, completeness, and representativeness of its data are known and documented. To ensure that the responsibility is met uniformly, each party must prepare a written Quality Assurance Project Plan (QAPP) covering each project it is to perform.

This QAPP presents the organization, objectives, functional activities, and specific QA and quality control (QC) activities associated with the Facility-wide Sampling and Analysis Plan (FSAP) for the RVAAP in Ravenna, Ohio. This QAPP also describes the specific protocols that will be followed for sampling, sample handling and storage, chain of custody, and laboratory analysis.

All QA/QC procedures will be in accordance with applicable professional technical standards, EPA requirements, government regulations and guidelines, and specific project goals and requirements. This QAPP is prepared by Science Applications International Corporation in accordance with EPA QAPP and USACE guidance documents, Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans (EPA 1991a), the Region V Model QAPP (EPA 1991b), EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA 1994a), and Requirements for the Preparation of Sampling and Analysis Plans (USACE 1994). Concurrence with the USACE Shell Document for Analytical Chemistry Requirements, version 1.0, 2 NOV 98 and Environmental Data Assurance Guideline, USACE–Louisville District, May 2000 is expected.

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1.0 PROJECT DESCRIPTION

This Quality Assurance Project Plan (QAPP) is prepared as part of the Facility-wide Sampling and Analysis Plan (FSAP) for the Ravenna Army Ammunition Plant (RVAAP) in Ravenna, Ohio. Investigation-specific addendum will supplement this plan as required when individual AOC investigations are implemented. The FSAP contains the primary project description and background information for the FSAP and, as such, the information contained in the FSAP shall be referenced here and not repeated.

1.1 SITE HISTORY/BACKGROUND INFORMATION

This information is contained in Section 1.1 of the FSAP. Individual tasks at RVAAP will address specific area history and background as needed in investigation-specific addenda.

1.2 PAST DATA COLLECTION ACTIVITY/CURRENT STATUS

This information is contained in Section 1.2 of the FSAP. Individual tasks at RVAAP will address specific area past and current data collection activities as needed in investigation-specific addenda.

1.3 PROJECT OBJECTIVES AND SCOPE

This information is contained in Section 3.0 of the FSAP. Individual tasks at RVAAP will address unique objectives and scope for specific areas as needed in investigation-specific addenda.

1.4 SAMPLE NETWORK DESIGN AND RATIONALE

This information is contained in Section 4.0 of the FSAP. Individual tasks at RVAAP will present sampling designs and sampling rationales as required in investigation-specific addenda.

1.5 PARAMETERS TO BE TESTED AND FREQUENCY

General sample matrix types, analytical parameters, and analytical methods can be found in Section 4.0 of the FSAP and Table 1-1 of this QAPP. Specific delineation of sample numbers, quality assurance (QA) sample frequencies and field quality control (QC) sample frequencies will be provided for each investigation in each specific addendum.

1.6 PROJECT SCHEDULE

Project schedule is discussed in Section 11.0 of the FSAP. Individual task schedules will be developed and defined in investigation-specific addenda.

Table 1-1. Soil, Sediment, Surface Water, and Groundwater Sampling, RVAAP

Parameter	Methods	No. of Field Samples	No. of Fld. Dup. Samples[a]	No. of Sampler Rinsates	No. of Trip Blanks[b]	Total A-E Samples	QA Dups./ Splits	QA Trip Blanks	Total QA Samples
Soil/Sediment									
Volatile Organics	SW-846, 8260B/5030								
Semivolatile Organics	SW-846, 8270C/3540								
Pesticides	SW-846, 8081A/3540								
PCBs	SW-846, 8082/3540								
Explosives	SW-846, 8330								
Nitroquanidine	SW846, 8330 Mod.								
Nitrocellulose	SW846, 9056 Mod.								
Polyaromatic Hydrocarbons	SW846, 8310								
Metals (TAL)	SW-846, 6010B/6020/7471								
Cyanide	SW-846, 9011/9012								
Geotech Analysis[c]	ASTM Methods								
Surface Water/ Groundwater									
Volatile Organics	SW-846, 8260B								
Semivolatile Organics	SW-846, 8270C/3520								
Pesticides	SW-846, 8081A/3520								
PCBs	8082/3520								
Explosives	SW-846, 8330								
Nitroquanidine	SW846, 8330 Mod.								
Nitrocellulose	SW846, 9056 Mod.								
Polyaromatic Hydrocarbons	SW846, 8310								
Metals (TAL)	SW-846, 6010B/6020/7471								
Cyanide	SW-846, 9010/9012								

[a]Field duplicates should be collected from areas having the highest potential for contamination.
[b]A trip blank is to accompany each cooler shipped with samples for volatile organic analysis in water.
[c]Geotechnical analysis may include: moisture content (ASTM D2216); grain size (ASTM D422, seive); Atterberg limits (ASTM D4318); Permeability (D2434); and USCS classification.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The generic functional project organization and responsibilities are described in Section 2.0 of the FSAP. Individual task assignments and responsibilities will be delineated in investigation-specific addenda.

Analytical laboratory support for specific investigations will be designated to a single subcontractor based on a competitive bidding process, unless otherwise specified in the scope of work. The selected subcontract laboratory will be validated by the U.S. Army Corps of Engineers (USACE) Hazardous, Toxic, and Radioactive Waste (HTRW) Center of Expertise (CX), Omaha, Nebraska. Relevant QA Manual, laboratory qualification statements, certifications, and license documentation will be provided to Ohio Environmental Protection Agency (Ohio EPA) and U.S. Environmental Protection Agency (EPA) organizations, when the subcontractor has been identified for each individual Area of Concern (AOC) task.

The investigative Contractor firm is responsible for the coordination and collection of all samples and analyses. All personnel participating in U.S. Army projects must sign an Ethics and Integrity Agreement.

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3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective is to develop and implement procedures for field sampling, chain of custody (COC), laboratory analysis, and reporting, which will provide results to be used in risk evaluation and assessment and that are technically and legally defensible. Specific procedures for sampling, COC, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field equipment, and corrective action are described in other sections of this QAPP. The purpose of this section is to address the specific objectives for analytical accuracy, precision, completeness, representativeness, and comparability.

3.1 DATA QUALITY OBJECTIVES

Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality of data required to support decisions made during investigation activities, and are based on the end uses of the data being collected. The primary concern is to develop and implement procedures for field sampling, COC, laboratory analysis, and reporting that will provide results which are acceptable for submission to EPA Region 5 and the Ohio EPA programs.

An analytical DQO summary generic to the investigations of all AOCs at RVAAP is presented in Tables 3-1 and 3-2. All QC parameters stated in the specific SW-846 methods (i.e., percent recoveries) will be adhered to for each chemical listed. Laboratories are required to comply with all methods as written; recommendations are considered requirements. In addition, analyses will be completed according to USACE requirements found in the Shell for Analytical Chemistry Requirements and USACE–Louisville Chemistry Guideline, Rev. 1, January 2001.

Table 3-1. Investigative DQO Summary, Ravenna Army Ammunition Plant - Soil/Sediment[a]

Data Use	Sample Type	Analytical Method	Precision (RPD[b]) Field	Precision (RPD[b]) Lab	Accuracy Laboratory	Completeness
Screening for sample site selection	Discrete	FID/PID Volatile Organics	+/- comparison	NA	NA	95%
Confirmation of contamination extent	Discrete	SW-8060B Volatile Organics	<50 RPD	<40 RPD	70-130% recovery	90%
	Discrete or composite	SW-8270C Semivolatile Organics	<50 RPD	<35 RPD	45-135% recovery	90%
		SW-8081B Pesticides	<50 RPD	<35 RPD	40-140% recovery	90%
		8082 PCBs	<50 RPD	<35 RPD	40-140% recovery	90%
		SW-8330 Explosives	<50 RPD	<35 RPD	40-140% recovery	90%
		SW-8310 PAHs	<50 RPD	<35 RPD	40-140% recovery	90%
		SW-6010B/7000 Metals	<50 RPD	<25 RPD	75-125% recovery	90%
		SW-9012 Cyanide	<50 RPD	<20 RPD	80-120% recovery	90%
Determination of Geological Regimes	Discrete	ASTM-D2216 Moisture Content	NA	<20 RPD	NA	90%
		ASTM-D422 Grain Size	NA	<20 RPD	NA	90%
		ASTM-D4318 Atterberg Limits	NA	<40 RPD	NA	90%
		ASTM-D2434 Permeability	NA	<40 RPD	NA	90%
IDW Characterization	Composite	SW-1311 TCLP analytes	NA	<40 RPD	75-125% recovery	80%

[a] Sample numbers and QC sample numbers are identified in Table 1-1, analytical deliverables are identified in Tables 9-1 and 9-2, and analyte sensitivity goals are identified in Tables 3-3 through 3-9 of this QAPP.
[b] RPD = Relative Percent Difference, at values within five times the reporting level comparison is acceptable if values are plus or minus the reporting level.

Table 3-2. Investigative DQO Summary, Ravenna Army Ammunition Plant - Surface Water/Groundwater[a]

Data Use	Sample Type	Analytical Method	Precision (RPD[b]) Field Dups	Precision (RPD[b]) Lab (MS)	Accuracy Laboratory (MS)	Completeness
Screening for sample site selection	Discrete	FID/PID Volatile Organics	NA	NA	NA	95%
Determination of basic water characteristics	Discrete	EPA-120.1 Conductivity	<10 RPD	NA	NA	95%
		EPA-150.1 pH	<10 RPD	NA	NA	95%
		EPA-170.1 Temperature	<10 RPD	NA	NA	95%
		Turbidometer	<10 RPD	NA	NA	95%
		EPA-360.1 Dissolved Oxygen	<10 RPD	NA	NA	95%
Confirmation of contamination extent	Discrete	SW-8060B Volatile Organics	<30 RPD	<20 RPD	70-130% recovery	90%
	Discrete or composite	SW-8270C Semivolatile Organics	<30 RPD	<20 RPD	45-135% recovery	90%
		SW-8081B Pesticides	<30 RPD	<20 RPD	40-140% recovery	90%
		8082 PCBs	<30 RPD	<20 RPDq	40-140% recovery	90%
		SW-8330 Explosives	<30 RPD	<20 RPD	40-140% recovery	90%
		SW-8310 PAHs	<30 RPD	<20 RPD	40-140% recovery	90%
		SW-6010B/7000 Metals	<30 RPD	<20 RPD	75-125% recovery	90%
		SW-9010 Cyanide	<30 RPD	<20 RPD	75-125% recovery	90%
IDW Characterization	Composite	SW-1311 TCLP analytes	NA	<30 RPD	75-125% recovery	80%

[a]Sample numbers and QC sample numbers are identified in Table 1-1, analytical deliverables are identified in Tables 9-1 and 9-2, and analyte sensitivity goals are identified in Tables 3-3 through 3-9 of this QAPP.
[b]RPD = Relative Percent Difference, at values within five times the reporting level comparison is acceptable if values are plus or minus the reporting level.

3.2 LEVEL OF QUALITY CONTROL EFFORT

To assess whether QA objectives have been achieved, analyses of specific field and laboratory QC samples will be required. These QC samples include field blanks, trip blanks, field duplicates, laboratory method blanks, laboratory control samples, laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples will be analyzed to assess the quality of the data resulting from the sampling program.

Field blanks, consisting of potable water used in the decontamination process, equipment rinsate blanks and trip blanks, will be submitted for analysis along with field duplicate (co-located) samples to provide a means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to determine procedural contamination at the site that may contribute to sample contamination. Equipment rinsate blanks are used to assess the adequacy of equipment decontamination processes. Trip blanks are used to assess the potential for contamination of samples due to contaminant migration during sample shipment and storage. Criteria and evaluation of blank determinations are provided in Section 9.2.2.3 and will be based on analytical method detection limits (MDLs) and project quantitation levels. Field duplicate samples are analyzed to determine sample heterogeneity and sampling methodology reproducibility.

Laboratory method blanks and laboratory control samples are employed to determine the accuracy and precision of the analytical method as implemented by the laboratory. MS samples spikes provide information about the effect of the sample matrix on the measurement methodology. Laboratory sample duplicates and MSDs assist in determining the analytical reproducibility and precision of the analysis for the samples of interest.

The general level of the QC effort will be at least one field duplicate for every ten investigative samples. One volatile organic compound (VOC) analysis trip blank consisting of analyte-free water will be included along with each shipment of VOC water samples. Field blank samples will be collected from each water source employed. The anticipated number of duplicate and field blank samples are specified in each site-specific addendum.

MS/MSD samples must be investigative samples. Soil MS/MSD samples require no extra volume for VOCs or extractable organics. However, aqueous MS/MSD samples must be collected at double the volume for VOCs and triple the volume for extractable organics. One MS/MSD sample will be designated in the field and collected for at least every 20 investigative samples per sample matrix (i.e., groundwater, soil).

The level of QC effort provided by the laboratory will be equivalent to the level of QC specified in each site-specific work plan. The facility-wide goal is to provide a level of QC effort in conformance with the protocols of the USACE Shell for Analytical Chemistry Requirements. The level of QC effort for testing and analysis of parameters beyond the scope of the Shell Document protocols will conform to accepted methods, such as EPA SW-846 protocols (Update 3, 1998), American Society for Testing and Materials (ASTM) protocols, and National Institute for Occupational Safety and Health (NIOSH) protocols.

The QC effort for in-field measurements, including conductivity, pH, organic vapors, dissolved oxygen, etc., will include daily calibration of the instrument using traceable standards and documented instrument manufacturer procedures. Field instruments and their method of calibration are discussed in the FSAP and will be further identified in task-specific documentation.

3.3 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

The fundamental QA objectives for accuracy, precision, and sensitivity of laboratory analytical data are the QC acceptance criteria of the analytical protocols. The accuracy and precision required for the specified analytical parameters are incorporated in Tables 3-1 and 3-2 and are consistent with the analytical requirements found in the USACE Shell Document. The sensitivities required for the possible analyses conducted at RVAAP are identified in Tables 3-3 through 3-9 as project quantitation levels. Note that laboratories may obtain permission to use the ultrasonic extraction method EPA 3550B if necessary, due to sample matrix and performance issues. In addition, should lower detection limits than those in Table 3-7 be required, alternative methods (e.g., method 8095 for explosives in soil) may be specified in the site-specific SAP addendum.

Accuracy and precision goals for field measurements of pH, conductivity, turbidity, dissolved oxygen, and temperature are listed in Table 3-2.

Analytical accuracy is expressed as the percent recovery of an analyte that has been added to a blank sample or environmental sample at a known concentration before analysis. Accuracy will be determined in the laboratory through the use of MS analyses, laboratory control sample (LCS) analyses, and/or blank spike analyses. The percent recoveries for specific target analytes will be calculated and used as an indication of the accuracy of the analyses performed.

Precision will be determined through the use of spike analyses conducted on duplicate pairs of environmental samples (MS/MSD) or comparison of positive duplicate pair responses. The relative percent difference (RPD) between the two results will be calculated and used as an indication of the precision of the analyses performed.

Sample collection precision will be assessed through the analyses of field duplicates. Precision will be reported as the RPD for two measurements.

3.4 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under ideal conditions. It is expected that laboratories will provide data meeting QC acceptance criteria for all samples tested. Overall project completeness goals are identified in Tables 3-1 and 3-2.

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter that depends upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of site conditions. During development of this FSAP, consideration was given to site history, past waste disposal practices, existing analytical data, physical setting and processes, and constraints inherent to the investigation of all AOCs at RVAAP. The rationale of the sampling design is discussed in detail for each specific AOC investigation in the SAP addenda.

Representativeness will be satisfied by ensuring that the FSAP and its addenda are followed, proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded. Representativeness will be determined by assessing the combined aspects of the QA program, QC measures, and data evaluations.

Table 3.3. Project Quantitation Levels for Volatile Organic Compounds in Soils and Waters Using SW-846 Methods 8260B/5030 and 8260B/5035 (GC/MS)

Compound	CAS Number	Project Quanitation Levels[a]	
		Water (µg/L)	Soil/Sediment (µg/kg)
1,1,1-Trichloroethane	71-55-6	1	5
1,1,2,2-Tetrachloroethane	79-34-5	1	5
1,1,2-Trichloroethane	79-00-5	1	5
1,1-Dichloroethane	75-35-3	1	5
1,1-Dichloroethene	75-34-4	1	5
1,2-Dibromoethane	106-93-4	1	5
1,2-Dichloroethane	107-06-2	1	5
1,2-Dichloroethene (total)	540-59-0	1	5
1,2-Dichloropropane	78-87-5	1	5
2-Butanone	78-93-3	10	20
2-Hexanone	591-78-6	10	20
4-Methyl-2-pentanone	108-10-1	10	20
Acetone	67-64-17	10	20
Benzene	71-43-2	1	5
Bromochloromethane	74-97-5	1	5
Bromodichloromethane	75-27-4	1	5
Bromoform	75-25-2	1	5
Bromomethane	74-83-9	1	5
Carbon disulfide	75-15-0	1	5
Carbon tetrachloride	56-23-5	1	5
Chlorobenzene	108-90-7	1	5
Chloroethane	75-00-3	1	5
Chloroform	67-66-3	1	5
Chloromethane	74-87-3	1	5
Cis-1,3-dichloropropene	10061-01-5	1	5
Dibromochloromethane	124-48-1	1	5
Ethyl benzene	100-41-4	1	5
Methylene chloride	75-09-2	1	5
Styrene	100-42-5	1	5
Tetrachloroethene	127-18-4	1	5
Toluene	108-88-3	1	5
Trans-1,3-dichloropropene	10061-02-6	1	5
Trichloroethene	79-01-6	1	5
Vinyl chloride	75-01-4	1	5
Xylenes (total)	1330-2-7	2	10

[a]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable.

Table 3.4. Project Quantitation Levels for Semivolatile Organic Compounds in Soils and Waters Using SW-846 Methods 8270C/3510C or 3520C and 8270C/3540C, 3541C or 3550B (GC/MS)[a]

Compound	CAS Number	Project Quantitation Levels[b]	
		Water (µg/L)	Soil/Sediment (µg/kg)
1,2,4-Trichlorobenzene	120-82-1	10	330
1,2-Dichlorobenzene	95-50-1	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
2,4,5-Trichlorophenol	95-95-4	25	800
2,4,6-Trichlorophenol	88-06-2	10	330
2,4-Dichlorophenol	120-83-2	10	330
2,4-Dimethylphenol	150-67-9	10	330
2,4-Dinitrophenol	51-28-5	25	800
2,4-Dinitrotoluene	121-14-2	10	330
2,6-Dinitrotoluene	606-20-2	10	330
2-Chloronaphthalene	91-58-7	10	330
2-Chlorophenol	95-57-8	10	330
2-Methylnaphthalene	91-57-6	10	330
2-Methylphenol	95-48-7	10	330
2-Nitroaniline	88-74-4	25	800
2-Nitrophenol	88-75-5	10	330
3 & 4-Methylphenol	106-44-5	10	330
3,3'-Dichlorobenzidine	91-94-1	10	330
3-Nitroaniline	99-09-2	25	800
4,6-Dinitro-2-methylphenol	534-52-1	25	800
4-Bromophenylphenyl ether	101-55-3	10	330
4-Chloro-3-methylphenol	59-50-7	10	330
4-Chloroaniline	106-47-8	10	330
4-Chlorophenylphenyl ether	7005-72-36	10	330
4-Nitroaniline	100-01-6	25	800
4-Nitrophenol	100-02-7	25	800
Acenaphthene	83-32-9	10	50
Acenaphthylene	208-96-8	10	50
Anthracene	120-12-7	10	50
Benzo(a)anthracene	56-55-3	10	50
Benzo(a)pyrene	50-32-8	10	50
Benzo(b)fluoranthene	205-99-2	10	50
Benzo(g,h,i)perylene	191-24-2	10	50
Benzo(k)fluoranthene	207-08-9	10	50
Benzoic acid	65-85-0	25	800
Benzyl alcohol	100-51-6	10	330
Bis(2-chloroisopropyl)ether	108-60-1	10	330
Bis(2-chloroethoxy)methane	111-91-1	10	330
Bis(2-chloroethyl)ether	111-44-4	10	330
Bis(2-ethylhexyl)phthalate	117-81-7	10	330
Butylbenzylphthalate	85-68-7	10	330
Carbazole	86-74-8	10	50
Chrysene	218-01-9	10	50

Table 3.4. Project Quantitation Levels for Semivolatile Organic Compounds in Soils and Waters Using SW-846 Methods 8270C/3510C or 3520C and 8270C/3540C, 3541C or 3550B (GC/MS)[a] (continued)

Compound	CAS Number	Project Quantitation Levels[b] Water (μg/L)	Project Quantitation Levels[b] Soil/Sediment (μg/kg)
Di-n-butylphthalate	84-74-2	10	330
Di-n-octylphthlalate	117-84-0	10	330
Dibenzo(a,h)anthrancene	53-70-3	10	50
Dibenzofuran	132-64-9	10	330
Diethylphthalate	84-66-2	10	330
Dimethylphthalate	31-11-3	10	330
Fluoranthene	206-44-0	10	50
Fluorene	96-73-7	10	50
Hexachlorobenzene	118-74-1	10	330
Hexachlorobutadiene	87-68-3	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
Hexchloroethane	67-72-1	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	50
Isophorone	78-59-1	10	330
n-Nitroso-di-n-propylamine	621-64-7	10	330
n-Nitroso-diphenylamine	96-30-6	10	330
Napthalene	91-20-3	10	50
Nitrobenzene	98-95-1	10	330
Pentachlorophenol	87-86-5	25	800
Phenanthrene	85-01-8	10	50
Phenol	108-95-2	10	330
Pyrene	129-00-0	10	50

[a]The primary solid sample preparation procedure will be Method 3540C or 3541C, Soxhlet Extraction. However, when it is demonstrated these methods cannot be employed effectively for specific matrices, analytical laboratories may obtain permission to utilize the Ultrasonic Extraction Method 3550B.

[b]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable.

Table 3.5. Project Quantitation Levels for Pesticide and PCB Compounds in Soils and Waters Using SW-846 Methods 8081A and 8082A (GC)[a]

Compound	CAS Number	Project Quantitation Levels[b] Water (µg/L)	Soil/Sediment (µg/kg)
Method 8081A			
Alpha-BHC	319-84-6	0.05	1.7
Beta-BHC	319-85-7	0.05	1.7
Delta-BHC	319-86-8	0.05	1.7
Gamma-BHC (Lindane)	58-89-9	0.05	1.7
Heptachlor	76-44-8	0.05	1.7
Aldrin	309-00-2	0.05	1.7
Heptachlor epoxide	1024-57-3	0.05	1.7
Endosulfan I	959-98-8	0.05	1.7
Dieldrin	60-57-1	0.05	1.7
4,4'-DDE	72-55-9	0.05	1.7
Endrin	72-20-8	0.05	1.7
Endosulfan II	33213-65-9	0.05	1.7
4,4'-DDD	72-54-8	0.05	1.7
Endosulfan sulfate	1031-07-8	0.05	1.7
4,4'-DDT	50-29-3	0.05	1.7
Methoxychlor	72-43-5	0.10	17
Endrin ketone	53494-70-5	0.05	1.7
Endrin aldehyde	7421-93-4	0.05	1.7
alpha-Chlordane	5103-71-9	0.05	1.7
gamma-Chlordane	5103-74-2	0.05	1.7
Toxaphene	8001-35-2	2.0	170
Method 8082A			
Arochlor-1016	12674-11-2	0.5	33
Arochlor-1221	11104-28-2	0.5	33
Arochlor-1232	11141-16-5	0.5	33
Arochlor-1242	53469-21-9	0.5	33
Arochlor-1248	12672-29-6	0.5	33
Arochlor-1254	11097-69-1	0.5	33
Arochlor-1260	11096-82-5	0.5	33

[a]The primary solid sample preparation procedure will be Method 3540C or 3541C, Soxhlet Extraction. However, when it is demonstrated these methods can not be employed effectively for specific matrices, analytical laboratories may obtain permission to utilize the Ultrasonic Extraction Method 3550B.

[b]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable.

Table 3.6. Project Quantitation Levels for Polyaromatic Hydrocarbons (PAH compounds) in Soils and Waters Using SW-846 Methods 8310 (HPLC)

Compound	CAS Number	Project Quantitation Levels[a]	
		Water (μg/L)	Soil/Sediment (μg/kg)
Acenaphthene	83-32-9	5	150
Acenaphthylene	208-96-8	5	150
Anthracene	120-12-7	2	60
Benzo(a)anthracene	56-55-3	0.1	3
Benzo(a)pyrene	50-32-8	0.1	3
Benzo(b)fluoranthene	205-99-2	0.1	3
Benzo(k)fluoranthene	207-08-9	0.1	3
Benzo(g,h,i)perylene	191-24-2	0.5	15
Chrysene	218-01-9	0.5	15
Dibenzo(a,h)anthrancene	53-70-3	0.1	3
Fluoranthene	206-44-0	0.5	15
Fluorene	96-73-7	0.5	15
Indeno(1,2,3-cd)pyrene	193-39-5	0.1	3
Napthalene	91-20-3	5	150
Phenanthrene	85-01-8	2	60
Pyrene	129-00-0	0.5	15

[a]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable. All "J" values less than laboratory reporting limits will be reported and evaluated.

Table 3.7. Project Quantitation Levels for Explosives (nitroaromatics) in Soils and Waters Using SW-846 Method 8330

Compound	CAS Number	Project Quantitation Levels[a]	
		Water (μg/L)	Soil/Sediment (mg/kg)
2-Amino-4,6-dinitrotoluene	355-72-78-2	0.2	0.25
4-Amino-2,6-dinitrotoluene	1946-51-0	0.2	0.25
1,3-Dinitrobenzene	99-65-0	0.2	0.25
2,4-Dinitrotoluene	121-14-2	0.1	0.25
2,6-Dinitrotoluene	606-20-2	0.1	0.25
HMX	2691-41-0	0.5	1.0
Nitrobenzene	98-95-3	0.2	0.25
2-Nitrotoluene	88-72-2	0.2	0.25
3-Nitrotoluene	99-08-1	0.2	0.25
4-Nitrotoluene	99-99-0	0.2	0.25
RDX	121-82-4	0.5	1.0
Tetryl	479-45-8	0.2	1.0
1,3,5-Trinitrobenzene	99-35-4	0.2	0.25
2,4,6-Trinitrotoluene	118-96-7	0.2	0.25
PETN	78-11-5	3	3
Nitroglycerin (8330 modified)	55-63-0	3	3
Nitroguanidine (8330 modified)	556-88-7	20	0.25
Perchlorate (by IC)	7601-90-3	25	0.05
Nitrocellulose (to EPA 9056)	9004-70-0	500	5

[a]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable. All “J” values less than laboratory reporting limits will be reported and evaluated.

Table 3.8. Project Quantitation Levels for Metals in Soils and Waters Using SW-846 Methods 6010B, 6020, or 7000 Series

Compound	CAS Number	Project Quantitation Levels[a]	
		Water (µg/L)	Soil/Sediment (mg/kg)
Aluminum	7429-90-5	100	10
Antimony	7440-36-0	5	0.5
Arsenic	7440-38-2	5	0.5
Barium	7440-39-3	10	1
Beryllium	7440-41-7	1	0.1
Cadmium	7440-43-9	1	0.1
Calcium	7440-70-2	100	10
Chromium	7440-47-3	5	0.5
Cobalt	7440-48-4	5	0.5
Copper	7440-50-8	5	0.5
Iron	7439-89-6	100	10
Lead	7439-92-1	3	0.3
Magnesium	7439-95-4	100	10
Manganese	7439-96-5	10	1
Mercury	7439-97-6	0.2	0.1
Nickel	7440-02-0	10	1
Potassium	7440-09-7	200	20
Selenium	7782-49-2	5	0.5
Silver	7440-22-4	5	0.5
Sodium	7440-22-4	200	20
Thallium	7440-28-0	2	0.2
Vanadium	7440-62-2	10	1
Zinc	7440-66-6	10	1

[a]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable.

Table 3.9. Project Quantitation Levels for Miscellaneous Parameters in Soils and Waters Using EPA Water and Wastewater Methods, SW846 Methods, or ASTM Methods

Compound	CAS Number	Project Quantitation Levels[a]	
		Water (mg/L)	Soil/Sediment (mg/kg)
Bicarbonate Alkalinity (310.1)		1.0	--
Carbonate Alkalinity (310.1)		1.0	--
Ammonia-N (350.2)		0.1	--
Chloride (300.0)		0.2	--
Bromide (300.0)		0.2	--
Fluoride (340.2)		0.1	--
Nitrate-N (300.0)		0.1	--
Nitrite-N (300.0)		0.1	--
Ortho-phosphate (300.0)		0.1	--
Phosphorous (total) (365.1)		0.1	--
Sulfate (300.0)		1.0	--
Sulfide (376.2)		1.0	--
Cyanide, total (9012)		0.01	0.5
Total Dissolved Solids (160.1)		1.0	--
Total Suspended Solids (160.2)		1.0	--
Settleable Solids (160.5)		1.0	--
pH (150.1)		--	--
Conductivity (120.1)		--	--
Temperature (170.1)		--	--
Turbidity (180.1)		0.1 NTU	--
Dissolved Oxygen (360.1)		0.2	--
Biological Oxygen Demand (405.1)		2.0	--
Chemical Oxygen Demand (410.1)		10	--
Oil & Grease (413.2)		1.0	10
Total Organic Carbon (415.2)		1.0	10
Total Petroleum Hydrocarbons (418.1)		1.0	10
Total Phenols (420.1)		0.1	1.0
Moisture Content (ASTM D2216)		--	NA
Grain Size (ASTM D422)		--	NA
Atterberg Limits (ASTM D4318)		--	NA
USCS Classification (ASTM D2487)		--	NA
Permeability (ASTM D2434)		--	NA

[a]Specific quantitation limits are highly matrix dependent; project quantitation levels listed here are goals and may not always be achievable.

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends upon the similarity of sampling and analytical methods. The procedures used to obtain the planned analytical data are expected to provide comparable data. These new analytical data, however, may not be directly comparable to existing data because of differences in procedures and QA objectives.

4.0 SAMPLING PROCEDURES

Sampling procedures are described in the FSAP and SAP addenda for each investigation. It is anticipated that investigations performed at RVAAP will produce surface soil, subsurface soil, sediment, surface water, groundwater and investigation-derived waste (IDW) samples for analysis. Additional samples will be collected to complete field QC duplicate and field blank and QA laboratory split sample analyses. Specific sample numbers (including anticipated parameters and methods) will be incorporated into tables similar to Table 1-1. Investigation samples may require VOC, semivolatile organic compound (SVOC), pesticide, polychlorinated biphenyl (PCB), metal, or miscellaneous analyte determinations, as represented in Tables 1-1, 3-1, and 3-2.

Tables 4-1 and 4-2 summarize sample container, preservation, and holding time requirements for soil/sediment and surface water/groundwater matrices associated with investigations at RVAAP. The specific number of containers required for each AOC investigation will be included in each investigation-specific QAPP addenda. Additional sample volumes will be provided, when necessary, for the express purpose of performing associated laboratory QC (laboratory duplicates, MS/MSD). These QC samples will be designated by the field and identified for the laboratory on the respective COCs. Field duplicate samples will be labeled and numbered in manner that does not allow the analytical facility to compare information with primary sample data.

Table 4-1. Container Requirements for Soil and Sediment Samples at Ravenna Army Ammunition Plant, Ravenna, Ohio

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Volatile Organic Compounds	2 - 2 oz glass jar with septum cap (no headspace)	20 g	Cool, 4°C	14 d
Semivolatile Organic Compounds	1 - 16 oz glass jar[a] with Teflon®-lined cap	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Pesticide Compounds	Include in SVOC container	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
PCBs	Include in SVOC container	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
PAH Compounds	Include in SVOC container	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Explosive Compounds	1 - 4 oz glass jar with Teflon®-lined cap	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Propellant Compounds	1 - 4 oz glass jar with Teflon®-lined cap	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Petroleum Hydrocarbons (gasoline range)	2 - 2 oz glass jar with septum cap	20 g	Cool, 4°C	14 d
Petroleum Hydrocarbons (diesel range)	1 - 4 oz glass jar with Teflon®-lined cap	60 g	Cool, 4°C	14 d (extraction) 40 d (analysis)
Metals	Include in SVOC container	50 g	Cool, 4°C	180 d; Hg @ 28 d
Cyanide	Include in SVOC container	25 g	Cool, 4°C	14 d

[a]When all fractions are being collected and shipped to the same analytical facility, one 16 oz. jar should cover all requirements. If analytical groups are sent to separate facilities, individual containers will be required.

Table 4-2. Container Requirements for Water Samples at Ravenna Army Ammunition Plant, Ravenna, Ohio

Analyte Group	Container	Minimum Sample Size	Preservative	Holding Time
Volatile Organic Compounds	3 -40 mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4°C	14 d
Semivolatile Organic Compounds	2 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Pesticide Compounds	2 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
PCBs	2 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
PAH Compounds	2 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Explosive Compounds	1 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Propellant Compounds	1 - 1L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Petroleum Hydrocarbons (gasoline range)	2 -40 mL glass vials with Teflon®-lined septum (no headspace)	80 mL	Cool, 4°C	14 d
Petroleum Hydrocarbons (diesel range)	2 - 1L amber glass bottle with septum lid	1000 mL	Cool, 4°C	7 d (extraction) 40 d (analysis)
Metals	1 - 1L polybottle	500 mL	HNO_3 to pH <2 Cool, 4°C	180 d; Hg @ 28 d
Cyanide	500 mL polybottle	500 mL	NaOH to pH >12 Cool, 4°C	14 d
Anions (Br, Cl, F, SO4)	250 mL polybottle	250 mL	Cool, 4°C	28 d
Nitrate-Nitrite	250 mL polybottle	100 mL	H_2SO_4 to pH <2 Cool, 4°C	28 d
TSS/TDS	500 mL polybottle	100 mL ea.	Cool, 4°C	28 d

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5.0 SAMPLE CUSTODY

It is the policy of the U.S. Army and will be the intent of this investigation to follow EPA policy regarding sample custody and COC protocols as described in “NEIC Policies and Procedures,” EPA-330/9-78DDI-R, Revised June 1985. This custody is in three parts: sample collection, laboratory analysis, and final evidence files. Final evidence files, including originals of laboratory reports and electronic files, are maintained under document control in a secure area. A sample or evidence file is under your custody when it is:

- in your possession;
- in your view, after being in your possession;
- in your possession and you place them in a secured location; or
- in a designated secure area.

5.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

The sample packaging and shipment procedures summarized below will ensure that samples will arrive at the laboratory with the COC intact. The protocol for specific sample numbering using case numbers and traffic report numbers (if applicable) and other sample designations are included in the FSAP.

5.1.1 Field Procedures

The field sampler is responsible for the care and custody of the samples until they are transferred or properly dispatched. As few people as possible should handle the samples. Each sample container will be labeled with a sample number, date and time of collection, sampler, and sampling location. Sample labels are to be completed for each sample using indelible ink, unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label, due to the non-functionality of ballpoint pens in freezing weather). The Contractor Project Manager, in conjunction with the U.S. Army, will review all field activities to determine whether proper custody procedures were followed during the field work and to decide if additional samples are required.

5.1.2 Field Logbooks/Documentation

The field logbook will provide a means of recording data collection activities performed. Entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory. Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel but stored in the document control center when not in use. Each logbook will be identified by a project-specific document number. The title page of each logbook will contain the name of the person to whom the logbook is assigned, the logbook number, the project name, and the project start and end dates.

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather, names of all sampling team members present, level of personal protection being used, and the signature of the person making the entry will be entered. The names of visitors to the site, field sampling or investigation team personnel, and the purpose of their visit will also be recorded in the field logbook. Measurements made and samples collected will be recorded. All entries will be made in ink and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and the entry will be initialed and dated.

Samples will be collected following the sampling procedures documented in the FSAP and its addenda. When a sample is collected or a measurement is made, a detailed description of the location shall be recorded. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume, and number of containers. A sample identification number will be assigned before sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description. Equipment employed to make field measurement will be identified along with their calibration dates.

5.1.3 Transfer of Custody and Shipment Procedures

Samples are accompanied by a properly completed COC form. The sample numbers and locations will be listed on the COC form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record will document transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis. A separate signed custody record will be enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape and custody seals for shipment to the laboratory. The preferred procedure also includes using a custody seal attached to the front right and back left of the cooler. The custody seals are covered with clear plastic tape. The cooler is strapped shut with strapping tape in at least two locations. When the samples are sent by common carrier, a bill of lading should be used. Receipts or bills of lading will be retained as part of the permanent documentation. When sent by mail, the package will be registered with return receipt requested. Commercial carriers are not required to sign off on the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

All shipments will be accompanied by the COC record identifying the contents. The original record will accompany the shipment, and copies will be retained by the sampler for return to project management and the project file. Whenever co-located or split samples are collected for comparison analysis by the U.S. Army QA Laboratory or a government agency, a separate COC is prepared for those samples and marked to indicate with whom the samples are being split.

All shipments will be in compliance with applicable U.S. Department of Transportation regulations for environmental samples.

5.2 LABORATORY COC PROCEDURES

Custody procedures along with the holding time and sample preservative requirements for samples will be described in laboratory QA Plans. These documents will identify the laboratory custody procedures for sample receipt and log-in, sample storage, tracking during sample preparation and analysis, and laboratory storage of data.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

The Contractor is the custodian of the evidence file and will maintain the contents of evidence files for each investigation, including all relevant records, reports, logs, field notebooks, pictures, subcontractor reports, correspondence, laboratory logbooks, and COC forms. Each project evidence file will be stored in a secure, limited-access area and under custody of the Contractor Project Manager.

Analytical laboratories will retain all original raw data information (both hard copy and electronic) in a secure, limited-access area and under custody of the Laboratory Project Manager.

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6.0 CALIBRATION PROCEDURES AND FREQUENCY

This section describes procedures for maintaining the accuracy of all the instruments and measuring equipment that are used for conducting field tests and laboratory analyses. These instruments and equipment shall be calibrated before each use or on a scheduled, periodic basis according to manufacturer instructions.

6.1 FIELD INSTRUMENTS/EQUIPMENT

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. All field instruments for this purpose will have unique identifiers, and each instrument will be logged in the Material and Testing Equipment (M&TE) Log Book before use in the field. The site safety and health officer or his/her designate will be responsible for performing and documenting daily calibration/checkout records for instruments used in the field.

Equipment to be used during the field sampling will be examined to certify that it is in operating condition. This will include checking the manufacturer's operating manual and instructions for each instrument to ensure that all maintenance requirements are being observed. Field notes from previous sampling trips will be reviewed so that the notation on any prior equipment problems will not be overlooked, and all necessary repairs to equipment will be carried out. Spare parts or duplication of equipment will be available to the sampling effort.

Calibration of field instruments is governed by the specific standard operating procedure (SOP) for the applicable field analysis method, and it will be performed at the intervals specified in the SOP. If no SOP is available, calibration of field instruments will be performed at intervals specified by the manufacturer or more frequently as conditions dictate. Calibration procedures and frequency will be recorded in a field logbook.

Field instruments will include a pH meter, thermometer, specific conductivity meter, turbidity meter, flame ionization detector (FID) or photoionization detector (PID) for organic vapor detection, and a combustible gas detection meter capable of determining lower explosive limits, upper explosive limits, and/or oxygen levels. If an internally calibrated field instrument fails to meet calibration/checkout procedures, it will be returned to the manufacturer for service and a back-up instrument will be calibrated and used in its place.

Detailed instructions on the proper calibration and use of each field instrument follow the guidelines established by the manufacturer. The technical procedures for each instrument used on this project include the manufacturer's instructions detailing the proper use and calibration of each instrument. Project personnel responsible for calibrating and operating field instruments will receive training in the proper use of each instrument. Documentation of current training records for all project field personnel will be maintained in the training records data base for the project.

6.1.1 pH Meter Calibration

The pH meter will be calibrated according to the manufacturer's instructions using traceable standard buffer solutions before work in the field. Before use in the field, calibration of the pH meter will be checked against two standard buffer solutions. Calibration procedures, lot numbers of buffer solutions, and other pertinent calibration or checkout information will be recorded in the M&TE Log Book for the project. The calibrations performed, standard used, and sample pH values are to be recorded in the field notebook. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field as necessary.

6.1.2 Temperature Calibration

Temperature measurements are carried out using a thermometer. Mercury thermometers must be inspected before use to ensure that there is no mercury separation. Thermometers should be rechecked in the field before and after each use to see if the readings are logical and the mercury is still intact. Thermometers should be checked biannually for calibration by immersing them in a bath of known temperature until equilibrium is reached. Thermometers should be discarded in an appropriate manner if found to have more than 10 percent error. The reference thermometer used for bath calibration should be National Institute of Standards and Testing (NIST) traceable. Temperatures will be recorded in the M&TE Log Book, the Sample Log Book, or the Cooler Log Book, as appropriate.

6.1.3 Conductivity Meter Calibration

The conductivity cells of the specific conductivity meter will be cleaned according to manufacturer's recommendations and specifications and checked against known conductivity standard solutions before each sampling event. The instrument will be checked daily with NIST-traceable standard solutions. If the instrument is more than 10 percent out of calibration when compared with standard solutions, the instrument will be recalibrated. If this cannot be done in the field, the instrument will be returned to the manufacturer or supplier for recalibration and a back-up instrument will be used in its place. Daily calibration readings and other relevant information will be recorded daily in the M&TE Log Book.

6.1.4 Turbidity Calibration

The turbidity meter will be calibrated each day against a known and traceable standard supplied by the manufacturer prior to use in the field. In the field the instrument will be checked against the standard and adjusted each time the instrument is turned on. Calibration information will be recorded in the M&TE Log Book; checks made in the field will be recorded in the Sample Log Book.

6.1.5 Organic Vapor Detection

Organic vapor detectors will be checked daily according to the manufacturer's instructions. FIDs will be checked daily by using the internal calibration mechanism. PIDs will be calibrated daily with a gas of known concentration. All daily calibration information will be recorded in the M&TE Log Book.

6.1.6 Combustible Gas and Oxygen Detection

Combustible gas calibration checks should be made daily using the gas recommended by the manufacturer. Calibration of the oxygen system should be checked daily while the combustible gas sensor is being checked. Record all appropriate calibration check data in the M&TE Log Book.

6.1.7 Dissolved Oxygen Calibration

The dissolved oxygen meter will be calibrated against a known standard according to the manufacturer's instructions. Calibration checks will be performed each day prior to use in the field. Calibration information will be recorded daily in the M&TE Log Book.

6.1.8 Geophysical Instruments

Geophysical instruments such as magnetometers, electromagnetic conductivity meters, and ground-penetrating radar equipment will be calibrated per manufacturer's instructions. Calibration procedures and equipment used should also be described in area-specific documentation.

6.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will be based on approved written procedures. Records of calibration, repairs, or replacement will be filed and maintained by laboratory personnel performing QC activities. These records will be filed at the location where the work is performed and will be subject to QA audit. Procedures and records of calibration will follow USACE direction as stated in the Shell for Analytical Chemistry Requirements and the Louisville District–Corp Environmental Data Assurance Guideline.

In all cases where analyses are conducted according to SW 846 methods, the calibration procedures and frequencies specified in the applicable SW 846 method and the Shell Document will be followed exactly. For analyses governed by SOPs, refer to the appropriate SOP for the required calibration procedures and frequencies.

Records of calibration will be kept as follows:

- Each instrument will have a record of calibration with an assigned record number.

- Instrument identification numbers, manufacturer, model numbers, date of last calibration, signature of calibrating analyst, and due date for next calibration will be documented. Reports and compensation or correction figures will be maintained with each instrument.

- A written step-wise calibration procedure will be available for each piece of test and measurement equipment.

- Any instrument that is not calibrated to the manufacturer's original specification will display a warning tag to alert the analyst that the device carries only a "Limited Calibration."

6.2.1 Organic Analyses

For all analyses, the laboratory will follow directions provided in the USACE Shell Document and individual analytical procedures for initial calibration, initial calibration checks, and continuing calibration checks. Before calibration, the instrument(s) used for gas chromatograph/mass spectrometer (GC/MS) analyses are tuned by analysis of p-bromofluorobenzene (BFB) for volatile analyses and decafluorotriphenyl phosphine (DFTPP) for semivolatile analyses. Once the tuning criteria for these reference compounds are met, the instrument should be initially calibrated by using a five-point calibration curve. The instrument tune will be verified each 12 hours of operation.

Calibration standards will be EPA- or NIST-traceable (when existent) and are spiked with internal standards and surrogate compounds. Calibration and continuing calibration verification of instruments will be performed at approved intervals as specified by the analytical method and the Shell Document.

6.2.2 Metals Analysis

For all analyses, the laboratory will follow directions provided in the USACE Shell Document and individual analytical procedures for initial calibration, initial calibration checks, and continuing calibration checks. Atomic Absorption Spectrophotometer instruments are calibrated by use of a minimum of three calibration standards prepared by dilution of certified stock solutions. Inductively coupled plasma (ICP) emission spectrophotometer instruments are calibrated by using a minimum of two calibration standards prepared by dilution of certified stock solutions. One calibration standard will be at the approximate method quantitation limit for the metal. Other standards bracket the concentration range of the samples. Calibration standards will contain acids at the same concentration as the digestates. An analysis blank is prepared as well.

Two continuing calibration standards (one mid-level and one low-level), prepared from a different stock solution than that used for preparation of the calibration standards, are analyzed after each ten samples or each two hours of continuous operation. The value of the continuing calibration standard concentration must agree within plus or minus 10% of the initial value.

For the ICP, linearity near the quantitation limit will be verified with a standard prepared at a concentration of two times the quantitation limit. This standard must be run at the beginning and end of each sample analysis run or a minimum of twice per 8-hour period.

7.0 ANALYTICAL PROCEDURES

All samples collected during the investigation activities will be analyzed by laboratories reviewed and certified by the USACE HTRW CX, Omaha, Nebraska. QA samples shall be collected of groundwater, surface water, and soil and analyzed by a project identified QA Laboratory. Designated QA laboratory facilities may be arranged through the auspices of the Ohio EPA or the USACE Louisville District office at the time of project-specific coordination efforts. Selected QA Laboratories will be logistically and corporately distinct from the primary Contractor's subcontract laboratory facility. Each laboratory supporting this work shall provide statements of qualifications including organizational structure, QA Manual, and SOPs, which will be appended to this Facility-wide QAPP.

7.1 LABORATORY ANALYSIS

Analytical parameters and project quantitation levels are listed in Tables 3-3 through 3-9.

Principal laboratory facilities will not subcontract or transfer any portion of this work to another facility, unless expressly permitted to do so in writing by the project Contractor with the concurrence of Ravenna Program Management.

If contaminant concentrations are high, or for matrices other than normal waters and soils, analytical protocols may be inadequate. In these cases, sample analysis may require modifications to defined methodology. Any proposed changes to analytical methods specified requires written approval from the Contractor and U.S. Army. All analytical method variations will be identified in investigation-specific addenda. These will be submitted for regulatory review and approval. All variations from standard SW-846 methods must be approved by both the U.S. Army and Ohio EPA prior to sample analysis.

These SOPs must be adapted from and reference standard EPA SW-846 methods and thereby specify:

- procedures for sample preparation,
- instrument start-up and performance check,
- procedures to establish the method detection limits for each parameter,
- initial and continuing calibration check requirements,
- specific methods for each sample matrix type, and
- required analyses and QC requirements.

All VOC, SVOC, pesticide, and PCB results will be expressed in μg/L for water samples and μg/kg (dry weight) for soil/sediment samples. Metal and explosive results will be expressed in μg/L for water samples and mg/kg (dry weight) for soil/sediment samples.

All reasonable effort must be made on the part of the laboratory to meet project quantitation levels for all analyses. Elevated reporting levels dues to dilution should be avoided by reporting both diluted and undiluted analyses. Attempts to limit elevated reporting levels such as sample clean-up steps should be documented and reported.

In addition, efforts must be made to analyze samples within the first half of the analytical holding time, to allow potential repeat analyses to be conducted within analytical holding time windows.

7.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field measurement of pH, specific conductivity, and temperature are described in the FSAP and Section 6.0 of this document. Tabulation of the methodologies appears in Tables 3-1 and 3-2.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

The assessment of field sampling precision and accuracy will be made by collecting field duplicates and field blanks in accordance with the procedures described in the FSAP and at the frequency indicated in the investigation-specific SAP addenda.

8.2 FIELD MEASUREMENT

QC procedures for most field measurements (i.e., pH, conductivity, temperature, etc.) are limited to checking the reproducibility of the measurement by obtaining multiple readings on a single sample or standard and by calibrating the instruments. Refer to the FSAP and its addenda for more detail regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures for investigations at RVAAP are specified in the method descriptions, the USACE Shell Document, and the USACE Louisville District Environmental Data Assurance Guideline. These specifications include the types of QC checks normally required; method blanks, LCS, MS, MSD, calibration standards, internal standards, surrogate standards, calibration check standards, and laboratory duplicate analysis. Calibration compounds and concentrations to be used and the method of QC acceptance criteria for these parameters have been identified.

To ensure the production of analytical data of known and documented quality, laboratories associated with the investigations at RVAAP will implement QA program and QC checks.

8.3.1 QA Program

All subcontracted analytical laboratories will have a written QA program that provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments.

The stated objectives of the laboratory QA program are to

- properly receive, preserve, and store all samples;
- maintain adequate custody records from sample receipt through reporting and archiving of results;
- use properly trained analysts to analyze all samples by approved methods within holding times;
- produce defensible data with associated documentation to show that each system was calibrated and operating within precision and accuracy control limits;

- accurately calculate, check, report, and archive all data using the Laboratory Information Management System; and

- document all the above activities so that all data can be independently validated.

All laboratory procedures are documented in writing as SOPs, which are edited and controlled by the QA department. Internal QC measures for analysis will be conducted with their SOPs and the individual method requirements specified.

External QA shall be provided by the designated Ohio EPA or USACE–Louisville District QA laboratory. The external QA laboratory shall receive QA sample splits as identified in each task specific set of documentation.

8.3.2 QC Checks

Implementation of QC procedures during sample collection, analysis, and reporting ensures that the data obtained are consistent with its intended use. Both field QC and laboratory QC checks are performed throughout the work effort to generate data confidence. Analytical QC measures are used to determine if the analytical process is in control, as well as to determine the sample matrix effects on the data being generated.

Specifications include the types of QC required (duplicates, sample spikes, surrogate spikes, reference samples, controls, blanks, etc.), the frequency for implementation of each QC measure, the compounds to be used for sample spikes and surrogate spikes, and the acceptance criteria for this QC.

Laboratories will provide documentation in each data package that both initial and ongoing instrument and analytical QC functions have been met. Any non-conforming analysis will be reanalyzed by the laboratory, if sufficient sample volume is available. It is expected that sufficient sample volumes will be collected to provide for reanalyses, if required.

8.3.2.1 Analytical process QC

8.3.2.1.1 *Method blanks*

A method blank is a sample of a non-contaminated substance of the matrix of interest (usually distilled/de-ionized water or silica sand) that is then subjected to all of the sample preparation (digestion, distillation, extraction) and analytical methodology applied to the samples. The purpose of the method blank is to check for contamination from within the laboratory that might be introduced during sample preparation and analysis that would adversely affect analytical results. One in 20 samples will be method blanks, with fractions rounded to the next whole number.

Analytical sensitivity goals are identified in Tables 3-3 through 3-9 as project quantitation levels. Method blank levels should be below these levels for all analytes, and below 2× the associated method detection levels.

8.3.2.1.2 *Laboratory control samples*

The LCS contains known concentrations of all target analytes to be determined and is carried through the entire preparation and analysis process. Commercially available LCSs or those from EPA may be used.

LCS standards that are prepared in-house must be made from a source independent of that of the calibration standards. In addition to a mid-level LCS, laboratories will include a low-level LCS check at 3× the MDL. This Quality Control Method Reporting Limit check will contain all target analytes and be reported similarly to standard LCS information.

The primary purpose of the LCS is to establish and monitor the laboratory's analytical process control. An LCS must be analyzed with each analytical sample batch. LCS information must contain the theoretical concentrations of analytes, measured concentrations, percent recoveries, and relative percent differences, if duplicate LCS samples are analyzed. Refer to direction provided by the USACE Shell Document and the USACE–Louisville District Guidance.

8.3.2.2 Matrix and sample-specific QC

8.3.2.2.1 *Laboratory duplicates*

Laboratory duplicates are separate aliquots of a single sample that are prepared and analyzed concurrently at the laboratory. This duplicate sample should not be a method blank, trip blank, or field blank. The primary purpose of the laboratory duplicate is to check the precision of the laboratory analyst, the sample preparation methodology, and the analytical methodology. If there are significant differences between the duplicates, the affected analytical results will be re-examined. One in 20 samples will be a laboratory duplicate, with fractions rounded to the next whole number.

8.3.2.2.2 *Surrogate spikes*

A surrogate spike is prepared by adding a pure compound to a sample before extraction. The compound in the surrogate spike should be of a similar type to that being assayed in the sample. The purpose of a surrogate spike is to determine the efficiency of recovery of analytes in the sample preparation and analysis. The percent of recovery of the surrogate spike is then used to gauge the total accuracy of the analytical method for that sample.

8.3.2.2.3 *Matrix spikes and matrix spike duplicates*

An MS is an aliquot of a sample spiked with known quantities of analytes and subjected to the entire analytical procedure. It is used to indicate the appropriateness of the method for the matrix by measuring recovery or accuracy. Accuracy is the nearness of a result or the mean of a set of results to the true or accepted value. An MSD is a second aliquot of the same sample with known quantities of compounds added. The purpose of the MSD, when compared to the MS, is to determine method precision. Precision is the measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions. MSs and MSDs are performed per 20 samples of similar matrix.

The MS must contain all analytes being determined in the sample set. In any batch of RVAAP samples, the MS/MSD must be performed on a RVAAP site sample. MS and MSD information must contain the theoretical concentrations of analytes spiked into the sample, concentrations of analytes present in the original sample, measured concentrations determined in the spiked sample, calculated percent recoveries, and relative percent differences for each MS/MSD pair.

8.3.2.2.4 *Method-specific QC*

The laboratory must follow specific quality processes as defined by the method. These will include measures such as calibration verification samples; instrument blank analysis; internal standards implementation; tracer analysis; and method of standard additions utilization, serial dilution analysis, post-digestion spike analysis, chemical carrier evaluation, etc.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 DATA REDUCTION

9.1.1 Field Measurements and Sample Collection

Raw data from field measurements and sample collection activities will be appropriately recorded in field logbooks. Data to be used in project reports will be reduced and summarized. The methods of data reduction will be documented.

The Contractor Project Manager or his/her designee is responsible for data review of all field-generated data. This includes verifying that all field descriptive data are recorded properly, that all field instrument calibration requirements have been met, that all field QC data have met frequency and criteria goals, and that field data are entered accurately in all logbooks and worksheets.

9.1.2 Laboratory Services

All samples collected for investigations at RVAAP will be sent to USACE CX qualified laboratories. Data reduction, evaluation, and reporting for samples analyzed by the laboratory will be performed according to specifications outlined in the laboratory's QA plan, this Facility-wide QAPP and any project specific addenda. Laboratory reports will include documentation verifying analytical holding time compliance.

Laboratories will perform in-house analytical data reduction under the direction of the Laboratory QA Officer. The Laboratory QA Officer is responsible for assessing data quality and informing the Contractor and U.S. Army of any data which are considered "unacceptable" or require caution on the part of the data user in terms of its reliability. Data will be reduced, evaluated, and reported as described in the laboratory QA plan. Data reduction, review, and reporting by the laboratory will be conducted as follows:

- Raw data are produced by the analyst who has primary responsibility for the correctness and completeness of the data. All data will be generated and reduced following the QAPP-defined methods and implementing laboratory SOP protocols.

- Level 1 technical data review is completed relative to an established set of guidelines by a peer analyst. The review shall ensure the completeness and correctness of the data while assuring all method QC measures have been implemented and were within appropriate criteria.

- Level 2 technical review is completed by the area supervisor or data review specialist. This reviews the data for attainment of QC criteria as outlined in the established methods and for overall reasonableness. It will ensure all calibration and QC data are in compliance and check at least 10% of the data calculations. This review shall document that the data package is complete and ready for reporting and archival.

- Upon acceptance of the raw data by the area supervisor, the report is generated and sent to the Laboratory Project Manager for Level 3 administrative data review. This review will ensure consistency and compliance with all laboratory instructions, the laboratory QA plan, the project laboratory SOW, and the project QAPP.

- The Laboratory Project Manager will complete a thorough review of all reports.

- Final reports will be generated and signed by the Laboratory Project Manager and Quality Assurance Officer.

- Data will then be delivered to the Contractor for data verification and validation.

The data review process will include identification of any out-of-control data points and data omissions, as well as interactions with the laboratory to correct data deficiencies. Decisions to repeat sample collection and analyses may be made by the Contractor Project Manager based on the extent of the deficiencies and their importance in the overall context of the project. The laboratory will provide flagged data to include such items as: (1) concentration below project quantitation levels, (2) estimated concentration due to poor spike recovery, and (3) concentration of chemical also found in laboratory blank.

Laboratories will prepare and retain full analytical and QC documentation for the project. Such retained documentation will be both hard (paper) copy and electronic storage media (e.g., magnetic tape) as dictated by the analytical methodologies employed. As needed, laboratories will supply hard copies of the retained information.

Laboratories will provide the following information to the Contractor in each analytical data package submitted:

- cover sheets listing the samples included in the report and narrative comments describing problems encountered in analysis;

- tabulated results of inorganic and organic compounds identified and quantified;

- analytical results for QC sample spikes, sample duplicates, initial and continuous calibration verifications of standards and blanks, standard procedural blanks, LCSs and other deliverables as identified in Section 9.3; and

- tabulation of method detection levels and instrument detection limits determined in pure water.

9.2 DATA VERIFICATION/VALIDATION

Analytical data for this project will be verified and validated by qualified chemists. Flags signifying the usability of data will be noted and entered into an analytical data base. Data discrepancies noted during the verification and validation processes will be recorded as nonconformance reports, which are sent to the laboratory for clarification and/or correction. Decisions to repeat sample collection and analyses may be made by the Contractor Project Manager or U.S. Army Project Manager based on the extent of the deficiencies and their importance in the overall context of the project.

All data generated for investigations will be computerized in a format organized to facilitate data review and evaluation. The electronic data set will include data flags in accordance with referenced protocols as well as additional comments from the data review process. Associated data flags will include such items as: (1) concentration below project quantitation levels, (2) estimated concentration due to poor below-required detection limit, (3) estimated concentration due to poor spike recovery, and (4) concentration of chemical also found in laboratory blank. RVAAP investigation data sets will be available for controlled access by the Contractor Project Manager and authorized personnel. Each data set will be incorporated into investigation reports as required.

9.2.1 Data Verification/Validation Approach

A systematic process for data verification and validation will be performed to ensure that the precision and accuracy of the analytical data are adequate for their intended use. The greatest uncertainty in a measurement is often a result of the sampling process and inherent variability in the environmental media rather than the analytical measurement. Therefore, analytical data validation will be performed only to the level necessary 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 compounds). This approach is consistent with the objectives for the program, with the analytical methods, and for determining contaminants of concern and calculating risk.

Samples will be analyzed through implementation of "definitive" analytical methods. "Definitive Data" will be reported consistent with the deliverables identified in Section 9.3. This report content is consistent with what is understood as an EPA Level III deliverable (data forms including laboratory QC and calibration information). DQOs identified in Section 3.0 and method-specified criteria will be verified and validated. Comprehensive analytical information will be retained by the subcontract laboratory.

This "Definitive Data" will then be verified and validated through the review process presented in Figure 9-1. Primary, field duplicate and QA split samples will be collected for each project. All primary and field duplicate samples will be analyzed at the Contractor's primary laboratory, and resultant data will receive primary review (STEP-1) by the analyzing facility. All primary laboratory data will be subjected to data verification (STEP-2) by the Contractor. Ten percent of the primary data will receive comprehensive validation (STEP-3a). This 10 percent will be selected to conform with the 10 percent of the samples randomly selected for field duplicate determinations. QA split sample analyses will be performed by the QA laboratory designated by either the Ohio EPA or the USACE–Louisville District. This data will receive primary review by the analyzing facility with subsequent verification and comprehensive validation (STEP-2 and -3b) by the USACE–Louisville District. Validation reports from STEP-3a and STEP-3b will be combined with QA-split samples comparison by the USACE–Louisville District into sequentially generated Chemical Quality Assurance Reports (CQARs) (STEP-4). At the end of a project, this information will form the basis for the Chemical Data Quality Assessment Report (CDQAR) produced by the USACE–Louisville District (STEP-5).

Verification support staff will conduct a systematic review of all primary data for compliance with the established QC criteria based on the following categories:

- holding times,
- blanks,
- LCSs,
- calibration,
- surrogate recovery (organic methods),
- internal standards (primarily organic methods),
- MS/MSD and duplicate results,
- sample reanalysis,
- secondary dilutions, and
- laboratory case narrative.

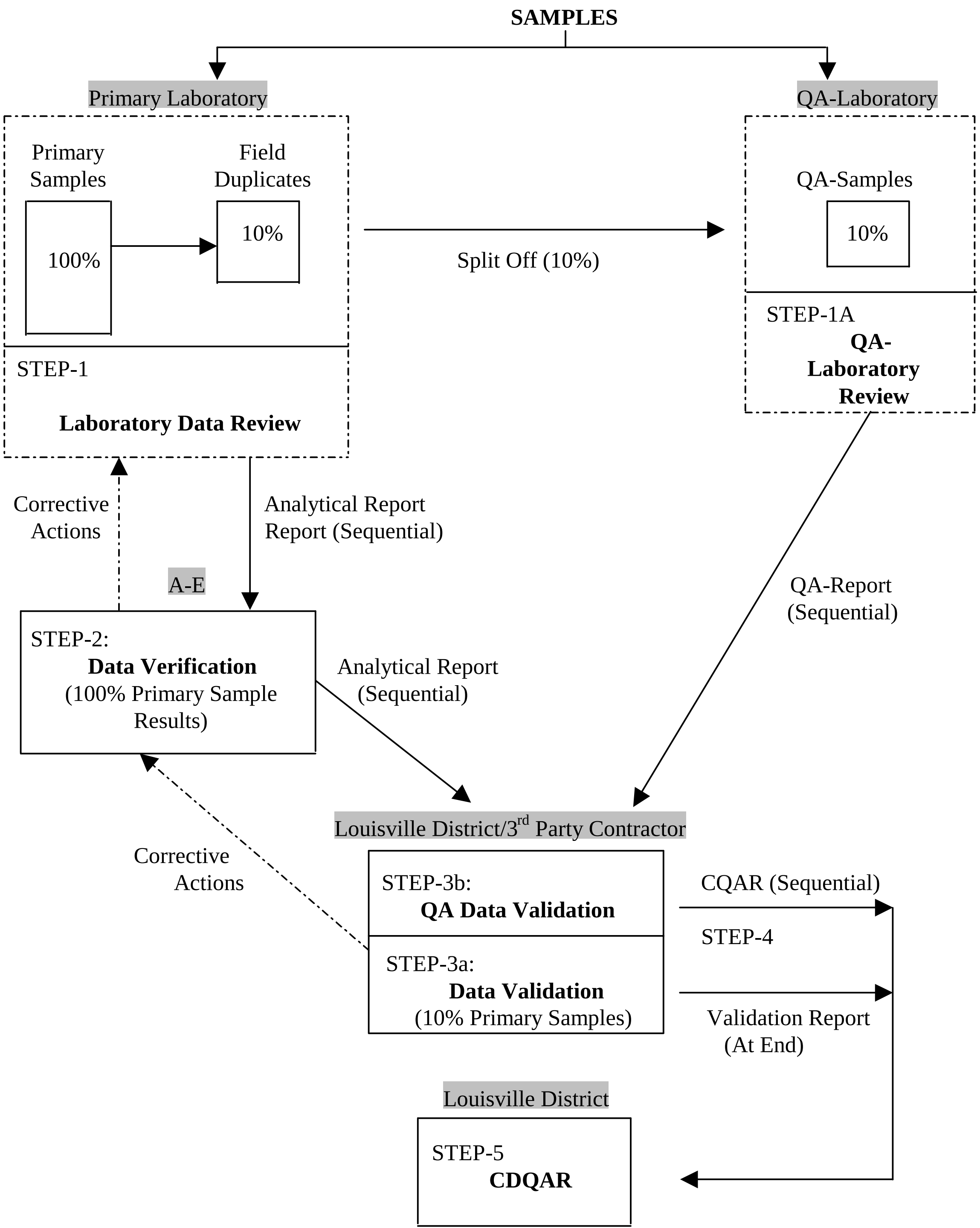

Figure 9-1. Definitive Data Review Process

Validation will be accomplished by comparing the contents of the data packages and QA/QC results to requirements contained in the requested analytical methods. The USACE's subcontracted validation support staff will be responsible for these activities. All validation staff will be independent of both the analytical laboratory and the Contractor, and all validation staff must be contracted by the USACE Louisville District. The protocol for analyte data validation is presented in:

- USACE Louisville Chemistry Guideline, Rev. 1.0, January 2001;
- Shell Analytical Chemistry Requirements, version 1.0, 2 November, 1998;
- Environmental Data Assurance Guideline, USACE Louisville, May 2000;
- EPA National Functional Guidelines for Organic Data Review (EPA 1994b); and
- EPA National Functional Guidelines for Inorganic Data Review (EPA 1994c).

Consistent with the data quality requirements as defined in the DQOs, all project data and associated QC will be evaluated and qualified as per the outcome of the review.

9.2.2 Primary Analytical Data Verification/Validation Categories

9.2.2.1 Holding times

Evaluation of holding times ascertains the validity of results based on the length of time from sample collection to sample preparation or sample analysis. Verification of sample preservation must be confirmed and accounted for in the evaluation of sample holding times. The evaluation of holding times is essential to establishing sample integrity and representativeness. Concerns regarding physical, chemical, or biochemical alteration of analyte concentrations can be eliminated or qualified through this evaluation.

9.2.2.2 Calibration

The purpose of initial and continuing calibration verification analyses is to verify the linear dynamic range and stability of instrument response. Relative instrument response is used to quantitate the analyte results. If the relative response factor is outside acceptable limits, the data quantification is uncertain and requires appropriate qualification.

9.2.2.3 Blanks

The assessment of blank analyses is performed to determine the existence and magnitude of contamination problems. The criteria for evaluation of blanks applies to any blank associated with the samples, including field, trip, equipment, and method blanks. Contamination during sampling or analysis, if not discovered, results in false-positive data.

Blanks will be evaluated against project quantitation levels as specified in Tables 3-3 through 3-9 and laboratory method detection limits. Analytical method blanks should be below 2× their respective method detection limits. Field, trip, and equipment rinsate blanks will be evaluated against their project quantitation levels. Sample data will be qualified relative to any blank contamination observed.

9.2.2.4 Laboratory control samples

The LCS serves as a monitor of the overall performance of the analytical process, including sample preparation, for a given set of samples. Evaluation of this standard provides confidence in or allows qualification of results based on a measurement of process control during each sample analysis.

9.2.2.5 Surrogate recovery

System monitoring compounds are added to every sample, blank, LCS, MS, MSD, and standard. They are used to evaluate extraction, cleanup, and analytical efficiency by measuring recovery on a sample-specific basis. Poor system performance as indicated by low surrogate recoveries is one of the most common reasons for data qualification. Evaluation of surrogate recovery is critical to the provision of reliable sample-specific analytical results.

9.2.2.6 Internal standards

Internal standards are utilized to evaluate and compensate for sample-specific influences on the analyte quantification. They are evaluated to determine if data require qualification due to excessive variation in acceptable internal standard quantitative or qualitative performance measures. For example, a decrease or increase in internal standard area counts for organics may reflect a change in sensitivity that can be attributed to the sample matrix. Because quantitative determination of analytes is based on the use of internal standards, evaluation is critical to the provision of reliable analytical results.

9.2.2.7 Matrix spike, matrix spike duplicate, and duplicate

MS, MSD, and duplicate results serve as an indicator of individual sample and matrix type influence over the analytical values. Evaluation of these measures provides confidence that the sample matrix has not impacted results or allows qualification of results based on the percent spike recovery or imprecision indicated by the duplicate comparison.

9.2.2.8 Post digestion spikes

Metal post-digestion spikes are evaluated to establish precision and accuracy of individual analytical determinations. Because of the nature of some elemental analytical techniques and because of the detailed decision tree and analysis scheme required for quantitation of the elements, evaluation of this QC is critical to ensuring reliable analytical results.

9.2.2.9 Sample reanalysis

When instrument performance-monitoring standards indicate an analysis is out of control, the laboratory is required to reanalyze the sample. If the reanalysis does not solve the problem (i.e., surrogate compound recoveries are outside the limits for both analyses), the laboratory is required to submit data from both analyses. An independent review is required to determine which is the appropriate sample result.

9.2.2.10 Secondary dilutions

When the concentration of any analyte in any sample exceeds the initial calibration range, a new aliquot of that sample must be diluted and reanalyzed. The laboratory is required to report data from both analyses. When this occurs, an independent review of the data is required to determine the appropriate results to be used for that sample. An evaluation of each analyte exceeding the calibration range must be made, including a review of the dilution analysis performed. Results chosen in this situation may be a combination of both the original results (i.e., analytes within initial calibration range) and the secondary dilution results.

9.2.2.11 Laboratory case narratives

Analytical laboratory case narratives are reviewed for specific information concerning the analytical process. This information is used to direct the data validator to potential problems with the data.

9.3 DATA REPORTING

Laboratories will prepare and submit analytical and QC data reports to the Contractor or the U.S. Army (QA split sample data) in compliance with the requirements of this QAPP, including data forms listed in Table 9-1 and will be considered a definitive data package. The definitive data package will include a cover sheet, table of contents, case narrative, the analytical results, sample management records, and internal laboratory QA/QC information. The laboratory data package should be organized so that the analytical results are reported on a per batch basis. A general outline is presented below:

Cover Sheet

- Title of report
- Name and location of laboratory
- Name and location of all subcontract laboratories
- Contract number
- Client name and address
- Project name and site location
- Statement of data authenticity with official signatures
- Amendments, if applicable

Table of Contents

Case Narrative

Analytical Results

- Laboratory name and location
- Project name and ID number
- Field sample ID number
- Laboratory sample ID number
- Matrix
- Sample description
- Sample preservation or condition at receipt
- Date sample collected
- Date sample received by the laboratory
- Date sample extracted or prepared
- Date sample analyzed
- Analysis time when holding time is <48 hours
- Analytical method numbers, including preparation numbers
- Preparation and analytical batch numbers
- Analyte or parameter
- Method reporting limits
- Method quantitation limits
- Method detection limits
- Analytical results
- Confirmation data
- Laboratory assigned data qualifiers
- Concentration units
- Dilution factors

- Percent moisture or percent solids
- Chromatograms, as needed
- Sample aliquot size analyzed
- Final extract volume

Laboratory Reporting Limits
Sample Management Records
QA/QC Information

Table 9-1. Standard Data Deliverables (Hard Copy), Ravenna Army Ammunition Plant, Ravenna, Ohio

Method Requirements	Deliverables
Requirements for all methods:	
- Holding time information and methods requested	Signed chain-of-custody forms
- Discussion of laboratory analysis, including any laboratory problems	Case narratives
- LCS (run with each batch of samples processed)	Results (control charts when available)
Organics: GC/MS analysis	
- Sample results, including TICs	EPA Form 1 or equivalent
- Surrogate recoveries	EPA Form 2 or equivalent
- Matrix spike/spike duplicate data	EPA Form 3 or equivalent
- Method blank data	EPA Form 4 or equivalent
- GC/MS tune	EPA Form 5 or equivalent
- GC/MS initial calibration data	EPA Form 6 or equivalent
- GC/MS continuing calibration data	EPA Form 7 or equivalent
- GC/MS internal standard area data	EPA Form 8 or equivalent
Organics: GC analysis	
- Sample results	EPA Form 1 or equivalent
- Surrogate recoveries	EPA Form 2 or equivalent
- Matrix spike/spike duplicate data	EPA Form 3 or equivalent
- Method blank data	EPA Form 4 or equivalent
- Initial calibration data	EPA Form 6 or equivalent
If calibration factors are used	A form listing each analyte, the concentration of each standard, the relative calibration factor, the mean calibration factor, and the %RSD
- Calibration curve if used	Calibration curve and correlation coefficient
- Continuing calibration data	EPA Form 9 or equivalent
- Positive identification (second column confirmation)	EPA Form 10 or equivalent
Metals	
- Sample results	EPA Form 1 or equivalent
- Initial and continuing calibration	EPA Form 2 or equivalent, dates of analyses and calibration curve, and the correlation coefficient factor
- Method blank	EPA Form 3 or equivalent and dates of analyses
- ICP interference check sample	EPA Form 4 or equivalent and dates of analyses
- Spike sample recovery	EPA Form 5A or equivalent

Table 9-1. Standard Data Deliverables (Hard Copy), Ravenna Army Ammunition Plant, Ravenna, Ohio (continued)

Method Requirements	Deliverables
- Postdigestion spike sample recovery for ICP metals	EPA Form 5B or equivalent
- Postdigestion spike for GFAA	EPA Form 5B or equivalent
- Duplicates	EPA Form 6 or equivalent
- LCS	EPA Form 7 or equivalent
- Standard additions (when implemented)	EPA Form 8 or equivalent
- Holding times	EPA Form 13 or equivalent
- Run log	EPA Form 14 or equivalent
Wet Chemistry	
- Sample results	Report result
- Matrix spike recovery	% Recovery
- Matrix spike duplicate or duplicate	% Recovery and % RPD
- Method blank	Report results
- Initial calibration	Calibration curve and correlation coefficient
- Continuing calibration check	Recovery and % difference
- LCS	LCS result and control criteria

GC = gas chromatography
GFAA = graphite furnace atomic absorption
ICP = inductively coupled plasma
LCS = laboratory control standard
MS = mass spectrometry
PCB = polychlorinated biphenyl
RPD = relative percent difference
RSD = relative standard deviation
TIC = tentatively identified compound

Electronic data deliverables (EDDs) will contain the same information as described for the hard copy deliverables. EDDs should use common syntax for terms; provide sufficient input to link analytical data; provide traceability of data; and allow a mechanism to report complex analytical relationships. Examples of EDDs are referenced in the Shell Document and may be obtained from USACE HTRW CX, Chemical data Quality Management Branch. An acceptable configuration is presented in Table 9-2.

The laboratory will be required to confirm sample receipt and log-in information. The laboratory will return a copy of the completed COC and confirmation of the laboratory's analytical log-in to the Contractor within two days of sample receipt.

The subcontract analytical laboratory will prepare and retain full analytical and QC documentation. Such retained documentation will include all hard copies and other storage media (e.g., disc storage). As needed, the subcontract analytical laboratory will make available all retained analytical data information.

Table 9-2. Standard Electronic Data Deliverables (EDD), Ravenna Army Ammunition Plant, Ravenna, Ohio[a]

EDD Fields (Max Length)	Description
SMP_ID (15)	The original client sample identification number. For Lab QC samples this field may be left empty or filled with a place holder like 'QC' or 'NA' for LCS and blanks. The original client sample ID should be used for MS, MSD, and SUR samples.
LAB_ID (15)	The laboratory's sample identification number.
DATE_REC (10)	The date the sample was received by the laboratory (MM/DD/YYYY).
DATE_EXT (10)	The date the sample was extracted (MM/DD/YYYY). The extraction refers to any preparatory techniques such as extraction, digestion, and separation.
DATE_ANA(10)	The date the sample was analyzed (MM/DD/YYYY).
TIME_ANA(5)	The time the sample was analyzed (HH:MM).
MATRIX (10)	The sample matrix. Valid values are Water, Solid, or Air.
METHOD (21)	The method requested by the client (e.g., SW846 8080). This should not be the lab method number.
RES_TYPE (4)	The laboratory result type. Currently the loading routine only handles the following values:
	REG-results of a primary analysis of a client sample
	REA- results of a reanalysis of a client sample
	DIL- results of an analysis of a diluted client sample
	LCS-results of a laboratory control sample as % recovery
	LCST-expected (true) result of a laboratory control sample as a concentration
	LCSF-actual (final) result of a laboratory control sample as a concentration
	SUR-surrogate recovery as % recovery
	MS-matrix spike recovery as a % recovery
	MST- expected (true) result of a matrix spike sample as a concentration
	MSF- actual (final) result of a matrix spike sample as a concentration
	MSD-matrix spike duplicate recovery as relative percent difference
	MSDT- expected (true) result of a matrix spike duplicate sample as a concentration
	MSDF- actual (final) result of a matrix spike duplicate sample as a concentration
	BLK-result of a laboratory blank sample.
CAS_NUM (15)	The CAS number or blank if no CAS number is available.
PARAMTR (50)	Chemical name for the analytic parameter.
RESULTS (N)	The analytic result.
UNITS (15)	The units for the result.
LABQUAL (6)	The qualifiers assigned by the laboratory.
DET_LIMIT (N)	The Contract-Required Detection Limit for the analyte being measured. It should be reported in the same units as the result.
UNC (N)	The 2 sigma error in the net count rate for radiological analyses. Should be expressed in the same units as the analytic result.
DILUTION (N)	The overall dilution of the sample aliquot. A value of one should correspond to nominal conditions for the method. Values less than one correspond to concentrations.
SMP_WT (N)	The weight or volume of the sample used for the analysis.
WT_UNITS (2)	The units for the sample weight or volume.
FILTERED (1)	Must have 'F' if the sample was filtered either by the lab or in the field.
PCT_SOL (N)	Percent solids.
TIC (10)	Enter 'TIC' or retention time for tentatively identified compound. Blank if not a TIC.

[a]The laboratory EDD may be delivered either as an Excel spreadsheet or as a comma or tab delimited file readable by Excel. The file name must include the SDG number or equivalent. For example, if multiple files were submitted for the same SDG, the filename could be the SDG number followed by a sequential number for each file in the SDG. A file cannot contain more than one SDG. Multiple analytic fractions may be present in the file. he first row of the file should contain the field names. The expected field names and comments about them are listed below. Fields do not have to be present in the order specified and additional fields may be included; however, columns must be present for all fields identified below.

N-Indicates that the field requires a numeric entry.

9.4 DATA QUALITY ASSESSMENT

The Contractor data assessment will be accomplished by the joint efforts of the data validator, the data assessor, and the Contractor Project Manager. Data assessment by data management will be based on the criteria that the sample was properly collected and handled according to the FSAP and Section 5.0 of this QAPP. An evaluation of data accuracy, precision, sensitivity and completeness, based on criteria in Section 12.0, will be performed by a data assessor and presented in the project report. This Quality Control Summary Report (QCSR) will indicate that data are: (1) usable as a quantitative concentration, (2) usable with caution as an estimated concentration, or (3) unusable due to out-of-control QC results.

As part of the on-going data quality assessment the U.S. Army chemist will compile information and provide CQARs and at the conclusion of the project assemble a CDQAR.

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10.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits of both field and laboratory activities will be conducted to verify that sampling and analysis are performed in accordance with the procedures established in the FSP and QAPP. Audits of field and laboratory activities will include both internal and external audits.

10.1 FIELD AUDITS

Internal audits of field activities (sampling and measurements) will be conducted by the Contractor's QA Officer and/or Field Team Leader. The audits will include examination of field sampling records, field instrument operating records, sample collection, handling and packaging in compliance with the established procedures, maintenance of QA procedures, COC, etc. These audits will occur at the onset of a project to verify that all established procedures are followed (systems audit).

Performance audits will follow to ensure deficiencies have been corrected and to verify that QA practices/procedures are being maintained throughout the duration of the project work effort. These audits will involve reviewing field measurement records, instrumentation calibration records, and sample documentation.

External audits may be conducted at the discretion of the U.S. Army, EPA Region 5, or Ohio EPA.

10.2 LABORATORY AUDITS

The USACE HTRW CX conducts on-site audits and certifies laboratories on a regular basis. These independent on-site systems audits in conjunction with performance evaluation samples (performance audits) qualify laboratories to perform U.S. Army environmental analysis every 18 months.

These system audits include examining laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Performance audits consist of sending performance evaluation samples to U.S. Army laboratories for on-going assessment of laboratory precision and accuracy. The analytical results of the analysis of performance evaluation samples are evaluated by USACE HTRW CX to ensure that laboratories maintain an acceptable performance.

Internal performance and system audits of laboratories will be conducted by the Laboratory QA Officer as directed in the laboratory QA plan. These system audits will include examination of laboratory documentation of sample receiving, sample log-in, sample storage, COC procedures, sample preparation and analysis, instrument operating records, etc. Internal performance audits are also conducted on a regular basis. Single-blind performance samples are prepared and submitted along with project samples to the laboratory for analysis. The Laboratory QA Officer will evaluate the analytical results of these single-blind performance samples to ensure that the laboratory maintains acceptable performance.

Additional audits of laboratories may be planned and budgeted within specific RVAAP task scopes. These project-specific laboratory performance review audits would be conducted by the Contractor at the direction of and in conjunction with the U.S. Army, when requested.

External audits may be conducted in conjunction with or at the direction of EPA Region 5 or the Ohio EPA.

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11.0 PREVENTIVE MAINTENANCE PROCEDURES

11.1 FIELD INSTRUMENTS AND EQUIPMENT

The field equipment for this project may include thermometers; pH meters; conductivity meters; turbidity meters; organic vapor detectors (FID or PID); combustible gas detectors capable of measuring the lower explosive limit, upper explosive limit, and/or oxygen levels; and geophysical testing equipment. Specific preventative maintenance procedures to be followed for field equipment are those recommended by the manufacturers. These procedures are included in the technical procedures governing the use of these instruments.

Field instruments will be checked and/or calibrated before they are shipped or carried to the field. Each field instrument will be checked daily against a traceable standard or reference with a known value to ensure that the instrument is in proper calibration. Instruments found to be out of calibration will be recalibrated before use in the field. If the instrument cannot be calibrated, it will be returned to the supplier or manufacturer for recalibration, and a back-up instrument will be used in its place. Calibration checks and calibrations will be documented on the Field Meter/Calibration Log Sheets in the M&TE Log Book. Any maintenance conducted on field equipment must be documented in the M&TE Log Book.

Critical spare parts such as tapes, papers, pH probes, electrodes, and batteries will be kept on site to minimize down time of malfunctioning instruments. Back-up instruments and equipment should be available on site or within 1-day shipment to avoid delays in the field schedules.

11.2 LABORATORY INSTRUMENTS

As part of their QA/QC Program, a routine preventive maintenance program will be conducted by all RVAAP investigation-associated laboratories to minimize the occurrence of instrument failure and other system malfunctions. All laboratory instruments will be maintained in accordance with manufacturers' specifications and the requirements of the specific method employed. This maintenance will be carried out on a regular, scheduled basis and will be documented in the laboratory instrument service log book for each instrument. Emergency repair or scheduled manufacturer's maintenance will be provided under a repair and maintenance contract with factory representatives.

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

12.1 FIELD MEASUREMENTS DATA

Field data will be assessed by the site QC Officer. The site QC Officer will review the field results for compliance with the established QC criteria that are specified in the QAPP and FSAP. Accuracy of the field measurements will be assessed using daily instrument calibration, calibration check, and analysis of blanks. Precision will be assessed on the basis of reproducibility by multiple reading of a single sample.

Field data completeness will be calculated using Equations (1a) and (1b).

Sample Collection (1a):

$$\text{Completeness} = \frac{\text{Number of Sample Points Sampled}}{\text{Number of Sample Points Planned}} \times 100\% \qquad \textbf{(1a)}$$

Field Measurements (1b):

$$\text{Completeness} = \frac{\text{Number of Valid Field Measurements Made}}{\text{Number of Field Measurements Planned}} \times 100\% \qquad \textbf{(1b)}$$

12.2 LABORATORY DATA

Laboratory results will be assessed for compliance with required precision, accuracy, completeness, and sensitivity as follows.

12.2.1 Precision

The precision of the laboratory analytical process will be determined through evaluation of LCS analyses. The standard deviation of these measurements over time will provide confidence that implementation of the analytical protocols was consistent and acceptable. These measurements will establish the precision of the laboratory analytical process.

Investigative sample matrix precision will be assessed by comparing the analytical results between MS/MSD for organic analysis and laboratory duplicate analyses for inorganic analysis. The RPD will be calculated for each pair of duplicate analysis using Equation (2). This precision measurement will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$\text{RPD} = \frac{|S - D|}{\frac{(S + D)}{2}} \text{ x } 100 \qquad \textbf{(2)}$$

where

S = First sample value (original or MS value),
D = Second sample value (duplicate or MSD value).

12.2.2 Accuracy

The accuracy of the laboratory analytical measurement process will be determined by comparing the percent recovery for the LCS versus its documented true value.

Investigative sample accuracy will be assessed for compliance with the established QC criteria that are described in Section 3.0 of this QAPP using the analytical results of method blanks, reagent/preparation blank, MS/MSD samples, field blank, and bottle blanks. The percent recovery (%R) of MS samples will be calculated using Equation (3). This accuracy will include variables associated with the analytical process, influences related to sample matrix interferences, and sample heterogeneity.

$$\%R = \frac{A - B}{C} \times 100 \qquad \textbf{(3)}$$

where

A = The analyte concentration determined experimentally from the spiked sample,
B = The background level determined by a separate analysis of the unspiked sample,
C = The amount of the spike added.

12.2.3 Completeness

Data completeness of laboratory analyses will be assessed for compliance with the amount of data required for decision making. The completeness is calculated using Equation (4).

$$\text{Completeness} = \frac{\text{Number of Valid Laboratory Measurements Made}}{\text{Number of Laboratory Measurements Planned}} \times 100\% \qquad \textbf{(4)}$$

12.2.4 Sensitivity

Achieving method detection limits depends on sample preparation techniques, instrumental sensitivity, and matrix effects. Therefore, it is important to determine actual MDLs through the procedures outlined in 40 *Code of Federal Regulations* (*CFR*) 136, Appendix B. MDLs should be established for each major matrix under investigation (i.e., water, soil) through multiple determinations, leading to a statistical evaluation of the MDL.

It is important to monitor instrument sensitivity through calibration blanks and low concentration standards to ensure consistent instrument performance. It is also critical to monitor the analytical method sensitivity through analysis of method blanks, calibration check samples, and LCSs, etc.

12.3 PROJECT COMPLETENESS

Project completeness will be determined by evaluating the planned versus actual data. Consideration will be given for project changes and alterations during implementation. All data not flagged as rejected by the review, verification, validation, or assessment processes will be considered valid. Overall, the project completeness will be assessed relative to media, analyte, and area of investigation.

12.4 REPRESENTATIVENESS/COMPARABILITY

Representativeness expresses the degree to which data accurately reflect the analyte or parameter of interest for the environmental media examined at the site. It is a qualitative term most concerned with the proper design of the sampling program. Factors that affect the representativeness of analytical data include appropriate sample population definitions, proper sample collection and preservation techniques, analytical holding times, use of standard analytical methods, and determination of matrix or analyte interferences. Sample collection, preservation, analytical holding time, analytical method application, and matrix interferences will be evaluated by reviewing project documentation and QC analyses.

Comparability, like representativeness, is a qualitative term relative to a project data set as an individual. Investigations at RVAAP will employ narrowly defined sampling methodologies, site audits/surveillances, use of standard sampling devices, uniform training, documentation of sampling, standard analytical protocols/procedures, QC checks with standard control limits, and universally accepted data reporting units to ensure comparability to other data sets. Through proper implementation and documentation of these standard practices, the project will establish confidence that data will be comparable to other project and programmatic information.

Additional input to determine representativeness and comparability may be gained through statistical evaluation of data populations, chemical charge balances, compound evaluations, or dual measurement comparisons (e.g., total versus dissolved water analysis, field versus fixed laboratory analyses, etc.).

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13.0 CORRECTIVE ACTIONS

Corrective actions may be required for two major types of problems: analytical/equipment problems and noncompliance with criteria. Analytical and equipment problems may occur during sampling, sample handling, sample preparation, laboratory instrumental analysis, and data review.

Noncompliance with specified criteria and analytical/equipment problems will be documented through a formal corrective action program at the time the problem is identified. The person identifying the problem is responsible for notifying the Contractor Project Manager and the U.S. Army Project Manager. When the problem is analytical in nature, information on these problems will be promptly communicated to the Contractor Analytical Laboratory Coordinator and the U.S. Army Chemist. Implementation of corrective action will be confirmed in writing.

Any nonconformance with the established QC procedures in the QAPP or FSAP will be identified and corrected in accordance with the QAPP. The Contractor Project Manager or his/her designee will issue a Nonconformance Report (NCR) for each nonconformance condition.

Corrective actions will be implemented and documented in the field record book. No staff member will initiate corrective action without prior communication of findings through the proper channels. If corrective actions are deemed insufficient, work may be stopped through a stop-work order issued by the Contractor Project Manager and the U.S. Army Project Manager.

13.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Technical staff and project personnel will be responsible for reporting all suspected technical and QA nonconformances or suspected deficiencies of any activity or issued document by reporting the situation to the Contractor Project Manager or his/her designee. The manager will be responsible for assessing the suspected problems in consultation with the Contractor Project QA Manager to make a decision based on the potential for the situation to impact the quality of the data. When it is determined that the situation warrants a reportable nonconformance and corrective action, then an NCR will be initiated by the manager.

The manager will be responsible for ensuring that corrective action for nonconformances are initiated by:

- evaluating all reported nonconformances,
- controlling additional work on nonconforming items,
- determining disposition or action to be taken,
- maintaining a log of nonconformances,
- reviewing NCRs and corrective actions taken, and
- ensuring that NCRs are included in the final site documentation project files.

If appropriate, the Contractor Project Manager will ensure that no additional work dependent on the nonconforming activity is performed until the corrective actions are completed.

Corrective action for field measurements may include:

- repeating the measurement to check the error;
- checking for all proper adjustments for ambient conditions such as temperature;
- checking the batteries;
- re-calibrating equipment;
- checking the calibration;
- modification of the analytical method including documentation and notification (i.e., standard additions);
- replacing the instrument or measurement devices; and
- stopping work (if necessary).

The Contractor Project Manager or his/her designee is responsible for all site activities. In this role, he/she may at times be required to adjust the site activities to accommodate site-specific needs. When it becomes necessary to modify a program, the responsible person notifies the Contractor Project Manager of the anticipated change and implements the necessary changes after obtaining the approval of the Contractor Program Manager and the U.S. Army Program Manager. All changes in the program will be documented on the field change request (FCR) that will be signed by the initiators and the Contractor Project Manager. The FCR for each document will be numbered serially as required. The FCR shall be attached to the file copy of the affected document. The Contractor Project Manager must approve the change in writing or verbally before field implementation. If unacceptable, the action taken during the period of deviation will be evaluated in order to determine the significance of any departure from established program practices and action taken.

The Contractor Project Manager for the site is responsible for the controlling, tracking, and implementation of the identified changes. Reports on all changes will be distributed to all affected parties, including the U.S. Army Project Manager. The U.S. Army will be notified whenever program changes in the field are made.

13.2 LABORATORY ANALYSES

Each RVAAP investigation laboratory QA plan provides systematic procedures to identify out-of-control situations and corrective actions. Corrective actions shall be implemented to resolve problems and restore malfunctioning analytical systems. Laboratory personnel have received QA training and are aware that corrective actions are necessary when:

- QC data are outside warning or control windows for precision and accuracy.
- Blanks contain target analytes above acceptable levels and must be investigated (see Table 3-3 and Section 9.2.2.2).
- Undesirable trends are detected in spike recoveries or RPD between duplicates.

- There are unusual changes in detection limits.

- Deficiencies are detected by internal audits, external audits, or from performance evaluation samples results.

- 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, Manager, and/or QA Department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with project records and the QA Department, and the information is summarized within case narratives.

Corrective actions may include:

- re-analyzing the samples, if holding time criteria permit;

- evaluation of blank contaminant sources, elimination of these sources, and reanalysis;

- modification of the analytical method (i.e., standard additions) with appropriate notification and documentation;

- resampling and analyzing;

- evaluating and amending sampling procedures; or

- accepting data and acknowledging the level of uncertainty.

If resampling is deemed necessary due to laboratory problems, the Contractor Project Manager will identify the necessary cost recovery approach to implement the additional sampling effort.

The following corrective action procedures will be required:

- Problems noted during sample receipt will be documented in the appropriate laboratory Letter of Receipt. The Contractor and U.S. Army will be contacted immediately to determine problem resolution. All corrective actions will be thoroughly documented.

- When sample extraction/digestion or analytical holding times are not within method required specifications, the Contractor and U.S. Army will be notified immediately to determine problem resolution. All corrective actions will be thoroughly documented.

- All initial and continuing calibration sequences that do not meet method requirements will result in a review of the calibration. When appropriate, re-analysis of the standards or re-analysis of the affected samples back to the previous acceptable calibration check is warranted.

- All appropriate measures will be taken to prepare and clean up samples in an attempt to achieve the practical quantitation limits as stated. When difficulties arise in achieving these limits, the laboratory will notify the Contractor and the U.S. Army to determine problem resolution. All corrective actions will be thoroughly documented.

- Any dilutions impacting the practical quantitation limits will be documented in case narratives along with revised quantitation limits for those analytes affected. Analytes detected above the method detection limits, but below the practical quantitation limits, will be reported as estimated values.

- Failure of method-required QC to meet the requirements specified in this project QAPP shall result in review of all affected data. Resulting corrective actions may encompass those identified earlier. The Contractor and U.S. Army will be notified as soon as possible to discuss possible corrective actions, particularly when unusual or difficult sample matrices are encountered.

- When calculation and reporting errors are noted within any given data package, reports will be reissued with applicable corrections. Case narratives will clearly state the reasons for reissuance of reports.

14.0 QA REPORTS TO MANAGEMENT

All performance and system audits of laboratory and field operations will be reported directly to project management, program management, and USACE in accordance with Section 10.0 of this document. In addition to these audit reports, laboratory LORs, and analytical case narratives will be required from the laboratory.

The laboratory will provide status reports, as requested, to the Contractor point of contact for analytical activities. These status reports will contain the status of each sample received for the project and may be presented from established laboratory information system electronic databases or spreadsheets. Information to be provided may include:

- project name and contract number;

- laboratory sample number, project sample identification number, matrix type, and location of samples received during the monthly reporting period;

- description of and justification for alternative methods used or modifications of existing methods (any proposed changes to analytical methods in approved sampling and analysis plans requires written approval from the Contractor and U.S. Army);

- control charts for all LCS or MS analyses applicable to the project;

- a summary of all out-of-control events during the monthly reporting period, including references to documentation and corrective action reports;

- changes in laboratory QA personnel and other key technical staff, including resumes of new personnel;

- changes in business affiliation or status; and

- changes in the laboratory QA plan, SOPs, or applicable operating licenses.

All COC forms will be compared with samples received by the laboratory and a Letter of Receipt will be prepared and sent to the Contractor describing any differences in the COC forms and the sample labels or tags. All deviations will be identified on the receiving report, such as broken or otherwise damaged containers. This report will be forwarded to the Contractor within two days of sample receipt and will include a signed copy of the COC form, itemized project sample numbers, laboratory sample numbers, cooler temperature upon receipt, and itemization of analyses to be performed.

Case narrative statements will accompany analytical results from the laboratory. These reports, in conjunction with evaluation of field QC and any significant problems/corrective actions, will form the basis for the project data quality assessment. Final project reports will contain QA sections that summarize data quality information collected during the project.

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