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14. ABSTRACT
This document presents the addendum to modify the frequency and anytical parameters for the Facility-Wide Groundwater Monitoring Program (FWGWMP) Plan for the RVAAP-66 groundwater services project at the Ravenna Army Ammunition Plant. This document includes an addendum to the FWGWMP to reduce the overall groundwater monitoring frequency from quarterly to semiannual and to revise the analytical parameter list based on previously identified contaminants of potential concern. Additionally this addendum includes proposed revision to the FWGWMP QAPP and Site Safety and Health Plan.

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FINAL

FACILITY-WIDE GROUNDWATER MONITORING PROGRAM PLAN
RVAAP-66 FACILITY-WIDE GROUNDWATER
SEMIANNUAL MONITORING ADDENDUM

RAVENNA ARMY AMMUNITION PLANT,
RAVENNA, OHIO

GSA Contract Number GS-10F-0293K
Delivery Order W912QR-11-F-0266

Prepared for

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

Prepared by

Environmental Quality Management, Inc.
1800 Carillon Boulevard
Cincinnati, Ohio 45240

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Final

RVAAP-66 Facility-Wide Groundwater
Semiannual Monitoring Addendum
Distribution List

Organization	Number of Printed Copies	Number of Electronic Copies
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USAEC Program Manager	0	1
Ohio EPA	2	2
OHARNG - RTLS/ENV	1	1
NGB Cleanup Program Manager	0	1
EQM	1	1

RVAAP – Ravenna Army Ammunition Plant
USACE – U.S. Army Corps of Engineers
USAEC – U.S. Army Environmental Center
OHARNG – Camp Ravenna/ENV – Ohio Army National Guard Site/Environmental
NGB – National Guard Bureau
Ohio EPA – Ohio Environmental Protection Agency
EQM – Environmental Quality Management, Inc.

STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Environmental Quality Management, Inc. (EQM) has completed the *Final Facility-Wide Groundwater Monitoring Program Plan Rvaap-66 Facility-Wide Groundwater Semiannual Monitoring Addendum.* Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy, principles, and procedures, utilizing justified and valid assumptions, was verified. This included review of technical assumptions, methods, procedures, and materials to be used, and whether the product meets customer's needs consistent with law and existing U.S. Army Corps of Engineers policy.

John M. Miller, CHMM
Senior Project Manager

Date: 1/18/12

Scott A. Spesshardt, CPG
Senior Geologist

Date: 1/18/2012

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APPENDICES

LIST OF GENERAL ACRONYMS AND ABBREVIATIONS

ADR	Automatic Data Review
AOC	Area of Concern
ASAP	As Soon As Possible
ASTM	American Society for Testing and Materials
Camp Ravenna	Camp Ravenna Joint Military Training Center
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CHMM	Certified Hazardous Materials Manager
cm/sec	Centimeters per Second
COPCs	Chemicals of Potential Concern
CPG	Certified Professional Geologist
CSM	Conceptual Site Model
^{o}C	Degree Celsius
DFFOs	Director's Final Findings and Orders
DLA	Defense Logistics Agency
DO	Dissolved Oxygen
DoD	Department of Defense
DOT	Department of Transportation
DQOs	Data Quality Objectives
EDD	Electronic Data Deliverable
EIS	Environmental Investigation Services Addendum
EQM	Environmental Quality Management, Inc.
EPA	Environmental Protection Agency
ft	Feet
FWCUGs	Facility-Wide Clean-Up Goals
FWGWMP	Facility-Wide Groundwater Monitoring Program
FWGWMPP	Facility-Wide Groundwater Monitoring Program Plan
FWSAP	Facility-Wide Sampling and Analysis Plan
gal	Gallon
GC	Gas Chromatograph
GOCO	Government Owned, Contractor Operated
GSA	Government Services Administration
H_2SO_4	Sulfuric Acid
HCl	Hydrochloric Acid
Hg	Mercury
HNO_3	Nitric Acid
HPLC	High-Performance Liquid Chromatography
IDW	Investigative Derived Waste
in.	Inch
IRP	Installation Restoration Program
L	Liter
LG	Licensed Geologist
MCLs	Maximum Contaminant Levels
mg/L	Milligram per Liter
mL	Milliliters
mL/min	Milliliters per Minute
MS	Mass Spectrometer

LIST OF GENERAL ACRONYMS AND ABBREVIATIONS (continued)

µm	Micron
MS/MSD	Matrix Spike/Matrix Spike Duplicate
N/A	Not Applicable
NaOH	Sodium Hydroxide
NGB	National Guard Bureau
OHARNG	Ohio Army National Guard
ORP	Oxidation Reduction Potential
OVA	Organic Vapor Analyzer
PAHs	Polycyclic Aromatic Hydrocarbons
PBA	Performance Based Acquisition
PCBs	Polychlorinated Biphenyls
PID	Photoionization Detector
PPE	Personal Protective Equipment
PWS	Performance Work Statement
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RDX	1,3,5-Trinitroperhydro-1,3,5-Triazine
REIMS	Ravenna Environmental Information Management System
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RSLs	Regional Screening Levels
RVAAP	Ravenna Army Ammunition Plant
SVOCs	Semivolatile Organic Compounds
TCLP	Toxicity Characteristic Leaching Procedure
TNT	2,4,6-Trinitrotoluene
µg/L	Microgram per Liter
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
USP&FO	United States Property and Fiscal Officer
UV	Ultraviolet
VOCs	Volatile Organic Compounds

LIST OF AREA OF CONCERN ACRONYMS

ASY	Atlas Scrap Yard
B12	Building 1200
BKG	Background
CBL	C-Block
CBP	Central Burn Pits
CP	Cobbs Pond
DA2	Demolition Area #2
EBG	Erie Burning Grounds
FBQ	Fuze and Booster Quarry
LNW	Landfill North of Winklepeck
LL	Load Line
MBS	Mustard Burial Site
NACA	National Advisory Committee for Aeronautics
NTA	NACA Test Area
RQL	Ramsdell Quarry Landfill
SCF	Sharon Conglomerate Formation
WBG	Winklepeck Burning Grounds

EXECUTIVE SUMMARY

This document is intended as a follow-up to the *Draft 2010 Addendum to the Facility-Wide Groundwater Monitoring Program Plan (FWGWMPP) RVAAP-66 Facility-Wide Groundwater* (USACE, November 15, 2010). As such it provides updates and proposed modifications to the current *Facility-Wide Groundwater Monitoring Program Plan* (USACE, 2004). Additionally, this document supplements the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Addendum* (EQM, January 2012), which includes three parts: Part I) Environmental Investigation Services Addendum (EIS Addendum), Part II) Quality Assurance Project Plan Addendum, and Part III) Site Safety and Health Plan Addendum.

The U.S. Army Corps of Engineers (USACE), Louisville District, is performing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) closure at the former Ravenna Army Ammunition Plant (RVAAP) located near Ravenna, Ohio. The USACE, under a Government Services Administration (GSA) Performance Based Acquisition (PBA) contract, retained Environmental Quality Management, Inc. (EQM) to obtain a signed Record of Decision (ROD) for the facility-wide groundwater (RVAAP-66) at the former RVAAP. Part of the Remedial Investigation/Feasibility Study (RI/FS) process will involve a determination of the future monitoring needs in support of any remedial activities or long-term monitoring/monitored natural attenuation required under the ROD.

The current Facility-Wide Groundwater Monitoring Program (FWGWMP) schedule involves quarterly sampling of a subset of the 243 existing wells at RVAAP. A baseline data set has been established for all of the wells at RVAAP. It appears from these data that the initial investigative phase for the existing wells has been completed [i.e., there is an understanding of the impacts of specific Area of Concern (AOC) sources to individual wells at the facility]. As a result, USACE and the Ohio Environmental Protection Agency (EPA) desire that the site move from an AOC-based approach to a facility-wide approach for groundwater. Based on this perspective, EQM proposes that the facility-wide groundwater monitoring schedule be modified from a quarterly to semiannual basis (January and July events), which would still be sufficient to assess potential adverse effects to human health and the environment during the RI/FS process.

In order to complete the RI/FS and eventual ROD, an additional 39 monitoring wells will be installed at the facility to further characterize the nature and extent of facility-wide groundwater impacts and to support hydrogeologic system and contaminant fate-and-transport modeling. The new wells are not included in the semiannual sampling network, although they will be sampled at the same time as the July 2012 semiannual sampling event. The 39 new wells will be sampled for four successive quarters beginning in April 2012.

Since there are numerous wells at the site, the approach used for identifying the semiannual well network was to select wells that have exhibited COPCs and to eliminate wells that provide redundancy or provide minimal information on groundwater quality or fate-and-transport migration. To this end, thirty-five (35) wells [including five Resource Conservation and Recovery Act (RCRA) wells] have been selected for sampling during the semiannual events in 2012. Nineteen (19) wells were selected in association with or paired with several of the new wells to assess horizontal and/or vertical contaminant distribution in groundwater. Two (2) of these wells are located in the northern portion of the facility to provide upgradient data for the various site-wide models. In addition, four (4) potential exit pathway wells were selected that have no direct association with the new wells [note that five (5) of the 19 paired wells are also potential exit pathway wells]. As mentioned previously, five of the semiannual wells are RCRA wells. One well, LL12mw-182, has historically been found to contain bis(2-ethylhexyl)phthalate at concentrations exceeding screening levels. A new stainless steel well (#39) will be installed near this location and both wells will be sampled to determine if bis(2-ethylhexyl)phthalate is an artifact of the polyvinyl chloride (PVC) well materials used to construct the older well. Five wells (LL10mw-003, LL12mw-185, LL12mw-187, LL12mw-242, and LL12mw-245) were selected for potential source evaluations. Lastly, one (1) well (LL12mw-246) located potentially upgradient of two of the newly installed wells was selected to provide groundwater quality data in support of the fate-and-transport model. Besides fulfilling the selection criteria, the groundwater quality information obtained from this well network will be incorporated into the hydrogeologic system and contaminant fate-and-transport models.

SECTION 1. INTRODUCTION

This document is intended as a follow-up to the *Draft 2010 Addendum to the Facility-Wide Groundwater Monitoring Program Plan (FWGWMPP) RVAAP-66 Facility-Wide Groundwater* (USACE, November 15, 2010). As such it provides updates and proposed modifications to the current *Facility-Wide Groundwater Monitoring Program Plan* (USACE, 2004). Additionally, this document supplements the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Addendum* (EQM, January 2012), which includes three parts: Part I) Environmental Investigation Services Addendum (EIS Addendum), Part II) Quality Assurance Project Plan Addendum, and Part III) Site Safety and Health Plan Addendum.

1.1 Background

The U.S. Army Corps of Engineers (USACE), Louisville District, is performing Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) closure at the former Ravenna Army Ammunition Plant (RVAAP) located near Ravenna, Ohio. CERCLA closure is occurring under the Installation Restoration Program (IRP). The USACE, under a Government Services Administration (GSA) Performance Based Acquisition (PBA) contract, retained Environmental Quality Management, Inc. (EQM) (Contract No. GS-10F-0293K – Delivery Order W912QR-11-F-0266) to obtain a signed Record of Decision (ROD) for the facility-wide groundwater (RVAAP-66) at the former RVAAP. Part of the Remedial Investigation/Feasibility Study (RI/FS) process will involve a determination of the future monitoring needs in support of any remedial activities or long-term monitoring/monitored natural attenuation required under the ROD.

The current Facility-Wide Groundwater Monitoring Program (FWGWMP) schedule involves quarterly sampling of a subset of all wells present at RVAAP. From an historical perspective, the quarterly sampling schedule has been used to complete a minimum of four quarters of sampling for the 243 existing wells at the facility, thereby providing a baseline for all of the facility groundwater monitoring wells, including seasonal fluctuations of water levels and contaminant levels. It appears from these data that the initial investigative phase for the existing wells has been completed [i.e., there is an understanding of the impacts of specific Area of Concern (AOC) sources to individual wells at the facility]. As a result, USACE and the Ohio Environmental Protection Agency (EPA) desire that the site move from an AOC-based approach to a facility-wide approach for groundwater. Based on this perspective, EQM proposes that the facility-wide groundwater monitoring schedule be modified from a quarterly to semiannual basis, which would still be sufficient to assess potential adverse effects to human health and the environment during the RI/FS process.

This addendum presents the proposed semiannual monitoring schedule, selected well network and rationale, and sampling and analysis activities to be conducted as part of this program. Appendix A presents the schedule. Appendix B provides various correspondence and comment responses that were resolved during finalization of this addendum.

1.2 Site Description

Past Department of Defense (DoD) activities at the RVAAP date to 1940 and include the manufacturing, loading, handling, and storage of military explosives and ammunition. Until 1999, the RVAAP was identified as a 21,419-acre installation. The property boundary was resurveyed by the Ohio Army National Guard (OHARNG) over a 2-year period from 2002 and 2003 and the actual total acreage of the property was found to be 21,683.289 acres. As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP have been transferred to the United States Property and Fiscal Officer (USP&FO) for Ohio for use by the OHARNG as a military training site. The current RVAAP consists of 1,280 acres in several distinct parcels scattered throughout the confines of the OHARNG Camp Ravenna Joint Military Training Center (Camp Ravenna). The RVAAP and Camp Ravenna are collocated on contiguous parcels of property and the Camp Ravenna perimeter fence completely encloses the remaining parcels of the RVAAP.

Camp Ravenna is in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 kilometers (3 miles) east-northeast of the City of Ravenna and approximately 1.6 kilometers (1 mile) northwest of the City of Newton Falls (Figure 1-1). The RVAAP portions of the property are solely located within Portage County. Camp Ravenna (inclusive of the RVAAP) is a parcel of property approximately 17.7 kilometers (11 miles) long and 5.6 kilometers (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (see Figures 1-1 and 1-2). Camp Ravenna is surrounded by several communities: Windham on the north; Garrettsville 9.6 kilometers (6 miles) to the northwest; Newton Falls 1.6 kilometers (1 mile) to the southeast; Charlestown to the southwest; and Wayland 4.8 kilometers (3 miles) to the south. When the RVAAP was operational Camp Ravenna did not exist and the entire 21,683-acre parcel was a government-owned, contractor-operated (GOCO) industrial facility. The RVAAP IRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP, and, therefore, references to the RVAAP in this document are considered to be inclusive of the historical extent of the RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

1.3 Site History

Although currently inactive, the RVAAP has historically handled hazardous wastes and operated several waste management units in support of its operation. Industrial operations comprised twelve (12) munitions-assembly facilities referred to as “load lines.” Load Lines 1 through 4 were used to melt and load 2,4,6-trinitrotoluene (TNT) and Composition B [a mixture of 1,3,5-trinitroperhydro-1,3,5-triazine (RDX) and TNT, generally in a 60:40 ration by weight] into large-caliber shells and bombs. The operations on the load lines produced explosive dust, spills, and vapors that collected on the floors and walls of each building. Periodically, the floors and walls were cleaned with water and steam. Following cleaning, the wastewater, which contained TNT and Composition B, was known as “pink water” for its characteristic color. Pink water was collected in concrete holding tanks, filtered, and pumped into unlined ditches for transport to

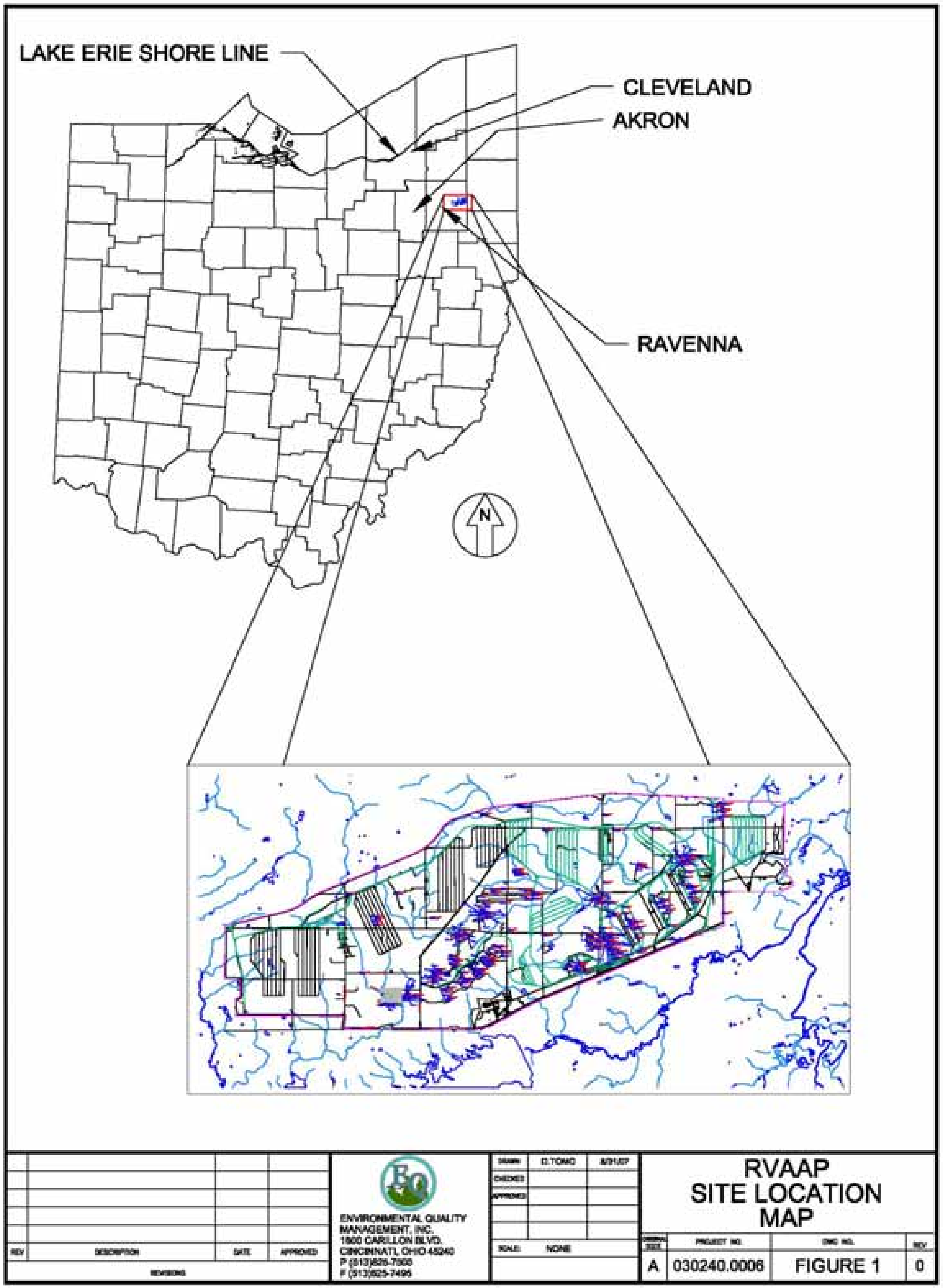


Figure 1-1. General Location Map

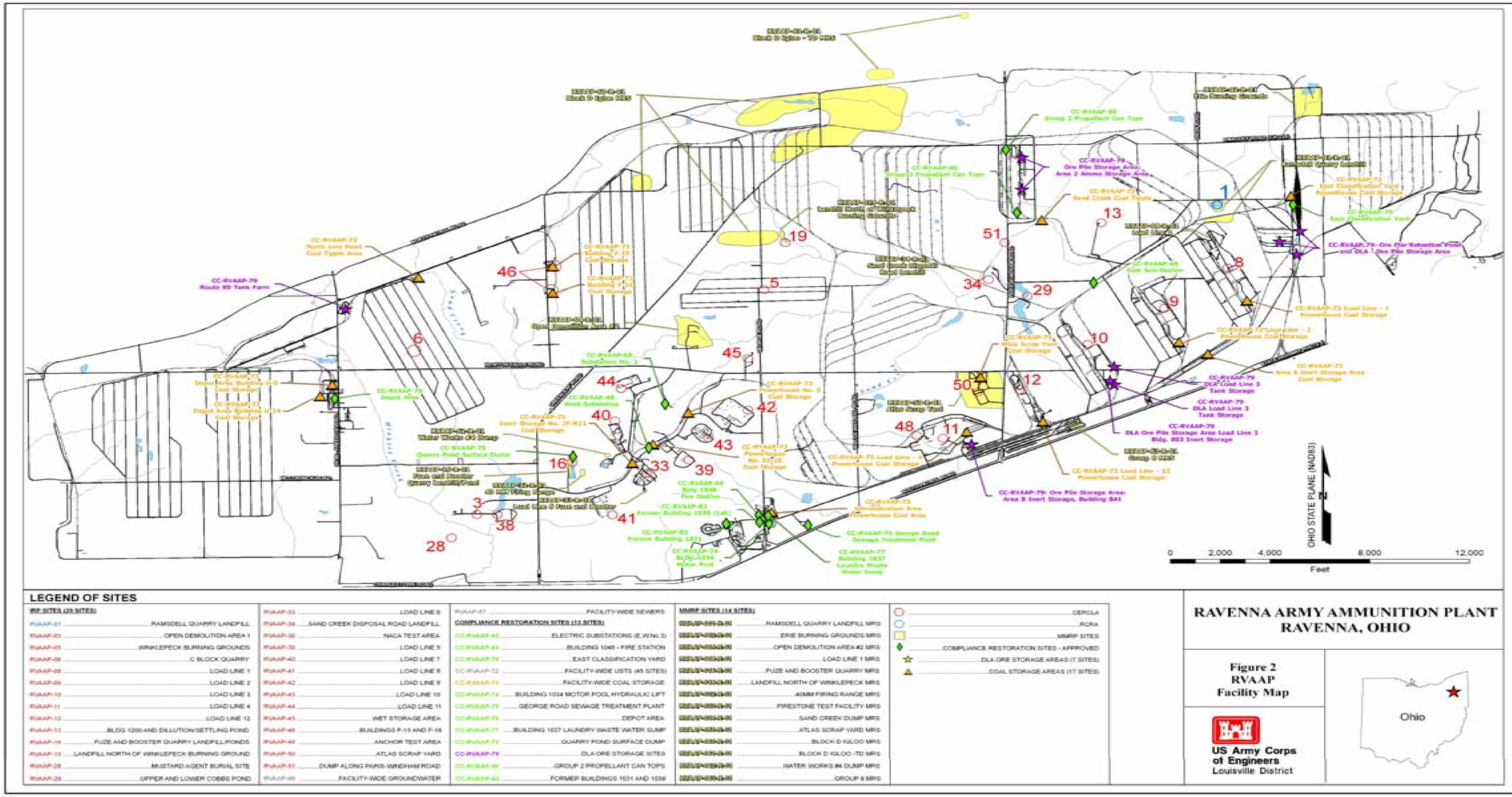


Figure 1-2. RVAAP Facility Map

earthen settling ponds. Load Lines 5 through 11 were used to manufacture fuses, primers, and boosters. Potential contaminants in these load lines include lead compounds, mercury compounds, and explosives. From 1946 to 1949, Load Line 12 was used to produce ammonium nitrate for explosives and fertilizers prior to use as a weapons demilitarization facility.

Various industrial operations at the RVAAP have been identified as potential sources of contaminants. These operations include the load lines, sewage treatment plants, wastewater treatment plants, vehicle maintenance areas, storage tanks, waste storage areas, equipment storage areas, and furnaces and evaporation units. Landfills at the RVAAP were used to bury wastes from industrial operations and sanitary sources. Settling and retention ponds at the site collected wastewater from munitions wash-down operations at various facilities. Additionally, the RVAAP includes several areas associated with the burning, demolition, and testing of various munitions. These burning grounds and demolition areas are located at several large areas or in abandoned quarries at the RVAAP. Strategic ores and other materials were stockpiled at several locations at the site; subsequent to removal by the Defense Logistics Agency (DLA), the residual materials may have left various contaminants in place. Potential contaminants at the site include, but are not limited to: primary explosives, secondary explosives, propellants, metals, polychlorinated biphenyls (PCBs), pesticides, waste oils, sludge from load lines, various laboratory chemicals, sanitary waste, mustard agent, and petroleum products.

The RVAAP is currently used as a military training site; no manufacturing operations are conducted at the facility.

A more comprehensive discussion of the RVAAP facility history and potential contaminants is presented in the Director's Final Findings and Orders (DFFOs) and Section 2.1 of the *Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations* (FWSAP; SAIC, 2011).

1.4 Environmental Setting

A comprehensive discussion of the RVAAP environmental setting is presented in Section 2.2 of the FWSAP.

1.5 Summary of Existing Data

During the last 30 years, multiple environmental-related investigations have been conducted at RVAAP. A brief summary of these investigations is provided in Section 1.3 of the *Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio* (SAIC, 2001) and Section 1.4 of the *Facility-Wide Groundwater Monitoring Program Plan* (USACE, 2004). Additional investigation activities will be conducted at the site in support of the RI/FS in 2012.

The USACE completed a review and evaluation of the entire groundwater database currently maintained in the Ravenna Environmental Information Management System (REIMS). The review and evaluation included available analytical data collected from 1996 through January 2010. The results of this evaluation are discussed in the *Draft 2010 Addendum to the Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater* (USACE, 2010). Table 1-1 summarizes the chemicals of potential concern (COPCs) identified above site-screening levels at various areas of the site.

1.6 Project Organization and Schedule

1.6.1 Project Organization and Responsibilities

EQM's overall project organization and responsibilities are presented in the Project Management Plan prepared for this PBA. The Project Manager for this project will be John M. Miller, CHMM. Quality assurance/quality control (QA/QC) protocols are addressed in Part II of the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP 66 Facility-Wide Groundwater Addendum* (EQM, January 2012). Health and safety requirements are addressed in Part III of the above-referenced addendum.

1.6.1.1 Field Team Leader

The Field Team Leader will be responsible for directing the sampling technicians during groundwater monitoring activities at the site. Generally, EQM mobilizes three field crews to perform the groundwater sampling. The Field Team Leader will ensure that all field sampling procedures are followed; equipment is properly calibrated, utilized, and decontaminated; health and safety measures are enforced; and field documentation protocols are met. The Field Team Leader will work closely with the Sample Manager to ensure that the data quality objectives are achieved. The Field Team Leader for this project will be Colleen Lear, LG.

1.6.1.2 Sample Manager

During the scheduled sampling events for RVAAP, the EQM Sample Manager will be on site to coordinate sample-related activities. The EQM Sample Manager will ensure that all samples are properly handled and shipped by:

- Ensuring that all samples are properly cooled and appropriately preserved.
- Verifying that samples are correctly labeled and identified.
- Filling out sample chain-of-custody forms accurately.
- Properly packaging sample containers into shipping coolers for transport.
- Coordinating sample shipments with the contracted analytical laboratory in an expeditious manner.

The Sample Manager will also serve as the Laboratory Coordinator, and as such will maintain regular communication with laboratory personnel with regard to sample schedule and shipment of selected samples. The Sample Manager for this project will be Erik Corbin.

Table 1-1. Groundwater Quality Summary for RVAPP

Area of Concern	Analytes									
	VOCs	SVOCs			Metals	Explosives	Pesticides	PCBs	Nitrate	Hexavalent Chromium
		Nitroaromatics & Phthalates	Phenols	PAHs						
Load Line 1	X	X			X	X	X			
Load Line 2	X	X	X		X	X	X	X		
Load Line 3	X	X			X	X	X			
Load Line 4	X	X			X	X	X			
Load Line 5		X			X			X		
Load Line 6		X		X	X					
Load Line 7	X	X			X	X				
Load Line 8		X			X					
Load Line 9		X		X	X		X			
Load Line 10	X	X		X	X	X				
Load Line 11	X	X			X	X	X			
Load Line 12	X	X	X	X	X	X	X	X	X	
Atlas Scrap Yard		X			X					X
Building 1200		X		X	X					
Building T-5301					X					
C-Block Quarry		X		X				X		X
Central Burn Pits		X			X		X	X		
Cobbs Ponds		X		X	X		X			
Demo Area #1					X					
Demo Area #2		X			X	X		X		X
Erie Burning Grounds		X			X					
Fuze and Booster	X	X			X	X	X			X
NACA Test Area	X	X		X	X			X		
Ramsdell Quarry	X	X		X	X	X	X	X		
Winklepeck	X	X			X	X				
Site-wide Background	X	X			X	X	X	X		
Sharon Conglomerate		X			X	X				

X = present at concentration above applicable screening criteria.

No exceedance above applicable screening criteria.

VOCs = volatile organic compounds.

SVOCs = semivolatile organic compounds.

PAHs = polycyclic aromatic hydrocarbons.

PCBs = polychlorinated biphenyls.

1.6.1.3 Contract Laboratory

TestAmerica in North Canton, Ohio, has been selected as the analytical laboratory for this project and will perform the majority of the analytical methodologies and coordinate all logistical aspects associated with the analysis and reporting of samples. The TestAmerica-North Canton laboratory will be supported by the TestAmerica-Sacramento laboratory for the analysis of explosive, propellant, and sulfur mustard degradation constituents and the TestAmerica-Denver laboratory for perchlorate analysis. Due to the close proximity of the TestAmerica-North Canton laboratory to RVAAP, TestAmerica shall use its courier service to directly pick up samples, including weekends as necessary. This approach will help to mitigate unnecessary risks associated with the use of a commercial courier (e.g., sample shipment delays, bottle breakage). Custody of the samples will be transferred directly from the Sample Manager or designee to personnel of the contract laboratory. The laboratory is required to provide evidence of acceptable sample receipt within 24 hours of sample delivery. The laboratory complies with this confirmation requirement by using an automatic report electronically generated and e-mailed from it Laboratory Information Management System. This report is sent at the close of business each day of sample receipt and can be routinely provided to USACE upon request. The Laboratory Project Manager will be responsible for notifying EQM of any non-conforming sample receipt issues by phone or e-mail as soon as possible following identification of the problem. TestAmerica will transmit original reports and final data packages by mail.

1.6.2 Schedule

Tasks to be completed under this milestone are described in this addendum to the FWGWMP Plan.

EQM's schedule to complete this project is presented in Appendix B. Key milestones are as follows:

- Prepare and submit amendment for the FWGWMP – September 30, 2011.
- Approval of amendment – December 31, 2011.
- Sample new wells – Quarterly (April, July, and October 2012 and January 2013).
- Sample semiannual wells – January and July 2012 through 2015.
- Draft Annual Report – December 15 of each year.

SECTION 2. SCOPE AND OBJECTIVES

2.1 Approach and Rationale

The approach and rationale for the facility-wide groundwater monitoring program at RVAAP is discussed in Section 3.1 of the FWGWMP Plan (USACE, 2004). Specific objectives for the FWGWMP are to:

- Characterize the nature and extent of facility-wide groundwater contamination at RVAAP;
- Assess the risk posed to human health and the environment from facility-wide groundwater contamination at RVAAP;
- Establish a system to monitor potential offsite migration of contaminants via groundwater; and
- Provide for continuing groundwater monitoring at the Ramsdell Quarry Landfill and Open Demolition Area #2 Resource Conservation and Recovery Act (RCRA) units.

The DFFOs specify that *"as groundwater investigations are completed at each AOC, Respondent shall evaluate those AOC specific wells for incorporation into the monitoring well network. The FWGWMP Plan will use an iterative process, with an annual review and revision cycle to accommodate the addition or deletion of wells from the monitoring well network."* As such, the USACE proposed an amendment to modify the total number of groundwater wells required for monitoring under the FWGWMP Plan monitoring well network (USACE, 2010). Specifically, the USACE has proposed that 10 to 25 percent of the total number of groundwater wells be required during any given monitoring event compared to the more rigid requirement of 20 percent of total wells currently established under the FWGWMP Plan. This modification allows the USACE more flexibility in focusing the groundwater monitoring program on those areas and/or wells that exhibit COPCs and anticipated contaminant flow directions, and reduces the amount of redundant data collection. EQM supports this premise with the caveat that unless specific circumstances arise during the course of this PBA that necessitate a change (i.e., new sources of contamination are discovered or there is a significant change in contamination levels), the wells chosen for analysis in 2012 and beyond should reflect the facility-wide approach. Note that the addition of 39 new wells in early 2012 and subsequent sampling of these wells may provide additional data that necessitate a modification to the monitoring well network beginning in 2013. Beyond that, no additional modifications are anticipated prior to the Record of Decision.

The primary objective of this addendum is to present the proposed monitoring well network and sampling schedule for facility-wide groundwater. The final choice of wells to be included in the semiannual program will be determined jointly by the Army and the Ohio EPA with input as needed from the stakeholders.

2.2 Data Quality Objectives

Facility-wide data quality objectives (DQOs) have been developed for the site and are discussed in more detail in Section 3.1.1 of the FWGWMP Plan. The FWGWMP-specific DQOs are:

- Assess hydrogeologic conditions and groundwater quality in shallow and deep groundwater using monitoring wells of known integrity.
- Provide a comparative assessment of hydrogeologic characteristics and groundwater quality in both unconsolidated and bedrock monitoring wells to evaluate potential hydraulic connectivity.
- Characterize groundwater chemical quality and examine potential contaminant migration via the facility-wide monitoring well network.
- Conduct analysis of chemical data from the network to form a basis for remedial decision-making.

2.3 Conceptual Site Model

A conceptual site model (CSM) is the cornerstone for planning a field sampling effort. It reflects an understanding of the known or suspected site conditions and serves as the basis for making decisions about sample locations, frequencies, and required analytes. A preliminary CSM for RVAAP has been developed using available information and is presented in Section 4.2.1 of the FWSAP (SAIC, 2011). The key elements of the preliminary CSM are:

- Surface geology across RVAAP is highly variable with overburden thicknesses ranging from 5 feet in the east to 40 feet in the west. Bedrock outcroppings have been noted in the southeastern portion of RVAAP. The till is reported to be somewhat impermeable with hydraulic conductivities of 10^{-6} cm/sec or greater.
- A buried glacial valley filled with sand and gravel potentially exists in the central portion of the property, trending from southwest to northeast.
- The variable nature of the till combined with the topography results in a complex surface water system comprising several water courses and ponds.
- Because of the relatively impermeable nature of the till, a large percentage of storm water is expected to exit the facility via the surface drainages.
- Groundwater is present in the unconsolidated sediment and underlying bedrock with an overall generalized flow to the east; however, the unconsolidated zone shows numerous local variations that are influenced by topography and drainage patterns.
- Sand and gravel aquifers associated with buried valleys are a major source of potable water. Local variations in flow direction suggest groundwater in the unconsolidated deposits is generally in direct hydraulic communication with surface water, and surface water drainage ways may act as discharge locations. In addition, topographic

ridges between drainage features serve as groundwater divides for shallow groundwater.

- Bedrock formations in the area are also a source of potable water, with the Sharon Conglomerate being the best producer. Other water-producing formations include the Connoquenessing Sandstone (where present) and Homewood Sandstone.
- Major COPCs include explosive-related chemicals, propellants, and metals. Additional chemicals, including PCBs, volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), phthalates, pesticides, and manganese, have been identified at some AOCs. With the exception of some VOCs and pesticides, most of the COPCs are relatively insoluble, tend to adsorb to soil particles rather than dissolve into water, and are relatively long-lived.
- Currently, public access to the facility is controlled and may include annual controlled deer hunts, wildlife trapping, firewood permits, and occasional guided public tours. OHARNG uses more than 20,000 acres of RVAAP as a training site. The most likely pathway of exposure to offsite receptors is via chemical migration through the surface water and groundwater systems.

2.4 Key Assumptions

Based on site-wide groundwater conceptual model, potential contaminant transport via the groundwater pathway can occur in the shallow unconsolidated deposits and/or the bedrock aquifer(s). Generalized groundwater flow is easterly in the till and bedrock aquifers; however, flow in the unconsolidated sediments is influenced by topography and surface water drainage. As a result, groundwater occurring in the unconsolidated deposits near surface water drainageways eventually discharges to the surface streams and may have local flow directions that vary from the regional hydraulic gradient.

It is reported for a large portion of the site that the hydraulic heads in the underlying bedrock aquifer are greater than the hydraulic heads in the unconsolidated deposits. This indicates that there is little potential for downward migration of contaminants to the bedrock aquifer. The exception to this observation occurs in the eastern portion of the RVAAP where the potentiometric surfaces of the unconsolidated and bedrock aquifers are nearly identical, suggesting potential hydraulic communication. A key assumption of the FWGWMP is that both unconsolidated wells and bedrock wells are available to detect groundwater impacts in the far eastern portion of RVAAP.

Several of the AOCs are monitored exclusively by bedrock wells (USACE, 2004). The following AOCs are monitored exclusively by bedrock wells: Load Lines 1, 2, 3, 7, 9, Building 1200, C Block, and Ramsdell Quarry Landfill. For these areas it is assumed that the unconsolidated deposits do not yield sufficient quantities of water to justify well completion in this zone. It is further assumed that the bedrock wells are adequate to detect potential groundwater impacts from historical activities at the AOCs.

Because of low permeability and lack of areal extent, the unconsolidated aquifer is important only on a localized scale, with the exception of the glacial outwash in the eastern portion of RVAAP. Consequently, unconsolidated wells selected for site-wide monitoring focus on local areas immediately downgradient of potential AOCs.

The potentiometric surfaces for the unconsolidated and Sharon aquifers merge just east of Load Line 1. Following the installation of additional monitoring wells at RVAAP, static water levels and flow directions will be further evaluated to determine whether potential offsite migration pathways have been captured by the perimeter wells in this area of the site.

2.5 Modified Well Sampling Network and Rationale

2.5.1 New Wells

In order to complete the RI/FS and eventual ROD, an additional 39 monitoring wells will be installed at the facility to further characterize the nature and extent of facility-wide groundwater impacts and to support hydrogeologic system and contaminant fate-and-transport modeling. The locations of the new wells and well installation and sampling procedures are described in the *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Environmental Investigation Services Addendum, Ravenna Army Ammunition Plant, Ravenna, Ohio* (EQM, January 2012).

The 39 new wells will be sampled for four successive quarters beginning in 2012. The new wells are not included in the semiannual sampling network, although they will be sampled at the same time as the July 2012 semiannual sampling event. Beginning in 2013, some or all of the new wells will be incorporated into the semiannual monitoring program, as determined jointly by the Army, Ohio EPA, and stakeholders.

2.5.2 RCRA Wells

The former RCRA/solid waste wells specified by the DFFOs will be sampled semiannually in conjunction with the proposed semiannual sampling events for the FWGWMP wells (i.e., January and July). The RCRA wells include the Ramsdell Quarry Landfill wells (RQLmw-007, RQLmw-008, and RQLmw-009) and the Open Demolition Area #2 wells (DET-003 and DET-004). The RCRA wells will be sampled using the same protocols and procedures used for the FWGWMP wells.

2.5.3 Existing CERCLA Wells

Selection of existing wells for semiannual site-wide monitoring was made based on consideration of the following criteria:

- Detect/monitor potential groundwater contamination near the downgradient facility boundary, which is also downgradient of AOCs.
- Identify/quantify occurrence of COPCs in the unconsolidated aquifer.

- Identify/quantify occurrence of COPCs in the bedrock aquifer(s).
- Evaluate potential hydraulic connection between unconsolidated and bedrock aquifers. Use existing wells paired with or near new wells.
- Include all currently monitored RCRA wells for the Ramsdell Quarry Landfill and Open Demolition Area #2.

In making the transition from an AOC approach to a facility-wide evaluation, it is important to realize that the proposed monitoring well network is not intended to assess each AOC individually but rather their composite contributions to groundwater quality in the unconsolidated and bedrock aquifers. Since there are numerous wells at the site, the approach used was to select wells that have exhibited COPCs and eliminate wells that provide redundancy or provide minimal information on groundwater quality or fate-and-transport migration. To this end, thirty-five (35) wells (including the five RCRA wells) have been selected for sampling during the semiannual events in 2012. Nineteen (19) wells were selected in association with or paired with several of the new wells to assess horizontal and/or vertical contaminant distribution in groundwater. Two (2) of these wells are located in the northern portion of the facility to provide upgradient data for the various site-wide models. In addition, four (4) potential exit pathway wells were selected that have no direct association with the new wells [note that five (5) of the 19 paired wells are also potential exit pathway wells]. As mentioned previously, five of the semiannual wells are RCRA wells. One well, LL12mw-182, has historically been found to contain bis(2-ethylhexyl)phthalate at concentrations exceeding screening levels. This well is located near the new stainless steel well (#39) and will be sampled for comparison with the new well. Five wells (LL10mw-003, LL12mw-185, LL12mw-187, LL12mw-242, and LL12mw-245) were selected for potential source evaluations. Lastly, one (1) well (LL12mw-246) located potentially upgradient of two of the newly installed wells was selected to provide groundwater quality data in support of the fate-and-transport model. Besides fulfilling the selection criteria, the groundwater quality information obtained from this well network will be incorporated into the hydrogeologic system and contaminant fate-and-transport models. Thirty (30) of the proposed semiannual wells, including the five RCRA wells, were also recommended by USACE in the *Draft 2010 Addendum to the Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility Wide Groundwater* (USACE, 2010). Of these, 25 wells were originally defined by USACE as focus wells (i.e., wells that have high reported concentrations of COPCs in groundwater). Although these wells were originally identified as AOC-specific wells, EQM believes that the locations of these wells are relevant to the facility-wide approach for groundwater, as they either serve as exit pathway wells and/or provide groundwater quality data that can be compared with the new wells for source input into the contaminant fate-and-transport model.

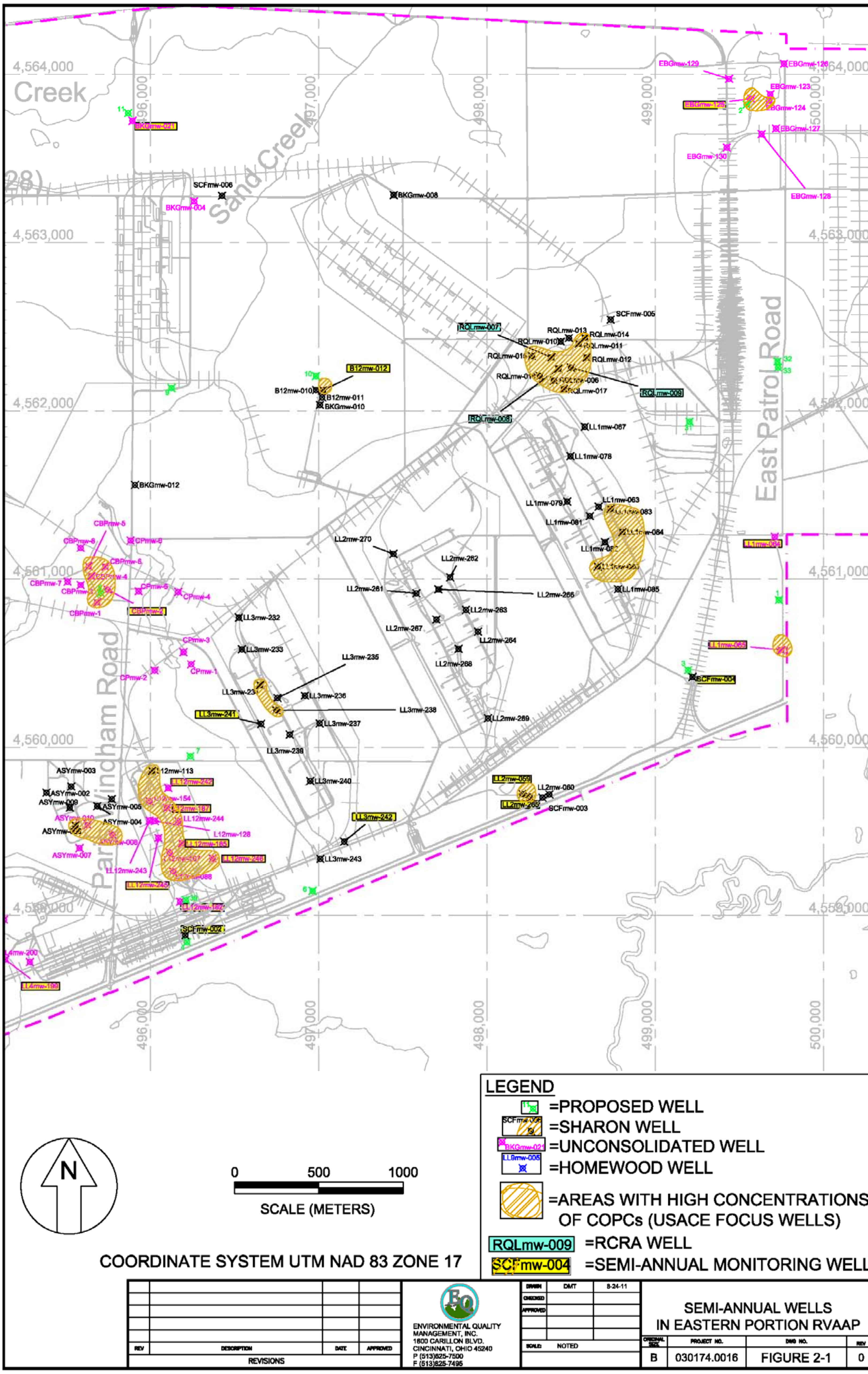
The wells selected for semiannual monitoring will not change between monitoring events in 2012. Table 2-1 lists the proposed wells and rationale for their inclusion in the semiannual monitoring program. Figures 2-1 through 2-3 show the wells to be sampled during the semiannual monitoring events.

Table 2-1. Semiannual Monitoring Wells and Rationale.

No.	RVAAP Area	Well Location	Rationale / Comments
1	SE/Load Line 1	LL1mw-064	Downgradient from Load Line 1, near proposed new Sharon well (#1), and serves as overburden monitoring well for the potential GW exit pathway off of RVAAP.
2	SE/Load Line 1	LL1mw-065	Downgradient from Load Line 1, near proposed new Sharon well (#1), and serves as overburden monitoring well for the potential GW exit pathway off of RVAAP.
3	SE	SCFmw-004	Downgradient of Load Lines 1 and 2, paired with proposed new Sharon well (#3), and serves as Sharon Conglomerate Member well for monitoring the potential GW exit pathway off of RVAAP in the deeper aquifer.
4	SE	SCFmw-002	Downgradient of Atlas Scrap Yard and Load Lines 1, 2, 3, 4, and 12, paired with proposed new Sharon well (#4), and serves as Sharon Conglomerate Member well for monitoring the potential GW exit pathway off of RVAAP in the deeper aquifer.
5	S/Load Line 2	LL2mw-059	Downgradient of Load Line 3 and serves as potential GW exit pathway off of RVAAP.
6	S/Load Line 2	LL2mw-265	Downgradient of Load Line 3 and serves as potential GW exit pathway off of RVAAP.
7	Load Line 3	LL3mw-241	Located upgradient of proposed new Sharon well (#7) to evaluate contaminant migration pathway between Load Lines 3 & 12.
8	Load Line 3	LL3mw-242	Downgradient of Load Lines 3 and 12 and serves as potential GW exit pathway off of RVAAP.
9	S/Load Line 4	LL4mw-199	Downgradient of well LL4mw-193; unconsolidated well paired with proposed new Sharon well (#5); potential GW exit pathway.
10	Load Line 6	LL6mw-002	Unconsolidated well near proposed new well pair (#27 and #28); comparison well for fate-and-transport model.
11	Load Line 6	LL6mw-005	Homewood well near proposed new well pair (#27 and #28); comparison well for fate-and-transport model.
12	Load Line 10	LL10mw-003	Homewood well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride).
13	Load Line 11	LL11mw-007	Near proposed new well pair (#29 and #30); unconsolidated comparison well for fate-and-transport model.
14	Load Line 12	LL12mw-182	Paired with new proposed stainless steel well (#39); unconsolidated comparison well for bis(2-ethylhexyl)phthalate evaluation.
15	Load Line 12	LL12mw-185	Unconsolidated well that has been found to contain elevated levels of nitrate and is downgradient of potential arsenic source.
16	Load Line 12	LL12mw-187	Unconsolidated well that has been found to contain elevated levels of nitrate.
17	Load Line 12	LL12mw-242	Unconsolidated well located downgradient of LL12mw-113, a potential arsenic source.
18	Load Line 12	LL12mw-245	Unconsolidated well located downgradient of potential nitrate source well LL12mw-185.

Table 2-1 (continued). Semiannual Monitoring Wells and Rationale.

No.	RVAAP Area	Well Location	Rationale / Comments
19	Load Line 12	LL12mw-246	Unconsolidated well located in southeast (downgradient) portion of Load Line 12. Downgradient of ASY wells and near two proposed new wells (#4 and #6).
20	North Perimeter	BKGmw-005	Unconsolidated background well located upgradient of C Block quarry, former Route 80 tank farm, and proposed new Sharon well (#35); upgradient well for hydrogeologic model.
21	North Perimeter	BKGmw-021	Unconsolidated background well paired with proposed new Sharon well (#11); upgradient well for hydrogeologic model.
22	C Block	CBLmw-002	Near proposed new Homewood well (#36); Homewood comparison well for fate-and-transport model.
23	Central Burn Pits	CBPmw-002	Unconsolidated well paired with proposed new Sharon well (#8); vertical distribution evaluation; fate-and-transport model.
24	Building 1200	B12mw-012	Sharon well with known contamination near proposed new Sharon well (#10); potential contaminant migration pathway evaluation.
25	Winklepeck	WBGmw-007	Unconsolidated well near proposed new well pair (#13 and #14); comparison well for fate-and-transport model.
26	Winklepeck	WBGmw-009	Unconsolidated well paired with proposed new Sharon well (#15); vertical distribution evaluation; fate-and-transport model.
27	Winklepeck	WBGmw-006	Unconsolidated well paired with proposed new Sharon well (#16); vertical distribution evaluation; fate-and-transport model.
28	Demo. Area 2	DA2mw-108	Unconsolidated well near proposed new well pair (#17 and #18); comparison well for fate-and-transport model.
29	Demo. Area 2	DETmw-003	RCRA well; unconsolidated well paired with proposed new Sharon well (#19); vertical distribution evaluation; fate-and-transport model.
30	Demo. Area 2	DETmw-004	RCRA well.
31	NACA Test	NTAmw-109	Unconsolidated well paired with proposed new Homewood well (#26); vertical distribution evaluation; fate-and-transport model.
32	Erie Burning Grounds	EBGmw-125	Unconsolidated well downgradient from Ramsdell Quarry; potential exit pathway.
33	Ramsdell Quarry	RQLmw-007	RCRA well.
34	Ramsdell Quarry	RQLmw-008	RCRA well.
35	Ramsdell Quarry	RQLmw-009	RCRA well.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CINCINNATI, OHIO 45240
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FIGURE 2-1
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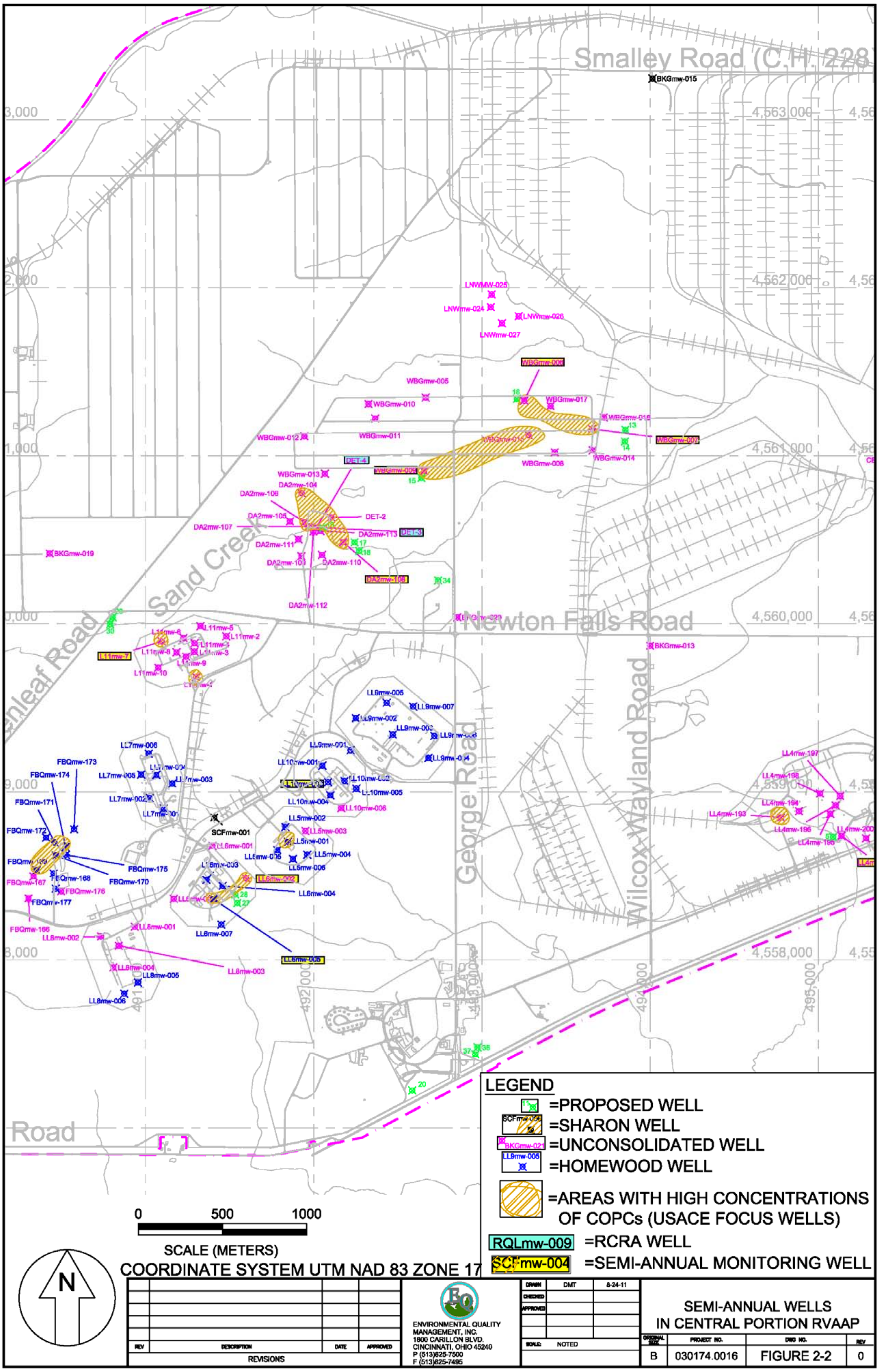

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RQLmw-009 =RCRA WELL
SCFmw-004 =SEMI-ANNUAL MONITORING WELL
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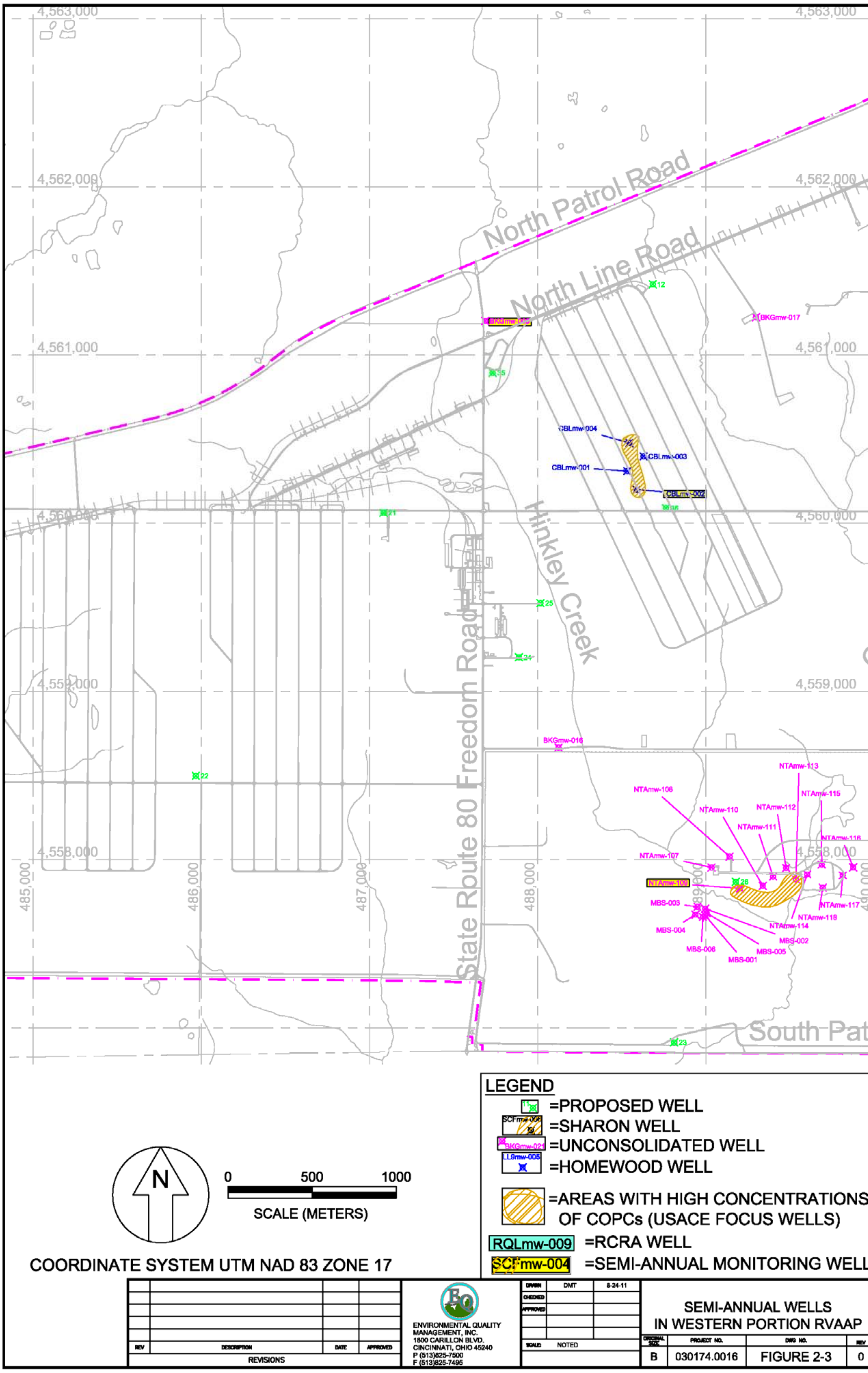
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CBLmw-002
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NTAmw-108
NTAmw-115
NTAmw-110
NTAmw-112
NTAmw-111
NTAmw-116
NTAmw-107
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LEGEND
=PROPOSED WELL
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=UNCONSOLIDATED WELL
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=AREAS WITH HIGH CONCENTRATIONS OF COPCs (USACE FOCUS WELLS)
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SCFmw-004 =SEMI-ANNUAL MONITORING WELL
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2.6 Groundwater Data Evaluation and Decision Rules

The analytical data generated from the semiannual monitoring wells will be screened using the approved decision process as follows:

1. **1st Screen: Screen data against the established facility-wide background values –** If chemical concentrations are less than the established background values, then these chemicals do not qualify as COPCs. If the chemical concentrations are equal to or greater than the background values, or there are no background values, then the chemicals qualify for further screening under Step 2.

2. **2nd Screen: Screen data against the Facility-Wide Clean-Up Goals (FWCUGs) –** If chemical concentrations are less than the restrictive and applicable FWCUGs, then these chemicals do not qualify as COPCs. However, if the FWCUG is less stringent than the USEPA's corresponding Maximum Contaminant Level (MCL), then the MCL will take precedence for comparison purposes. If the chemical concentrations are equal to or greater than the most restrictive and applicable FWCUGs (or MCLs), then these chemicals qualify as COPCs. If there are no chemical-specific FWCUGs, then the chemicals qualify for further screening under Step 3.

3. **3rd Screen: Screen data against the United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSLs) –** If chemical concentrations are less than the RSLs, then these chemicals do not qualify as COPCs. If the chemical concentrations are equal to or greater than the RSLs, then these chemicals qualify as COPCs. If there are no chemical-specific RSLs, then the chemicals qualify as COPCs.

The FWCUGs will be used to address groundwater remedial actions. In addition, the USEPA's MCLs will be used to assist in the identification of COPCs and will serve as alternate cleanup goals for groundwater contaminants (as applicable and appropriate). The more conservative of the FWCUGs and MCLs will be used to address groundwater mitigation efforts.

2.7 Parameters to be Analyzed

During the 2012 sampling events, the new monitoring wells will be sampled and analyzed for the current analytical suite as presented in Table 2-2. This approach will both satisfy the Ohio EPA requirements for being protective of human health and the environment and reduce overall risk to the Army. For the remaining wells, the list of analytes will be reduced to reflect only those constituents identified above the applicable screening criteria within certain areas of the site. As noted in Table 1-1 for example, VOCs are among the list of COPCs that were not identified in groundwater during the data screen in wells located in Load Line 6, C-Block, Central Burn Pits, Building 12, Demolition Area #2, and the East Burning Grounds. Consequently, VOCs are not included in the semiannual analyte list for selected wells in these areas, with the exception of the RCRA wells in Demolitions Area #2. In contrast, additional parameters will be analyzed in groundwater samples collected from wells SCFmw-002 and SCFmw-004 due to their potential downgradient associations with Load Line 12 and Atlas Scrap Yard or Load Lines 1 and 2, respectively. The refined analyte list for the semiannual wells is presented in Table 2-3. The analytical methods for these analytes are provided in Table 2-2.

Table 2-2. Current Analytical Suite of Chemicals

Constituents	Method[1]
Polychlorinated biphenyls (PCBs)	Gas Chromatograph (GC) – Semivolatile Organics (SVOCs) (8082)
Pesticides	GC Semivolatile Organics (8081A)
Base/Neutrals and Acids (SVOCs)	GC/Mass Spectrograph (MS) Semivolatile Organics (8270C)
Volatile Organic Compounds (VOCs)	GC/MS Volatile Organics (8260B)
Nitroguanidine (Propellant)	Organic compounds by UV/HPLC (8330 modified)
Nitroaromatics & Nitramines (Explosives)	GC Semivolatile Organics Explosives (8330)
Nitrocellulose (Propellant)	General Chemistry (WS-WC-0050)
Nitrate/Nitrites	General Chemistry (353.2)[2]
Cyanide (Total)	General Chemistry (9012A)
Metals (Magnesium, Manganese, Barium, Nickel, Potassium, Silver, Sodium, Vanadium, Chromium, Calcium, Cobalt, Copper, Arsenic, Lead, Selenium)	Inductively Coupled Plasma (6010B)
Metals (Antimony, Iron, Beryllium, Thallium, Zinc, Cadmium, Aluminum)	Inductively Coupled Plasma Mass Spectrometry (6020)
Perchlorates	Method 6860 (1 quarter only)
Hexavalent Chromium	Method 7196A (1 quarter only)
Mercury	(7470A, Cold Vapor) - Liquid
Alpha/beta screen	Method 900.0[3] – Route 80 Tank Farm Area only.
Gamma radionuclides	Method 901.1[3] – Route 80 Tank Farm Area only.

1 = USEPA SW846
2 = EPA Methods for Chemical Analysis of Water and Waste
3 = Prescribed Test Procedures for Measurement of Radioactivity in Drinking Water, EPA-600/4-80-032, August 1980

Table 2-3. Semiannual Analyte List

Well Location	Analytes										
	VOCs	SVOCs			Metals[d]	Explosives	Pesticides	PCBs	Nitrate	Cyanide	Hexavalent Chromium
		Nitroaromatics & Phthalates[a]	Phenols[b]	PAHs[c]							
SCFmw-002	x	x	x	x	x	x	x	x	x		x
SCFmw-004	x	x	x		x	x	x	x			
LL1mw-064	x	x			x	x	x				
LL1mw-065	x	x			x	x	x				
LL2mw-059	x	x	x		x	x	x	x			x
LL2mw-265	x	x	x		x	x	x	x			x
LL3mw-241	x	x			x	x	x				
LL3mw-242	x	x			x	x	x				
LL4mw-199	x	x			x	x	x				
LL6mw-002		x		x	x						
LL6mw-005		x		x	x						
LL10mw-003	x				x						
LL11mw-007	x	x			x	x	x				
LL12mw-182		x									
LL12mw-185					x (As. only)				x		
LL12mw-187	x	x	x	x	x	x	x	x	x		
LL12mw-242	x	x	x	x	x	x	x	x	x		
LL12mw-245	x	x	x	x	x	x	x	x	x		
LL12mw-246	x	x	x	x	x	x	x	x	x		
BKGmw-005	x	x			x	x	x	x			
BKGmw-021	x	x			x	x	x	x			
CBLmw-002		x		x				x			x
CBPmw-002		x			x		x	x			
B12mw-012		x		x	x						
WBGmw-006	x	x			x	x					
WBGmw-007	x	x			x	x					
WBGmw-009	x	x			x	x					
DA2mw-108		x			x	x		x			x
DET-003	x	x	x	x	x	x	x	x		x	x
DET-004	x	x	x	x	x	x	x	x		x	x
NTAmw-109	x	x		x	x			x			
EBGmw-125		x			x						
RQLmw-007	x	x	x	x	x	x	x	x		x	
RQLmw-008	x	x	x	x	x	x	x	x		x	
RQLmw-009	x	x	x	x	x	x	x	x		x	

[a] Analyte list includes: 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, Bis(2-ethylhexyl)phthalate, Butyl benzyl phthalate, Diethyl phthalate, Dimethyl phthalate, Di-n-butyl phthalate, Di-n-octyl phthalate, and Nitrobenzene

[b] Analyte list includes: 2,4,5-Trichlorophenol, 2,4,6-Trichlorophenol, 2,4-Dichlorophenol, 2,4-Dimethylphenol, 2,4-Dinitrophenol, 2-Chlorophenol, 2-Methylphenol, 2-Nitrophenol, 4,6-Dinitro-2-methylphenol, 4-Chloro-3-methylphenol, 3&4 Methylphenol, 4-Nitrophenol, Pentachlorophenol, and Phenol

[c] Analyte list includes: Acenaphthene, Acenaphthylene, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Fluoranthene, Fluorene, Indeno(1,2,3-cd)pyrene, Naphthalene, Phenanthrene, and Pyrene.

[d] Analyte list includes: Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Mercury, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, and Zinc.

During one sampling event in 2012, groundwater samples from seven selected wells in the semiannual monitoring well network, as well as the new wells, will also be submitted for analysis of hexavalent chromium. In addition, the new well installed near the Route 80 Tank Farm Area and the upgradient background well (BKGmw-005) to this location will also be sampled and analyzed for alpha/beta and gamma radionuclides since gamma radiation was previously identified in soil in this area of the site. Lastly, well LL12mw-182 and the new proposed stainless steel well (#39) at this location will be sampled for bis(2-ethylhexyl)phthalate only to assess whether the presence of bis(2-ethylhexyl)phthalate in well LL12mw-182 is an artifact from the PVC construction materials.

2.8 Data Validation and Reporting

2.8.1 Data Validation

Data validation begins with the laboratory analyst and continues until the data are reported. Individual analysts will verify the completion of the appropriate data forms to ensure the completeness and correctness of data acquisition and reduction. All in-laboratory data validation will be conducted in accordance with methods delineated in the USEPA's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (SW-846), and "Manual for Chemical Analysis of Water and Wastes" (EPA 600/4-79-020).

Additional validation of analytical results will be performed by the Project Quality Assurance (QA) Manager. Qualified EQM project chemists will verify 100 percent of the data generated for this project as outlined in Section 4.3.2 (Step-2) of the Louisville DoD Quality Systems Manual Supplement, Version 1. The data will be reviewed to ensure holding times are met, matrix spike recoveries are within acceptable ranges, and blank sample results do not exceed acceptable concentrations. If project-specific analytes are detected in the blanks, the data will be evaluated on a case-by-case basis to assess the effect on the project objective. When determined to be necessary, corrective actions, such as reanalysis or resampling and analysis, will be evaluated and implemented.

The QA objectives for precision, accuracy, representativeness, completeness, and comparability of the data for this project are specified in the *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Quality Assurance Project Plan Addendum* (QAPP; EQM, January 2012), which is Part II of the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Addendum*. Data validation will be performed in accordance with the QAPP. Additional detail regarding data validation procedures are described in Section 4 of the QAPP.

Field data will be recorded on the appropriate field record form or in a bound field sample logbook or equivalent (see Section 4.2). All field data will be verified and reviewed by the Field Sampling Manager.

2.8.2 Data Reporting

All results will be reported by the laboratory to the Field Sampling Manager or his designee by sample batch and will be certified by the laboratory. Data reports will be forwarded to EQM from TestAmerica within 4 weeks following laboratory receipt of samples. All reports and documentation required, including quality control results, will be clearly labeled with the laboratory sample number and associated field sample number.

Analytical results will be given in units of µg/L or mg/L for liquid samples. In addition to the analytical results and quality control (QC) data, details regarding the corrective actions taken and a discussion of any necessary modifications of the protocols established in the referenced methods will be included in the final data report. The final data package submitted by the analytical laboratory will include a summary of the analytical results for each sample as well as all reports and documentation generated as required by analytical methods. The final data package will be compared to the preliminary results by the Field Sampling Manager. Any discrepancies affecting field activities will be reported to the Project QA Manager immediately. Analytical Level IV will be followed for all groundwater sampling for this project. The analytical laboratory will provide the Analytical Level IV data package for all field sampling.

SECTION 3. SAMPLING PROCEDURES

3.1 Clearing and Grubbing

Annually, a path will be cleared to each of the monitoring wells at the facility using a tractor-mounted mower, as needed. Any brush surrounding the wells will be cleared to a 3-ft-diameter around each well using hand tools such as weed-eaters, pruning shears, and small chain saws (where necessary). However, every effort will be made to leave larger trees (i.e., greater than 6-in. diameter) in place. EQM will not proceed with any brush/vegetation clearing without prior approval from the OHARNG.

3.2 Well Maintenance

In conjunction with the water level measurement event for all wells at the facility (see Section 3.3), EQM will conduct well inspections for all wells detailing the condition of the pad, casing, guard posts, etc. The inspection will also identify any maintenance needs. Subsequently, EQM will conduct annual well maintenance as identified during the annual well inspections. This will include:

- Painting well identification numbers on the sides of monitoring wells using stencils. This action will be performed on those wells in which the identification numbers have faded. During the PBA period of performance, EQM proposes to repaint and reapply well identification numbers on 30 wells each year. (Note that not all of the existing wells need repainting.)
- Repairing concrete pads or guard posts, as needed.
- Repairing outer well casings, including installation of new well tops.
- Replacing well caps and locks, as needed.

EQM will also conduct any redevelopment of wells due to excessive silting.

3.3 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 5.4.3 of the FWSAP. All monitoring wells will be field screened for VOCs using a photoionization detector (PID) or organic vapor analyzer (OVA) during groundwater sample collection. Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe.

3.3.1 Static Water Levels

Beginning on the first day of mobilization for each monitoring event water-level measurements will be taken for the wells sampled. Additionally, water levels will be collected from all the wells onsite once annually to produce potentiometric maps for the facility. Historically, various localized groundwater flow patterns have been interpreted from the Load Line 12 wells. As a result, EQM will measure the static water levels in all of the Load Line 12 wells on a semiannual basis.

Static water-level measurements will be made using an electronic water-level indicator. The distance between the top of the casing and the groundwater surface will be recorded in the field logbook, Groundwater Sampling Log, or equivalent to within 0.01 feet. Relative groundwater elevations for each well will be calculated by deducting the depth to groundwater from the top-of-casing elevation. This information will be used to estimate flow direction. A map presenting this information and interpretation will be generated for the sampling event.

3.3.2 pH, Conductivity, Dissolved Oxygen, and Temperature

Groundwater parameters will be obtained using a combination meter with flow-through cell designed to measure these parameters. The readings will be recorded when the meter reading reaches equilibrium. Groundwater field parameters will be collected in accordance with Section 5.4.3.2 of the Facility-Wide SAP.

Additional parameters, such as turbidity, may also be obtained, where required.

3.4 Groundwater Purging and Sampling

3.4.1 Purging

Prior to sampling, each well will be purged using bailing or micropurge techniques following those procedures specified in the FWSAP. The bailing method will be used for those wells that have historically had poor yields (e.g., the DET wells) or contain minimal water (i.e., less than 2 feet). For this method a disposable Teflon™ bailer will be used to purge and sample. The well will be purged to dryness and allowed to recover prior to sampling. The bailer will be attached to new polyethylene rope and slowly lowered until it contacts the groundwater surface. The bailer will be allowed to sink and fill with a minimum of surface disturbance and then raised slowly to the surface. The sample will be transferred from the bailer to the appropriate sample bottles. A minimum of one set of water quality indicators [e.g., pH, specific conductance, turbidity, dissolved oxygen (DO), oxidation reduction potential (ORP), and temperature] will be obtained during this procedure.

For micropurging, the purge rate will be between 100 and 500 ml/min; however, the higher rate will only be used if it can be shown that the increased rate will not disturb the stagnant water column above the well screen (i.e., will not result in drawdown greater than 1 foot). The maximum flow rate shall not exceed 500 ml/min. Water quality indicators will be collected every 3 to 5 minutes to monitor stabilization of the water quality parameters. A minimum of three readings will be collected from each well during purging. Each parameter is consistent with the requirements of the FWSAP, with the exception of ORP and turbidity. Oxidation reduction potential and turbidity are required as additional field parameters to assist in the geochemical study for groundwater.

Water generated during purging activities and decontamination fluids will be containerized in a Department of Transportation (DOT)-approved 55-gal drum or poly tank for future treatment and disposal. Purging activities will be recorded on the Groundwater Sampling Log or equivalent for each well. Immediately following purging, each well will be sampled. (If separate-phase liquid is present, no purging or sampling of the groundwater will be performed.)

3.4.2 Sampling

Once purging activities are complete, groundwater samples will be collected from below the top of the well screen using a bladder pump. Samples will be transferred directly to laboratory precleaned sample containers. EQM's field personnel will wear new, disposable nitrile gloves during sample collection. The gloves will be changed between wells and the used gloves will be discarded appropriately. Sample aliquots will be placed in the appropriate sample containers, pre-preserved (if required), sealed with Teflon-lined septa, and labeled with a unique sample identification number. Samples will then be placed in a cooler with ice and submitted to an offsite laboratory for analysis. A chain-of-custody form will accompany the sample shipment.

Each well requiring metals analysis will be sampled for filtered metals. The list of metals to be analyzed is consistent with Table 4-1 of the QAPP. The wells identified for hexavalent chromium analysis will also be field filtered. Sampling and analysis procedures will follow the FWSAP. A 0.45-micron in-line filter will be used to filter samples. The filtered sample will be transferred directly into pre-preserved sample containers supplied by the laboratory.

Groundwater sampling activities will be documented on a Groundwater Sampling Log or equivalent for each monitoring well.

3.5 Sample Containers, Preservatives, and Holding Times

Upon collection, samples will be transferred directly into the appropriate sample container. Only pre-cleaned sampling containers supplied by the laboratory will be used. Pre-preserved bottles will be provided by the analytical laboratory. Care will be taken to obtain representative samples for volatile organic analysis. To prevent unnecessary stripping of volatile constituents from the sample, the water sample will be added slowly to minimize turbulence and aeration when filling the container until a positive meniscus is achieved above the rim of the container. The container will be capped immediately and checked for the presence of air bubbles. If bubbles are detected, additional sample will be added until a positive meniscus is re-established. Care will be taken not to overfill and wash out the preservative. All samples will be cooled to 4°C immediately upon collection and maintained at this temperature during sample shipment. Table 3-1 summarizes the container types and sizes, preservatives, and sample holding times.

Table 3-1. Sample Containers, Preservatives, and Holding Times

Analyte Group	Containers*	Minimum Sample Size	Preservative	Holding Time (days)
VOCs	(3) 40-mL glass vials with Teflon-lined septa	80 mL	HCl to pH<2, Cool, 4°C	14 days
SVOCs	(2) 1-liter amber bottles with Teflon-lined lid	1 L	Cool, 4°C	7 days extraction 40 days analysis
Pesticides				
PCBs				
Metals	500-mL polybottle	300 mL	0.45 µm filter; HNO_3 to pH<2; Cool, 4°C	180 days, Hg at 28 days
Perchlorate	250-mL polybottle	250 mL	0.2 µm filter with prefilter; Cool, 4°C	28 days
Cyanide	250-mL polybottle	250 mL	NaOH to pH>12, Cool, 4°C	14 days
Explosives & Propellants	(3) 1-liter amber bottles with Teflon-lined lid	2 L	Cool, 4°C	7 days extraction, 40 days analysis
Hexavalent Chromium	250-mL polybottle	200 mL	0.45 µm filter; Cool, 4°C	24 hours
Alpha, Beta, and Gamma emitters	Plastic or Glass	250 mL	HCl or HNO_3 to pH<2; Cool, 4°C	6 months
Nitrate	250-mL polybottle	250 mL	H_2SO_4 to pH<2, Cool, 4°C	28 days
TCLP Metals	(4) 1-L amber Glass (1) 250 mL polybottle	1 L	Cool, 4°C	180 days, Hg at 28 days
TCLP VOCs		1 L		14 days
TCLP SVOCs		1 L		14 days
Reactive Cyanide		250 ml		14 days
Reactive Sulfide				7 days
pH		1 L		ASAP
Flashpoint				N/A

* Container requirements listed are for one sample; MS/MSD analysis each considered a sample.

3.6 Field Quality Control Sampling Procedures

Quality assurance/quality control samples will be collected during quarterly groundwater monitoring of the 39 new wells and semiannual monitoring of the 35 selected wells. These quality control samples will include duplicates and split groundwater samples, matrix spike and matrix spike duplicates (MS/MSD), equipment rinsates, and trip blanks as described in Section 5.4.7 of the FWSAP. Duplicate samples will be collected at a frequency of 10 percent of the total number of samples. Matrix spike and matrix spike duplicate samples will typically represent 5 percent of the total number of field samples. Equipment rinseate samples will be collected daily. A trip blank, which comprises a sealed container of American Society for Testing and Materials (ASTM) Type I or equivalent water that originates at the laboratory, will be submitted with each shipment of coolers containing aqueous samples for VOC analysis. Split samples will be submitted to the approved USACE contract laboratory for independent analyses.

Additional QA/QC samples may include source blanks, which are collected from potable water sources used for decontamination, and temperature blanks, which provide a measure of adequate cooling during sample shipment.

3.7 Equipment Decontamination

Portable groundwater sampling equipment (e.g., bladder pumps) will be cleaned prior to collecting each sample to prevent cross-contamination using the following eight-step procedure:

1) Scrub and wash with laboratory-grade detergent.
2) Rinse with approved potable water.
3) Rinse thoroughly with hydrochloric acid (2 percent solution) or nitric acid (10 percent solution).
4) Rinse with ASTM Type I or equivalent deionized/distilled water.
5) Rinse with pesticide-grade isopropanol or methanol (wash bottle).
6) Rinse with ASTM Type I or equivalent deionized/distilled water.
7) Allow equipment to air dry.
8) Place equipment on clean, dry plastic if it is to used immediately or wrap in aluminum foil if storage is required.

Field measurement equipment (e.g., water level indicators, pH meters, etc.) will also be decontaminated between well locations. Due to the sensitive nature of these measuring devices, the decontamination procedure will involve a non-phosphate detergent wash, followed by a potable water rinse, and a final rinse using ASTM Type I or equivalent water.

SECTION 4. SAMPLE MANAGEMENT

Field personnel are responsible for the identification, preservation, packaging, handling, shipping, and storage of samples obtained in the field such that all samples can be readily identified and will retain, to the extent possible, *in situ* characteristics to be determined through analysis. All samples collected will be tracked by preparing and using a sample chain-of-custody form as described in Section 6.4.3 of the FWSAP.

4.1 Field Logbook

A field sample logbook will be initiated at the start of the first onsite sampling activity and maintained to record sampling activities throughout the project. The field sample logbook is a controlled document that becomes part of the permanent site file. The logbook will consist of a bound notebook with consecutively numbered pages that cannot be removed. All data entries will be recorded using a non-erasable ink pen.

All information pertinent to on-site environmental task activities will be recorded in field logbooks, field forms, or electronic equivalent, including:

- Date of activities
- Arrival and departure of sampling personnel and observers
- Field sample activities
- Individual sample description (color, consistency, odor, etc.)
- Sample pickup, including chain-of-custody form number, carrier, date, and time
- Unusual events during sampling
- Health and safety issues related to sampling
- Weather conditions

All field logbook information will follow procedures identified in Section 6.1 of the FWSAP.

4.2 Field Data Management

Field data will be entered into an electronic database at the time of sample collection (i.e., in the field). This process has been proven effective at RVAAP by reducing errors and expediting final reporting. Field measurements and records are recorded using field-durable laptop computers in conjunction with the use of standard logbooks. The data is direct loaded into a Microsoft Access™ database, which performs check-routines for correct loading. These electronic data are then processed to generate data summary tables, electronic data deliverables (EDDs), and USACE Automated Data Review (ADR) deliverables.

4.3 Sample Identification System

Each sample (including QC samples) will be identified with a unique sample number. This number will provide easy identification of the sample in field logs, field data sheets, analytical reports, chain-of-custody forms, and project reports. The sample numbering system that will be used to identify samples collected during the groundwater sampling is explained in Section 6.3 of the FWSAP. Samples collected will be identified sequentially by following the numbering system. If a sample is not collected or is reassigned to another location, a specific reason and notation will be written in the project field books or equivalent. The sample number system is presented in Figure 4-1 and presents the sample numbers that will be used during this project.

4.4 Sample Labeling

Samples will be labeled at the time of sample collection by affixing a self-stick label to the sample container. The labels are computer-generated in-house for clarity and accuracy. At a minimum, all sample labels will include the following information:

- Project name
- Unique sample identification number (see Section 4.3)
- Date and time the sample was collected
- Initials of the sample collector
- Sampling location and sample description

Additional information that may be recorded on the labels is described in Section 6.4.1 of the FWSAP.

4.5 Sample Custody

Sample chain of custody tracks the life of a sample from collection to analysis. A record of the sample custody will be maintained to establish and document sample possession during collection, shipment, laboratory receipt, and laboratory analysis. This documentation will be evidenced on a chain-of-custody record by the signatures of the individuals collecting, shipping, and receiving each sample. Section 6.4.3 of the FWSAP describes the sample custody procedures in detail.

4.6 Documentation Procedures

Documentation and tracking of samples and field information will follow the series of steps identified in Section 6.5 of the FWSAP.

Sampling Location Identification: XXXmm-NNN(n)				
XXX	=	Area Designator	Examples LL4 - DA2 -	 Load Line 4 Demolition Area 2
mm	=	Sample Location Type	Examples MW SB	 Monitoring Well Soil Boring
NNN	=	Sequential Sample Location Number: Unique, sequential number for each sample location beginning with the following number from the last number used from previous investigation stations and extending into any subsequent phases.	Examples 004 012 099 107	
(n)	=	Special Identifier: Optional use (as needed) to identify special sample matrices of sample location characteristics.	Examples D B A	 Deep zone aquifer Background location Abandoned well
Sample Identification: XXXmm-NNN(n)-####-tt				
###	=	Sequential Sample Number [must be unique for entire project site/AOC]	Examples 0001 0002 0003	
tt	=	Sample Type	Examples GW GF SO GT TB FB ER	 Groundwater (unfiltered) Groundwater (filtered) Soil Sample Geotechnical Sample Trip Blank Field Blank Equipment Rinsate

Figure 4-1. Sample Identification System

4.7 Corrections to Documentation

Any corrections to documentation will follow guidance established in Section 6.6 of the FWSAP.

4.8 Sampling Event Reports

EQM will prepare preliminary draft, draft, and final versions of all reports in accordance with the Performance Work Statement (PWS), DFFO, and the FWGWMP Plan.

4.9 Monthly Reports

Monthly reports will be submitted during implementation of the field investigation activities. Monthly reports will be submitted on the 5^{th} day of the following month to the USACE. The content of the reports will have content similar to that specified in Section 6.7 of the FWSAP.

4.10 Annual Reporting and Program Review

In addition to the sampling event and monthly project reports, EQM will prepare and submit the Annual Report per the requirements and schedule set forth in the PWS, DFFO, and FWGWMP Plan. In accordance with the DFFO milestone, the Annual Groundwater Report will be submitted no later than December 15 each year.

SECTION 5. SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Packaging and shipping procedures will be followed in accordance with Section 7.0 of the FWSAP. All samples collected during this study will be properly labeled and packaged for delivery to the offsite laboratory. Glass containers will be secured in sturdy coolers to prevent breakage during transport. Ice will be placed in the coolers to preserve the samples at 4°C. Coolers will be secured with tape and labeled to ensure the samples are not disturbed during transportation. A chain-of-custody seal(s) will be attached so that any attempts at opening or tampering will result in a broken seal.

SECTION 6. INVESTIGATION-DERIVED WASTE

All investigation-derived waste (IDW), including personal protective equipment (PPE), disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Section 8.0 of the FWSAP. At the conclusion of field activities for the semiannual groundwater sampling, a letter report will be submitted to USACE and the RVAAP Environmental Coordinator documenting the characterization and classification of the wastes. Upon approval of the IDW classification report, all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor. All shipments of IDW offsite will be coordinated through the RVAAP Environmental Coordinator.

Three (3) types of IDW are anticipated, which will be contained separately. The types and estimated quantities for each include:

- Development and purge water from monitoring wells;
- Decontamination fluids, including those derived from decontamination of sampling equipment; and
- Expendables/solid wastes, including PPE and disposable sampling equipment.

Characterization and classification of the different types of IDW will be based on the specific protocols described below. Expendable solid waste will be not sampled for characterization purposes.

- **IDW Water:** Purge water and excess water not used for environmental samples will be placed in 55-gal drums. Disposition will be based on the analytical results of the environmental samples. If results indicate that IDW water is potentially hazardous, Toxicity Characteristic Leaching Procedure (TCLP) samples will be collected.

- **Decontamination Fluids:** Decontamination fluids will be placed in drums or a polytank up to 1,500 gallons in size as needed. Disposition of decontamination liquid will be based on the collection and analysis of TCLP liquid sample(s).

Drummed IDW water and decontamination fluids will be transported to a location designated by the RVAPP Environmental Coordinator, where it will be staged on wooden pallets within secondary containment structures. To avoid potential drum rupture due to freezing conditions, drums containing liquid IDW will be filled only to 75 percent capacity.

6.1 Wastewater Sampling

Accumulated IDW decontamination water and purge water will be containerized in 55-gal drums on site pending transport and treatment at an offsite wastewater treatment facility. Wastewater samples, if needed, will be collected by gently lowering a new, disposable bailer attached to new polypropylene rope into the holding vessel. The bailer has a bottom check valve that seats over the bottom opening during retrieval, thereby keeping the water within the bailer column as the bailer is withdrawn from the poly tank or drum. Water collected in the bailer will be transferred directly from the bailer to a decontaminated 3- to 5-gal glass container for homogenization. Water from the bucket will then be transferred into the appropriate sample containers. The bailer will be lowered into the drums several times, and to different depths, to collect a sufficient representative sample of the water to submit to the laboratory for waste characterization analysis in accordance with the disposal facility's characterization requirements. New, disposable nitrile gloves will be donned prior to each wastewater sample event. The used gloves, bailer, and rope will be discarded appropriately after each event.

6.2 Waste Container Labeling

All IDW containers will be labeled in accordance with Section 8.2 of the FWSAP.

SECTION 7. REFERENCES

EQM (Environmental Quality Management, Inc.). January 2012. *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Addendum, Ravenna Army Ammunition Plant, Ravenna, Ohio*.

EQM. January 2012. *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Environmental Investigation Services Addendum, Ravenna Army Ammunition Plant, Ravenna, Ohio*. Part I of RVAAP-66 Facility-Wide Groundwater Addendum.

EQM. January 2012. *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Quality Assurance Project Plan Addendum, Ravenna Army Ammunition Plant, Ravenna, Ohio.* Part II of RVAAP-66 Facility-Wide Groundwater Addendum.

SAIC (Science Applications International Corporation). March 2001. *Facility-Wide Sampling and Analysis Plan for Environmental Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio*.

SAIC. February 2011. *Final Facility-Wide Sampling and Analysis Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio.*

USACE (U.S. Army Corps of Engineers). September 2004. *Facility-Wide Groundwater Monitoring Program Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio*.

USACE. November 2010. *Draft 2010 Addendum to the Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater, Ravenna Army Ammunition Plant, Ravenna, Ohio*.

APPENDIX A

SCHEDULE

ID	Task Name	Duration	Start	Finish	Predecessors
1	**2012 FWGWMP Sampling, Analysis & Reporting**	**587 days**	**Mon 9/19/11**	**Sat 4/27/13**	
2	Prepare Amendment to the FWGWMP to revise frequency of sampling and analyte list for wells	104 days	Mon 9/19/11	Sat 12/31/11	
3	Completion of January 2012 Sampling Event	20 days	Mon 1/2/12	Sat 1/21/12	
4	Prepare Preliminary Draft of January Groundwater Report	60 days	Sun 1/22/12	Wed 3/21/12	3
5	Army Review of Preliminary Draft	30 days	Thu 3/22/12	Fri 4/20/12	4
6	Response to Comments and Prepare Draft of January Groundwater Report	14 days	Sat 4/21/12	Fri 5/4/12	5
7	Stakeholder Review	45 days	Sat 5/5/12	Mon 6/18/12	6
8	Response to Comments & Submittal of Responses	15 days	Tue 6/19/12	Tue 7/3/12	7
9	Stakeholder Review	15 days	Wed 7/4/12	Wed 7/18/12	8
10	Prepare Final of October Groundwater Report	15 days	Wed 7/4/12	Wed 7/18/12	
11	Ohio EPA Approval of Final January Report	15 days	Thu 7/19/12	Thu 8/2/12	10
12					
13	Completion of April 2012 Sampling Event (new wells only)	15 days	Mon 4/9/12	Mon 4/23/12	
14	Prepare Preliminary Draft of April Groundwater Report	60 days	Tue 4/24/12	Fri 6/22/12	13
15	Army Review of Preliminary Draft	30 days	Sat 6/23/12	Sun 7/22/12	14
16	Response to Comments and Prepare Draft of April Groundwater Report	14 days	Mon 7/23/12	Sun 8/5/12	15
17	Stakeholder Review	45 days	Mon 8/6/12	Wed 9/19/12	16
18	Response to Comments & Submittal of Responses	15 days	Thu 9/20/12	Thu 10/4/12	17
19	Stakeholder Review	15 days	Fri 10/5/12	Fri 10/19/12	18
20	Prepare Final of April Groundwater Report	15 days	Fri 10/5/12	Fri 10/19/12	
21	Ohio EPA Approval of Final April Report	15 days	Sat 10/20/12	Sat 11/3/12	20
22					
23	Completion of July 2012 Sampling Event (includes sampling of new wells)	20 days	Mon 7/2/12	Sat 7/21/12	
24	Prepare Preliminary Draft of July Groundwater Report	60 days	Sun 7/22/12	Wed 9/19/12	23
25	Army Review of Preliminary Draft	30 days	Thu 9/20/12	Fri 10/19/12	24
26	Response to Comments and Prepare Draft of July Groundwater Report	14 days	Sat 10/20/12	Fri 11/2/12	25
27	Stakeholder Review	45 days	Sat 11/3/12	Mon 12/17/12	26
28	Response to Comments & Submittal of Responses	15 days	Tue 12/18/12	Tue 1/1/13	27
29	Stakeholder Review	15 days	Wed 1/2/13	Wed 1/16/13	28
30	Prepare Final of July Groundwater Report	15 days	Wed 1/2/13	Wed 1/16/13	
31	Ohio EPA Approval of Final July Report	15 days	Thu 1/17/13	Thu 1/31/13	30
32					
33	Completion of October 2012 Sampling Event (new wells only)	15 days	Mon 10/1/12	Mon 10/15/12	
34	Prepare Preliminary Draft of October Groundwater Report	60 days	Tue 10/16/12	Fri 12/14/12	33
35	Army Review of Preliminary Draft	30 days	Sat 12/15/12	Sun 1/13/13	34
36	Response to Comments and Prepare Draft of October Groundwater Report	14 days	Mon 1/14/13	Sun 1/27/13	35
37	Stakeholder Review	45 days	Mon 1/28/13	Wed 3/13/13	36
38	Response to Comments & Submittal of Responses	15 days	Thu 3/14/13	Thu 3/28/13	37
39	Stakeholder Review	15 days	Fri 3/29/13	Fri 4/12/13	38
40	Prepare Final of October Groundwater Report	15 days	Fri 3/29/13	Fri 4/12/13	
41	Ohio EPA Approval of Final October Report	15 days	Sat 4/13/13	Sat 4/27/13	40
42					
43	Prepare Preliminary Draft of 2012 Annual Groundwater Report	60 days	Mon 8/27/12	Thu 10/25/12	
44	Army Review of Preliminary Draft	30 days	Fri 10/26/12	Sat 11/24/12	43
45	Response to Comments and Prepare Draft of 2012 Annual Groundwater Report	14 days	Sun 11/25/12	Sat 12/8/12	44
46	Stakeholder Review	45 days	Sun 12/9/12	Tue 1/22/13	45
47	Response to Comments & Submittal of Responses	15 days	Wed 1/23/13	Wed 2/6/13	46
48	Stakeholder Review	15 days	Thu 2/7/13	Thu 2/21/13	47
49	Prepare Final of 2012 Annual Groundwater Report	15 days	Sat 2/16/13	Sat 3/2/13	
50	Ohio EPA Approval of the Final 2012 Annual Groundwater Report	15 days	Sun 3/3/13	Sun 3/17/13	49
51					
52	**2013 FWGWMP Sampling, Analysis & Reporting**	**442 days**	**Mon 1/7/13**	**Mon 3/24/14**	
53	Completion of January 2013 Sampling Event (including new wells)	15 days	Mon 1/7/13	Mon 1/21/13	
54	Prepare Preliminary Draft of January Groundwater Report	60 days	Tue 1/22/13	Fri 3/22/13	53
55	Army Review of Preliminary Draft	30 days	Sat 3/23/13	Sun 4/21/13	54
56	Response to Comments and Prepare Draft of January Groundwater Report	14 days	Mon 4/22/13	Sun 5/5/13	55
57	Stakeholder Review	45 days	Mon 5/6/13	Wed 6/19/13	56

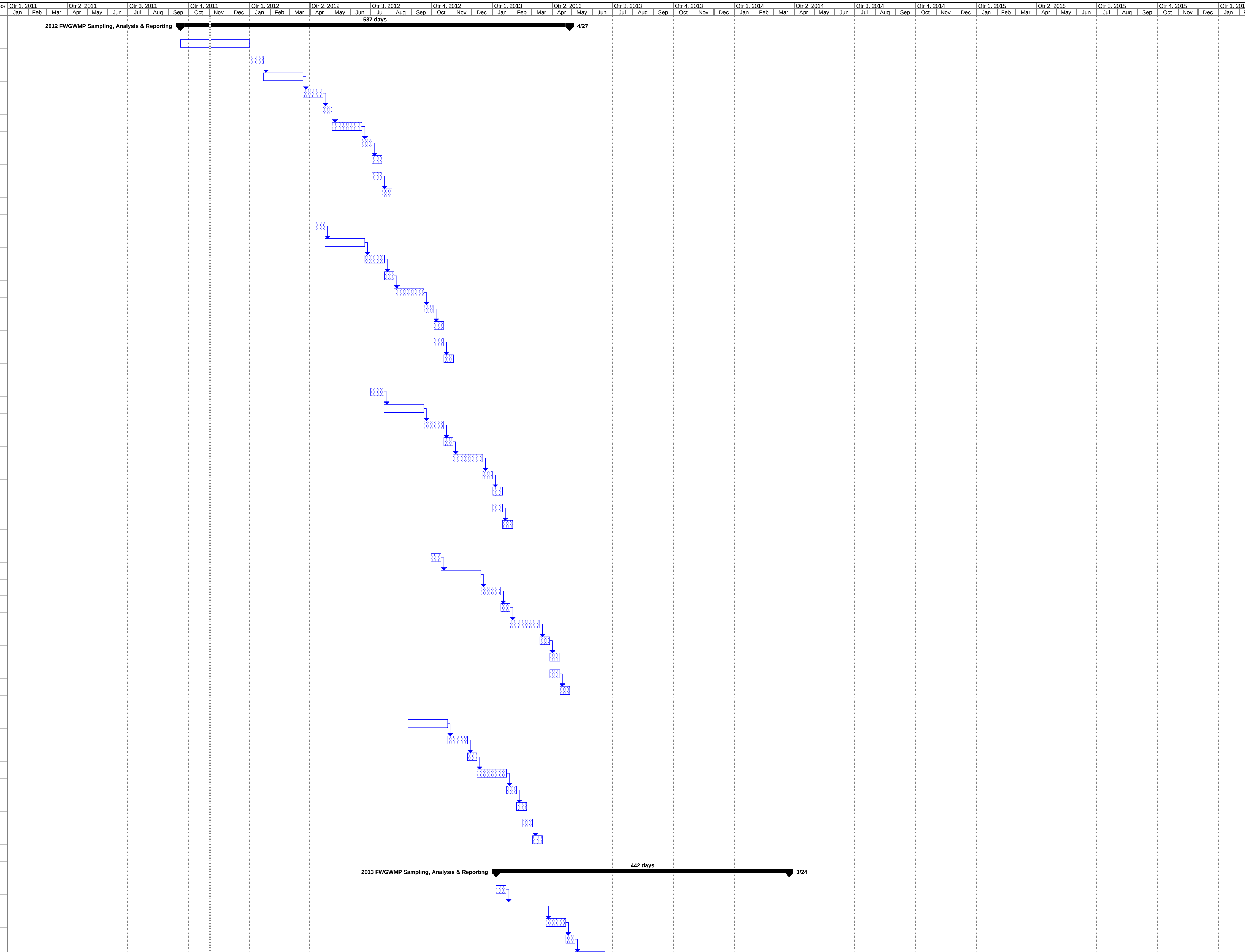

Figure II-1
Facility-Wide Groundwater Schedule - RVAAP

Task | Progress | Summary | Rolled Up Critical Task | Rolled Up Progress | External Tasks | Group By Summary
Critical Task | Milestone | Rolled Up Task | Rolled Up Milestone | Split | Project Summary | Deadline

ID	Task Name	Duration	Start	Finish	Predecessors
58	Response to Comments & Submittal of Responses	15 days	Thu 6/20/13	Thu 7/4/13	57
59	Stakeholder Review	15 days	Fri 7/5/13	Fri 7/19/13	58
60	Prepare Final of January Groundwater Report	15 days	Fri 7/5/13	Fri 7/19/13	
61	Ohio EPA Approval of Final January Report	15 days	Sat 7/20/13	Sat 8/3/13	60
62					
63	Completion of July 2013 Sampling Event	15 days	Mon 7/8/13	Mon 7/22/13	
64	Prepare Preliminary Draft of July Groundwater Report	60 days	Tue 7/23/13	Fri 9/20/13	63
65	Army Review of Preliminary Draft	30 days	Sat 9/21/13	Sun 10/20/13	64
66	Response to Comments and Prepare Draft of July Groundwater Report	14 days	Mon 10/21/13	Sun 11/3/13	65
67	Stakeholder Review	45 days	Mon 11/4/13	Wed 12/18/13	66
68	Response to Comments & Submittal of Responses	15 days	Thu 12/19/13	Thu 1/2/14	67
69	Stakeholder Review	15 days	Fri 1/3/14	Fri 1/17/14	68
70	Prepare Final of July Groundwater Report	15 days	Fri 1/3/14	Fri 1/17/14	
71	Ohio EPA Approval of Final July Report	15 days	Sat 1/18/14	Sat 2/1/14	70
72					
73	Prepare Preliminary Draft of 2013 Annual Groundwater Report	60 days	Wed 8/28/13	Sat 10/26/13	
74	Army Review of Preliminary Draft	30 days	Sun 10/27/13	Mon 11/25/13	73
75	Response to Comments and Prepare Draft of 2012 Annual Groundwater Report	14 days	Tue 11/26/13	Mon 12/9/13	74
76	Stakeholder Review	45 days	Tue 12/10/13	Thu 1/23/14	75
77	Response to Comments & Submittal of Responses	15 days	Fri 1/24/14	Fri 2/7/14	76
78	Stakeholder Review	15 days	Sat 2/8/14	Sat 2/22/14	77
79	Prepare Final of 2012 Annual Groundwater Report	15 days	Sun 2/23/14	Sun 3/9/14	78
80	Ohio EPA Approval of Final 2012 Annual Report	15 days	Mon 3/10/14	Mon 3/24/14	79
81					
82	**2014 FWGWMP Sampling, Analysis & Reporting**	**423 days**	**Wed 1/8/14**	**Fri 3/6/15**	
83	Completion of January 2014 Sampling Event	15 days	Wed 1/8/14	Wed 1/22/14	
84	Prepare Preliminary Draft of January Groundwater Report	60 days	Thu 1/23/14	Sun 3/23/14	83
85	Army Review of Preliminary Draft	30 days	Mon 3/24/14	Tue 4/22/14	84
86	Response to Comments and Prepare Draft of January Groundwater Report	14 days	Wed 4/23/14	Tue 5/6/14	85
87	Stakeholder Review	45 days	Wed 5/7/14	Fri 6/20/14	86
88	Response to Comments & Submittal of Responses	15 days	Sat 6/21/14	Sat 7/5/14	87
89	Stakeholder Review	15 days	Sun 7/6/14	Sun 7/20/14	88
90	Prepare Final of January Groundwater Report	15 days	Sun 7/6/14	Sun 7/20/14	
91	Ohio EPA Approval of Final January Report	15 days	Mon 7/21/14	Mon 8/4/14	90
92					
93	Completion of July 2014 Sampling Event	15 days	Mon 7/7/14	Mon 7/21/14	
94	Prepare Preliminary Draft of July Groundwater Report	60 days	Tue 7/22/14	Fri 9/19/14	93
95	Army Review of Preliminary Draft	30 days	Sat 9/20/14	Sun 10/19/14	94
96	Response to Comments and Prepare Draft of July Groundwater Report	14 days	Mon 10/20/14	Sun 11/2/14	95
97	Stakeholder Review	45 days	Mon 11/3/14	Wed 12/17/14	96
98	Response to Comments & Submittal of Responses	15 days	Thu 12/18/14	Thu 1/1/15	97
99	Stakeholder Review	15 days	Fri 1/2/15	Fri 1/16/15	98
100	Prepare Final of July Groundwater Report	15 days	Fri 1/2/15	Fri 1/16/15	
101	Ohio EPA Approval of Final July Report	15 days	Sat 1/17/15	Sat 1/31/15	100
102					
103	Prepare Preliminary Draft of 2014 Annual Groundwater Report	60 days	Mon 8/25/14	Thu 10/23/14	
104	Army Review of Preliminary Draft	30 days	Fri 10/24/14	Sat 11/22/14	103
105	Response to Comments and Prepare Draft of 2012 Annual Groundwater Report	14 days	Sun 11/23/14	Sat 12/6/14	104
106	Stakeholder Review	45 days	Sun 12/7/14	Tue 1/20/15	105
107	Response to Comments & Submittal of Responses	15 days	Wed 1/21/15	Wed 2/4/15	106
108	Stakeholder Review	15 days	Thu 2/5/15	Thu 2/19/15	107
109	Prepare Final of 2012 Annual Groundwater Report	15 days	Thu 2/5/15	Thu 2/19/15	
110	Ohio EPA Approval of Final 2012 Annual Report	15 days	Fri 2/20/15	Fri 3/6/15	109
111					
112	**2015 FWGWMP Sampling, Analysis & Reporting**	**389 days**	**Wed 1/7/15**	**Sat 1/30/16**	
113	Completion of January 2015 Sampling Event	15 days	Wed 1/7/15	Wed 1/21/15	
114	Prepare Preliminary Draft of January Groundwater Report	60 days	Thu 1/22/15	Sun 3/22/15	113

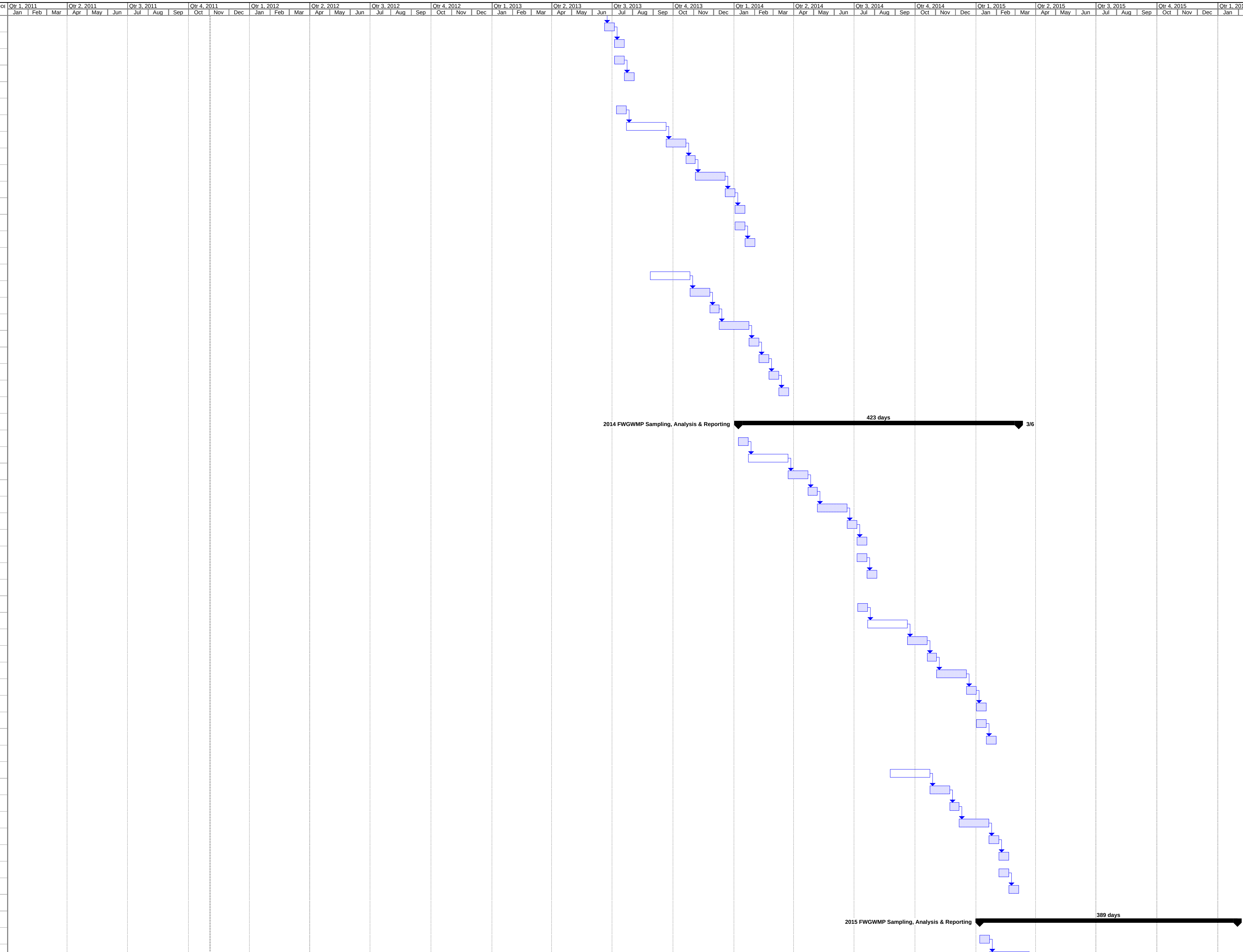

Figure II-1
Facility-Wide Groundwater Schedule - RVAAP

Task	Progress	Summary	Rolled Up Critical Task	Rolled Up Progress	External Tasks	Group By Summary
Critical Task	Milestone	Rolled Up Task	Rolled Up Milestone	Split	Project Summary	Deadline

ID		Task Name	Duration	Start	Finish	Predecessors
115		Army Review of Preliminary Draft	30 days	Mon 3/23/15	Tue 4/21/15	114
116		Response to Comments and Prepare Draft of January Groundwater Report	14 days	Wed 4/22/15	Tue 5/5/15	115
117		Stakeholder Review	45 days	Wed 5/6/15	Fri 6/19/15	116
118		Response to Comments & Submittal of Responses	15 days	Sat 6/20/15	Sat 7/4/15	117
119		Stakeholder Review	15 days	Sun 7/5/15	Sun 7/19/15	118
120		Prepare Final of January Groundwater Report	14 days	Sun 7/5/15	Sat 7/18/15	
121		Ohio EPA Approval of Final January Report	15 days	Sun 7/19/15	Sun 8/2/15	120
122						
123		Completion of July 2015 Sampling Event	15 days	Mon 7/6/15	Mon 7/20/15	
124		Prepare Preliminary Draft of July Groundwater Report	60 days	Tue 7/21/15	Fri 9/18/15	123
125		Army Review of Preliminary Draft	30 days	Sat 9/19/15	Sun 10/18/15	124
126		Response to Comments and Prepare Draft of July Groundwater Report	14 days	Mon 10/19/15	Sun 11/1/15	125
127		Stakeholder Review	45 days	Mon 11/2/15	Wed 12/16/15	126
128		Response to Comments & Submittal of Responses	15 days	Thu 12/17/15	Thu 12/31/15	127
129		Stakeholder Review	15 days	Fri 1/1/16	Fri 1/15/16	128
130		Prepare Final of July Groundwater Report	15 days	Fri 1/1/16	Fri 1/15/16	
131		Ohio EPA Approval of Final July Report	15 days	Sat 1/16/16	Sat 1/30/16	130

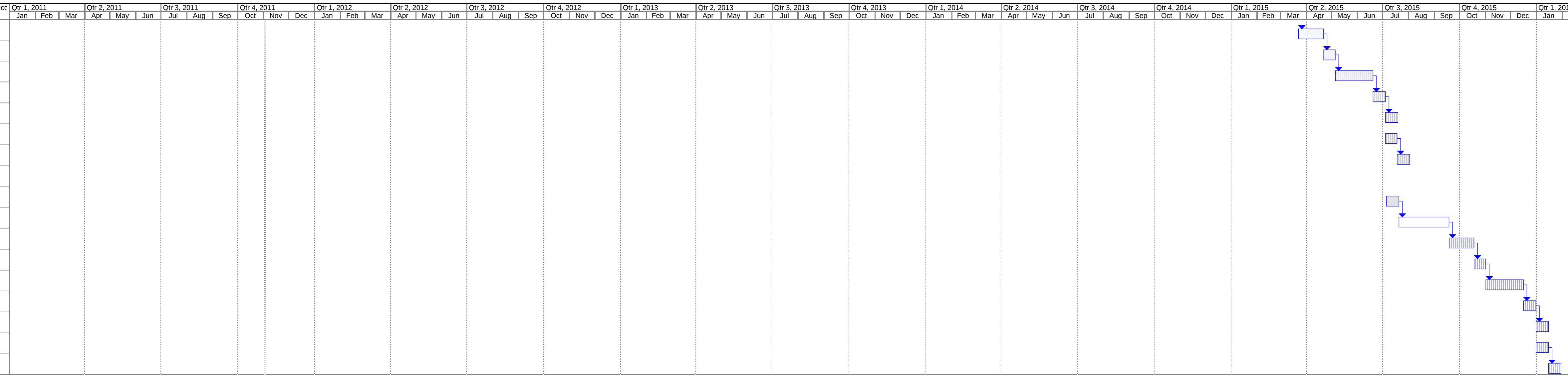

Figure II-1
Facility-Wide Groundwater Schedule - RVAAP

Task		Progress		Summary		Rolled Up Critical Task		Rolled Up Progress		External Tasks		Group By Summary	
Critical Task		Milestone		Rolled Up Task		Rolled Up Milestone		Split		Project Summary		Deadline	

APPENDIX B

CORRESPONDENCE/COMMENT RESPONSES

Ohio | Environmental Protection Agency
John R. Kasich, Governor
Mary Taylor, Lt. Governor
Scott J. Nally, Director

January 17, 2012

RE: RAVENNA ARMY AMMUNITION PLANT, PORTAGE/TRUMBULL COUNTIES, FWGWMP, DRAFT RVAAP-66 FACILITY-WIDE GROUNDWATER SEMIANNUAL MONITORING ADDENDUM, RESPONSE TO OHIO EPA COMMENTS DATED JANUARY 5, 2012, (# 267000859036)

Mr. Mark Patterson
Installation Manager
Ravenna Army Ammunition Plant
8451 State Route 5
Ravenna, OH 44266

CERTIFIED MAIL
7010 3090 0000 3936 6290

Dear Mr. Patterson:

The Ohio Environmental Protection Agency (Ohio EPA) has received and reviewed the "Draft, Facility-Wide Groundwater Monitoring Program (FWGWMP), RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum, Response to Ohio EPA Comments" document. The document was received at Ohio EPA, Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR) on January 6, 2011, and is dated January 5, 2011. The document was prepared for the U.S. Army Corps of Engineers (USACE) – Louisville District, by Environmental Quality Management, Inc. (EQM), under contract No. GS-10F-0293K.

This document is intended as a follow-up to the "Draft 2010 Addendum to FWGWMP" from the USACE, dated November 15, 2010, which is still outstanding and needs to be closed out. It also supplements the Draft FWGWMP Groundwater Addendum, dated October 2011. The primary objective, as stated in the document, is to present the proposed monitoring well network and the sampling schedule (semiannual) for facility-wide groundwater. Thirty-five wells have been identified for sampling.

All comments have been adequately addressed. In addition, as discussed during a meeting at the RVAAP on January 11, 2012, monitoring well LL-12mw-185 has been added to the list of wells to be sampled (nitrate and arsenic) and static water levels will be measured for all wells at LL-12 during every sampling event. Please forward all replacement title covers, text changes, etc.

Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087-1924

330 | 963 1200
330 | 487 0769 (fax)
www.epa.ohio.gov

If you have any questions, please call me at (330) 963-1207.

Sincerely,

Vicki Deppisch

Vicki Deppisch
Hydrogeologist/Project Coordinator
Division of Environmental Response and Revitalization

VD/kss

cc: Eileen Mohr, Ohio EPA, NEDO, DERR

ec: Katie Tait, OHARNG RTLS
LTC Ed Meade, OHARNG RTLS
Glen Beckham, USACE Louisville
Mark Eldridge, AEC
John Miller, EQM
Mark Nichter, USACE Louisville
Kim Harriz, NGB
Christy Esler, Vista/RVAAP
Nancy Zikmanis, Ohio EPA, NEDO, DERR
Todd Fisher, Ohio EPA, NEDO, DERR
Conni McCambridge, Ohio EPA, NEDO, DDAGW

Environmental Quality Management, Inc.
1800 Carillon Boulevard
Cincinnati, Ohio 45240
(513) 825-7500
FAX (513) 825-7495
www.eqm.com

January 5, 2012

Ms. Vicki Deppisch
Ohio Environmental Protection Agency, NE District Office
Division of Emergency and Remedial Response
2110 E. Aurora Road
Twinsburg, OH 44087

Re: Facility-Wide Groundwater Monitoring Program
RVAAP-66 Facility-Wide Semiannual Groundwater Monitoring Addendum

Dear Ms. Deppisch:

On behalf of the US Army Corps of Engineers (USACE) Environmental Quality Management, Inc. (EQM) is submitting to the Ohio EPA the responses to Ohio EPA comments (dated December 20, 2011, 2011) on the *Draft Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum* for the Ravenna Army Ammunition Plant. Enclosed please find two (2) printed copies of the responses. An electronic copy of the responses has also been sent via email.

If you have any questions, please call me at (513) 825-7500, or Mr. Mark Nichter of the USACE at (502) 315-6375.

Sincerely,

ENVIRONMENTAL QUALITY MANAGEMENT, INC.

John M. Miller, CHMM
Project Manager

cc: M. Nichter – USACE
M. Patterson – RVAAP (BRAC)

Ohio EPA Comment Response Table
RVAAP – FWGWMP
Draft Semiannual Monitoring Addendum Dated November 4, 2011
Reviewers: Conni McCambridge and Vicki Deppisch, Ohio EPA
(December 20, 2011)

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
			Ohio EPA (V. Deppisch/C. McCambridge)		
1	Pg. 11, Sec. 2.4		The document states, "Several of the ACOs are monitored exclusively by bedrock wells. For these areas it is assumed that the unconsolidated deposits do not yield sufficient quantities of water to justify well completion in this zone......." Can this be verified?	Please try to verify and, if so, change/add the text wording to indicate this has been verified.	This key assumption was first presented in Section 3.1.3 of the Facility-Wide Groundwater Monitoring Program Plan (USACE, 2004). The following AOCs are monitored exclusively by bedrock wells: Load Lines 1, 2, 3, 7, 9, Bldg 12, C Block, and Ramsdell Quarry LF. In addition, Fuze and Booster and Load Lines 5 and 10 are predominantly monitored by bedrock wells, although one or two overburden wells are also present in these AOCs. Also note that the existing wells at the facility were apparently installed as first water wells, therefore it is assumed that the unconsolidated deposits did not yield sufficient quantities of water to justify well completion in the unconsolidated zone at that time.
2	Pg. 12, Sec. 2.4, last paragraph, "Key Assumptions"		The paragraph states, "potentiometric surfaces for the unconsolidated and Sharon aquifers merge just east of LL-1. In this region, possible groundwater contaminants from the entire site can be monitored. Consequently, selected bedrock wells downgradient of LL-1 are downgradient of the entire site. These	Ohio EPA recommends deleting this paragraph except for the first sentence. Ohio EPA suggests evaluating flow directions, once the static water levels for the additional 38 wells have been measured and added to the flow maps, and provide	This key assumption was first presented in Section 3.1.3 of the Facility-Wide Groundwater Monitoring Program Plan (USACE, 2004). However, EQM will modify the text as follows: *The potentiometric surfaces for the unconsolidated and Sharon aquifers merge just east of LL-1. Following the*

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
Ohio EPA (V. Deppisch/C. McCambridge)					
			wells form the basis of the facility-wide monitoring plan for indicating potential offsite groundwater contaminant migration." As stated, Ohio EPA does not agree with this paragraph. Although the static water levels appear to be the same for the bedrock and unconsolidated wells in the eastern area, flow maps indicate multiple flow directions for the unconsolidated wells and the bedrock wells. Thirty-eight additional wells are planned to be installed. It might be premature to list the above as a "key assumption" that contaminants from the entire site can be monitored with the eastern wells.	recommendations for monitoring the site at a later time in a future document.	*installation of additional monitoring wells at RVAAP, static water levels and flow directions will be further evaluated to determine whether potential offsite migration pathways have been captured by the perimeter wells in this area of the site.*
3	Pg.14,Sec. 5.3, Table 2-1		The submittal discusses the rationale behind the selection of 29 wells for semiannual monitoring. However, it appears that no wells were selected from Load Lines 5, 7, 8, 9, and 10.	Please provide a brief explanation for the exclusion of wells from these five Load Lines for semiannual monitoring.	From a facility-wide basis, EQM believes that the proposed wells to be installed in Load Line 6 (Nos. 27-28) and near the Administration buildings (Nos. 20, 37, and 38) are downgradient of the aforementioned load lines and provide reasonable coverage for these AOCs. Moreover, the contamination previously identified at these load lines has not been significant, with the exception of several COPCs in Load Line 7, which we again feel is adequately

Ohio EPA Comment Response Table
RVAAP – FWGWMP
Draft Semiannual Monitoring Addendum Dated November 4, 2011
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(December 20, 2011)

Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
Ohio EPA (V. Deppisch/C. McCambridge)					
					covered by the wells in Load Line 6. After further review, however, we have determined that the historically consistent occurrence of VOCs (specifically carbon tetrachloride) in well LL10mw-003 is notable. Consequently, we will add this well to our semiannual monitoring well network for VOCs and metals analysis only.
4	Pgs. 14-15 and 20, Sec. 2.5.3, Tables 2-1 and 2.2		Table 2.1 lists 29 wells for semiannual monitoring, which include LL6mw-005. However, Table 2.2 lists 29 wells, which include DA2mw-107, but not LL6mw-005.	This discrepancy on the inclusion and exclusion of wells LL6mw-005 and DA2mw-107 in these two tables needs to be checked. An appropriate explanation should be added in the submittal	This is a typographical error. Well LL6mw-005 is a Homewood well, which will be sampled for comparison with the new Homewood well to be installed nearby at proposed new pair locations 27-and 28. Well DA2mw-107 is unnecessary since the nearby DET-003 well is already being sampled for comparison with proposed well 19. Table 2-3 will be modified accordingly.
5	Pg. 14, Table 2-1, LL-12 well		The table indicates the only well selected for semiannual monitoring is LL12mw-246. According to an SAIC Draft FS, dated Sept. 2009 (that is currently on hold), the following wells were sampled with corresponding rationale: LL12mw-113 (historical	Given that this AOC has contradictory flow patterns and detections that were above the MCL for nitrate, please consider re-evaluating wells in this AOC for inclusion in the semiannual sampling or provide detailed	The semiannual monitoring network was designed to provide comparison data near the new wells and to monitor potential exit pathways. With the installation and quarterly monitoring of proposed wells 4, 6, and 7, EQM believes that contaminant migration from Load Line 12 has been

Ohio EPA Comment Response Table
RVAAP – FWGWMP
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Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
			Ohio EPA (V. Deppisch/C. McCambridge)		
			HMX contamination found in this well and arsenic source area); LL12mw-128 (downgradient of LL12-187 and arsenic source are); LL12-185 (nitrate source, 171 J mg/L); LL12-187 (nitrate source, 1,330 J mg/L); LL12mw-242 (upgradient of LL12-187, downgradient of LL12mw-113 and arsenic source area); LL12-243 (downgradient of LL12mw-185 and LL12mw-187 and arsenic source area); LL12mw-245 (downgradient of LL12mw-185); and LL-12mw-246 (downgradient of LL12mw-185 and arsenic source area). In addition, various flow maps have indicated conflicting flow patterns.	rationale for exclusion for each well. Also, please consider measuring static water levels for all wells regardless of sampling inclusion.	adequately covered. However, we are willing to include wells LL12mw-187, LL12mw-245, and LL12mw-242 to the well network. We are recommending not including well LL12mw-113 due to persistent siltation issues with this well. Consequently, we have selected downgradient well LL12mw-242 to provide coverage from this area of the load line. We will also perform well gauging of this area on a semiannual basis. The text will be modified accordingly. Wells LL12mw-187, LL12mw-245, and LL12mw-242 will be analyzed for the same analytical suite as LL12mw-246 presented in Table 2-3.
6	Pg. 21 and 22, Table 2-3, and text pg. 22		Table 2.3 indicates that only six wells will be sampled for hexavalent chromium. It is unclear how these wells were selected for hexavalent chromium analysis.	Please provide clarification as to how these wells were selected for hexavalent chromium analysis.	A review of historical data has identified four areas in which hexavalent chromium has been sporadically identified at concentrations exceeding screening criteria. These AOCs include Atlas Scrap Yard, C Block Quarry, Demolition Area #2, and Fuze and Booster Quarry. Well SCFmw-002 has been selected for hex chromium analysis and is located downgradient of Atlas Scrap Yard; well CBLmw-002 has been selected for hex chromium analysis in

Ohio EPA Comment Response Table
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Ohio EPA (V. Deppisch/C. McCambridge)					
					C Block, and all three wells in Demo Area 2 will be sampled for hexavalent chromium. (Note that well DA2mw-107 will be removed from Table 2-3 as described in our response to Comment 4 above.) In addition, all of the new wells will be sampled for hexavalent chromium on at least one occasion; five of these wells (20, 27, 28, 37, and 38) are located downgradient of Fuze and Booster Quarry.
7	Pg. 26, Sec. 3.4.2		The submittal indicates that filtering will be done on ground water samples collected for metals analysis. It is unclear whether hexavalent chromium samples will be filtered.	Clarification is needed on whether hexavalent chromium samples will be filtered. If these samples will be filtered, an explanation should be provided as to why this procedure will be necessary.	The hexavalent chromium samples are field filtered. Filtering is part of the SW-846 Method 7996 for analyzing for hexavalent chromium. The following text will be added to Section 3.4.2: *The wells identified for hexavalent chromium analysis will also be field filtered.*
8	Pg. 26, Sec. 3.5, Table 3-1		Section 3.5 (Table 3-1) does not indicate if some ground water sampling containers will be pre-preserved. In some sampling cases, it may be necessary to use non-preserved vials for VOC sampling due to effervescence.	Clarification is needed as to whether some sampling vials/bottles will be pre-preserved. Cautions for sampling with this type of containers should be noted in the text (i.e., overfilling and/or washing out of the preservatives).	The laboratory supplies pre-preserved vials for VOC samples and pre-preserved bottles for metals and cyanide. To date, EQM has not noted a chemical reaction at RVAAP when filling VOA vials. The following text will be added to Section 2.13: *Pre-preserved bottles will be provided by the analytical laboratory. Care will be taken to obtain representative samples for*

Ohio EPA Comment Response Table
RVAAP – FWGWMP
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Comment Number	Page or Sheet	New Page or Sheet	Comment	Recommendation	Response
			Ohio EPA (V. Deppisch/C. McCambridge)		
					volatile organic analysis. To prevent unnecessary stripping of volatile constituents from the sample, the water sample will be added slowly to minimize turbulence and aeration when filling the container until a positive meniscus is achieved above the rim of the container. The container will be capped immediately and checked for the presence of air bubbles. If bubbles are detected, additional sample will be added until a positive meniscus is re-established. Care will be taken not to overfill and wash out the preservative.