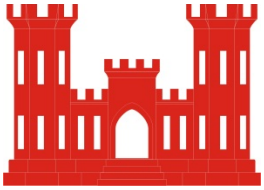
FINAL
FACILITY-WIDE GROUNDWATER MONITORING PROGRAM PLAN
RVAAP-66 FACILITY-WIDE GROUNDWATER
SEMIANNUAL GROUNDWATER MONITORING ADDENDUM FOR 2015

FORMER RAVENNA ARMY AMMUNITION PLANT
PORTAGE AND TRUMBULL COUNTIES, OHIO

February 20, 2015

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

Prepared for



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REPORT DOCUMENTATION PAGE

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Ravenna, Ohio

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None

14. ABSTRACT

This document presents a summary of the changes to facility-wide groundwater monitoring and a supplement to the Facility-Wide Groundwater Monitoring Program Plan. Included in the addendum are:

- Background of the facility-wide groundwater monitoring.
- Purpose of the addendum.
- Scope of work under the addendum.
- Schedule.

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John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

March 9, 2015

Mr. Mark Leeper
Army National Guard Directorate
ARNGD-ILE Clean Up
111 South George Mason Drive
Arlington, VA 22204

Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Approval of the RVAAP-66 Final Facility-Wide Groundwater Semiannual Groundwater Monitoring Addendum for 2015, Dated February 20, 2015, Ohio EPA ID # 267-000859-036

Dear Mr. Leeper:

The Ohio Environmental Protection Agency (Ohio EPA) has received the "Final Facility Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Addendum for 2015" at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on February 23, 2015. This submittal provided satisfactory responses to Ohio EPA's comments provided in our letter dated February 4, 2015. The report was prepared for the US Army Corps of Engineers (USACE) Louisville District by Environmental Quality Management, Inc., under Contract Number W912QR-11-F-0266.

These documents were reviewed by personnel from Ohio EPA's Division of Environmental Response and Revitalization (DERR). Ohio EPA has determined that all required changes have been made to the document and considers it to be final and approved.

Pursuant to the CERCLA process, the property owner usually can provide the expected land uses to assist in ensuring that the investigation addresses all receptors for both

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current and future land uses. Be advised that due to land use uncertainty, Ohio EPA may require additional work in the future, to address data gaps. It is incumbent upon the Army to finalize land use at Camp Ravenna as soon as possible, otherwise additional work and schedule slippage may result.

If you have any questions, please call me at 330-963-1292.

Sincerely,

Kevin M. Palombo
Environmental Specialist
Division of Environmental Response and Revitalization

KP/nvr

cc: Katie Tait, OHARNG RTLS
Kevin Sedlak, ARNG
Gregory F. Moore, USACE
Rebecca Haney/Gail Harris, VISTA Sciences Corp.

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Justin Burke, Ohio EPA, CO DERR
Albert Muller, Ohio EPA, NEDO DDAGW

CONTRACTOR'S 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 Groundwater Monitoring Addendum for 2015.* Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in this project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions, methods, procedures, and materials used; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing United States Corps of Engineers policy.

John M. Miller
Senior Project Manager

Date: 2/17/15

Scott Spesshardt, CPG
Geologist

Date: 2/18/2015

Document Distribution for the
Final
FWGWMP Semiannual Groundwater Monitoring Addendum for 2015
Former Ravenna Army Ammunition Plant

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USACE Technical Manager, Nathaniel Peters	2	3
EQM Project Manager, John Miller	1	1

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RVAAP – Ravenna Army Ammunition Plant
USACE – U.S. Army Corps of Engineers
EQM – Environmental Quality Management, Inc.

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EXECUTIVE SUMMARY

The Semiannual Groundwater Monitoring Addendum for 2015 is a supplement to the Facility-Wide Groundwater Monitoring Program Plan (FWGWMPP) and discusses the subset of existing monitoring wells at the former Ravenna Army Ammunition Plant (RVAAP) in Portage and Trumbull Counties, Ohio, that will be monitored in January and July 2015 and the contaminants of potential concern that will be evaluated at each selected well. This document supersedes the Semiannual Monitoring Addendum for 2014 that was submitted in 2013 (finalized August 1, 2013) for the groundwater sampling that began with the July 2013 event and continued through the July 2014 sampling event.

A total of 42 existing wells at the former RVAAP have been identified for semiannual sampling in 2015 to evaluate potential offsite migration and potential source area attenuation and temporal fluctuations. Under this revised addendum, wells DA2mw-114 and LL2mw-265 will not be sampled in 2015; whereas, wells LL2mw-060 and LL7mw-001 have been added to the 2015 semi-annual well network. In addition, wells LL1mw-088, LL2mw-271, and LL3mw-246 have been formerly added to the 2015 sampling schedule. (Note that these three wells were installed in December 2013 and were sampled for four consecutive quarters in 2014.) Four wells (FWGmw-002, RQLmw-011, RQLmw-012 and RQLmw-013) were selected for semiannual pH monitoring. No other additions or deletions to the prior 2014 semi-annual well network are proposed.

BACKGROUND

The United States 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 in Portage and Trumbull Counties near Ravenna, Ohio. CERCLA closure is occurring under the Installation Restoration Program (IRP). Activities include monitoring of an extensive network of groundwater monitoring wells. During the time period of 2005 through 2007, the USACE developed a database of groundwater quality information based on the sampling of approximately 36 monitoring wells. Beginning in fiscal year 2008, the USACE expanded the Facility-Wide Groundwater Monitoring Program (FWGWMP) to include the characterization of groundwater from 243 existing monitoring wells at the facility.

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. In support of completion of a Remedial Investigation/Feasibility Study (RI/FS) necessary to supplement the ROD, EQM reviewed the currently available groundwater data. Based on this review, EQM determined that additional monitoring wells were needed at the facility to complete the RI/FS and eventual ROD. EQM believed that additional wells were necessary to complete hydrogeologic system modeling and to conduct contaminant fate-and-transport modeling for a Facility-Wide groundwater approach. The approach for installing these wells was described in the approved *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Addendum* dated January 6, 2012 and supplemented by the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Additional*

Well Installation Addendum dated September 4, 2013. In accordance with these two addendums, EQM has installed 41 groundwater monitoring wells to determine nature and extent of groundwater impacts, provide additional information in support of hydrogeologic and fate-and-transport models, evaluate potential exit pathways, evaluate vertical contaminant distribution and/or particle inflow/outflow through the central portion of the facility, and assess potential groundwater impacts from Compliance Restoration (CR) sites. A description of the initial 38 wells is presented in the approved *Final Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Well Installation Report* dated December 18, 2012. Information regarding installation of the three additional RI wells is included in Appendix B of the *Draft Facility-Wide Groundwater Monitoring Program RVAAP-66 Facility-Wide Groundwater Monitoring Report on the January 2014 Sampling Event* dated May 9, 2014.

To supplement the RI, EQM prepared the *Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Semiannual Monitoring Addendum* (Semiannual Monitoring Addendum; January 2012). Under this addendum, the facility-wide groundwater monitoring schedule was modified from a quarterly to semiannual basis (January and July events). The new RI wells were not included in the semiannual monitoring network, but these wells were monitored quarterly beginning in April 2012 and overlapped with the semiannual sampling events. The semiannual well network eliminated wells that provided redundancy or minimal information on groundwater quality or fate-and-transport migration. A subset of the well network was selected in association with or paired with several of the new RI wells to assess horizontal and/or vertical contaminant distribution; provide up-gradient data for the various site-wide models; assess potential exit pathway wells that had no direct association with the new wells; and provide continued monitoring of the five Resource Conservation and Recovery Act (RCRA) wells at the site. A total of 35 wells were selected as part of the 2012-2013 semiannual well network. Besides fulfilling the selection criteria, the groundwater quality information obtained from the semiannual well network was designed for incorporation into the hydrogeologic system and contaminant fate-and-transport models under the RI.

The Semiannual Monitoring Addendum was revised in 2013 (finalized August 1, 2013) to address semi-annual monitoring beginning with the July 2013 event and continuing through the July 2014 sampling event. Specifically, EQM re-evaluated the semiannual monitoring well network to determine if any of the new RI wells should be permanently added to the semiannual monitoring network. Additionally, since the purpose of several of the semiannual wells was to provide additional data in support of the hydrogeologic and contaminant fate-and-transport models, including horizontal and/or vertical contaminant distribution through pairings with new RI wells, their inclusion in the semiannual well network was also re-evaluated. Consequently, forty-two (42) wells (including the five RCRA wells and the three new RI wells) were selected for sampling during the semiannual events in 2013 and 2014.

PURPOSE OF ADDENDUM

The 38 original RI wells installed between February and July 2012 have been monitored for four successive quarters. [Note that one well (FWGmw-009) was frozen during the January 2013 event, so it was only sampled for three consecutive quarters. This well was sampled for a fourth time during August 2013.] The three additional RI wells installed in December 2013 have been sampled for three consecutive quarters; the fourth quarter event will take place in October 2014.

Moving forward, the primary objectives of the facility-wide monitoring well network are to assess potential exit pathways and monitor contaminant levels strictly tied to historical RVAAP activities (e.g., explosives/propellants, volatile organic compounds, semivolatile organic compounds, pesticides, and polychlorinated biphenyls) at selected source area wells for trend analysis. Metals will also be evaluated in groundwater, but their relationship to historical activities and/or natural occurrence has not been fully determined. EQM re-evaluated the semiannual monitoring well network to determine if any of the three new RI wells should be permanently added to the semiannual monitoring network and whether the current list of semiannual wells should be revised based on the cumulative historical and recent data.

As a result, EQM has identified three new wells (LL1mw-088, LL2mw-271, and LL3mw-246) and one existing well (LL2mw-060) that should be incorporated into the semiannual monitoring well network as exit pathway wells; several current semiannual wells (see following section for list) that should be retained as potential exit pathway or source area wells; and one additional source area well (LL7mw-001) that should be added to the program to evaluate current levels of contaminants previously identified at this location that are associated with former RVAAP operations (specifically, chlorinated solvents and explosives);. Note that LL2mw-060 will replace LL2mw-265 in the semiannual network as an exit pathway well since the former has occasionally been found to contain low level explosives; whereas, well LL2mw-265 has not.

Several wells selected under the 2013 semiannual monitoring addendum will no longer be sampled at this time since they have not been found to contain any former operations related contaminants other than metals during the past several sampling events (i.e., LL2mw-265 and DA2mw-114). These wells will not be physically removed from the monitoring well network; they are merely being excluded from the list of wells to be included in the 2015 semiannual groundwater monitoring well network.

SCOPE OF WORK UNDER THE ADDENDUM

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 contaminants of potential concern (COPCs) and eliminate wells that provide redundancy or provide minimal information on groundwater quality or fate-and-transport migration. To this end, forty-two (42) wells (including five RCRA wells and three new RI wells) have been selected for sampling during the semiannual events in 2015. Additionally, four wells have been selected for field pH and the other stabilization criteria monitoring only.

pH Monitored Wells

Selection of existing wells for semiannual pH monitoring was made based on anomalous pH values outside the typical range of natural groundwater (i.e., 5 to 9s.u.). The four wells selected are FWGmw-002, RQLmw-011, RQLmw-012 and RQLmw-013. The monitoring will include time-series graphs.

New Wells

In order to complete the RI/FS and eventual ROD, three new monitoring wells (LL1mw-088, LL2mw-271, and LL3mw-246) were installed at the facility in December 2013 to further characterize the nature and extent of facility-wide groundwater impacts. The locations of the new wells and well installation and sampling procedures are described in the *"Final Facility-Wide Groundwater Monitoring Program Plan, RVAAP-66 Facility-Wide Groundwater Additional Well Installation Addendum,"* dated 4 September 2013.

The new wells have been sampled for three successive quarters beginning in January 2014. The new wells will ultimately be sampled for four consecutive quarters for the analyte list detailed in the *Final Facility-Wide Groundwater Monitoring Program Plan RVAAP-66 Facility-Wide Groundwater Addendum* dated January 6, 2012. The last quarterly sampling event for the three new wells is scheduled for October 2014.

Based on the analytical data from these wells, EQM proposes to retain these three wells (LL1mw-088, LL2mw-271, and LL3mw-246) in the semiannual sampling network. They are included in the list of existing CERCLA wells described below.

RCRA Wells

The former RCRA/solid waste wells specified by the Director's Final Findings and Orders (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 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.

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.
- Monitor specific source area wells that have consistently been found to contain COPCs associated with former RVAAP operations (e.g., explosives/propellants, nitrate) with the primary objective of monitoring increasing/decreasing trends.
- 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 Demolition Area #2.
- Note that additional field work to be conducted under the Remedial Investigation Work Plan will include additional wells in the area of existing wells LL1mw-086 and LL1mw-088 to investigate the deeper unconsolidated zone and to ensure that potential contaminants are not migrating off site from LL1.

On this basis, the proposed network of existing CERCLA wells will include: 19 potential exit pathway wells (LL1mw-064, LL1mw-065, LL1mw-086, LL1mw-087, LL1mw-088, LL2mw-059, LL2mw-060, LL2mw-271, LL3mw-244, LL3mw-246, LL12mw-247, FWGmw-004, FWGmw-007, FWGmw-011, FWGmw-012, FWGmw-015, FWGmw-016, SCFmw-002, and SCFmw-004) along the southern and eastern perimeter of former RVAAP; and 18 wells (LL1mw-083, LL1mw-084, LL2mw-267, LL3mw-238, LL3mw-241, LL7mw-001, LL10mw-003, LL12mw-185, LL12mw-187, LL12mw-242, LL12mw-245, DA2mw-115, FBQ-174, NTAmw-119, WBGmw-006, WBGmw-009, WBGmw-020, and WBGmw-021) for source evaluations or to monitor horizontal and/or vertical migration of contaminants from expected source areas.

In total, 42 wells (37 CERCLA and five RCRA wells) for sampling and 4 wells for monitoring will be included as part of the semiannual monitoring well network for 2015. It is not anticipated that the wells selected for semiannual monitoring will change between monitoring events in 2015. Table 1 lists the proposed wells and rationale for their inclusion in the semiannual monitoring program. Figures 1 through 3 show the wells to be sampled during the semiannual monitoring events.

The wells will be sampled in accordance with the *Facility-Wide Sampling and Analysis Plan for Environmental Investigations, Ravenna Army Ammunition Plant, Ravenna, Ohio* (SAIC, February 2011) and the two previous semiannual monitoring addendums. Specifically, samples will be collected using low-flow sampling procedures (with the exception of RCRA well DETmw-004, which requires the bailer method due to low yield). Metals samples will be field filtered. For the selected semiannual wells, the list of analytes reflects the primary constituents of concern within certain areas of the site or immediately downgradient of potential source areas, as appropriate. The refined analyte list for the semiannual wells is presented in Table 2. The analytical methods for these analytes are provided in Table 3. Evaluation of data from all future groundwater monitoring will be subject, where applicable, to the Risk Assessment and Land Use Technical Memorandum.

SCHEDULE

EQM will begin semiannual groundwater monitoring activities in March 2015 upon approval of this addendum.

TABLES

Table 1. Semiannual Monitoring Wells and Rationale

No.	RVAAP-66 Area	Well Location	Rationale/Comments
1	SE/Load Line 1	LL1mw-064	**Unconsolidated** monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
2	SE/Load Line 1	LL1mw-065	**Unconsolidated** monitoring well located downgradient from Load Line 1 and serves to monitor potential GW exit pathway off of former RVAAP.
3	Load Line 1	LL1mw-083	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, and 4-amino-2,6-DNT).
4	Load Line 1	LL1mw-084	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 2,4-DNT, 4-amino-2,6-DNT, and RDX).
5	SE/Load Line 1	LL1mw-086	Second water-bearing zone well (**deep unconsolidated**) downgradient of Load Line 1 for monitoring potential GW exit pathway; pesticide beta-BHC identified in groundwater at this location.
6	SE	LL1mw-087	**Unconsolidated** well located approximately downgradient of Load Lines 1, 2, 3, 4, and 12, which have been found to contain elevated concentrations of metals, explosives, pesticides, nitrate, and/or PCBs. Monitors potential GW exit pathway.
7	Load Line 1	LL1mw-088	**Unconsolidated** well located downgradient of Load Line 1 and LL1mw-086, which has had pesticides. Sentinel well for monitoring GW exit pathway outside perimeter fence.
8	S/Load Line 2	LL2mw-059	**Upper Sharon** well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP; consistently found to contain the explosive 2,4-DNT.
9	S/Load Line 2	LL2mw-060	**Upper Sharon** well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP.
10	Load Line 2	LL2mw-267	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4-DNT and RDX).
11	Load Line 2	LL2mw-271	**Upper Sharon** well located downgradient of Load Lines 2 and 3 and serves as potential GW exit pathway off of former RVAAP.
12	Load Line 3	LL3mw-238	**Upper Sharon** source area well that has consistently been found to contain explosive constituents (2,4,6-TNT, 4-amino-2,6-DNT, and RDX).
13	Load Line 3	LL3mw-241	**Upper Sharon** source area well that has been found to contain explosives (2,4,6-TNT and RDX) in groundwater; also used to evaluate contaminant migration pathway between Load Lines 3 & 12.

Table 1 (continued). Semiannual Monitoring Wells and Rationale

No.	RVAAP-66 Area	Well Location	Rationale/Comments
14	Load Line 3	LL3mw-244	**Upper Sharon** well located downgradient of Load Lines 3 and 12; consistently found to contain low level explosive constituents (2-amino-4,6-DNT, 4-amino-2,6-DNT, and RDX) and hexavalent chromium.
15	Load Line 3	LL3mw-246	**Upper Sharon** well located downgradient of Load Lines 3 and 12 and affected well LL3mw-244; serves as potential GW exit pathway off of former RVAAP; low levels of explosives consistently identified in well.
16	Load Line 7	LL7mw-001	**Homewood** source area well that has historically been found to contain chlorinated solvents (specifically 1,1-dichloroethane, 1,1-dichloroethene, and 1,1,1-trichloroethane).
17	Load Line 10	LL10mw-003	**Homewood** well that has had historically consistent occurrence of VOCs (specifically carbon tetrachloride and chloroform).
18	Load Line 12	LL12mw-185	**Unconsolidated** well that has been found to contain elevated levels of nitrate and is downgradient of potential arsenic source.
19	Load Line 12	LL12mw-187	**Unconsolidated** well that has been found to contain elevated levels of nitrate.
20	Load Line 12	LL12mw-242	**Unconsolidated** well located downgradient of LL12mw-113, a potential arsenic source.
21	Load Line 12	LL12mw-245	**Unconsolidated** well located downgradient of potential nitrate source well LL12mw-185.
22	SE	LL12mw-247	**Unconsolidated** well located approximately downgradient of Load Lines 1, 2, 3, 4, and 12, which have been found to contain elevated concentrations of metals, explosives, pesticides, nitrate, and/or PCBs. Monitors potential GW exit pathway.
23	Fuze and Booster	FBQmw-174	**Homewood** source area well that has consistently been found to contain explosive constituents (2,4-DNT, 2,4,6-TNT, and 4-amino-2,6-DNT).
24	Admin/George Road	FWGmw-004	**Unconsolidated** exit pathway well located near the south property line and downgradient of several Compliance Restoration sites.
25	SW	FWGmw-007	**Unconsolidated** well located in the western portion of former RVAAP. Potential exit pathway well near Hinkley Creek.
26	East Classification Yard	FWGmw-011	**Unconsolidated** well located east of Ramsdell Quarry and former East Classification Yard. Serves as exit pathway well.
27	East Classification Yard	FWGmw-012	**Upper Sharon** formation well paired with FWGmw-011; serves as exit pathway well for the Sharon aquifer.

Table 1 (continued). Semiannual Monitoring Wells and Rationale

No.	RVAAP-66 Area	Well Location	Rationale/Comments
28	Admin/George Road	FWGmw-015	**Unconsolidated** well. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as first-water unconsolidated exit pathway well.
29	Admin/George Road	FWGmw-016	**Upper Sharon** well paired with FWGmw-015. Located near the south property line and downgradient of several Compliance Restoration sites. Serves as upper Sharon formation exit pathway well.
30	NACA Test	NTAmw-119	**Deep unconsolidated** well that has been found to contain trace amounts of tetrachloroethene, naphthalene, as well as metals. Monitors second water-bearing zone in buried valley unconsolidated.
31	Demo. Area 2	DA2mw-115	**Upper Sharon** well paired with well DETmw-003; serves to monitor potential vertical migration in this area of the site.
32	Demo. Area 2	DETmw-003	**Unconsolidated** RCRA well.
33	Demo. Area 2	DETmw-004	**Unconsolidated** RCRA well.
34	Ramsdell Quarry	RQLmw-007	**Upper Sharon** RCRA well.
35	Ramsdell Quarry	RQLmw-008	**Upper Sharon** RCRA well.
36	Ramsdell Quarry	RQLmw-009	**Upper Sharon** RCRA well.
37	SE	SCFmw-002	**Sharon Conglomerate Member** well located downgradient of Atlas Scrap Yard and Load Lines 1, 2, 3, 4, and 12, paired with LL12mw-247, and selected for monitoring the potential GW exit pathway off of former RVAAP in the deeper aquifer.
38	SE	SCFmw-004	**Sharon Conglomerate Member** well located downgradient of Load Lines 1 and 2, paired with LL1mw-087, and selected for monitoring the potential GW exit pathway off of former RVAAP in the deeper aquifer.
39	Winklepeck	WBGmw-006	**Unconsolidated** well paired with WBGmw-021; source area well has been found to contain explosives (RDX).
40	Winklepeck	WBGmw-009	**Unconsolidated** well paired with WBGmw-020; source area well has been found to contain explosive constituents (RDX).
41	Winklepeck	WBGmw-020	**Upper Sharon** well paired with WBGmw-009; source area well for monitoring potential vertical migration in Sharon aquifer.
42	Winklepeck	WBGmw-021	**Upper Sharon** well paired with WBGmw-006; source area well for monitoring potential vertical migration in Sharon aquifer.

Note – unless otherwise stated, all wells were completed in the first water-bearing zone identified during well installation.

Table 2. Semiannual Analyte List

Well Location	Analytes											
	VOCs	SVOCs			Metals[d]	Explosives/ Propellants	Pesticides	PCBs	Nitrate	Cyanide	Hexavalent Chromium[d]	Perchlorate
		Nitroaromatics & Phthalates[a]	Phenols[b]	PAHs[c]								
LL1mw-064		x			x	x						
LL1mw-065		x			x	x						
LL1mw-083		x			x	x	x					
LL1mw-084		x			x	x	x					
LL1mw-086		x			x	x	x					
LL1mw-087		x			x	x						
LL1mw-088		x			x	x	x					
LL2mw-059		x			x	x						
LL2mw-060		x			x	x						
LL2mw-267		x			x	x						
LL2mw-271		x			x	x						x
LL3mw-238		x			x	x	x					
LL3mw-241		x			x	x	x					
LL3mw-244		x			x	x	x				x	
LL3mw-246		x			x	x						x
LL7mw-001	x	x			x	x						
LL10mw-003	x	x			x							
LL12mw-185					x (As. only)				x			
LL12mw-187		x			x	x			x			
LL12mw-242		x			x	x			x			
LL12mw-245		x			x	x			x			
LL12mw-247		x			x	x			x		x	
FBQmw-174		x			x	x	x					
FWGmw-004		x			x	x						
FWGmw-007		x			x	x						
FWGmw-011		x			x	x						

Table 2 (continued). Semiannual Analyte List

Well Location	Analytes											
	VOCs	SVOCs			Metals[d]	Explosives/ Propellants	Pesticides	PCBs	Nitrate	Cyanide	Hexavalent Chromium[d]	Perchlorate
		Nitroaromatics & Phthalates[a]	Phenols[b]	PAHs[c]								
FWGmw-012		x			x	x						
FWGmw-015		x			x	x						
FWGmw-016		x			x	x						
NTAmw-119	x	x		x	x	x						
DA2mw-115		x			x	x						
DET-003	x	x	x	x	x	x	x	x		x		
DET-004	x	x	x	x	x	x	x	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		
SCFmw-002		x			x	x	x				x	
SCFmw-004		x			x	x	x					
WBGmw-006		x			x	x						
WBGmw-009		x			x	x						
WBGmw-020		x			x	x						
WBGmw-021		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, Dibenzo(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. Hexavalent chromium will be sampled semiannually in wells LL3mw-244, LL12mw-247, and SCFmw-002.

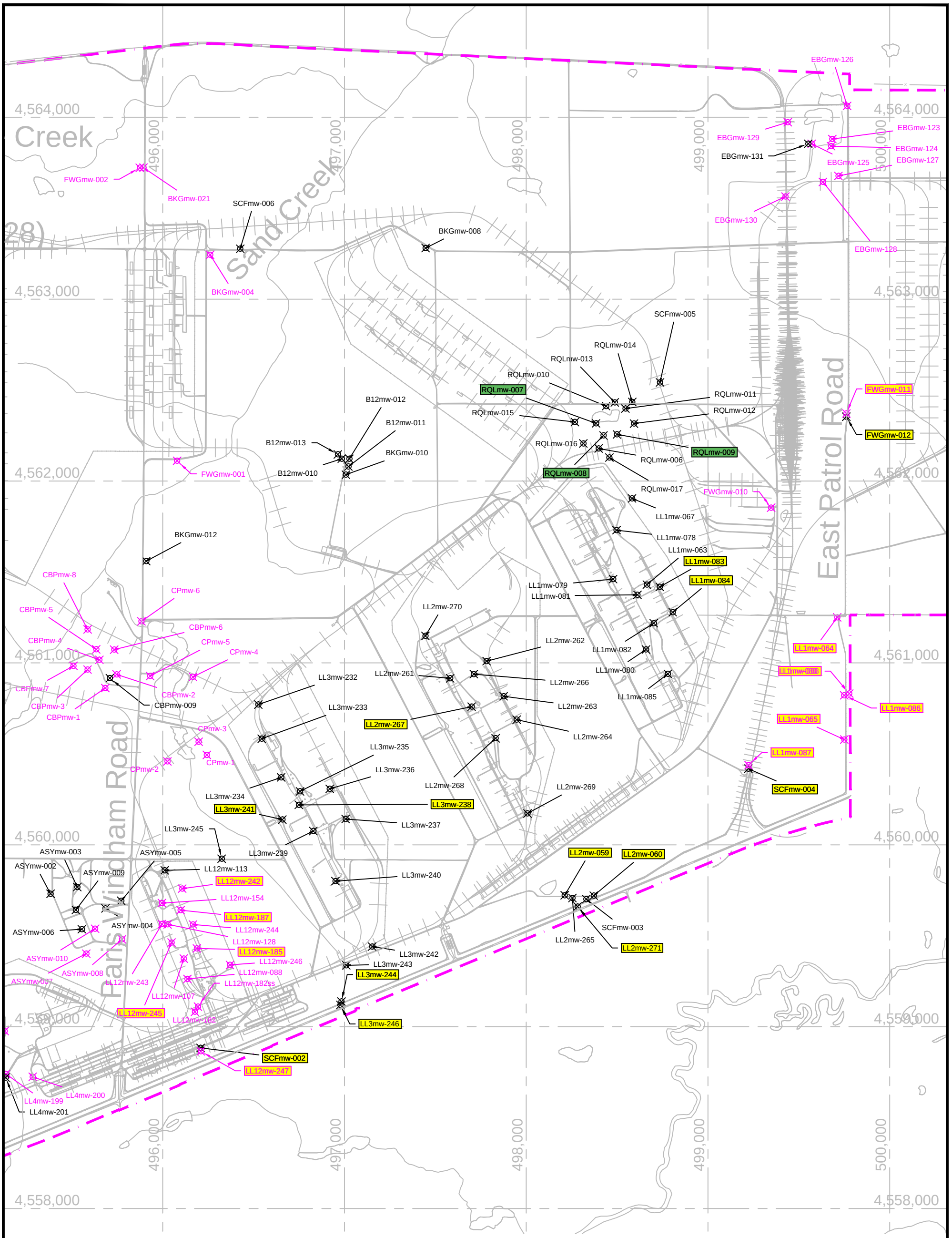
Table 3. Current Analytical Suite of Chemicals

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, Manga-nese, 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)
Hexavalent Chromium	Method 218.6[2]
Mercury	Liquid Waste Cold Vapor Technique (7470A)
Perchlorate	Method 6860

1 = USEPA SW846

2 = EPA Methods for Chemical Analysis of Water and Waste

FIGURES



COORDINATE SYSTEM UTM NAD 83 ZONE 17

REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER

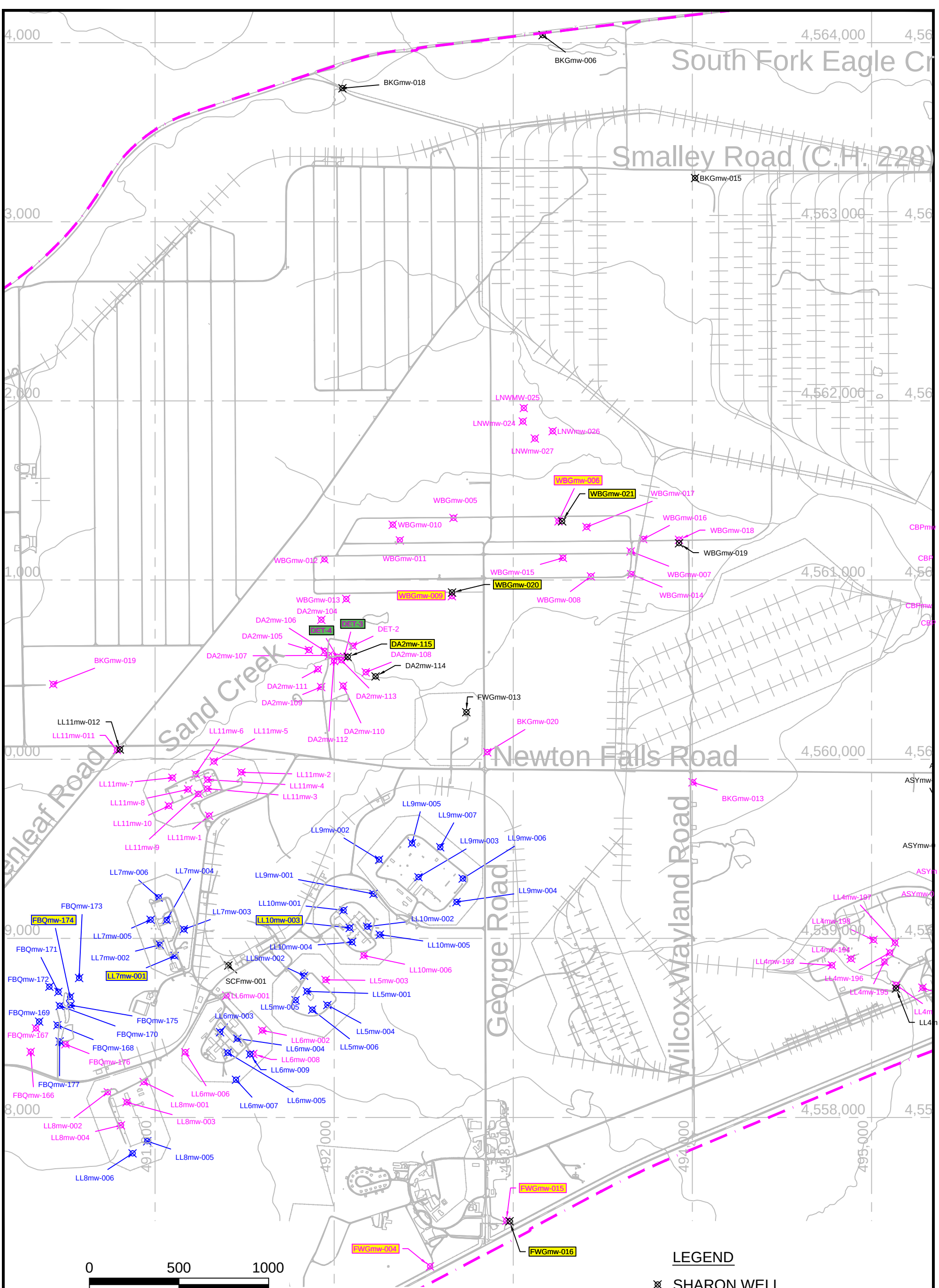
REVISIONS

ENVIRONMENTAL QUALITY MANAGEMENT, INC.
1800 CARILLON BLVD., CINCINNATI, OHIO 45240
PHONE 513.825.7500 | FAX 513.825.7495
WWW.EQM.COM

DRAWN	R. RUSSELL	05-03-2013
CHECKED	S. SPESSHARDT	05-06-2013
APPROVED	J. MILLER	05-06-2013
SCALE:	AS SHOWN	

2015 SEMI-ANNUAL WELLS IN EASTERN PORTION RVAAP

SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 1	2



COORDINATE SYSTEM UTM NAD 83 ZONE 17

REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER

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DRAWN	R. RUSSELL	05-03-2013
CHECKED	S. SPESSHARDT	05-06-2013
APPROVED	J. MILLER	05-06-2013
SCALE:	AS SHOWN	

2015 SEMI-ANNUAL WELLS IN CENTRAL PORTION RVAAP

SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 2	2

4,563,000
4,562,000
4,561,000
4,560,000
4,559,000
4,558,000
485,000
486,000
487,000
488,000
489,000
490,000
North Patrol Road
North Line Road
Hinkley Creek
State Route 80 Freedom Road
South Patr
BKGmw-005
FWGmw-003
BKGmw-017
FWGmw-014
CBLmw-004
CBLmw-003
CBLmw-001
CBLmw-002
CBLmw-005
FWGmw-005
FWGmw-009
FWGmw-008
BKGmw-016
FWGmw-006
NTAmw-113
NTAmw-108
NTAmw-115
NTAmw-110
NTAmw-112
NTAmw-111
NTAmw-116
NTAmw-107
NTAmw-109
MBS-003
NTAmw-119
NTAmw-118
NTAmw-117
NTAmw-114
MBS-004
MBS-002
MBS-006
MBS-005
MBS-001
FWGmw-007

N

0 500 1000

SCALE (METERS)

LEGEND

- SHARON WELL
- UNCONSOLIDATED WELL
- HOMEWOOD WELL
- RCRA WELL
- SEMI-ANNUAL MONITORING WELL

COORDINATE SYSTEM UTM NAD 83 ZONE 17

REV	DESCRIPTION	DATE	APPROVED
2	REVISED SEMI-ANNUAL MONITORING WELLS	10-09-2014	J. MILLER
1	REVISED SEMI-ANNUAL MONITORING WELLS	08-14-2014	J. MILLER

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DRAWN	R. RUSSELL	05-03-2013
CHECKED	S. SPESSHARDT	05-06-2013
APPROVED	J. MILLER	05-06-2013
SCALE:	AS SHOWN	

2015 SEMI-ANNUAL WELLS IN WESTERN PORTION RVAAP

SIZE	PROJECT NO.	DWG NO.	REV
B	030174.0016	FIGURE 3	2

APPENDIX A
CORRESPONDENCE & COMMENT/RESPONSE

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

February 4, 2015

Mr. Mark Leeper
Army National Guard Directorate
ARNGD-ILE Clean Up
111 South George Mason Drive
Arlington, VA 22204

Re: US Army Ammunition Plt RVAAP
Remediation Response
Project Records
Remedial Response
Portage County
267000859

Subject: Ravenna Army Ammunition Plant, Portage/Trumbull Counties. Approval with Modifications on the RVAAP-66 Draft Facility-Wide Groundwater Monitoring Program RVAAP-66, Semiannual Groundwater Addendum for 2015 for the Ravenna Army Ammunition Plant, Ravenna, Ohio, Dated December 19, 2014, Ohio EPA ID # 267-000859-036

Dear Mr. Leeper:

The Ohio Environmental Protection Agency (Ohio EPA) has received the "Draft Facility-Wide Groundwater Monitoring Program RVAAP-66, Semiannual Groundwater Addendum for 2015" at the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on December 22, 2014. The report was prepared for the US Army Corps of Engineers (USACE) Louisville District by Environmental Quality Management, Inc., under Contract Number W912QR-11-F-0266.

Pursuant to The Directors Findings and Orders Paragraph 39 (b), Ohio EPA approves the submittal upon specified conditions as presented below:

Ohio EPA's November 25, 2014, comments and the National Guard's December 19, 2014, responses to those comments are presented below, along with Ohio EPA's current response.

E-MAILED 02-09-2015

Ohio EPA Comment 1: Inconsistency in the Naming of Ground Water Zones

Table 1 inconsistently identifies wells screened in unconsolidated glacial material either as "overburden" wells or as "unconsolidated" wells. This is unnecessarily confusing. The identifying name of the hydrostratigraphic unit needs to be

RECEIVED 02-09-2015

consistent and accurately identify the unit. Ohio EPA discourages the use of the term "overburden" because it is ambiguous and not appropriate. "Overburden" is a mining term that refers to material of any nature, consolidated or unconsolidated, that overlies a deposit of useful material (e.g., gravel, ore, and coal) that are mined from the surface by open cuts.

Army National Guard Response: This is the first correspondence that we have received in which the Ohio EPA has mentioned that they discourage the use of the term "overburden." We will change the term "overburden" to "unconsolidated" in Table 1.

Ohio EPA's Response to The National Guard's Response to Comment 1

The National Guard's response adequately addresses Ohio EPA's Comment 1.

Ohio EPA Comment 2: Shallow and Deep Unconsolidated Ground Water Zones. Table 1 indicates that 17 of the wells to be monitored are screened in the "first" or "uppermost water-bearing zone" in the unconsolidated glacial material and two of the wells to be monitored are screened in the "second water bearing zone" or "deep" portion of the unconsolidated glacial material. It is unclear if there are one or two hydrostratigraphic zones within the unconsolidated glacial material beneath the RVAAP. In order to assure that the facility is adequately monitored, it needs to be clarified if the two ground water zones have the same potentiometric surface, and to what extent the two zones are interconnected.

Army National Guard Response: During installation of the preliminary RI wells in 2012, 19 wells were completed in the unconsolidated aquifer, which was the first water-bearing zone encountered. However, three of these wells (FWGmw-002, LL1mw-086, and NTAmw-119) were completed in an apparent second water- bearing zone within deeper unconsolidated strata. It was originally intended that these three wells would be completed in bedrock to monitor vertical migration in these areas of the site. However, due to the thickness of the unconsolidated material (greater than 70-ft-thick), the presence of clay till between the first and second water-bearing zones in the unconsolidated material, and the predicted communication between these deeper unconsolidated strata and the upper portion of the bedrock aquifer, it was concluded that the second water-bearing zone at these locations should be evaluated. Wells FWGmw-002 and NTAmw-119 appear to be associated with a suspected buried tributary valley to the Mahoning River, which has been mentioned in prior RVAAP documents (USATHAMA, 1978 and Barnes, 1950).

(Note that the unconsolidated deposits at LL11mw-012 were also more than 70-ft-thick; this well, which was ultimately completed in shale, would also be within the tributary valley mentioned above.) These locations were the only ones identified with thick (i.e., >70 feet) unconsolidated deposits at the former RVAAP. Table 1 summarizes the well completion information for the 284 wells at RVAAP, including the depth to bedrock where encountered. Table 2 shows the well comparisons and vertical hydraulic gradients between the upper consolidated water-bearing strata and the deeper unconsolidated water-bearing strata for these three locations during six sampling and well gauging events between July 2012 and July 2014. (Note that well LL1mw-088 was not installed until December 2013). In general, the potentiometric surface elevations show that the shallow and deep unconsolidated water-bearing strata are disparate aquifers. In addition, the vertical hydraulic gradients indicate a downward vertical gradient from the upper to lower water-bearing zones.

Ohio EPA's Response to The National Guard's Response to Comment 2

The National Guard's response adequately addresses Ohio EPA's Comment 2.

Ohio EPA Comment 3: Horizontal Extent Evaluated with Well Pair LL1mw-086 and LL1mw-088. The SAGWMA indicates (page 2) that a subset of the well network was selected in association with or paired with several of the new RI wells to assess horizontal and vertical contaminant distribution. Table 1 indicates that Well LL1mw-086, screened in the second (deep) ground water zone in the unconsolidated glacial till, is paired with "sentinel" well LL1mw-088, screened in the first ground water zone in the unconsolidated glacial till. LL1mw-088 is a "new" well that was installed in December 2013. LL1mw-086 is located downgradient of Load Line 1, and LL1mw-088 is located downgradient of LL1mw-086 and outside the perimeter fence. Considering these wells' relationship to each other, it is unclear how this well pair is being used to determine horizontal and vertical extent. This needs to be explained.

Army National Guard Response: Due to the thickness of the unconsolidated strata in this area of the former RVAAP (approx.75 feet), these two wells are being used as exit pathway wells to monitor dissolved constituents in the upper and lower portions of the unconsolidated material. As mentioned previously, the groundwater elevations for the two wells are nearly equal (difference of 0.02 feet), indicating that the two water-bearing zones within the unconsolidated strata are in hydraulic communication in this area of the Site.

Ohio EPA's Response to The National Guard's Response to Comment 3

Ohio EPA believes that although the potentiometric surface is similar between the two locations (LL1mw-086, approximate depth 75 feet and LL1-088, approximate depth 24 feet), we are not confident that deeper contaminants identified in LL1-mw-086 could be picked up in the shallow LL1 mw-088. Ohio EPA understands that LL1mw-088 still serves the purpose of identifying potential migration of contaminants in the shallow ground water. We will anticipate, however; that the RI Work Plan will include additional wells in this area (deeper unconsolidated zone), to ensure potential contaminants are not migrating off site from LL1.

Ohio EPA Comment 4: Wells Used for Upgradient Data. The 2015 SAGWMA (page 2) indicates that some of the 42 selected wells for monitoring are to provide upgradient data for the various site-wide models. Information in Table 1 indicates that all 42 of the wells selected for monitoring are located downgradient of an area of concern (AOC), impacted by constituents of concern (COCs), and would not be appropriate for representing background water quality at the facility. It needs to be clarified which of the 42 wells are to be used to provide upgradient data for the various site models, as well as the rationale that was used to select these wells.

Army National Guard Response: The second paragraph on page 2 of the 2015 SAGWMA discusses the rationale for the initial 2012-2013 Semiannual Addendum under the RI, not the proposed 42 wells for 2015. Specifically, the statement "provide up-gradient data for the various site-wide models" was one of several listed justifications for the monitoring well network presented in the 2012-2013 Semiannual Groundwater Monitoring Addendum (EQM, January 2012). During a meeting with the Ohio EPA in September 2013, the Ohio EPA indicated that the current network of background (BKG) wells was insufficient for determining background conditions at the former RVAAP. The Army subsequently proposed a subset of wells for inclusion in the background network, which the Ohio EPA appears willing to entertain; however, the Ohio EPA indicated in their comment letter dated January 16, 2014, that the number of proposed background wells may not be sufficient. The ARNG is in the process of preparing and submitting a Request for Proposal to eligible contractors to continue the RI/FS work at the former RVAAP, including installation of additional wells for establishing background conditions. Consequently, the Semiannual Groundwater Addendum for 2015 is designed to monitor potential offsite migration and potential fluctuations in contaminant concentrations at selected source area wells. No specific upgradient wells were selected for monitoring at this time since the existing background data is not considered relevant. The data

generated from the proposed semiannual monitoring wells for 2015 are still useful for any fate-and-transport modeling that may be prepared as part of the future RI work.

Ohio EPA's Response to The National Guard's Response to Comment 4

The National Guard's response adequately addresses Ohio EPA's Comment 4.

Ohio EPA Comment 5: Wells with Consistently Anomalous pH Values Need to be Monitored. Wells with consistently anomalous pH values outside the typical range of natural ground water (i.e., 5 to 9) need to be added to the list of wells to be sampled semiannually. Wells that appear to have consistently had anomalous pH values include FWGmw-002, RQLmw-011, RQLmw-012, and RQLmw-013. These wells need to have pH and other field parameters outlined in the *FWGWMP Ground Water Monitoring Program Plan* measured as part of semiannual sampling.

Army National Guard Response: Wells FWGmw-002, RQLmw-011, RQLmw-012, and RQLmw-013 will be monitored for pH and the other stabilization criteria during the 2015 semiannual sampling events. Time-series graphs for pH will be prepared for each well and included in future annual and semiannual groundwater reports.

Ohio EPA's Response to The National Guard's Response to Comment 5

The National Guard's response adequately addresses Ohio EPA's Comment 5.

Ohio EPA Comment 6: How Installation and Sampling of Three Proposed Wells Will Be Incorporated into the 2015 Sampling Schedule. Considering the concentrations of arsenic (LL1mw-088 and LL2mw-271), thallium (LL2mw-271), cobalt (LL2mw-271), and manganese (LL3mw-246) exceeding their respective (primary or secondary) MCLs and/or RSLs and the low concentrations of perchlorates and explosives/propellants present in one of the "new" monitoring wells (LL3mw-246), Ohio EPA agrees in principle with the National Guard's proposal at the May 21, 2014, RAB Meeting, to install three additional monitoring wells near the southeast corner of the facility near Load Lines # 1 through # 3. The details of such a proposal, including the location and construction of planned wells, would have to be reviewed and approved by Ohio EPA. Ohio EPA had made a similar comment based on its review of the January 2014 ground water

sampling data from the facility, and in an October 6, 2014 letter, to the National Guard Directorate. To date, no such proposal to install additional monitoring wells has been submitted to the Agency. It is not clear how the installation of these new wells will fit into the 2015 sampling schedule. This needs to be explained.

Army National Guard Response: As mentioned in our response to Comment 4, the ARNG is in the process of preparing and submitting a Request for Proposal to eligible contractors to continue the RI/FS work at the former RVAAP. Following selection of a Contractor to complete the RI efforts, a RI/FS Work Plan will be prepared with details regarding the location and construction of any additional RI wells at the former RVAAP. Any new wells will be sampled quarterly for the complete list of parameters under the FWGWMP. A schedule for completing this work will be provided as part of the RI/FS Work Plan.

Ohio EPA's Response to The National Guard's Response to Comment 6

The National Guard's response adequately addresses Ohio EPA's Comment 6.

Ohio EPA Comment 7: "New" Wells Not Tested for Perchlorates. It is not clear why the three "new" wells installed in December 2013 are not scheduled to be tested for perchlorates (refer to Table 2). Low levels of this compound were detected in samples from two of the "new" wells (LL2mw-271 and LL3mw-246) collected during the January 2014 sampling event. Ohio EPA made a similar comment in an October 6, 2014 letter, to the National Guard Directorate. This issue needs to be explained.

Army National Guard Response: Historically, each well at RVAAP bas only been sampled once for perchlorates. There have been 195 wells that have had perchlorate detections above the reporting limit, ranging from 0.0089 J ug/L to 0.19 ug/L (note that the RSL is 14 ug/L and the Interim Drinking Water Health Advisory is 15 ug/L). Given the locations of the detections in LL2mw-271 and LL3MW-246 (i.e., outside the perimeter fence), the Army will include perchlorates in the semiannual sampling for these two wells in 2015.

Ohio EPA's Response to The National Guard's Response to Comment 7

The National Guard's response adequately addresses Ohio EPA's Comment 7.

Pursuant to the CERCLA process, the property owner usually can provide the expected land uses to assist in ensuring that the investigation addresses all receptors for both current and future land uses. Be advised that due to land use uncertainty, Ohio EPA may require additional work in the future to address data gaps. It is incumbent upon the Army to finalize land use at camp Ravenna as soon as possible, otherwise additional work and schedule slippage may result.

If you have any questions, please call me at (330) 963-1292.

Sincerely,

Kevin M. Palombo
Environmental Specialist
Division of Environmental Response and Revitalization

KP/nvr

cc: Katie Tait, OHARNG RTLS
Kevin Sedlak, ARNG
Gregory F. Moore, USACE
Mark Nichter, USACE
Rebecca Haney/Gail Harris, VISTA Sciences Corp.

ec: Susan Netzley-Watkins, Ohio EPA, NEDO DERR
Rodney Beals, Ohio EPA NEDO DERR
Justin Burke, Ohio EPA, CO DERR
Albert Muller, Ohio EPA, NEDO DDAGW

NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON VA 22204-1373

December 19, 2014

Ohio Environmental Protection Agency
DERR-NEDO
Attn: Mr. Kevin Palombo
2110 East Aurora Road
Twinsburg, OH 44087-1924

Subject: Ravenna Army Ammunition Plant (RVAAP) Restoration Program
Portage/Trumbull Counties
RVAAP-66 Facility-Wide Groundwater
Draft Facility-Wide Groundwater Semiannual Groundwater Addendum for 2015
Ohio EPA I.D. 267-000859-036

Dear Mr. Palombo:

On December 1, 2014 the Army received a letter of correspondence from the Ohio Environmental Protection Agency (Ohio EPA), dated November 25, 2014. The letter presented the Ohio EPA comments on the "Draft Facility-Wide Groundwater Semiannual Groundwater Addendum for 2015" for the Ravenna Army Ammunition Plant in Portage/Trumbull Counties Ohio. Below please find the responses to the Ohio EPA comments. This document was prepared for the US Army Corps of Engineers (USACE) - Louisville District, by Environmental Quality Management, Inc. under Contract No. W912QR-11-F-0266.

Ohio EPA Comment 1: Inconsistency in the Naming of Ground Water Zones
Table 1 inconsistently identifies wells screened in unconsolidated glacial material either as "overburden" wells or as "unconsolidated" wells. This is unnecessarily confusing. The identifying name of the hydrostratigraphic unit needs to be consistent and accurately identify the unit. Ohio EPA discourages the use of the term "overburden" because it is ambiguous and not appropriate. "Overburden" is a mining term that refers to material of any nature, consolidated or unconsolidated, that overlies a deposit of useful material (e.g., gravel, ore, and coal) that are mined from the surface by open cuts.

Response: This is the first correspondence that we have received in which the Ohio EPA has mentioned that they discourage the use of the term "overburden." We will change the term "overburden" to "unconsolidated" in Table 1.

Ohio EPA Comment 2: Shallow and Deep Unconsolidated Ground Water Zones. Table 1 indicates that 17 of the wells to be monitored are screened in the "first" or "uppermost water-bearing zone" in the unconsolidated glacial material and two of the wells to be monitored are screened in the "second water bearing zone" or "deep" portion of the unconsolidated glacial material. It is unclear if there are one or two hydrostratigraphic zones within the unconsolidated glacial material beneath the RVAAP. In order to assure that the facility is adequately monitored, it needs to be clarified if the two ground water zones have the same potentiometric surface, and to what extent the two zones are interconnected.

Response: During installation of the preliminary RI wells in 2012, 19 wells were completed in the unconsolidated aquifer, which was the first water-bearing zone encountered. However, three of these wells (FWGmw-002, LL1mw-086, and NTAmw-119) were completed in an apparent second water-bearing zone within deeper unconsolidated strata. It was originally intended that these three wells would

be completed in bedrock to monitor vertical migration in these areas of the site. However, due to the thickness of the unconsolidated material (greater than 70-ft-thick), the presence of clay till between the first and second water-bearing zones in the unconsolidated material, and the predicted communication between these deeper unconsolidated strata and the upper portion of the bedrock aquifer, it was concluded that the second water-bearing zone at these locations should be evaluated. Wells FWGmw-002 and NTAmw-119 appear to be associated with a suspected buried tributary valley to the Mahoning River, which has been mentioned in prior RVAAP documents (USATHAMA, 1978 and Barnes, 1950). (Note that the unconsolidated deposits at LL11mw-012 were also more than 70-ft-thick; this well, which was ultimately completed in shale, would also be within the tributary valley mentioned above.) These locations were the only ones identified with thick (i.e., >70 feet) unconsolidated deposits at the former RVAAP. Table 1 summarizes the well completion information for the 284 wells at RVAAP, including the depth to bedrock where encountered.

Table 2 shows the well comparisons and vertical hydraulic gradients between the upper consolidated water-bearing strata and the deeper unconsolidated water-bearing strata for these three locations during six sampling and well gauging events between July 2012 and July 2014. (Note that well LL1mw-088 was not installed until December 2013). In general, the potentiometric surface elevations show that the shallow and deep unconsolidated water-bearing strata are disparate aquifers. In addition, the vertical hydraulic gradients indicate a downward vertical gradient from the upper to lower water-bearing zones.

Ohio EPA Comment 3: Horizontal Extent Evaluated with Well Pair LL1mw-086 and LL1mw-088. The SAGWMA indicates (page 2) that a subset of the well network was selected in association with or paired with several of the new RI wells to assess horizontal and vertical contaminant distribution. Table 1 indicates that Well LL1mw-086, screened in the second (deep) ground water zone in the unconsolidated glacial till, is paired with "sentinel" well LL1mw-088 screened in the first ground water zone in the unconsolidated glacial till. LL1mw-088 is a "new" well that was installed in December 2013. LL1mw-086 is located downgradient of Load Line 1, and LL1mw-088 is located downgradient of LL1mw-086 and outside the perimeter fence. Considering these wells' relationship to each other, it is unclear how this well pair is being used to determine horizontal and vertical extent. This needs to be explained.

Response: Due to the thickness of the unconsolidated strata in this area of the former RVAAP (approx. 75 feet), these two wells are being used as exit pathway wells to monitor dissolved constituents in the upper and lower portions of the unconsolidated material. As mentioned previously, the groundwater elevations for the two wells are nearly equal (difference of 0.02 feet) indicating that the two water-bearing zones within the unconsolidated strata are in hydraulic communication in this area of the Site.

Ohio EPA Comment 4: Wells Used for Upgradient Data. The 2015 SAGWMA (page 2) indicates that some of the 42 selected wells for monitoring are to provide upgradient data for the various site-wide models. Information in Table 1 indicates that all 42 of the wells selected for monitoring are located downgradient of an area of concern (AOC), impacted by constituents of concern (COCs), and would not be appropriate for representing background water quality at the facility. It needs to be clarified which of the 42 wells are to be used to provide upgradient data for the various site models, as well as the rationale that was used to select these wells.

Response: The second paragraph on page 2 of the 2015 SAGWMA discusses the rationale for the initial 2012-2013 Semiannual Addendum under the RI, not the proposed 42 wells for 2015. Specifically, the statement "provide up-gradient data for the various site-wide models" was one of several listed justifications for the monitoring well network presented in the 2012-2013 Semiannual Groundwater Monitoring Addendum (EQM, January 2012).

During a meeting with the Ohio EPA in September 2013, the Ohio EPA indicated that the current network of background (BKG) wells was insufficient for determining background conditions at the former RVAAP. The Army subsequently proposed a subset of wells for inclusion in the background network, which the Ohio EPA appears willing to entertain; however, the Ohio EPA indicated in their comment letter dated January 16, 2014, that the number of proposed background wells may not be sufficient. The ARNG is in the process of preparing and submitting a Request for Proposal to eligible contractors to continue the RI/FS work at the former RVAAP, including installation of additional wells for establishing background conditions. Consequently, the Semiannual Groundwater Addendum for 2015 is designed to monitor potential offsite migration and potential fluctuations in contaminant concentrations at selected source area wells. No specific upgradient wells were selected for monitoring at this time since the existing background data is not considered relevant. The data generated from the proposed semiannual monitoring wells for 2015 are still useful for any fate-and-transport modeling that may be prepared as part of the future RI work.

Ohio EPA Comment 5: Wells with Consistently Anomalous pH Values Need to be Monitored. Wells with consistently anomalous pH values outside the typical range of natural ground water (i.e., 5 to 9) need to be added to the list of wells to be sampled semiannually. Wells that appear to have consistently had anomalous pH values include FWGmw-002, RQLmw-011, RQLmw-012, and RQLmw-013. These wells need to have pH and other field parameters outlined in the *FWGWMP Ground Water Monitoring Program Plan* measured as part of semiannual sampling.

Response: Wells FWGmw-002, RQLmw-011, RQLmw-012, and RQLmw-013 will be monitored for pH and the other stabilization criteria during the 2015 semiannual sampling events. Time-series graphs for pH will be prepared for each well and included in future annual and semiannual groundwater reports.

Ohio EPA Comment 6: How Installation and Sampling of Three Proposed Wells Will Be Incorporated into the 2015 Sampling Schedule. Considering the concentrations of arsenic (LL1mw-088 and LL2mw-271), thallium (LL2mw-271), cobalt (LL2mw-271), and manganese (LL3mw-246) exceeding their respective (primary or secondary) MCLs and/or RSLs and the low concentrations of perchlorates and explosives/propellants present in one of the "new" monitoring wells (LL3mw-246). Ohio EPA agrees in principle with the National Guard's proposal at the May 21, 2014, RAB Meeting, to install three additional monitoring wells near the southeast corner of the facility near Load Lines #1 through #3. The details of such a proposal, including the location and construction of planned wells, would have to be reviewed and approved by Ohio EPA. Ohio EPA had made a similar comment based on its review of the January 2014 ground water sampling data from the facility, and in an October 6, 2014, letter to the National Guard Directorate. To date, no such proposal to install additional monitoring wells has been submitted to the Agency. It is not clear how the installation of these new wells will fit into the 2015 sampling schedule. This needs to be explained.

Response: As mentioned in our response to Comment 4, the ARNG is in the process of preparing and submitting a Request for Proposal to eligible contractors to continue the RI/FS work at the former RVAAP. Following selection of a Contractor to complete the RI efforts, a RI/FS Work Plan will be prepared with details regarding the location and construction of any additional RI wells at the former RVAAP. Any new wells will be sampled quarterly for the complete list of parameters under the FWGWMP. A schedule for completing this work will be provided as part of the RI/FS Work Plan.

Ohio EPA Comment 7: "New" Wells Not Tested for Perchlorates. It is not clear why the three "new" wells installed in December 2013 are not scheduled to be tested for perchlorates (refer to Table 2). Low levels of this compound were detected in samples from two of the "new" wells (LL2mw-271 and

LL3mw-246) collected during the January 2014 sampling event. Ohio EPA made a similar comment in an October 6, 2014, letter to the National Guard Directorate. This issue needs to be explained.

Response: Historically, each well at RVAAP has only been sampled once for perchlorates. There have been 195 wells that have had perchlorate detections above the reporting limit, ranging from 0.0089 J µg/L to 0.19 µg/L (note that the RSL is 14 µg/L and the Interim Drinking Water Health Advisory is 15 µg/L). Given the locations of the detections in LL2mw-271 and LL3MW-246 (i.e., outside the perimeter fence), the Army will include perchlorates in the semiannual sampling for these two wells in 2015.

Finalization of this document will occur in accordance with the Director's Final Findings and Orders upon receipt of the Ohio Environmental Protection Agency approval letter.

Please contact the undersigned at (703) 607-7955 or mark.s.leeper.civ@mail.mil if there are issues or concerns with this submission.

Sincerely,

Mark S. Leeper
RVAAP Restoration Program Manager
Army National Guard Directorate

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Table 1. RVAAP Monitoring Well Construction Details

RVAAP Area	Well ID	Ohio State Plane Easting	Ohio State Plane Northing	GL Elevation[a]	Total Drilled Depth[b]	TOC Elevation[a]	Well Head Type[c]	Monitoring Zone	Depth to Bedrock, ft	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)	Bottom of Inner Casing Plug or End Cap (ft BGS)	Stickup height (ft AGS)
Facility-Wide Background	BKGmw-004	2368852.97	569464.76	962.63	50.0	965.16	A	Unconsolidated	NA	9.2	19.2	19.5	2.45
	BKGmw-005	2340835.86	562288.45	1146.94	19.0	1149.44	A	Unconsolidated	NA	8.2	18.2	18.5	2.50
	BKGmw-006	2358643.96	571910.47	1023.87	35.1	1026.38	A	Bedrock	3.5	24.7	34.7	35.1	2.50
	BKGmw-008	2372741.08	569654.23	968.14	25.0	970.40	A	Bedrock	10.0	14.7	24.7	25.0	2.50
	BKGmw-010	2371372.95	565540.76	1003.89	22.0	1006.29	A	Bedrock	4.0	8.9	18.9	19.2	2.50
	BKGmw-012	2367795.23	563918.86	995.22	59.8	997.57	A	Bedrock	8.0	39.6	59.6	59.8	2.50
	BKGmw-013	2261627.39	558269.16	984.38	25.5	986.59	A	Unconsolidated	NA	15.2	25.2	25.5	2.50
	BKGmw-015	2361482.00	569339.87	1035.71	55.0	1037.90	A	Bedrock	10.5	30.1	50.1	50.4	2.50
	BKGmw-016	2342407.08	553983.50	1096.10	19.0	1098.42	A	Unconsolidated	NA	8.4	18.5	18.6	2.50
	BKGmw-017	2346115.35	562452.00	1130.69	34.8	1132.80	A	Unconsolidated	NA	23.2	33.3	33.6	2.50
	BKGmw-018	2354993.91	570873.35	1040.82	25.0	1043.06	A	Bedrock	3.0	14.5	24.5	24.7	2.50
	BKGmw-019	2349882.14	559864.55	1105.85	34.0	1108.24	A	Unconsolidated	NA	23.0	33.0	33.2	2.50
	BKGmw-020	2357856.00	558756.24	1062.68	30.7	1065.00	A	Bedrock	10.0	20.5	30.5	30.7	2.50
	BKGmw-021	2367622.95	571016.75	969.71	19.0	972.16	A	Unconsolidated	NA	7.7	17.8	18.1	2.50
Load Line 1	LL1mw-063	2376841.36	563650.53	992.20	27.4	994.84	A	Bedrock	3.1	17.1	27.1	27.4	2.64
	LL1mw-064	2380286.97	563118.74	932.32	18.4	935.10	A	Unconsolidated	NA	8.0	18.0	18.4	2.78
	LL1mw-065	2380452.00	560916.92	941.53	20.5	944.41	A	Unconsolidated	NA	10.2	20.2	20.5	2.88
	LL1mw-067	2376545.30	565201.14	977.55	23.4	980.36	A	Bedrock	5.7	12.8	22.5	22.8	2.81
	LL1mw-078	2376275.85	564623.87	993.40	40.0	995.84	A	Bedrock	1.0	28.7	38.2	38.7	2.44
	LL1mw-079	2376228.31	563739.63	995.30	40.4	997.87	A	Bedrock	1.1	29.5	38.9	39.5	2.57
	LL1mw-080	2376845.07	562479.73	993.70	24.5	996.27	A	Bedrock	0.0	9.5	19.0	19.5	2.57
	LL1mw-081	2376672.66	563462.73	996.40	40.4	998.92	A	Bedrock	2.1	29.4	38.9	39.4	2.52
	LL1mw-082	2376977.38	562956.86	1003.70	39.5	1006.45	A	Bedrock	1.8	28.9	38.5	39.0	2.75
	LL1mw-083	2377074.80	563612.75	992.80	39.5	995.20	A	Bedrock	0.2	29.1	38.6	39.3	2.40
	LL1mw-084	2377316.02	563160.44	996.40	37.2	998.73	A	Bedrock	2.0	26.7	36.3	37.0	2.33
	LL1mw-085	2377246.94	562046.25	994.30	45.0	996.84	A	Bedrock	6.1	32.2	41.6	42.1	2.54
	LL1mw-086	2380437.00	561714.00	938.00	77.2	940.63	A	Unconsolidated	77.2	64.5	74.5	74.7	2.63
	LL1mw-087	2378732.00	560375.00	941.80	17.5	944.32	A	Unconsolidated	NA	7.0	17.0	17.2	2.52
	LL1mw-088	2380525.00	561746.00	936.30	24.0	938.63	A	Unconsolidated	NA	13.9	23.9	24.2	2.33
Load Line 2	LL2mw-059	2375453.00	558020.00	964.33	22.9	966.67	A	Bedrock	7.7	9.3	19.1	19.5	2.34
	LL2mw-060	2375978.00	558022.00	958.93	19.2	961.57	A	Bedrock	7.9	8.1	17.9	18.3	2.64
	LL2mw-261	2373317.01	561898.59	1008.97	20.5	1011.40	A	Bedrock	0.7	9.8	19.8	20.0	2.43
	LL2mw-262	2373971.46	562219.47	1010.62	21.2	1012.62	A	Bedrock	5.2	10.6	20.6	20.8	2.00
	LL2mw-263	2374290.29	561590.92	1008.97	22.2	1011.47	A	Bedrock	6.0	10.8	20.8	21.0	2.50
	LL2mw-264	2374532.76	561173.63	1009.51	20.5	1011.88	A	Bedrock	6.2	9.8	19.8	20.0	2.37
	LL2mw-265	2375593.47	557972.08	958.74	22.5	961.24	A	Bedrock	8.0	11.8	21.8	22.0	2.50
	LL2mw-266	2373744.61	561982.68	1013.67	20.5	1016.28	A	Bedrock	6.0	9.8	19.8	20.0	2.61
	LL2mw-267	2373714.17	561393.73	1012.36	20.5	1014.81	A	Bedrock	9.8	9.8	19.8	20.0	2.45
	LL2mw-268	2374156.40	560831.44	1014.53	28.8	1017.28	A	Bedrock	12.3	17.3	27.3	27.5	2.75
	LL2mw-269	2374756.74	559483.90	1008.91	28.0	1011.62	A	Bedrock	18.6	17.1	27.1	27.3	2.71
	LL2mw-270	2372858.94	562656.18	1007.72	20.5	1010.18	A	Bedrock	7.7	9.8	19.8	20.0	2.46
	LL2mw-271	2375714.00	557827.00	958.70	25.0	961.19	A	Bedrock	11.0	14.6	24.6	24.9	2.49
Load Line 3	LL3mw-232	2369863.32	561365.12	998.59	37.8	1000.41	A	Bedrock	22.0	26.8	36.8	37.0	2.23
	LL3mw-233	2369933.58	560750.64	1002.47	31.8	1004.36	A	Bedrock	8.0	20.1	30.1	30.3	2.50
	LL3mw-234	2370296.54	560059.47	1004.47	20.5	1006.56	A	Bedrock	3.5	9.8	19.8	20.0	2.66

RVAAP Well Construction Details

RVAAP Area	Well ID	Ohio State Plane Easting	Ohio State Plane Northing	GL Elevation[a]	Total Drilled Depth[b]	TOC Elevation[a]	Well Head Type[c]	Monitoring Zone	Depth to Bedrock, ft	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)	Bottom of Inner Casing Plug or End Cap (ft BGS)	Stickup height (ft AGS)
Load Line 3	LL3mw-235	2370642.38	559811.55	1008.05	21.2	1009.94	A	Bedrock	4.0	10.1	20.1	20.3	2.60
	LL3mw-236	2371178.61	559867.34	1008.94	25.0	1011.70	A	Bedrock	5.8	13.8	23.8	24.0	2.60
	LL3mw-237	2371474.81	559327.11	1003.57	23.9	1005.57	A	Bedrock	5.0	12.7	22.7	22.9	2.58
	LL3mw-238	2370624.55	559569.39	1004.75	20.7	1006.91	A	Bedrock	1.5	10.5	20.5	20.7	2.70
	LL3mw-239	2370894.17	559101.84	1001.70	35.7	1003.50	A	Bedrock	6.5	24.9	34.9	35.0	2.53
	LL3mw-240	2371308.54	558204.42	1005.60	35.5	1007.52	A	Bedrock	15.5	24.4	34.4	34.6	2.50
	LL3mw-241	2370332.94	559299.00	992.41	23.8	994.65	A	Bedrock	1.5	12.7	22.7	22.9	2.72
	LL3mw-242	2371993.44	557035.28	997.39	20.5	999.23	A	Bedrock	3.1	9.8	19.8	20.0	2.64
	LL3mw-243	2371532.06	556688.50	989.36	24.5	991.16	A	Bedrock	8.1	13.8	23.8	24.0	2.35
	LL3mw-244	2371456.00	556033.00	986.20	45.0	988.78	A	Bedrock	17.7	34.5	44.5	44.7	2.58
	LL3mw-245	2369249.00	558573.00	978.70	47.0	981.24	A	Bedrock	24.5	36.5	46.5	46.7	2.54
	LL3mw-246	2371441.00	555969.00	986.50	43.0	988.84	A	Bedrock	14.0	32.8	42.8	43.0	2.34
Load Line 4	LL4mw-193	2364236.52	554960.27	980.42	21.9	982.92	A	Unconsolidated	NA	11.3	21.3	21.5	2.50
	LL4mw-194	2364584.86	555089.22	981.39	22.0	983.76	A	Unconsolidated	NA	11.3	21.3	21.5	2.37
	LL4mw-195	2365198.86	555046.75	980.02	21.0	982.59	A	Unconsolidated	NA	10.3	20.3	20.5	2.57
	LL4mw-196	2365297.10	555213.52	982.08	20.0	984.55	A	Unconsolidated	NA	9.2	19.2	19.4	2.47
	LL4mw-197	2365384.91	555397.05	983.16	21.7	985.46	A	Unconsolidated	NA	10.8	20.8	21.0	2.30
	LL4mw-198	2364991.19	555442.04	981.17	22.0	983.42	A	Unconsolidated	NA	10.3	20.3	20.5	2.25
	LL4mw-199	2365420.78	554621.03	974.73	22.0	977.28	A	Unconsolidated	NA	10.3	20.3	20.5	2.55
	LL4mw-200	2365903.05	554580.15	985.33	23.5	987.93	A	Unconsolidated	NA	12.6	22.6	23.0	2.60
	LL4mw-201	2365417.00	554607.00	975.90	67.0	978.02	A	Bedrock	42.0	56.5	66.5	66.7	2.12
Load Line 5	LL5mw-001	2354625.07	554319.25	1125.00	26.0	1127.92	A	Unconsolidated	20.4	14.0	24.0	24.0	2.92
	LL5mw-002	2354571.52	554604.01	1125.80	25.0	1128.68	A	Unconsolidated	24.6	15.0	25.0	25.0	2.88
	LL5mw-003	2354964.47	554535.41	1124.70	21.0	1127.70	A	Unconsolidated	NA	11.0	21.0	21.0	3.00
	LL5mw-004	2355006.44	554073.73	1122.90	22.4	1125.81	A	Unconsolidated	21.8	12.0	22.0	22.0	2.91
	LL5mw-005	2354422.02	554152.73	1126.50	27.8	1129.42	A	Unconsolidated	26.0	17.0	27.0	27.0	2.92
	LL5mw-006	2354730.78	553984.82	1125.10	24.5	1128.00	A	Unconsolidated	22.0	14.0	24.0	24.0	2.90
Load Line 6	LL6mw-001	2353153.23	554214.84	1124.46	18.0	1124.16	F	Unconsolidated	NA	7.0	17.0	17.0	-0.30
	LL6mw-002	2353820.09	553589.88	1125.58	23.0	1129.36	A	Unconsolidated	NA	12.5	22.5	22.5	3.78
	LL6mw-003	2353048.68	553544.34	1122.03	23.4	1125.38	A	Unconsolidated	20.0	12.5	22.5	22.5	3.35
	LL6mw-004	2353368.79	553431.82	1122.81	23.0	1125.39	A	Unconsolidated	18.0	12.5	22.5	22.5	2.58
	LL6mw-005	2353194.52	553170.76	1117.51	19.9	1120.47	A	Unconsolidated	12.9	9.5	19.5	19.5	2.96
	LL6mw-006	2352419.15	553165.28	1124.67	20.0	1124.37	F	Unconsolidated	NA	7.0	17.0	17.0	-0.30
	LL6mw-007	2353354.89	552677.17	1115.92	20.0	1115.62	F	Unconsolidated	18.2	9.5	19.5	19.5	-0.30
	LL6mw-008	2353616.00	553154.00	1121.30	17.8	1124.15	A	Unconsolidated	17.5	7.2	17.2	17.4	2.85
	LL6mw-009	2353604.00	553149.00	1121.40	39.5	1123.75	A	Bedrock	17.5	29.0	39.0	39.2	2.35
Load Line 7	LL7mw-001	2352192.91	554925.77	1126.90	30.0	1129.64	A	Bedrock	14.4	19.5	29.5	29.5	2.74
	LL7mw-002	2351918.23	555126.55	1126.70	26.5	1129.55	A	Bedrock	1.6	15.0	25.0	25.0	2.85
	LL7mw-003	2352351.04	555417.04	1118.23	31.5	1120.84	A	Bedrock	16.9	21.0	31.0	31.0	2.61
	LL7mw-004	2352035.20	555581.14	1123.30	29.5	1126.32	A	Bedrock	9.5	19.5	29.5	29.5	3.02
	LL7mw-005	2351741.47	555581.80	1133.30	28.2	1135.87	A	Bedrock	2.0	18.0	28.0	28.0	2.57
	LL7mw-006	2351879.92	555990.59	1120.70	28.0	1123.56	A	Bedrock	10.0	17.5	27.5	27.5	2.86
Load Line 8	LL8mw-001	2351666.10	552607.06	1118.69	24.0	1121.46	A	Unconsolidated	NA	14.0	24.0	24.0	2.77
	LL8mw-002	2351010.33	552408.18	1121.67	30.4	1124.51	A	Unconsolidated	NA	20.0	30.0	30.0	2.84

RVAAP Well Construction Details

RVAAP Area	Well ID	Ohio State Plane Easting	Ohio State Plane Northing	GL Elevation[a]	Total Drilled Depth[b]	TOC Elevation[a]	Well Head Type[c]	Monitoring Zone	Depth to Bedrock, ft	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)	Bottom of Inner Casing Plug or End Cap (ft BGS)	Stickup height (ft AGS)
Load Line 8	LL8mw-003	2351359.25	552231.14	1116.30	21.0	1119.05	A	Unconsolidated	NA	10.5	20.5	20.5	2.75
	LL8mw-004	2351261.83	551807.58	1112.73	20.5	1115.75	A	Unconsolidated	NA	10.0	20.0	20.0	3.02
	LL8mw-005	2351748.32	551522.48	1112.51	24.0	1115.73	A	Unconsolidated	23.5	14.0	24.0	24.0	3.22
	LL8mw-006	2351483.58	551296.77	1114.33	24.2	1117.15	A	Unconsolidated	18.2	14.0	24.0	24.0	2.82
Load Line 9	LL9mw-001	2355817.04	556125.81	1131.84	21.6	1134.62	A	Bedrock	15.5	10.5	20.5	20.5	2.78
	LL9mw-002	2355907.76	556755.11	1124.88	21.0	1127.30	A	Bedrock	0.5	10.0	20.0	20.0	2.42
	LL9mw-003	2356635.21	556445.31	1133.46	22.0	1135.76	A	Bedrock	9.0	11.5	21.5	21.5	2.30
	LL9mw-004	2357338.76	556002.00	1128.92	33.0	1131.83	A	Bedrock	2.7	22.0	32.0	32.0	2.91
	LL9mw-005	2356505.95	557063.36	1127.63	20.6	1130.93	A	Bedrock	2.0	10.0	20.0	20.0	3.30
	LL9mw-006	2357446.67	556434.79	1126.98	26.8	1129.88	A	Bedrock	3.2	16.0	26.0	26.0	2.90
	LL9mw-007	2357024.34	557000.56	1120.29	19.1	1119.99	F	Bedrock	0.4	8.5	18.5	18.5	-0.30
Load Line 10	LL10mw-001	2355272.22	555816.25	1130.00	28.0	1132.77	A	Bedrock	15.0	17.0	27.0	27.0	2.77
	LL10mw-002	2355710.51	555523.36	1124.40	28.0	1127.13	A	Bedrock	15.0	17.0	27.0	27.0	2.73
	LL10mw-003	2355389.92	555494.71	1127.40	26.4	1130.28	A	Bedrock	12.5	16.0	26.0	26.0	2.88
	LL10mw-004	2355438.20	555236.59	1119.60	31.2	1122.39	A	Bedrock	18.0	21.0	31.0	31.0	2.79
	LL10mw-005	2355943.55	555380.53	1122.90	27.0	1125.67	A	Bedrock	13.8	16.5	26.5	26.5	2.77
	LL10mw-006	2355654.80	554995.25	1121.20	24.0	1123.83	A	Unconsolidated	23.0	13.5	23.5	23.5	2.63
Load Line 11	LL11mw-1	2352778.82	557504.99	1097.46	23.0	1100.16	A	Unconsolidated	NA	11.4	21.4	21.4	2.70
	LL11mw-2	2353354.22	558310.52	1080.29	20.0	1080.00	F	Unconsolidated	NA	6.3	16.3	16.3	-0.29
	LL11mw-3	2352737.22	557999.67	1088.75	17.0	1088.49	F	Unconsolidated	NA	5.9	15.9	15.9	-0.30
	LL11mw-4	2352737.29	558164.29	1084.85	17.0	1084.73	F	Unconsolidated	NA	6.1	16.1	16.1	-0.12
	LL11mw-5	2352847.62	558501.21	1079.61	17.0	1079.41	F	Unconsolidated	NA	6.2	16.2	16.2	-0.20
	LL11mw-6	2352521.37	558263.54	1086.61	17.0	1086.50	F	Unconsolidated	NA	5.6	15.6	15.6	-0.11
	LL11mw-7	2352094.87	558189.94	1079.22	23.0	1082.00	A	Unconsolidated	NA	12.4	22.4	22.4	2.78
	LL11mw-8	2352388.57	557981.20	1087.90	17.0	1087.74	F	Unconsolidated	NA	5.6	15.6	15.6	-0.16
	LL11mw-9	2352577.22	557901.21	1088.38	17.0	1088.28	F	Unconsolidated	NA	6.7	16.7	16.7	-0.10
	LL11mw-10	2352038.91	557675.59	1080.23	22.0	1082.68	A	Unconsolidated	NA	10.9	20.9	20.9	2.45
	LL11mw-011	2351119.00	558680.00	1077.40	18.5	1080.20	A	Unconsolidated	NA	7.8	17.8	18.0	2.80
	LL11mw-012	2351125.00	558691.00	1077.90	115.0	1080.36	A	Bedrock	88.0	104.5	114.5	114.7	2.46
Load Line 12	LL12mw-088	2368667.10	556393.61	978.94	29.0	981.06	A	Unconsolidated	NA	14.8	24.8	25.0	2.12
	LL12mw-107	2368595.04	556758.74	978.03	33.0	980.19	A	Unconsolidated	NA	20.7	30.7	31.0	2.16
	LL12mw-113	2368224.40	558345.63	977.67	23.0	980.18	A	Unconsolidated	22.0	12.3	22.3	22.5	2.51
	LL12mw-128	2368292.51	557371.32	976.21	33.0	978.24	A	Unconsolidated	NA	21.1	31.1	31.3	2.03
	LL12mw-153	2368138.58	557823.69	975.34	26.0	977.85	A	Unconsolidated	NA	12.3	22.3	22.5	2.51
	LL12mw-154	2368184.18	557753.99	977.00	29.0	979.06	A	Unconsolidated	NA	16.4	26.4	26.6	2.06
	LL12mw-182	2368853.04	555891.03	982.20	36.1	984.42	A	Unconsolidated	34.0	25.2	35.2	35.5	2.22
	LL12mw-182ss	2368867.00	555897.00	982.30	38.0	985.02	A	Unconsolidated	38.0	25.3	35.3	35.5	2.72
	LL12mw-183	2369225.00	556067.67	980.59	36.0	983.04	A	Unconsolidated	34.0	23.3	33.3	33.6	2.45
	LL12mw-184	2368998.16	556399.95	980.96	29.5	983.16	A	Unconsolidated	NA	18.8	28.8	29.0	2.20
	LL12mw-185	2368830.45	556947.17	979.09	24.0	981.31	A	Unconsolidated	NA	10.8	20.8	21.0	2.22
	LL12mw-186	2367911.63	559065.62	976.34	23.0	978.31	A	Unconsolidated	22.0	8.8	18.8	19.0	1.97
	LL12mw-187	2368524.72	557633.56	977.90	29.0	979.94	A	Unconsolidated	NA	17.2	27.2	27.4	2.04
	LL12mw-188	2367909.05	558131.81	978.46	20.5	980.63	A	Unconsolidated	NA	9.8	19.8	20.0	2.17
	LL12mw-189	2367946.67	558569.23	976.17	18.5	978.04	A	Unconsolidated	15.5	7.5	17.5	17.7	1.87
	LL12mw-242	2368545.29	558020.51	978.40	26.3	981.20	A	Unconsolidated	NA	15.5	25.5	25.5	2.80

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Load Line 12	LL12mw-243	2368190.04	557376.32	978.10	24.0	980.79	A	Unconsolidated	NA	13.0	23.0	23.0	2.69
	LL12mw-244	2368751.42	557377.17	978.10	30.0	980.65	A	Unconsolidated	NA	19.5	29.5	29.5	2.55
	LL12mw-245	2368370.74	557044.55	977.50	29.0	980.04	A	Unconsolidated	NA	18.0	28.0	28.0	2.54
	LL12mw-246	2369432.17	556658.89	982.00	32.0	984.83	A	Unconsolidated	32.0	21.5	31.5	31.5	2.83
	LL12mw-247	2368932.00	555141.00	981.30	20.5	984.25	A	Unconsolidated	18.3	10.0	20.0	20.2	2.95
Atlas Scrap Yard	ASYmw-001	2366260.85	558404.04	978.40	22.0	981.13	A	Unconsolidated	16.0	11.0	21.0	21.0	2.73
	ASYmw-002	2366170.86	557887.86	982.00	20.0	985.24	A	Unconsolidated	18.0	9.5	19.5	19.5	3.24
	ASYmw-003	2366651.49	558015.94	979.70	21.5	982.21	A	Unconsolidated	20.0	11.0	21.0	21.0	2.51
	ASYmw-004	2367166.04	557640.81	977.10	27.8	979.66	A	Unconsolidated	27.5	17.0	27.0	27.0	2.56
	ASYmw-005	2367448.16	557783.01	977.60	29.0	979.80	A	Unconsolidated	26.0	14.0	24.0	24.0	2.20
	ASYmw-006	2366746.73	557257.72	980.20	27.0	983.01	A	Unconsolidated	27.0	16.0	26.0	26.0	2.81
	ASYmw-007	2366834.49	556818.08	981.40	30.0	984.16	A	Unconsolidated	30.0	16.0	26.0	26.0	2.76
	ASYmw-008	2367475.07	557087.66	976.20	28.0	978.85	A	Unconsolidated	NA	15.0	25.0	25.0	2.65
	ASYmw-009	2366631.94	557603.68	979.90	22.0	982.70	A	Unconsolidated	22.0	11.5	21.5	21.5	2.80
	ASYmw-010	2366985.37	557270.61	978.20	28.0	981.05	A	Unconsolidated	28.0	17.0	27.0	27.0	2.85
Building 1200	B12mw-010	2371292.81	565827.43	1002.72	21.0	1005.92	A	Bedrock	3.0	10.0	20.0	20.0	3.20
	B12mw-011	2371416.15	565687.82	1003.76	24.7	1006.70	A	Bedrock	2.0	14.0	24.0	24.0	2.94
	B12mw-012	2371430.41	565828.01	1003.43	22.3	1006.32	A	Bedrock	2.5	12.0	22.0	22.0	2.89
	B12mw-013	2371221.00	565904.00	1001.80	22.0	1004.48	A	Bedrock	1.2	11.5	21.5	21.7	2.68
C-Block Quarry	CBLmw-001	2343657.08	559403.12	1178.50	50.0	1181.08	A	Bedrock	1.9	39.0	49.0	49.0	2.58
	CBLmw-002	2343845.22	559044.48	1172.50	45.3	1175.24	A	Bedrock	6.0	34.5	44.5	44.5	2.74
	CBLmw-003	2343970.00	559695.52	1172.22	44.0	1175.06	A	Bedrock	2.5	33.0	43.0	43.0	2.84
	CBLmw-004	2343688.76	559951.58	1172.08	45.0	1174.84	A	Bedrock	5.0	34.0	44.0	44.0	2.76
	CBLmw-005	2344572.00	558686.00	1155.60	31.0	1158.10	A	Bedrock	9.0	22.0	30.0	30.2	2.50
Central Burn Pits	CBPmw-1	2367095.37	561616.01	972.71	32.3	975.84	A	Unconsolidated	NA	21.8	31.8	31.8	3.13
	CBPmw-2	2367295.66	561865.83	967.33	30.0	970.04	A	Unconsolidated	NA	19.5	29.5	29.5	2.71
	CBPmw-3	2366768.68	561944.14	972.04	25.0	974.67	A	Unconsolidated	NA	14.5	24.5	24.5	2.63
	CBPmw-4	2366978.80	562123.80	968.58	27.5	971.13	A	Unconsolidated	NA	17.0	27.0	27.0	2.55
	CBPmw-5	2366919.66	562311.88	968.83	28.0	971.59	A	Unconsolidated	NA	14.5	24.5	24.5	2.76
	CBPmw-6	2367243.68	562311.87	965.01	23.0	967.64	A	Unconsolidated	23.0	12.5	22.5	22.5	2.63
	CBPmw-7	2366512.62	562006.41	973.47	30.0	976.37	A	Unconsolidated	NA	19.5	29.5	29.5	2.90
	CBPmw-8	2366757.21	562668.84	970.57	25.5	973.19	A	Unconsolidated	NA	15.0	25.0	25.0	2.62
	CBPmw-9	2367174.00	561797.00	969.90	65.0	972.48	A	Bedrock	44.0	54.0	64.0	64.2	2.58
Cobbs Pond	CPmw-1	2368948.81	560440.91	975.46	16.0	975.26	F	Unconsolidated	NA	5.5	15.5	15.5	-0.20
	CPmw-2	2368239.23	560311.26	972.72	16.0	972.31	F	Unconsolidated	NA	5.5	15.5	15.5	-0.41
	CPmw-3	2368796.49	560676.30	973.27	18.5	972.92	F	Unconsolidated	NA	8.0	18.0	18.0	-0.35
	CPmw-4	2368674.31	561843.46	978.51	20.0	981.20	A	Unconsolidated	NA	9.5	19.5	19.5	2.69
	CPmw-5	2367900.41	561846.78	970.71	40.0	973.58	A	Unconsolidated	NA	29.5	39.5	39.5	2.87
	CPmw-6	2367727.13	562830.13	962.97	18.5	965.13	A	Unconsolidated	18.0	8.0	18.0	18.0	2.16
Demo. Area 2	DET-1B	2354959.47	560820.03	1063.35	39.0	1065.85	A	Unconsolidated	NA	26.0	36.0	39.0	2.50
	DET-2	2355360.33	560664.71	1060.24	39.0	1061.24	A	Unconsolidated	29.0	34.0	39.0	39.0	1.00
	DET-3	2355204.94	560456.10	1035.81	15.0	1036.81	A	Unconsolidated	12.0	7.0	12.0	12.0	1.00

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Demo. Area 2	DET-4	2355072.36	560454.22	1037.68	11.0	1038.68	A	Unconsolidated	11.0	6.0	11.0	11.0	1.00
	DA2mw-104	2354773.79	561129.59	1070.82	27.0	1073.89	A	Unconsolidated	NA	16.3	26.3	26.5	3.07
	DA2mw-105	2354557.62	560572.58	1042.66	14.0	1045.34	A	Unconsolidated	NA	8.3	13.3	13.5	2.68
	DA2mw-106	2354848.84	560560.49	1041.19	16.0	1043.79	A	Unconsolidated	10.6	8.3	15.3	15.5	2.60
	DA2mw-107	2354924.29	560480.04	1039.18	15.0	1041.63	A	Unconsolidated	12.0	8.8	13.8	14.0	2.45
	DA2mw-108	2355604.43	560181.77	1029.92	15.0	1032.36	A	Bedrock	3.5	9.3	14.3	14.5	2.44
	DA2mw-109	2354793.14	559897.89	1068.66	24.0	1071.29	A	Unconsolidated	NA	11.3	21.3	21.5	2.63
	DA2mw-110	2355195.91	559927.02	1061.39	20.0	1063.78	A	Unconsolidated	NA	9.3	19.3	19.5	2.39
	DA2mw-111	2354728.33	560222.94	1039.63	16.0	1042.12	A	Bedrock	8.0	7.1	12.1	12.3	2.49
	DA2mw-112	2355018.98	560378.35	1034.87	15.0	1037.44	A	Unconsolidated	11.0	8.8	13.8	14.0	2.57
	DA2mw-113	2355153.13	560394.81	1034.51	14.0	1037.11	A	Unconsolidated	12.6	8.3	13.3	13.5	2.60
	DA2mw-114	2355785.00	560109.00	1029.50	19.5	1031.90	A	Bedrock	3.5	9.2	19.2	19.4	2.40
	DA2mw-115	2355269.00	560459.00	1035.40	44.0	1038.08	A	Bedrock	14.3	33.8	43.8	44.0	2.68
Erie Burning Grounds	EBGmw-123	2380049.21	571747.04	945.59	32.0	947.82	A	Unconsolidated	NA	21.0	31.0	31.5	2.23
	EBGmw-124	2380030.24	571618.07	939.02	32.0	941.39	A	Unconsolidated	NA	20.0	30.0	30.5	2.37
	EBGmw-125	2379679.20	571655.63	947.55	25.0	949.89	A	Unconsolidated	NA	14.0	24.0	24.5	2.34
	EBGmw-126	2380307.31	572348.81	938.20	28.0	940.61	A	Unconsolidated	NA	15.2	25.2	25.5	2.41
	EBGmw-127	2380172.16	571083.61	940.21	30.0	943.07	A	Unconsolidated	NA	19.0	29.0	29.5	2.86
	EBGmw-128	2379892.79	570970.32	942.47	28.0	942.47	A	Unconsolidated	NA	15.0	25.0	25.3	2.66
	EBGmw-129	2379240.52	572035.68	941.97	29.0	944.36	A	Unconsolidated	NA	16.0	26.0	26.0	2.39
	EBGmw-130	2379220.69	570695.61	941.18	26.0	944.00	A	Unconsolidated	NA	15.2	25.2	25.5	2.82
	EBGmw-131	2379666.00	571655.00	947.50	71.0	950.08	A	Bedrock	50.1	60.5	70.5	70.7	2.58
Facility-Wide	FWGmw-001	2368321.00	565739.00	953.60	17.5	956.62	A	Unconsolidated	16.0	7.0	17.0	17.2	3.02
	FWGmw-002	2367606.00	571015.00	970.60	71.0	973.10	A	Unconsolidated	71.0	57.0	67.0	67.2	2.50
	FWGmw-003	2344042.00	563118.00	1129.40	19.0	1131.96	A	Unconsolidated	NA	8.5	18.5	18.7	2.56
	FWGmw-004	2356970.00	549319.00	1034.50	20.0	1037.15	A	Unconsolidated	16.0	9.5	19.5	19.7	2.65
	FWGmw-005	2338973.00	558510.00	1167.50	29.5	1170.10	A	Bedrock	17.0	19.3	29.3	29.5	2.60
	FWGmw-006	2335421.00	553142.00	1181.90	18.0	1184.33	A	Unconsolidated	NA	7.5	17.5	17.7	2.43
	FWGmw-007	2344785.00	548356.00	1072.80	30.0	1075.41	A	Unconsolidated	NA	19.5	29.5	29.7	2.61
	FWGmw-008	2341569.00	555735.00	1109.00	21.0	1111.61	A	Unconsolidated	NA	10.0	20.0	20.2	2.61
	FWGmw-009	2341998.00	556784.00	1099.50	18.5	1102.14	A	Unconsolidated	NA	8.0	18.0	18.2	2.64
	FWGmw-010	2379060.00	565077.00	959.50	17.3	962.15	A	Unconsolidated	NA	6.0	16.0	16.2	2.65
	FWGmw-011	2380390.00	566801.00	939.00	17.5	941.61	A	Unconsolidated	17.5	6.0	16.0	16.2	2.61
	FWGmw-012	2380389.00	566790.00	938.90	40.0	941.39	A	Bedrock	17.5	29.5	39.5	39.7	2.49
	FWGmw-013	2357460.00	559483.00	1057.10	34.5	1059.51	A	Bedrock	11.0	24.0	34.0	34.2	2.41
	FWGmw-014	2341064.00	560957.00	1135.00	18.5	1137.57	A	Unconsolidated	NA	8.3	18.3	18.5	2.57
	FWGmw-015	2358353.00	550179.00	1012.10	26.0	1014.51	A	Unconsolidated	NA	13.5	23.5	23.7	2.41
	FWGmw-016	2358364.00	550171.00	1011.90	65.0	1014.39	A	Bedrock	36.8	54.5	64.5	64.7	2.49
Fuze and Booster Quarry	FBQmw-166	2349584.83	553123.42	1104.87	16.0	1108.86	A	Unconsolidated	NA	5.5	15.5	15.5	3.99
	FBQmw-167	2349674.57	553554.09	1112.05	22.0	1115.90	A	Unconsolidated	NA	5.0	15.0	15.0	3.85
	FBQmw-168	2350068.61	553620.36	1131.27	19.5	1133.91	A	Unconsolidated	17.0	9.0	19.0	19.5	2.64
	FBQmw-169	2349730.90	553681.21	1117.36	16.0	1120.58	A	Unconsolidated	15.0	5.0	15.0	15.0	3.22
	FBQmw-170	2350102.41	553975.40	1139.67	30.5	1142.26	A	Bedrock	8.0	20.0	30.0	30.5	2.59
	FBQmw-171	2350072.44	554230.93	1140.49	30.0	1143.55	A	Bedrock	9.5	18.0	28.0	28.0	3.06
	FBQmw-172	2349907.37	554322.17	1145.71	33.0	1150.09	A	Bedrock	18.0	20.0	30.0	30.0	4.38
	FBQmw-173	2350449.01	554491.35	1162.43	50.0	1165.94	A	Bedrock	3.0	29.5	49.5	50.0	3.51

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Fuze and Booster Quarry	FBQmw-174	2350289.81	554142.44	1135.78	22.5	1139.97	A	Bedrock	1.0	12.0	22.0	22.5	4.19
	FBQmw-175	2350297.98	553989.24	1137.16	22.5	1140.73	A	Bedrock	4.0	12.0	22.0	22.5	3.57
	FBQmw-176	2350219.45	553273.33	1129.57	21.5	1131.91	A	Unconsolidated	17.0	11.0	21.0	21.0	2.34
	FBQmw-177	2350112.18	553321.94	1125.73	22.5	1128.57	A	Unconsolidated	18.0	12.0	22.0	22.0	2.84
Landfill North of Winklepeck	LNWmw-024	2358403.21	564825.89	1035.30	24.0	1038.00	A	Unconsolidated	18.5	10.0	20.0	20.0	2.70
	LNWmw-025	2358417.06	565071.92	1027.20	19.0	1029.13	A	Unconsolidated	12.0	8.0	18.0	18.0	1.93
	LNWmw-026	2358952.24	564658.16	1025.00	24.0	1027.80	A	Unconsolidated	NA	13.0	23.0	23.0	2.80
	LNWmw-027	2358628.75	564517.41	1024.40	25.0	1027.13	A	Bedrock	10.0	14.0	24.0	24.0	2.73
NACA Test Area	NTAmw-107	2345433.40	551697.29	1077.65	24.0	1080.30	A	Unconsolidated	NA	12.0	22.0	22.0	2.65
	NTAmw-108	2345781.60	551916.22	1083.22	23.0	1085.62	A	Unconsolidated	NA	12.0	22.0	22.0	2.40
	NTAmw-109	2345997.72	551293.25	1076.89	19.0	1079.84	A	Unconsolidated	NA	8.0	18.0	18.0	2.95
	NTAmw-110	2346438.94	551351.46	1080.03	30.0	1082.62	A	Unconsolidated	NA	17.0	27.0	27.0	2.59
	NTAmw-111	2346638.01	551538.60	1078.07	20.0	1080.94	A	Unconsolidated	NA	9.5	19.5	19.5	2.87
	NTAmw-112	2346889.48	551712.14	1075.36	23.9	1078.33	A	Unconsolidated	NA	13.9	23.9	23.9	2.97
	NTAmw-113	2347082.83	551488.52	1072.61	27.5	1075.68	A	Unconsolidated	NA	17.0	27.0	27.5	3.07
	NTAmw-114	2347301.57	551592.94	1075.61	20.0	1078.71	A	Unconsolidated	NA	9.5	19.5	19.5	3.10
	NTAmw-115	2347581.16	551791.78	1086.91	24.0	1089.65	A	Unconsolidated	NA	12.5	22.5	22.5	2.74
	NTAmw-116	2348196.39	551748.00	1091.68	22.0	1094.33	A	Unconsolidated	NA	10.0	20.0	20.0	2.65
	NTAmw-117	2347994.83	551584.57	1091.67	25.0	1094.54	A	Unconsolidated	NA	14.5	24.5	24.5	2.87
	NTAmw-118	2347609.41	551335.04	1078.86	22.5	1081.44	A	Unconsolidated	NA	12.0	22.0	22.0	2.58
	NTAmw-119	2346013.00	551286.00	1077.40	130.0	1080.07	A	Unconsolidated	NA	90.0	100.0	100.2	2.67
Ramsdell Quarry Landfill	RQLmw-006	2375927.71	566091.26	993.52	39.9	995.39	A	Bedrock	4.2	19.4	39.4	39.6	1.87
	RQLmw-007	2375872.56	566544.36	963.86	18.7	965.91	A	Bedrock	0.0	6.0	16.0	16.2	2.05
	RQLmw-008	2376011.08	566327.95	963.82	18.7	966.08	A	Bedrock	0.5	6.0	16.0	16.2	2.26
	RQLmw-009	2376253.65	566351.20	962.60	16.5	964.58	A	Bedrock	0.0	5.9	15.9	16.4	1.98
	RQLmw-010	2376048.58	566857.39	980.04	33.0	982.14	A	Bedrock	2.8	12.5	32.5	33.0	2.10
	RQLmw-011	2376398.19	566819.66	974.60	32.9	976.57	A	Bedrock	2.5	12.4	32.4	32.6	1.97
	RQLmw-012	2376558.19	566551.95	975.12	30.5	977.65	A	Bedrock	2.8	19.8	29.8	30.0	2.53
	RQLmw-013	2376204.93	566928.09	978.04	34.4	980.71	A	Bedrock	0.6	23.7	33.7	33.9	2.67
	RQLmw-014	2376519.38	566941.29	970.83	29.4	973.49	A	Bedrock	2.4	18.6	28.6	28.9	2.66
	RQLmw-015	2375490.96	566560.90	989.19	40.1	991.26	A	Bedrock	0.4	29.2	39.2	39.5	2.07
	RQLmw-016	2375649.55	566177.68	994.02	39.5	996.60	A	Bedrock	2.7	28.5	38.5	39.0	2.58
	RQLmw-017	2376124.18	565931.38	988.69	30.5	991.23	A	Bedrock	2.0	19.8	29.8	30.0	2.54
Winklepeck Burning Grounds	WBGmw-005	2357163.55	563037.18	1052.20	19.0	1054.70	A	Unconsolidated	NA	8.3	18.3	18.6	2.50
	WBGmw-006	2359087.79	563008.87	1012.16	19.0	1014.66	A	Unconsolidated	NA	7.6	17.6	17.9	2.50
	WBGmw-007	2360420.44	562479.87	998.09	24.0	1000.59	A	Unconsolidated	NA	13.5	23.5	23.8	2.50
	WBGmw-008	2359700.57	562010.35	1005.71	18.5	1008.21	A	Unconsolidated	NA	8.1	18.2	18.5	2.50
	WBGmw-009	2357159.20	561603.54	1045.03	24.0	1047.53	A	Unconsolidated	NA	11.4	21.4	21.5	2.50
	WBGmw-010	2356051.96	562893.20	1067.10	21.0	1069.85	A	Unconsolidated	NA	10.5	20.5	20.8	2.75
	WBGmw-011	2356187.29	562609.18	1069.70	22.0	1072.38	A	Unconsolidated	NA	11.0	21.0	21.3	2.68
	WBGmw-012	2354810.65	562240.90	1076.50	30.0	1079.11	A	Unconsolidated	NA	19.0	29.0	29.3	2.61
	WBGmw-013	2355223.25	561518.27	1069.10	22.0	1071.70	A	Unconsolidated	NA	11.0	21.0	21.3	2.60
	WBGmw-014	2360439.22	562061.26	994.10	23.0	996.78	A	Unconsolidated	NA	12.0	22.0	22.3	2.68
	WBGmw-015	2359182.41	562340.12	1009.10	22.0	1011.60	A	Unconsolidated	NA	11.0	21.0	21.3	2.50
	WBGmw-016	2360645.88	562709.13	994.90	24.0	997.03	A	Unconsolidated	NA	13.0	23.0	23.3	2.13
	WBGmw-017	2359603.84	562913.24	1004.00	22.0	1006.62	A	Unconsolidated	NA	11.0	21.0	21.3	2.62

RVAAP Well Construction Details

RVAAP Area	Well ID	Ohio State Plane Easting	Ohio State Plane Northing	GL Elevation[a]	Total Drilled Depth[b]	TOC Elevation[a]	Well Head Type[c]	Monitoring Zone	Depth to Bedrock, ft	Top of Screen (ft BGS)	Bottom of Screen (ft BGS)	Bottom of Inner Casing Plug or End Cap (ft BGS)	Stickup height (ft AGS)
Winklepeck Burning Grounds	WBGmw-017	2359603.84	562913.24	1004.00	22.0	1006.62	A	Unconsolidated	NA	11.0	21.0	21.3	2.62
	WBGmw-018	2361302.00	562659.00	990.50	24.0	991.45	A	Unconsolidated	NA	13.5	23.5	23.7	0.95
	WBGmw-019	2361304.00	562645.00	989.30	50.0	990.25	A	Bedrock	30.0	39.6	49.6	49.8	0.95
	WBGmw-020	2357161.00	561623.00	1043.40	43.3	1044.31	A	Bedrock	24.0	32.9	42.9	43.1	0.91
	WBGmw-021	2359106.00	563009.00	1010.00	42.5	1010.92	A	Bedrock	24.1	32.0	42.0	42.2	0.92
Suspected Mustard Agent Burial Site	MBS-001	2345323.00	550759.50	1079.68	30.0	1082.20	A	Unconsolidated	NA	19	28.7	29.0	2.52
	MBS-002	2345322.30	550886.20	1080.50	30.0	1083.22	A	Unconsolidated	NA	18	27.3	28.0	2.72
	MBS-003	2345172.40	550922.80	1082.45	30.0	1084.45	A	Unconsolidated	NA	18.5	28.2	28.5	2.00
	MBS-004	2345134.20	550767.90	1079.55	26.0	1081.80	A	Unconsolidated	NA	14.7	24.4	24.7	2.25
	MBS-005	2345354.10	550800.70	1080.50	30.0	1082.42	A	Unconsolidated	NA	18	28	28.08	1.92
	MBS-006	2345282.30	550726.10	1080.29	28.0	1081.83	A	Unconsolidated	NA	16.5	26.5	26.56	1.54
Sharon Conglomerate	SCFmw-001	2353178.98	554768.62	1118.53	230.0	1120.71	A	Bedrock	32.5	201.0	211.0	211.0	2.18
	SCFmw-002	2368927.36	555152.38	982.28	153.0	984.56	A	Bedrock	24.0	137.0	147.0	147.0	2.28
	SCFmw-003	2375843.20	557957.67	956.14	140.0	958.47	A	Bedrock	10.0	125.5	135.5	135.5	2.33
	SCFmw-004	2378730.23	560361.03	941.87	120.0	944.17	A	Bedrock	50.0	100.0	110.0	110.0	2.30
	SCFmw-005	2377014.05	567302.35	958.43	160.0	960.80	A	Bedrock	11.0	139.0	154.0	154.0	2.37
	SCFmw-006	2369394.54	569583.41	963.69	90.0	965.92	A	Bedrock	53.7	76.0	86.0	86.0	2.23

[a] elevations are in feet above mean sea level (amsl).
[b] total drilled well borehole depth relative to ground surface.
[c] A = above grade completion; F = flush-mount completion
NA = not available.

Table 2.
Comparison of Shallow and Deep Unconsolidated Well Pairs

Well #	Monitored Zone	TOC Elev., ft amsl	July-12				January-13				August-13			
			DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]	DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]	DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]
BKGmw-021	Unconsolidated	974.66	15.34	959.32	956.91	-0.179	17.39	957.27	956.91	-0.119	15.30	959.36	956.91	-0.165
FWGmw-002	Deep Unconsol.	973.10	24.00	949.10	908.60		23.14	949.96	908.60		23.29	949.81	908.60	
LL1mw-086	Deep Unconsol.	940.63	9.92	930.71	868.50	NA	7.35	933.28	868.50	NA	7.07	933.56	868.50	NA
LL1mw-088[b]	Unconsolidated	938.63	NM	NM	917.40		NM	NM	917.40		NM	NM	917.40	
NTAmw-109	Unconsolidated	1079.84	12.53	1067.31	1063.89	-0.005	11.82	1068.02	1063.89	-0.011	11.79	1068.05	1063.89	-0.006
NTAmw-119	Deep Unconsol.	1080.07	12.90	1067.17	982.40		12.75	1067.32	982.40		12.30	1067.77	982.40	

Well #	Monitored Zone	TOC Elev., ft amsl	January-14				May-14				July-14			
			DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]	DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]	DTW, ft amsl	Potentiometric Elevation, ft	Elevation at Midpoint of Well Screen, ft amsl	Vertical Hydraulic Gradient[a]
BKGmw-021	Unconsolidated	974.66	NM[c]	NM[c]	956.91	NA	13.41	961.25	956.91	-0.191	NM[c]	NM[c]	956.91	NA
FWGmw-002	Deep Unconsol.	973.10	NM[c]	NM[c]	908.60		22.66	950.44	908.60		23.66	949.44	908.60	
LL1mw-086	Deep Unconsol.	940.63	5.94	934.69	868.50	0.000	5.96	934.67	868.50	-0.041	8.45	932.18	868.50	-0.048
LL1mw-088[b]	Unconsolidated	938.63	5.92	932.71	917.40		3.94	934.69	917.40		6.09	932.54	917.40	
NTAmw-109	Unconsolidated	1079.84	NM[c]	NM[c]	1063.89	NA	10.41	1069.43	1063.89	-0.005	NM[c]	NM[c]	1063.89	NA
NTAmw-119	Deep Unconsol.	1080.07	11.83	1068.24	982.40		10.82	1069.25	982.40		12.00	1068.07	982.40	

[a] Vertical hydraulic gradient equals the difference in water levels divided by the vertical distance between the midpoint of the well screens. A positive vertical gradient indicates the potential for upward flow; whereas a negative gradient equals downward flow potential.

[b] Well not installed until December 2013.

[c] Well not gauged or sampled as part of this semi-annual sampling event.

NM = not measured.

NA = not applicable.

John R. Kasich, Governor
Mary Taylor, Lt. Governor
Craig W. Butler, Director

November 25, 2014

Mr. Brett Merkel
Army National Guard Directorate
ARNGD-ILE Clean Up
111 South George Mason Drive
Arlington, VA 22203

Re: US Army Ravenna Ammunition Plt RVAAP
Assessment
Remedial Response
Portage
267000859

Subject: Ravenna Army Ammunition Plant Portage/Trumbull Counties, Comment Letter, Re. FWGWMP Draft Facility-Wide Groundwater Semiannual Groundwater Monitoring Addendum for 2015, Dated October 10, 2014, Ohio EPA ID # 267-000859-036

Dear Mr. Merkel:

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 Groundwater Monitoring Addendum for 2015." This document was received at Ohio EPA's Northeast District Office (NEDO), Division of Environmental Response and Revitalization (DERR), on October 10, 2014, and is dated October 10, 2014. 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.

The report outlines the subset of 42 of the existing 284 FWGWMP monitoring wells at the former Ravenna Army Ammunition Plant (RVAAP) that will be sampled during semiannual sampling events scheduled for January and July 2015. According to the document, the wells are being sampled to evaluate potential offsite migration, potential source area contaminant attenuation, and seasonal/temporal variation. Further, a subset of the well network was selected in association with or paired with several "new" wells to assess horizontal and/or vertical contaminant distribution and to provide upgradient data for the various site-wide models.

Comments on the document based on Ohio EPA review are provided below. Please provide responses to the enclosed comments in accordance with the Directors Findings and Orders.

E-MAILED 12-01-2014 RWH

COMMENTS

1. **Inconsistency in the Naming of Ground Water Zones.** Table 1 inconsistently identifies wells screened in unconsolidated glacial material either as "overburden" wells or as "unconsolidated" wells. This is unnecessarily confusing. The identifying name of the hydrostratigraphic unit needs to be consistent and accurately identify the unit. Ohio EPA discourages the use of the term "overburden" because it is ambiguous and not appropriate. "Overburden" is a mining term that refers to material of any nature, consolidated or unconsolidated, that overlies a deposit of useful material (e.g., gravel, ore, and coal) that are mined from the surface by open cuts.

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2. **Shallow and Deep Unconsolidated Ground Water Zones.** Table 1 indicates that 17 of the wells to be monitored are screened in the "first" or "uppermost water-bearing zone" in the unconsolidated glacial material and two of the wells to be monitored are screened in the "second water bearing zone" or "deep" portion of the unconsolidated glacial material. It is unclear if there are one or two hydrostratigraphic zones within the unconsolidated glacial material beneath the RVAAP. In order to assure that the facility is adequately monitored, it needs to be clarified if the two ground water zones have the same potentiometric surface, and to what extent the two zones are interconnected.

3. **Horizontal Extent Evaluated with Well Pair LL1mw-086 and LL1mw-088.** The *SAGWMA* indicates (page 2) that a subset of the well network was selected in association with or paired with several of the new RI wells to assess horizontal and vertical contaminant distribution. Table 1 indicates that Well LL1mw-086, screened in the second (deep) ground water zone in the unconsolidated glacial till, is paired with "sentinel" well LL1mw-088 screened in the first ground water zone in the unconsolidated glacial till. LL1mw-088 is a "new" well that was installed in December 2013. LL1mw-086 is located downgradient of Load Line 1, and LL1mw-088 is located downgradient of LL1mw-086 and outside the perimeter fence. Considering these wells' relationship to each other, it is unclear how this well pair is being used to determine horizontal and vertical extent. This needs to be explained.

4. **Wells Used for Upgradient Data.** The 2015 *SAGWMA* (page 2) indicates that some of the 42 selected wells for monitoring are to provide upgradient data for the various site-wide models. Information in Table 1 indicates that all 42 of the wells selected for monitoring are located downgradient of an area of concern (AOC), impacted by constituents of concern (COCs), and would not be appropriate for representing background water quality at the facility. It needs to be clarified which of the 42 wells are to be used to provide upgradient data for various site models, as well as the rationale that was used to select these wells.

5. **Wells with Consistently Anomalous pH Values Need to be Monitored.** Wells with consistently anomalous pH values outside the typical range of natural ground water (i.e., 5 to 9) need to be added to the list of wells to be sampled semiannually. Wells that appear to have consistently had anomalous pH values include FWGmw-002, RQLmw-011, RQLmw-012, and RQLmw-013. These wells need to have pH and other field parameters outlined in the *FWGWMP Ground Water Monitoring Program Plan* measured as part of semiannual sampling.

6. **How Installation and Sampling of Three New Proposed Wells Will Be Incorporated into the 2015 Sampling Schedule.** Considering the concentrations of arsenic (LL1mw-088 and LL2mw-271), thallium (LL2mw-271), cobalt (LL2mw-271), and manganese (LL2mw-246) exceeding their respective (primary or secondary) MCLs and/or RSLs and the low concentrations of perchlorates and explosives/propellants present in one of the "new" monitoring wells (LL3mw-246). Ohio EPA agrees in principle with the National Guard's proposal at the May 21, 2014, RAB Meeting, to install three additional monitoring wells near the southeast corner of the facility near

Load Lines # 1 through # 3. The details of such a proposal, including the location and construction of planned wells, would have to be reviewed and approved by Ohio EPA. Ohio EPA had made a similar comment based on its review of the January 2014 ground water sampling data from the facility, and in an October 6, 2014, letter to the National Guard Directorate. To date, no such proposal to install additional monitoring wells has been submitted to the Agency. It is not clear how the installation of these new wells will fit into the 2015 sampling schedule. This needs to be explained.

7. **"New" Wells Not Tested for Perchlorates**. It is not clear why the three "new" wells installed in December 2013 are not scheduled to be tested for perchlorates (refer to Table 2). Low levels of this compound were detected in samples from two of the "new" wells (LL2mw-271 and LL3MW-246) collected during the January 2014 sampling event. Ohio EPA made a similar comment in an October 6, 2014, letter to the National Guard Directorate. This issue needs to be explained.

Pursuant to the CERCLA process, the property owner usually can provide the expected land uses to assist in ensuring that the investigation addresses all receptors for both current and future land uses. Be advised that due to land use uncertainty, Ohio EPA may require additional work in the future, to address data gaps. It is incumbent upon the Army to finalize land use at Camp Ravenna as soon as possible, otherwise additional work and schedule slippage may result.

This document was reviewed by personnel from Ohio EPA, DERR. Ohio EPA has determined that additional information is necessary to approve the document. If you have any questions, please call me at (330) 963-1292.

Sincerely,

Kevin M. Palombo
Environmental Specialist
Division of Environmental Response and Revitalization

KP/nvr

cc: Katie Tait, OHARNG RTLS
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