**Final**

# Sampling and Analysis Plan for Groundwater Sampling at the RVAAP-12 Load Line 12 Addendum No. 1

**Ravenna Army Ammunition Plant,**
**Ravenna, Ohio**

**April 14, 2009**

**Contract No. W912QR-04-D-0028**
**Delivery Order No. 0001**

**Prepared for:**

US Army Corps of Engineers

**United States Army Corps of Engineers**
**Louisville District**

**Prepared by:**

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From Science to Solutions

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This Sampling and Analysis Plan outlines the approach to sample groundwater at Load Line 12 at the Ravenna Army Ammunition Plant (RVAAP). The groundwater results will be used to support the completion of the Feasibility Study for Load Line 12 at RVAAP.

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## CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

Science Applications International Corporation (SAIC) has completed the Final Sampling and Analysis Plan for Groundwater Sampling at the RVAAP-12 Load Line 12 Addendum No. 1 at the Ravenna Army Ammunition Plant, Ravenna, Ohio. Notice is hereby given that an independent technical review has been conducted that is appropriate to the level of risk and complexity inherent in the project. During the independent technical review, compliance with established policy principles and procedures, utilizing justified and valid assumptions, was verified. This included review of data quality objectives; technical assumptions; methods, procedures, and materials to be 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 USACE policy.

Paul Parish
Study/Design Team Leader

04/08/09
Date

W. Kevin Jago, P.G.
Independent Technical Review Team Leader

04/08/09
Date

Significant concerns and the explanation of the resolution are as follows:

Internal SAIC Independent Technical Review comments are recorded on a Document Review Record per SAIC quality assurance procedure QAAP 3.1. This Document Review Record is maintained in the project file. Changes to the report addressing the comments have been verified by the Study/Design Team Leader. As noted above, all concerns resulting from independent technical review of the project have been considered.

Scott Armstrong
Principal w/ A-E firm

April 8, 2009
Date

# Final

# Sampling and Analysis Plan for Groundwater Sampling at the RVAAP-12 Load Line 12 Addendum No. 1

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-04-D-0028
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**Prepared For:**
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600 Martin Luther King, Jr. Place
Louisville, Kentucky 40202


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April 14, 2009

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**Ravenna Army Ammunition Plant**
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Ohio EPA-NEDO = Ohio Environmental Protection Agency-Northeast District Office
Ohio EPA-SWDO = Ohio Environmental Protection Agency-Southwest District Office
OHARNG = Ohio Army National Guard
RVAAP = Ravenna Army Ammunition Plant
USACE = United States Army Corps of Engineers
USAEC = United States Army Environmental Command
REIMS = Ravenna Environmental Information Management System
SAIC = Science Applications International Corporation

# PART I

# Final

# Field Sampling Plan
# for the Sampling and Analysis Plan
# Groundwater Sampling at the RVAAP-12 Load Line 12
# Addendum No. 1

Ravenna Army Ammunition Plant
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**Prepared For:**
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April 14, 2009

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| COC | Chemical of Concern |
| EQM | Environmental Quality Management, Inc. |
| ESTCP | Environmental Security Technology Certification Program |
| FS | Feasibility Study |
| FWGWMP | Facility-Wide Groundwater Monitoring Program |
| HMX | High Melting Explosive |
| IDW | Investigation-Derived Waste |
| MNA | Monitored Natural Attenuation |
| Ohio EPA | Ohio Environmental Protection Agency |
| OVA | Organic Vapor Analyzer |
| PBA | Performance-Based Acquisition |
| PCB | Polychlorinated Biphenyls |
| PID | Photoionization Detector |
| PPE | Personal Protective Equipment |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RDX | Royal Demolition Explosive |
| RVAAP | Ravenna Army Ammunition Plant |
| SAIC | Science Applications International Corporation |
| SAP | Sampling and Analysis Plan |
| SVOC | Semivolatile Organic Compounds |
| TAL | Target Analyte List |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TOC | Total Organic Carbon |
| USACE | U.S. Army Corps of Engineers |
| VOCs | Volatile Organic Compound |

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# 1.0 PROJECT DESCRIPTION

This Sampling and Analysis Plan (SAP) Addendum No. 1 addresses groundwater sampling in Load Line 12 at the Ravenna Army Ammunition Plant (RVAAP), figures 1-1, 1-2 and 1-3. This work is being conducted by Science Applications International Corporation (SAIC) as part of the 2008 Performance-Based Acquisition (PBA) for Environmental Investigation and Remediation at the RVAAP under contract W912QR-04-D-0028, Delivery Order 0001, Task 4 with the U.S. Army Corps of Engineers (USACE) Louisville District.

Groundwater sampling activities will be conducted at selected monitoring wells within and downgradient of former source areas at Load Line 12 to obtain current contemporaneous data for numerical fate and transport modeling and evaluation of remedial alternatives in a Feasibility Study (FS). Samples will be collected and analyzed for groundwater chemistry necessary to evaluate remedial alternatives for monitored natural attenuation (MNA) parameters. These data will be incorporated into a future assessment of degradation rates for nitrate and RDX. Proposed sampling locations are shown in Figure 1-3.

As part of the Facility-Wide Groundwater Monitoring Program (FWGWMP), all the wells at Load Line 12 were sampled for a full suite of analytes required under the FWGWMP and four quarters of data will have been collected by October 2008. The data from those sampling events will be evaluated along with the data generated by SAIC during this investigation. The 2008 FWGWMP data provide the majority of information needed for the future FS for groundwater at Load Line 12. However, additional sampling will be required under this SAP Addendum as some water chemistry parameters needed to evaluate MNA were not sampled as part of the quarterly sampling conducted under the FWGWMP.

This SAP Addendum No. 1 for groundwater sampling at Load Line 12 tiers under and supplements the guidance and methods presented in the *Facility-Wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 2001). The Facility-Wide SAP provides the general technical procedures and protocols for conducting fieldwork at RVAAP. This SAP Addendum No. 1 includes the sampling and analysis objectives, rationales, planned activities, and technical specifications for the work to be conducted for this investigation. Where appropriate, this SAP Addendum No. 1 contains references to the Facility-Wide SAP for standard procedures and protocols.

The groundwater sampling to be conducted will be consistent with the Facility-Wide Groundwater Monitoring Program (USACE 2004). Groundwater sampling will be sampled using low-flow methods as specified in the Facility-Wide SAP.

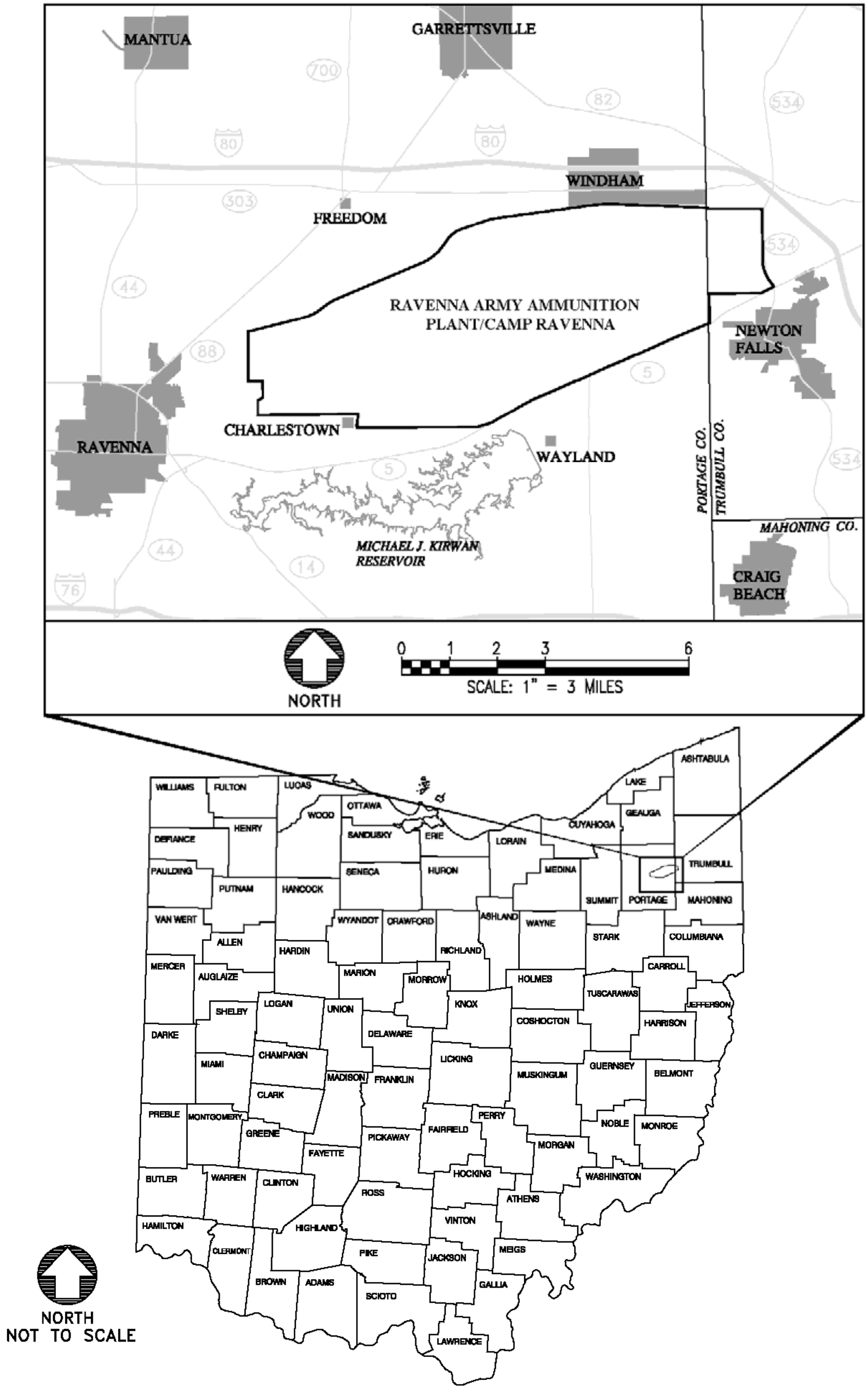
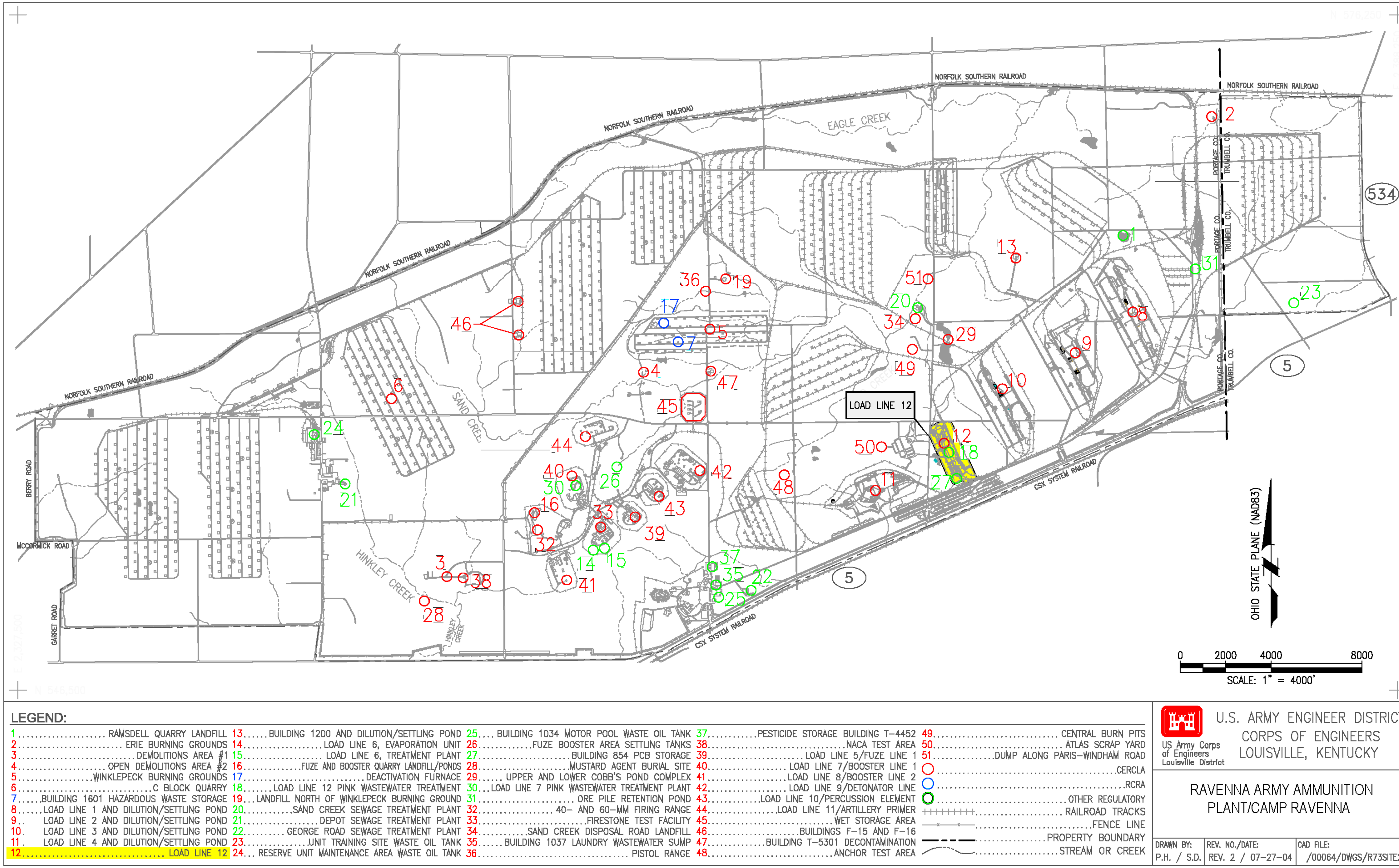



**Figure 1-1. General Locations and Orientation of the RVAAP/RTLS**




le: W:\CAD Gov\Ravenna\PBC 2005\Location Map\RVAAP Site.dwg Layout: Load Line 12 User: williamsbe Jun 20, 2007 - 10:02am

**Figure 1-2. Location of Load Line 12 at the RVAAP**

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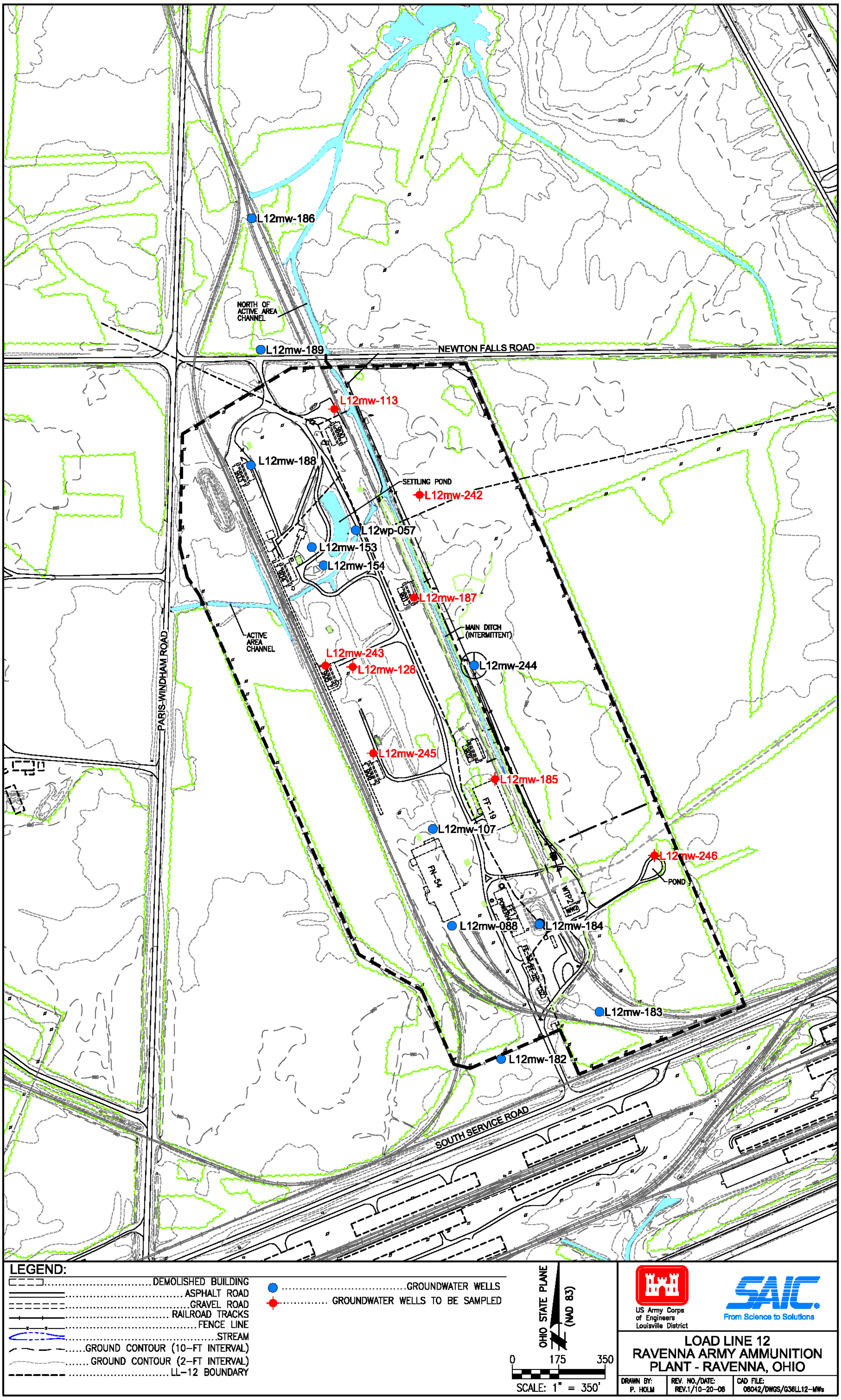


**Figure 1-3. Proposed Well Sample Locations at Load Line 12**

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# 2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

## 2.1 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization and responsibilities are presented in Figure 2-1. The functional responsibilities of key personnel are described in Section 2 of the Facility-Wide SAP and, therefore, are not presented here.

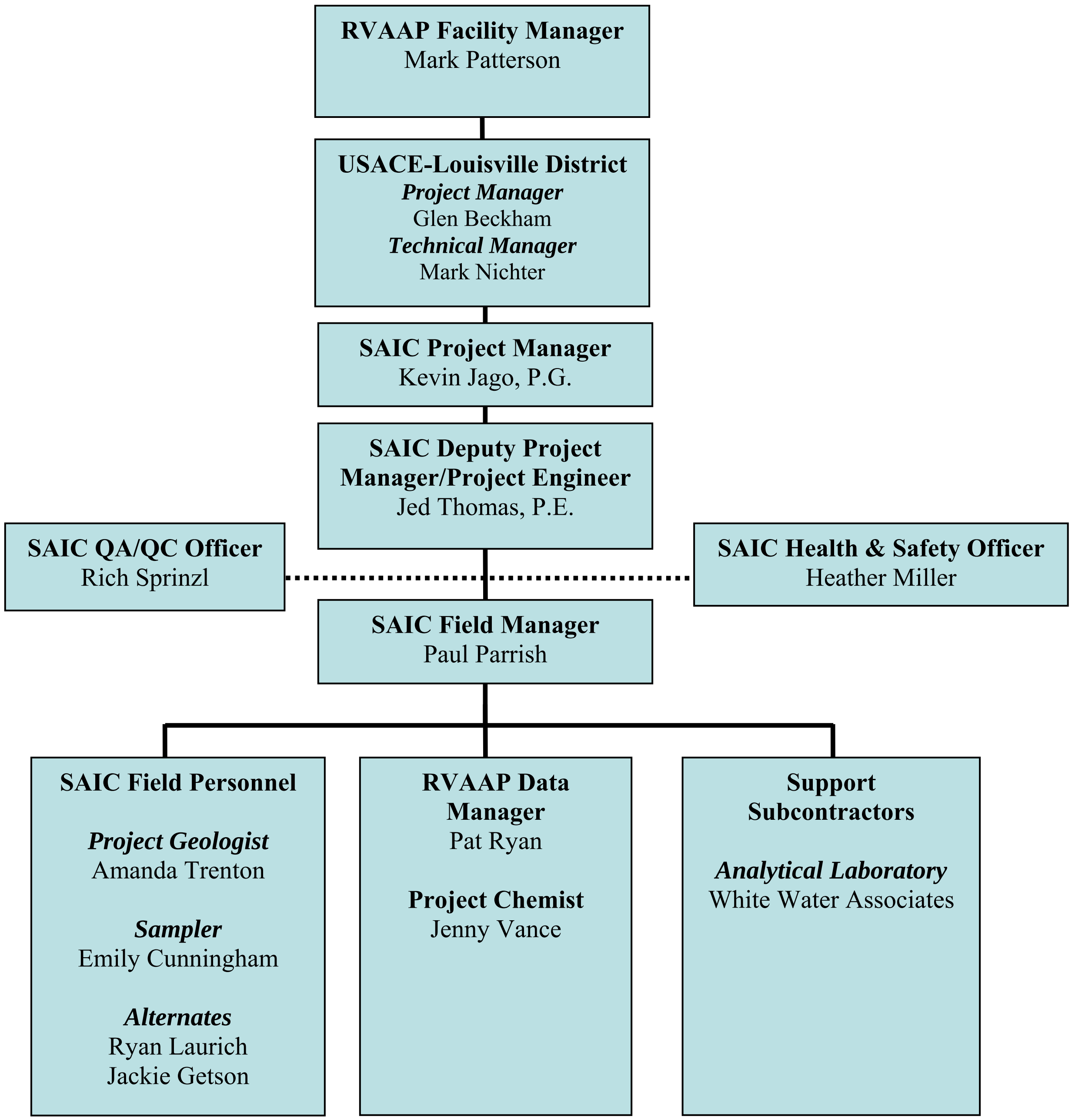


**Figure 2-1. Project Personnel Organization Chart**

## 2.2 PROJECT SCHEDULE

Groundwater sampling activities are estimated to require 22 days. Sampling activities will include one sampling event for eight monitoring wells located at Load Line 12, data verification and reduction and analysis of the data. Results of the sampling investigation will be presented in a Feasibility Study for Groundwater at Load Line 12.

| ID | Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|---|
| 1 | **LL12 Groundwater Supplemental Sampling and Analysis Plan** | **45 days** | **Mon 4/13/09** | **Wed 5/27/09** | |
| 2 | Prepare and Submit Final to Army and Ohio EPA | 0 days | Mon 4/13/09 | Mon 4/13/09 | |
| 3 | Army and Ohio EPA Review and Approval | 45 days | Mon 4/13/09 | Wed 5/27/09 | 2 |
| 4 | **Implement LL12 Groundwater Supplemental Sampling Plan** | **22 days** | **Thu 5/28/09** | **Thu 6/18/09** | |
| 5 | Conduct Supplemental Sampling | 2 days | Thu 5/28/09 | Fri 5/29/09 | 3 |
| 6 | Sampling Analysis and Data Verification | 20 days | Sat 5/30/09 | Thu 6/18/09 | 5 |

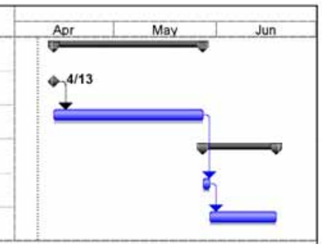


**Figure 2-2. Project Schedule**

# 3.0 PROJECT SCOPE AND OBJECTIVES

The scope of this investigation is to sample groundwater at selected monitoring wells within, and downgradient of, the nitrate source area at Load Line 12 to obtain current contemporaneous data for modeling and attenuation rate calculation purposes. Table 3-1 below presents the wells to be sampled during this investigation, and their rationale for their inclusion. Figures 3-1 through 3-5 present the available potentiometric surface maps for Load Line 12.

**Table 3-1. Wells to be Sampled and Rationale for Inclusion**

| Well | Rationale |
|---|---|
| L12mw-113 | Historic HMX contamination found in this well |
| L12mw-128 | Downgradient of L12mw-187 |
| L12mw-185 | Nitrate Source Area |
| L12mw-187 | Nitrate Source Area |
| L12mw-242 | Upgradient of L12mw-187 and Downgradient of L12mw-113 |
| L12mw-243 | Downgradient of L12mw-185 and L12mw-187 |
| L12mw-245 | Downgradient of L12mw-185 |
| L12mw-246 | Downgradient of L12mw-185 |

Wells closest to nitrate source areas were chosen so that degradation calculations can be made with respect to wells at different distances downgradient from those source area wells.

A total of four quarters of sampling was completed in October 2008 for all of the wells located at Load Line 12 (performed under FWGWMP by Environmental Quality Management, Inc. [EQM]). EQM sampled the wells for explosives, propellants, target analyte list (TAL) metals, cyanide, nitrate, semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, and volatile organic compounds (VOCs). A summary of the groundwater data generated from previous quarterly sampling events for all of the site wells located at Load Line 12 is included as Appendix A to this SAP. Nitrate results for some sampling events were qualified "B" during the data verification process, as nitrate was found in either the equipment rinse blank or the method blank. The results that were less than 5 times the blank contamination were flagged "B". The method blank or equipment rinsate blank results are included at the end of the data summary in Appendix A. SAIC proposes not to collect any additional samples for COCs, and to collect one round of sampling for MNA parameters at the eight selected wells. The MNA parameters selected for analysis are based on and consistent with the Environmental Security Technology Certification Program's (ESTCP) *Natural Attenuation of Explosives in Groundwater* completion report (Pennington, Zakikhani, Harrelson and Allen 1999). Such an approach was utilized at Louisiana Army Ammunition Plant and Joliet Army Ammunition Plant. These parameters were also utilized in an MNA evaluation for explosives as part of the RCRA Facility Investigation for Site-Wide Groundwater at Holston Army Ammunition Plant (USACE 2007). Table 3-2 presents a list of the MNA parameters to be collected, and the justification for inclusion for this investigation.

**Table 3-2. Description of MNA Analytical Suite**

| Analyte | Description and Justification for Inclusion in MNA Suite |
|---|---|
| DNX, MNX, TNX | The nitroso derivatives of RDX (DNX, MNX, and TNX) are first-stage degradation compounds. DNX and MNX are additionally first stage degradation compounds of HMX. These intermediates are also susceptible to subsequent degradation and are short-lived in the environment. |
| Dimethylhydrazines (1,1- and 1,2-) | Intermediate degradation products of RDX. Short-lived in the environment. |
| Hydrazine | End product indicator of RDX. Short-lived in the environment. |
| Ammonia | End product indicator for explosives degradation |
| Nitrate | End product indicator. Nitrate is the most efficient electron acceptor in anaerobic biodegradation. Also, nitrate is reduced to nitrite when utilized by microorganisms as an electron acceptor |
| Methane | Methane is an end product indicator and an anaerobic biodegradation transformation product of explosives degradation. Ethane and ethylene results are also reported under the laboratory's organic gases suite, but these analytes are not considered significant to the evaluation of MNA processes |
| Methanol | End product indicator and anaerobic biodegradation transformation product |
| Phosphorous | Limiting nutrient for microbial growth and activity. Low levels indicate decreasing potential for the maintenance of adequate habitats for degradative microorganisms |
| Organic Nitrogen | End product indicator. Also supports co-metabolic microbial activity |
| Total Organic Carbon (TOC) | Anaerobic studies suggest degradation of explosives in groundwater can utilize co-metabolic processes that incorporate organic carbon as a co-metabolite |
| Ferrous Iron | Iron is a common electron acceptor utilized in anaerobic biodegradation |
| Sulfate and Sulfide | Sulfate can be utilized by microbes as an electron acceptor in anaerobic biodegradation, resulting in the production of sulfide |
| Alkalinity | Indicator of feasibility and types of degradation processes possible. Alkaline conditions favor degradation of explosives |
| Carbon Dioxide | Microorganisms utilize carbon dioxide as an electron acceptor once sulfate is exhausted |
| Oxidation-reduction potential | Indicator of feasibility and types of degradation processes possible. Monitored as a field parameter |

Sources: Brannon and Pennington 2002; Strategic Environmental Research and Development Program 2004; and Pennington et. al., 1999.
MNA = Monitored natural attenuation.
RDX = 1,3,5-Trinitroperhydro-1,3,5-triazine.

One round of sampling for the MNA parameters will be sufficient to evaluate the current site conditions because of the use of the recent data collected by EQM for the primary COCs. The MNA parameters will be used to evaluate if natural attenuation is taking place at the site. Based on the results of the sampling natural attenuation will be further evaluated in the FS phase of this investigation.

Groundwater monitoring results from the source area and downgradient areas will be used to assess the degradation rates for nitrate and RDX. Groundwater sampling will be conducted in accordance with the RVAAP Facility-Wide SAP.

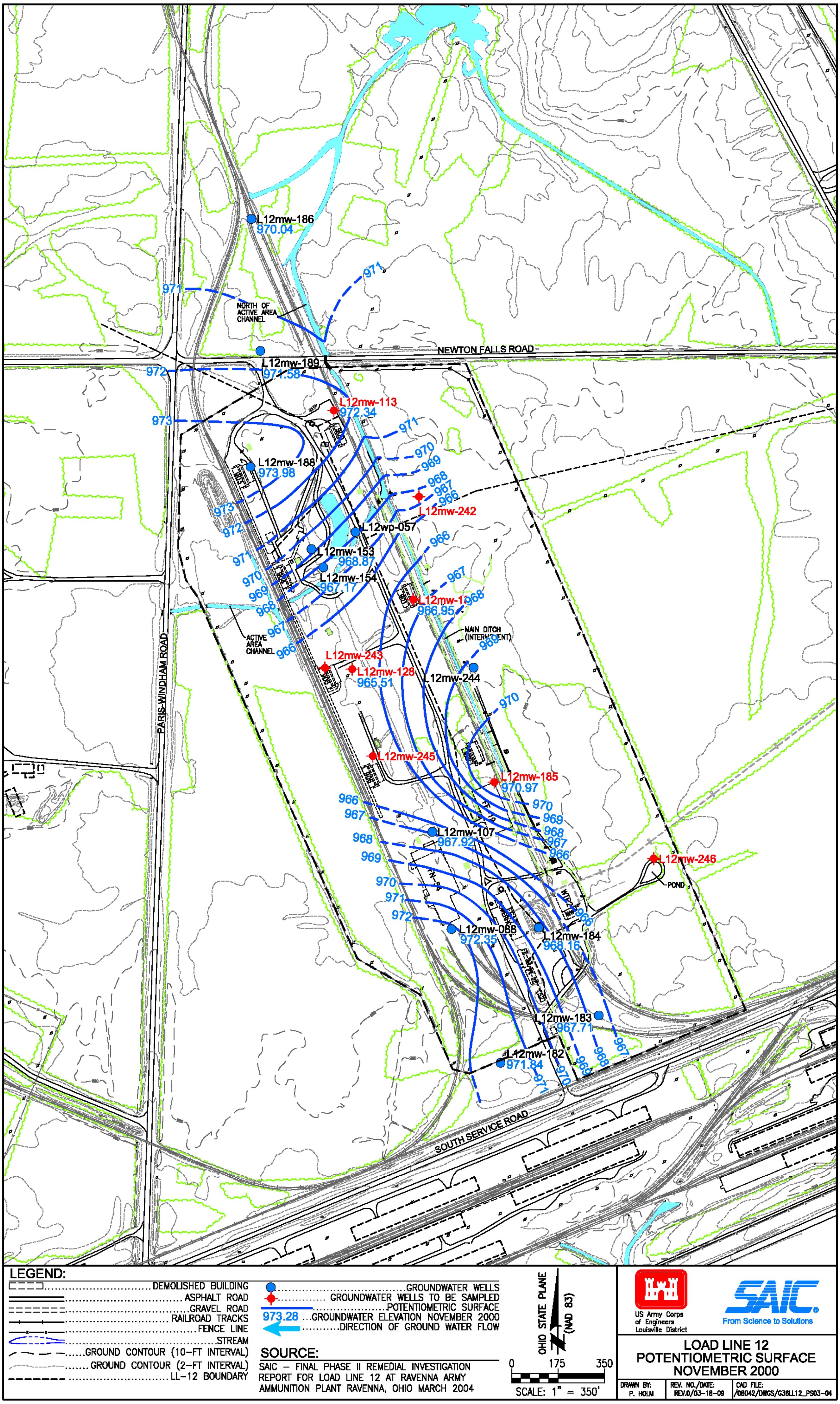


**Figure 3-1. Potentiometric Surface – November 2000**

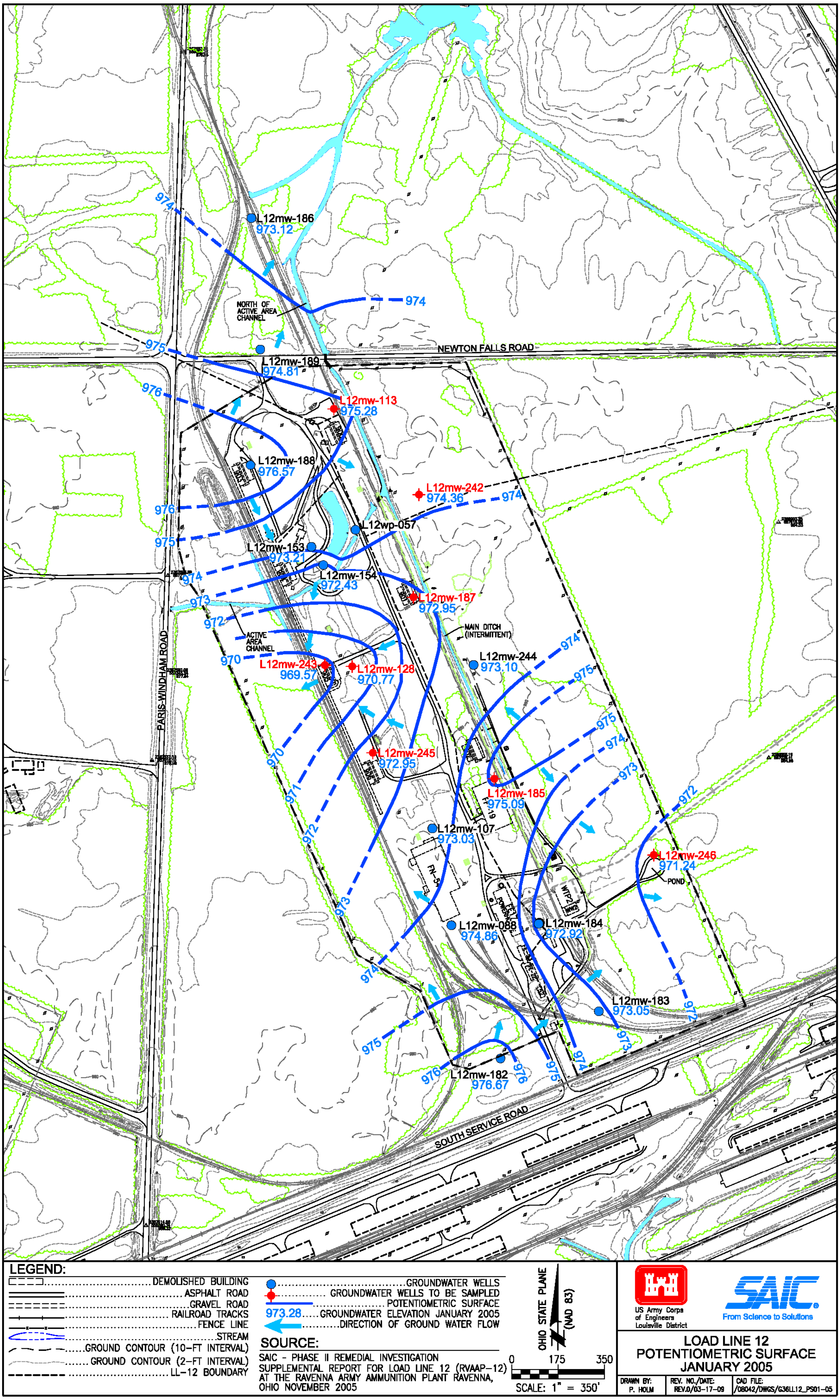


**Figure 3-2. Potentiometric Surface – January 2005**

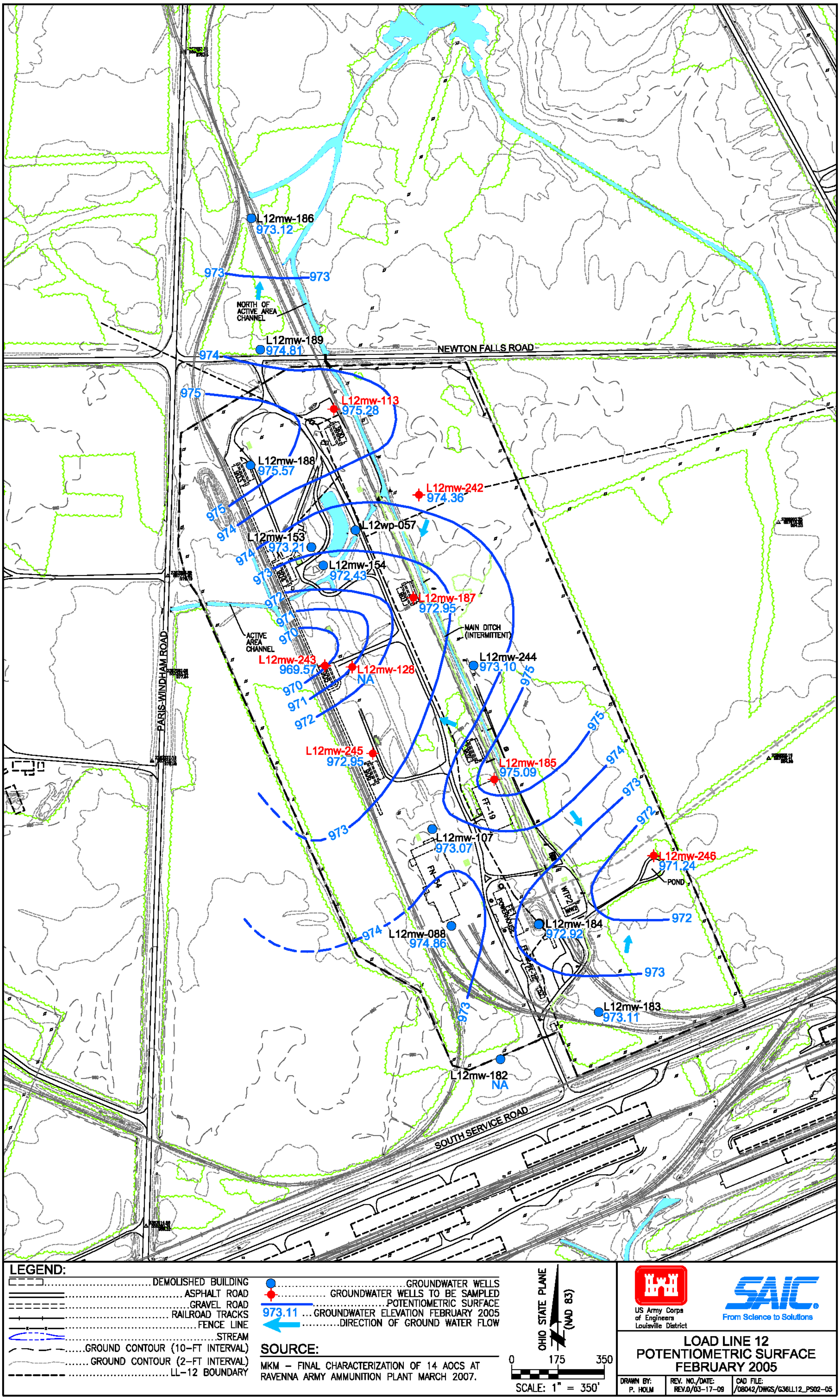


**Figure 3-3. Potentiometric Surface – February 2005**

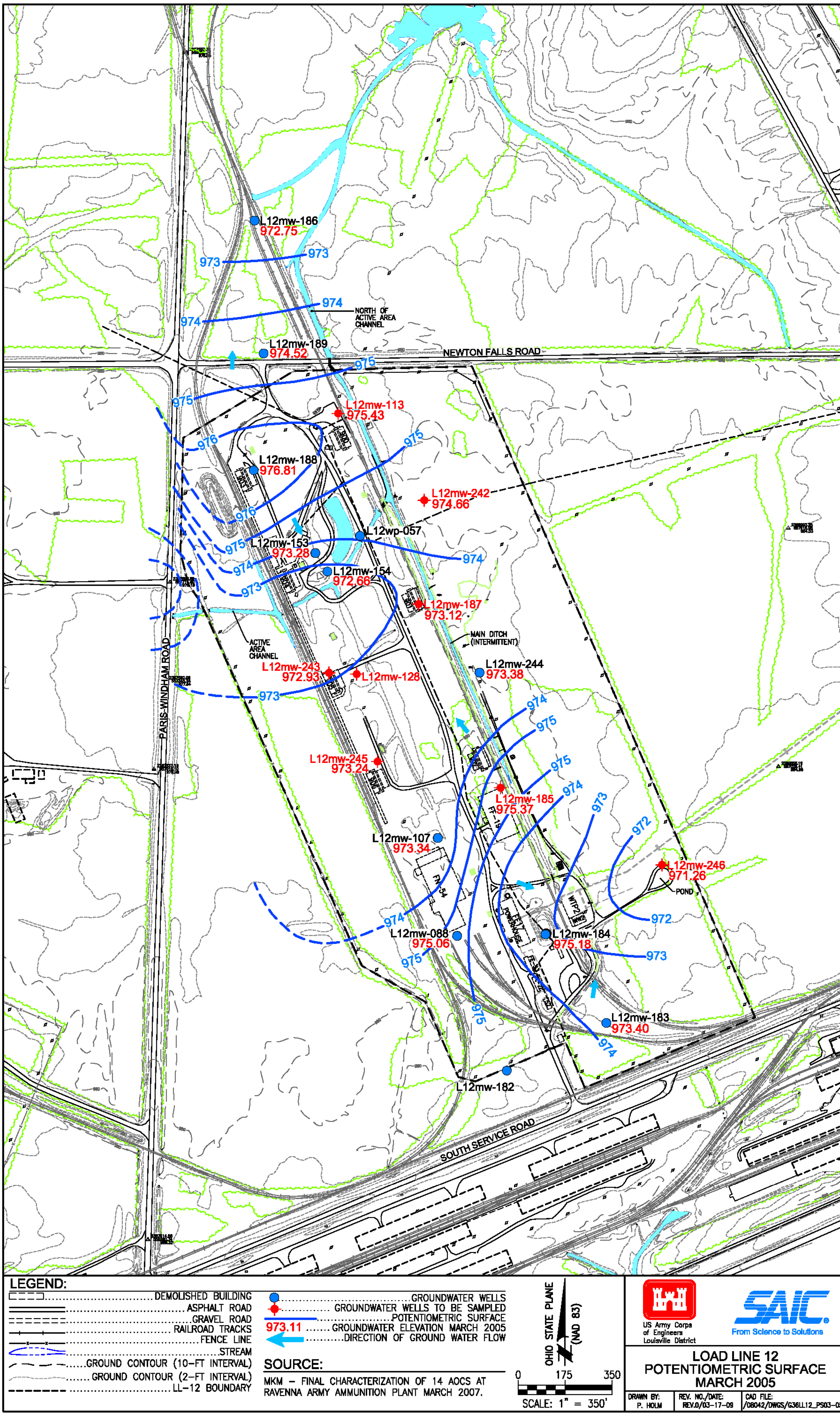


**Figure 3-4. Potentiometric Surface – March 2005**

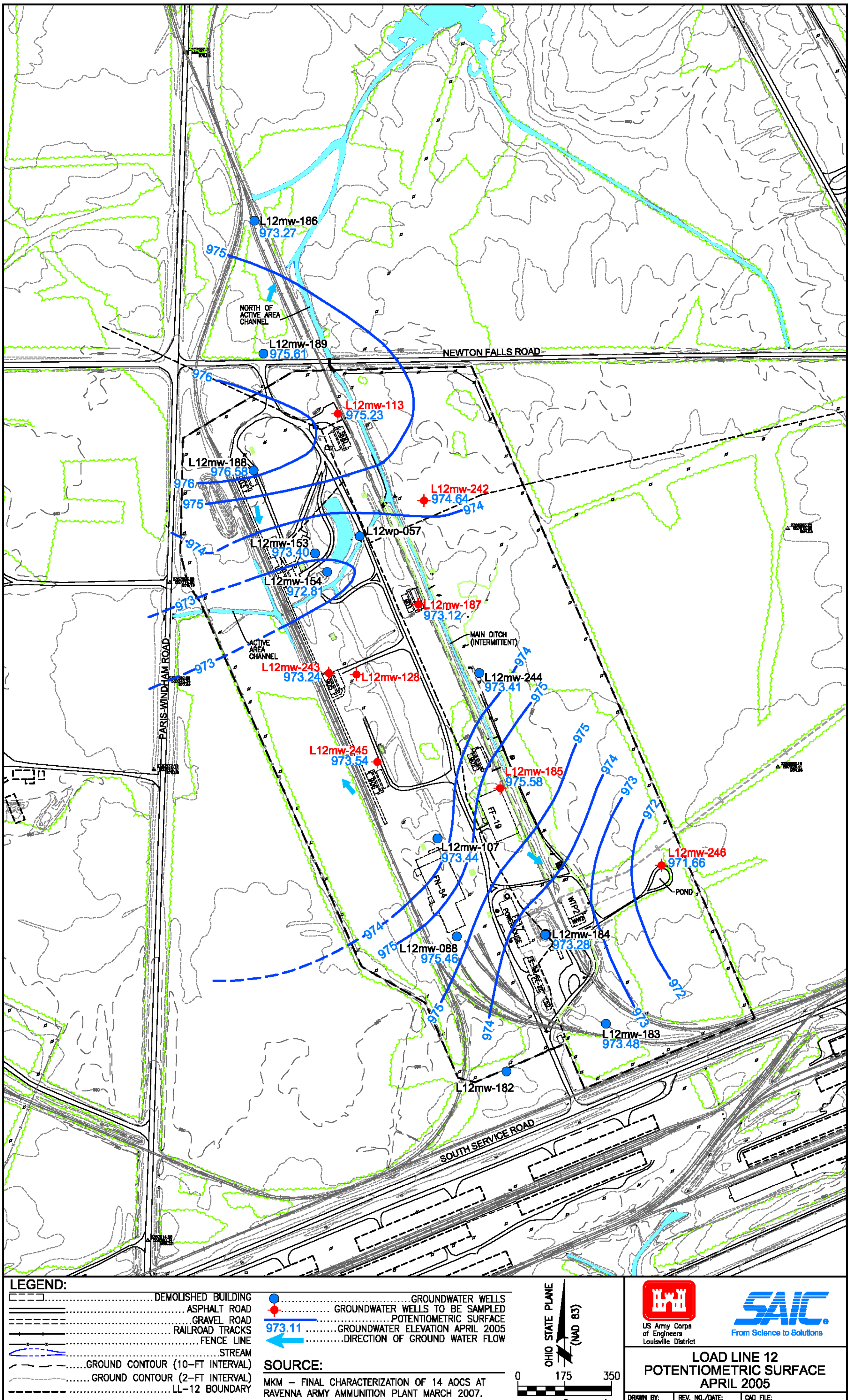


**Figure 3-5. Potentiometric Surface – April 2005**

# 4.0 FIELD ACTIVITIES

## 4.1 GROUNDWATER SAMPLING

Eight monitoring wells will be sampled for analysis of MNA parameters. These wells include two nitrate source area wells (LL12mw-185 and LL12mw-187) and six downgradient wells of the source area (L12mw-113, L12mw-128, L12mw-242, L12mw-243, L12mw-245, and L12mw-246). The location of these proposed sampling locations are shown in Figure 1-3.

### 4.1.1 Water Level Measurement

Water level measurements will be collected prior to well purging and sampling following the procedure presented in Section 4.3.2.6 of the Facility-Wide SAP.

### 4.1.2 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 4.3.3 of the Facility-Wide SAP. For health and safety purposes (reference the SSHP Addendum), all monitoring wells will be field screened for VOCs using a photoionization detector (PID) or organic vapor analyzer (OVA) during groundwater sample collection. Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe.

### 4.1.3 Well Purging Methods

In order to obtain representative samples and minimize the quantity of liquid investigation-derived waste (IDW) generated as a result of well purging, wells will be purged and sampled using low-flow methods where conditions permit, in accordance with Section 4.3.4.2 of the Facility-Wide SAP and Ohio EPA technical guidance (Ohio EPA 1995), as follows:

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

Where low-flow cannot be accomplished for any reason, then purging of all monitoring wells during the field investigation will be conducted in accordance with procedures discussed in Section 4.3.4 of the Facility-Wide SAP.

### 4.1.4 Sample Containers and Preservation Techniques

Requirements for sample containers and preservation techniques for groundwater samples are presented in Section 8.2 of the Quality Assurance Project Plan (QAPP) Addendum No.1 for Groundwater Sampling at RVAAP-12 Load Line 12.

### 4.1.5 Field Quality Control Sampling Procedures

Quality control (QC) samples for monitoring well groundwater sampling activities will include duplicate groundwater samples, split samples and equipment rinsates as described in Section 4.3.7 of the Facility-Wide SAP.

### 4.1.6 Decontamination Procedures

Decontamination of equipment associated with groundwater sampling will be in accordance with the procedure presented in Section 4.3.8 of the Facility-Wide SAP.

# 5.0 SAMPLE CHAIN OF CUSTODY/DOCUMENTATION

## 5.1 FIELD LOGBOOK

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

## 5.2 PHOTOGRAPHS

Information regarding the documentation of photographs for the groundwater sampling activities is presented in Section 4.3.2.4.3 of the Facility-Wide SAP. Representative photographs may be taken during fieldwork activities with particular attention to any special features of interest that are identified during the field effort. Photographs will be suitable for presentation in a public forum, as well as for documenting scientific information.

## 5.3 SAMPLE NUMBERING SYSTEM

The sample numbering system that will be used to identify samples collected during the groundwater sampling is explained in Section 5.3 of the Facility-Wide SAP. Samples collected will be identified sequentially by following the numbering system. If a sample is not collected or is reassigned to another location, a specific reason and notation will be written in the project field books. The sample number system is presented in Figure 5-1 and presents the sample numbers that will be used during this project.

## 5.4 SAMPLE DOCUMENTATION

All sample label, logbook, field record, and field form information will follow structures identified in Section 5.0 of the Facility-Wide SAP.

## 5.5 DOCUMENTATION PROCEDURES

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

## 5.6 CORRECTIONS TO DOCUMENTATION

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

## 5.7 MONTHLY REPORTS

Monthly reports during implementation of the field work investigation are not specified by contract. However, monthly reports for the groundwater sampling at Load Line 12 delivery order in general will be provided as a best management practice. The content of the reports will have content similar to that specified in Section 5.7 of the Facility-Wide SAP.

| **Sampling Location Identification: XXXmm-NNN(n)** | |
|---|---|
| XXX = Area Designator | Examples<br>L12 - Load Line 12 |
| mm = Sample Location Type | Examples<br>MW - Groundwater Monitoring Well |
| NNN(n) = Sequential Sample Location Number<br>[must be unique for each designator] | Examples<br>004<br>012<br>099 |
| (n) can be used as a special identifier and is optional. For example:<br><br>Use a D to identify the well as an adjacent deep zone/aquifer well (004D)<br>Use a B to identify the well as a background location (012B)<br>Use an A to identify an abandoned well (099A) | |
| Sample Identification: XXXmm-NNN(n)-####-tt | |
| #### = Sequential Sample Number<br>[must be unique for entire project site] | Examples<br>0001<br>0002<br>0003 |
| tt = Sample Type | Examples<br>GW - Groundwater Sample (unfiltered)<br>ER - Equipment Rinsate |
| Proposed Sample IDs for Groundwater Sampling<br><br>L12mw-113-0800-GW<br>L12mw-128- 0801-GW<br>L12mw-185- 0802-GW<br>L12mw-185- 0803-ER<br>L12mw-187- 0804-GW<br>L12mw-242- 0805-GW<br>L12mw-243- 0806-GW<br>L12mw-245- 0807-GW<br>L12mw-246- 0808-GW | |

**Figure 5-1. Sample ID Example and Planned Sample IDs For The Project**

# 6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample packaging and shipping shall follow procedures in Section 6.0 of the Facility-Wide SAP.

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# 7.0 INVESTIGATION-DERIVED WASTE

All IDW, including personal protective equipment (PPE), disposable sampling equipment, and decontamination fluids, will be properly handled, labeled, characterized, and managed in accordance with Section 7.0 of the Facility-Wide SAP. At the conclusion of field activities, a letter report will be submitted to the USACE, the RVAAP Facility Manager and Ohio EPA documenting the characterization and classification of the wastes. Upon approval of the IDW classification report, all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor. All shipments of IDW off-site will be coordinated through the RVAAP Facility Manager.

Three types of IDW are anticipated, which will be contained separately.

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

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

- **IDW Water:** Purge water and excess water not used for environmental samples will be placed in 55-gallon drums. Disposition will be based on process knowledge and analytical results of the environmental samples. If data indicate that IDW water is potentially hazardous, toxicity characteristic leaching procedure (TCLP) samples will be collected.
- **Decontamination Fluids:** Decontamination fluids will be placed in drums or a polytank up to 1,500 gallons in size as needed. Disposition of decontamination liquid will be based on the collection and analysis of TCLP liquid sample(s).
- **Solid Waste:** Trash, gloves and other expendable solid waste will be placed in sanitary waste containers for removal from the site in coordination with the RVAAP Facility Manager.

IDW water and decontamination fluid will be transported to a location designated by the RVAAP Facility Manager, where it will be placed in separate steel drums and staged on pallets in secondary containment. To avoid potential rupture due to freezing conditions, drums containing liquid IDW will be filled only to 75% capacity.

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# 8.0 REFERENCES

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# APPENDIX A

## Previous Groundwater Sampling Data for all Site Wells at Load Line 12

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load Line 12 | LL12mw-088 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 6.6 J | 10 U | 10 U | 10 U | NS | 1900 | * |
| | | | 4-Methyl-2-pentanone | - - | - - | - - | - - | 0.36 J | 10 U | 10 U | 10 U | NS | 1900 | * |
| | | | Acetone | - - | - - | - - | - - | 58 JB | 10 U | 10 U | 1.6 JB | NS | 610 | * |
| | | | Arsenic | - - | - - | - - | - - | **16.8** | **21.9** | *14.2 U* | **13.8** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | **301** | **379** | **363** | **383** | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.32 JB | 5 | 0.35 | * |
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.015 J | 0.03 U | NS | 0.037 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 1 J | 1.8 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | *114000* | **149000** | **150000** | **163000** | NS | NS | 115000 |
| | | | Iron | - - | - - | - - | - - | **2860 J** | **3100** | **2470** | **1700** | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | *41400* | **52500** | **52600** | **57200** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *304* | *412* | *371* | *392* | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | **6.4 J** | 10 U | **3.7 J** | **3.8 J** | NS | 730 | 0 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 100 U | 100 U | 40 J | 60 J | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 1825 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.65 U | 0.7 U | 0.63 U | 0.63 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.055 J | 0.097 U | 0.097 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.65 U | 0.7 U | 0.63 U | 0.63 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.54 U | 0.48 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.092 J | 0.097 U | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.54 U | 0.48 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.11 U | 0.097 U | 0.097 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.54 U | 0.48 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **5490** | *2410 J* | *2370* | **2890 J** | NS | NS | 2890 |
| | | | Selenium | - - | - - | - - | - - | 5 U | **4.3 J** | 5 U | 5 U | 50 | 180 | 0 |
| | | | Sodium | - - | - - | - - | - - | *13600* | *12800* | *12500* | *13800* | NS | NS | 45700 |
| | | | Thallium | - - | - - | - - | - - | 1 U | 1 U | **0.17 J** | 1 U | 2 | 2 | 0 |
| | | | Zinc | - - | - - | - - | - - | *3.3 JB* | 10 U | *7.3 J* | *5.4 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-107 | Unconsolidated | 4,4'-DDT | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.019 J | 0.03 U | NS | 0.2 | * |
| | | | Acetone | - - | - - | - - | - - | 10 U | 10 U | 10 U | 4.4 JB | NS | 5500 | * |
| | | | Arsenic | - - | - - | - - | - - | **17.4** | 5 U | *7.3 B* | **15.1** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *27* | *27.7* | *28.4* | *30.6* | 2000 | 2600 | 82.1 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.03 U | 0.022 J | NS | 0.032 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 0.91 J | 10 U | 1.7 J | 1.2 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **157000** | **162000** | **172000** | **186000** | NS | NS | 115000 |
| | | | Cobalt | - - | - - | - - | - - | 5 U | 5 U | **2.1 J** | **2.7 J** | NS | 730 | 0 |
| | | | Cyanide | - - | - - | - - | - - | 0.01 U | 0.01 R | 0.015 | 0.01 U | NS | 730 | * |
| | | | Iron | - - | - - | - - | - - | **2090 J** | *50.8 J* | **1690 J** | **2700** | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **67800** | **68500** | **71800** | **77500** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *225* | *277* | *280* | *311* | 50 | 880 | 1020 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 300 J | 100 U | 30 J | 100 U | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 1825 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.65 U | 0.64 U | 0.64 U | 0.65 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.055 J | 0.098 U | 0.1 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.65 U | 0.64 U | 0.64 U | 0.65 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.49 U | 0.49 U | 0.5 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.076 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.49 U | 0.49 U | 0.5 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.098 U | 0.098 U | 0.1 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.49 U | 0.49 U | 0.5 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 210 J | 500 UJ | NS | NS | * |
| | | | Perchlorate | - - | - - | - - | - - | NT | NT | 0.013 J | NT | NS | 3.6 | * |
| | | | Potassium | - - | - - | - - | - - | **3560** | *2240* | *2570* | *2280 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *17700* | *16800* | *17300* | *18500* | NS | NS | 45700 |
| | | | Vanadium | - - | - - | - - | - - | 10 U | **1 J** | 10 U | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | *3.9 JB* | 10 U | *7.2 J* | *3.2 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-113 | Unconsolidated | Acetone | - - | - - | - - | - - | 10 U | 10 U | 10 U | *1.7 JB* | NS | 5500 | * |
| | | | Aluminum | - - | - - | - - | - - | **28500** | **1350** | **10400 J** | 50 U | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | **0.56 J** | **0.33 J** | **0.34 J** | **0.35 J** | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **54.3** | *4.9 J* | **23.8** | *7.3* | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *111* | *28.5* | *63* | *25* | 2000 | 2600 | 256 |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 10 U | *0.97 JB* | NS | 4.8 | * |
| | | | Benzene | - - | - - | - - | - - | 1 U | 0.25 J | 1 U | 0.31 J | 5 | 0.35 | * |
| | | | Beryllium | - - | - - | - - | - - | **1.5** | 1 U | **0.42 J** | 1 U | 4 | NS | 0 |
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.021 J | 0.03 U | 0.011 J | NS | 0.037 | * |
| | | | Cadmium | - - | - - | - - | - - | **0.45 J** | **0.19 J** | **0.2 J** | **0.28 J** | 5 | NS | 0 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Calcium | - - | - - | - - | - - | **296000** | **186000** | **230000** | **293000** | NS | NS | 53100 |
| | | | Chromium | - - | - - | - - | - - | *41.3* | *2.2 J* | *15.7* | 5 U | 100 | NS | 7.3 |
| | | | Cobalt | - - | - - | - - | - - | **38.8** | **4.2 J** | **15.6** | **7.1** | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | **84.4** | 5 U | **21.2** | 5 U | 1300 | 1500 | 0 |
| | | | Cyanide | - - | - - | - - | - - | 0.0087 J | 0.01 U | 0.01 U | 0.01 U | NS | 730 | * |
| | | | Iron | - - | - - | - - | - - | **88300** | **3660** | **29100** | *371* | 300 | 11000 | 1430 |
| | | | Lead | - - | - - | - - | - - | **47** | *2.1 J* | *10.4* | 3 U | 15 | NS | 23 |
| | | | Magnesium | - - | - - | - - | - - | **122000** | **75200** | **101000** | **125000** | NS | NS | 15000 |
| | | | Manganese | - - | - - | - - | - - | **4410** | **1510** | **2450** | **2800** | 50 | 880 | 1340 |
| | | | Nickel | - - | - - | - - | - - | *77.1* | *5.1 J* | *36.2* | *14.1* | NS | 730 | 83.4 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 600 | 100 U | 1100 J | 100 U | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.09 U | 0.058 J | 0.092 U | 0.1 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.58 U | 0.67 U | 0.6 U | 0.68 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.09 U | 0.055 J | 0.092 U | 0.1 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.58 U | 0.67 U | 0.6 U | 0.68 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.45 U | 0.52 U | 0.46 U | 0.52 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.09 U | 0.11 U | 0.092 J | 0.1 U | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.45 U | 0.52 U | 0.46 U | 0.52 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.09 U | 0.1 U | 0.092 U | 0.1 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.45 U | 0.52 U | 0.46 U | 0.52 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 130 J | 140 J | 500 UJ | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **11800** | *4580 J* | **8160** | **8330 J** | NS | NS | 5770 |
| | | | Sodium | - - | - - | - - | - - | *24200* | *23000* | *23500* | *29600* | NS | NS | 51400 |
| | | | Thallium | - - | - - | - - | - - | **0.42 J** | 1 U | **0.25 J** | 1 U | 2 | 2.4 | 0 |
| | | | Vanadium | - - | - - | - - | - - | **46.7 J** | **0.83 J** | **16.9** | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | **178** | *13.1* | **66.2** | *8.1 JB* | 5000 | 11000 | 52.3 |
| Load Line 12 | LL12mw-128 | Unconsolidated | Aluminum | - - | - - | - - | - - | **1340** | **6570** | 50 U | **546 J** | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | 2 U | **0.28 J** | **0.29 J** | 2 U | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **40.1** | **52.9** | **51.5** | **47.6** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *68.1* | *75.5* | *58.6* | *52.8* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | *0.24 JB* | 5 | 0.35 | * |
| | | | Beryllium | - - | - - | - - | - - | 1 U | **0.29 J** | 1 U | 1 U | 4 | NS | 0 |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 2.2 J | 1.3 J | 1.1 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **180000** | **165000** | **209000** | **179000** | NS | NS | 115000 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Chloromethane | - - | - - | - - | - - | 1 U | 1 U | 1 U | 1.4 | NS | 160 | * |
| | | | Chromium | - - | - - | - - | - - | 5 U | **8.9** | 5 U | 5 U | 100 | NS | 0 |
| | | | Cobalt | - - | - - | - - | - - | 5 U | **6.3** | 5 U | 5 U | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | 5 U | **6 J** | 5 U | 5 U | 1300 | 1500 | 0 |
| | | | Iron | - - | - - | - - | - - | **7310** | **17400 J** | **5480 J** | **5650** | 300 | 11000 | 279 |
| | | | Lead | - - | - - | - - | - - | 3 U | **5.2** | 3 U | 3 U | 15 | NS | 0 |
| | | | Magnesium | - - | - - | - - | - - | **108000** | **101000** | **126000** | **106000** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *199* | *333* | *189* | *192* | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | 10 U | **14.4** | 10 U | 10 U | NS | 730 | 0 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 90 JB | 100 U | 100 U | 20000 J | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 1825 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.7 U | 0.68 U | 0.68 U | 0.64 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.11 U | 0.055 J | 0.1 U | 0.098 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.7 U | 0.68 U | 0.68 U | 0.64 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.54 U | 0.52 U | 0.52 U | 0.49 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.067 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.098 J | 0.52 U | 0.52 U | 0.49 U | NS | 61 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.11 U | 0.1 U | 0.1 U | 0.098 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.54 U | 0.52 U | 0.52 U | 0.49 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **2970** | **3630 J** | *2170* | *2010 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *23700* | *19000* | *24700* | *21600* | NS | NS | 45700 |
| | | | Thallium | - - | - - | - - | - - | 1 U | **0.18 J** | 1 U | 1 U | 2 | 2 | 0 |
| | | | Vanadium | - - | - - | - - | - - | 10 U | **9.6 J** | 10 U | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | *12.4 B* | *30.5* | *3.1 J* | *17.4 B* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-153 | Unconsolidated | Aluminum | 50 U | **13.3 J** | 50 U | 50 U | - - | - - | - - | - - | 200 | 36000 | 0 |
| | | | Antimony | 2 U | 2 U | **0.096 J** | **0.22 J** | - - | - - | - - | - - | 6 | 15 | 0 |
| | | | Arsenic | **12.7** | **14.6** | **26.9** | **24.6** | - - | - - | - - | - - | 10 | 0 | 11.7 |
| | | | Barium | *73.2* | *74.9* | *74.4 J* | *79.4* | - - | - - | - - | - - | 2000 | 2600 | 82.1 |
| | | | beta-BHC | 0.03 U | 0.03 U | 0.03 U | 0.01 J | - - | - - | - - | - - | NS | 0.04 | * |
| | | | Calcium | **133000** | **138000 J** | **145000 J** | **147000** | - - | - - | - - | - - | NS | NS | 115000 |
| | | | Copper | 5 U | **3 J** | 5 U | 5 U | - - | - - | - - | - - | 1300 | 1500 | 0 |
| | | | Iron | **4020** | **4000** | **4810** | **4180** | - - | - - | - - | - - | 300 | 11000 | 279 |
| | | | Magnesium | **72600** | **75500** | **79700** | **80500** | - - | - - | - - | - - | NS | NS | 43300 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Manganese | *187* | *198 J* | *195 J* | *206* | - - | - - | - - | - - | 50 | 880 | 1020 |
| | | | Nickel | 10 U | **1.7 J** | 10 U | 10 U | - - | - - | - - | - - | NS | 730 | 0 |
| | | | Nitrate-Nitrite | 100 U | 100 U | 100 U | 20 J | - - | - - | - - | - - | 10000 | 1000 | * |
| | | | Nitroguanidine | 20 U | 20 U | 20 U | 20 U | - - | - - | - - | - - | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 73 | * |
| | | | RDX | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | NS | * |
| | | | HMX | 0.097 U | 0.097 U | 0.098 U | 0.052 J | - - | - - | - - | - - | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | NS | * |
| | | | Tetryl | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 365 | * |
| | | | Nitroglycerin | - - | 0.65 U | 0.64 U | 0.73 U | - - | - - | - - | - - | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 36 | * |
| | | | PETN | - - | 0.65 U | 0.64 U | 0.73 U | - - | - - | - - | - - | NS | NS | * |
| | | | 2-Nitrotoluene | 0.48 U | 0.097 J | 0.49 U | 0.5 U | - - | - - | - - | - - | NS | 110 | * |
| | | | Nitrobenzene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 3.4 | * |
| | | | 3-Nitrotoluene | 0.48 U | 0.48 U | 0.49 U | 0.56 U | - - | - - | - - | - - | NS | 61 | * |
| | | | 1,3,5-Trinitrobenzene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | 0.097 U | 0.097 U | 0.098 U | 0.11 U | - - | - - | - - | - - | NS | 3.6 | * |
| | | | 4-Nitrotoluene | 0.48 U | 0.48 U | 0.49 U | 0.56 U | - - | - - | - - | - - | NS | 0.66 | * |
| | | | Nitrocellulose | 500 U | 500 U | 500 U | 500 U | - - | - - | - - | - - | NS | NS | * |
| | | | Potassium | *1960 J* | *1950 J* | *2120 J* | *2150* | - - | - - | - - | - - | NS | NS | 2890 |
| | | | Sodium | *24400* | *25400* | *25100* | *26900* | - - | - - | - - | - - | NS | NS | 45700 |
| | | | Zinc | *6.9 J* | *7.9 J* | *4.6 J* | *6.2 J* | - - | - - | - - | - - | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-154 | Unconsolidated | Acetone | - - | - - | - - | - - | 10 U | 1.6 JB | 10 U | 10 UJ | NS | 610 | * |
| | | | Aluminum | - - | - - | - - | - - | **4820** | 50 U | 50 U | 50 U | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | **0.33 J** | 2 U | 2 U | 2 U | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **651** | *8* | **16.3 B** | **24.7** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | **117** | *43.3* | *47.7* | *51.5* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.32 JB | 5 | 0.35 | * |
| | | | Beryllium | - - | - - | - - | - - | **0.24 J** | 1 U | 1 U | 1 U | 4 | NS | 0 |
| | | | beta-BHC | - - | - - | - - | - - | 0.026 J | 0.03 U | 0.012 J | 0.03 UJ | NS | 0.037 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 1.3 J | 10 U | 10 U | 1.1 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **130000** | **130000** | **148000** | **145000** | NS | NS | 115000 |
| | | | Chromium | - - | - - | - - | - - | **5.9** | 5 U | 5 U | 5 U | 100 | NS | 0 |
| | | | Cobalt | - - | - - | - - | - - | **4.7 J** | 5 U | 5 U | 5 U | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | **10.7** | 5 U | 5 U | 5 U | 1300 | 1500 | 0 |
| | | | Cyanide | - - | - - | - - | - - | 0.01 U | 0.01 R | 0.057 | 0.01 U | NS | 730 | * |
| | | | Iron | - - | - - | - - | - - | **53200 J** | **162 J** | **2580 J** | **2440** | 300 | 11000 | 279 |
| | | | Lead | - - | - - | - - | - - | **5.4** | 3 U | 3 U | 3 U | 15 | NS | 0 |
| | | | Magnesium | - - | - - | - - | - - | **58300** | **60500** | **72400** | **66800** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *213* | *70.5* | *95.9* | *80.7* | 50 | 880 | 1020 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nickel | - - | - - | - - | - - | **11.3** | 10 U | 10 U | 10 U | NS | 730 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 60 JB | 100 U | 50 J | 100 B | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 1825 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.65 U | 0.64 U | 0.64 U | 0.64 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.055 J | 0.098 U | 0.098 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.65 U | 0.64 U | 0.64 U | 0.64 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.5 U | 0.5 U | 0.49 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.092 J | 0.098 U | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.5 U | 0.5 U | 0.49 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.099 U | 0.098 U | 0.098 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.5 U | 0.5 U | 0.49 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 140 J | 500 UJ | 130 J | 500 UJ | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **3430** | *1950* | *1920* | *1820 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *20100* | *21400* | *24200* | *22400* | NS | NS | 45700 |
| | | | Vanadium | - - | - - | - - | - - | **7.8 J** | 10 U | 10 U | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | *39.3 J* | 10 U | *4.1 J* | *3.6 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-182 | Unconsolidated | Aluminum | **5.4 J** | **14.7 J** | **20.1 J** | 50 U | - - | - - | - - | - - | 200 | 36000 | 0 |
| | | | Antimony | 0.34 J | 2 U | 2 U | 2 U | - - | - - | - - | - - | 6 | 15 | 0 |
| | | | Arsenic | **26.6** | **35.3** | **51** | **40.5** | - - | - - | - - | - - | 10 | 0 | 11.7 |
| | | | Barium | **94.4** | **85.8** | *79 J* | *72.4* | - - | - - | - - | - - | 2000 | 2600 | 82.1 |
| | | | Benzoic Acid | 10 U | 8.3 J | 10 U | 10 R | - - | - - | - - | - - | NS | 150000 | * |
| | | | beta-BHC | 0.03 U | 0.03 U | 0.03 U | 0.019 J | - - | - - | - - | - - | NS | 0.04 | * |
| | | | bis(2-Ethylhexyl) phthalate | 10 U | 1.4 J | 3.7 J | 3 J | - - | - - | - - | - - | NS | 4.8 | * |
| | | | Calcium | *73200* | *83700 J* | *83200 J* | *81500* | - - | - - | - - | - - | NS | NS | 115000 |
| | | | Copper | 2 J | **2.4 J** | 5 U | 5 U | - - | - - | - - | - - | 1300 | 1500 | 0 |
| | | | Cyanide | 3.5 J | 0.01 U | 0.01 U | 0.01 R | - - | - - | - - | - - | NS | 730 | * |
| | | | Iron | **292** | **1170** | **1680 J** | **1100** | - - | - - | - - | - - | 300 | 11000 | 279 |
| | | | Magnesium | **49700** | **61900** | **65100** | **65300** | - - | - - | - - | - - | NS | NS | 43300 |
| | | | Manganese | *22.3* | *52.6 J* | *53.8 J* | *56.1* | - - | - - | - - | - - | 50 | 880 | 1020 |
| | | | Methoxychlor | 0.1 U | 0.1 U | 0.1 U | 0.01 J | - - | - - | - - | - - | 40 | 180.00 | * |
| | | | Nickel | 1.6 J | 10 U | 10 U | 10 U | - - | - - | - - | - - | NS | 730 | 0 |
| | | | Nitrate-Nitrite | 100 U | 100 U | 100 U | 100 U | - - | - - | - - | - - | 10000 | 1000 | * |
| | | | Nitroguanidine | 20 U | 20 U | 20 U | 20 U | - - | - - | - - | - - | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 2.2 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2,4-Dinitrotoluene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 73 | * |
| | | | RDX | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | NS | * |
| | | | HMX | 0.097 U | 0.098 U | 0.098 U | 0.066 J | - - | - - | - - | - - | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | NS | * |
| | | | Tetryl | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 365 | * |
| | | | Nitroglycerin | - - | 0.65 U | 0.64 U | 0.75 U | - - | - - | - - | - - | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | .059 J | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 36 | * |
| | | | PETN | - - | 0.65 U | 0.64 U | 0.75 U | - - | - - | - - | - - | NS | NS | * |
| | | | 2-Nitrotoluene | 0.48 U | 0.1 J | 0.49 U | 0.58 U | - - | - - | - - | - - | NS | 110.0 | * |
| | | | Nitrobenzene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 3.4 | * |
| | | | 3-Nitrotoluene | 0.48 U | 0.49 U | 0.49 U | 0.58 U | - - | - - | - - | - - | NS | 61 | * |
| | | | 1,3,5-Trinitrobenzene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | 0.097 U | 0.098 U | 0.098 U | 0.12 U | - - | - - | - - | - - | NS | 3.6 | * |
| | | | 4-Nitrotoluene | 0.31 J | 0.49 U | 0.49 U | 0.58 U | - - | - - | - - | - - | NS | 3.2 | * |
| | | | Nitrocellulose | 500 U | 500 U | 500 U | 500 U | - - | - - | - - | - - | NS | NS | * |
| | | | Nitrobenzene | 0.097 U | 0.097 U | 0.064 J | 0.12 U | - - | - - | - - | - - | NS | 3.4 | * |
| | | | Nitrocellulose | 120 J | 150 B | 500 U | 500 U | - - | - - | - - | - - | NS | NS | * |
| | | | Potassium | **6140 J** | **3950 J** | **4100 J** | **3230** | - - | - - | - - | - - | NS | NS | 2890 |
| | | | Sodium | *29200* | *27300* | *26300* | *25500* | - - | - - | - - | - - | NS | NS | 45700 |
| | | | Zinc | *4.8 J* | *6.1 J* | *3.8 J* | *3.1 J* | - - | - - | - - | - - | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-183 | Unconsolidated | Aluminum | 50 U | **5.3 J** | 50 U | 50 U | - - | - - | - - | - - | 200 | 36000 | 0 |
| | | | Antimony | **.12 J** | 2 U | 2 U | **0.2 J** | - - | - - | - - | - - | 6 | 15 | 0 |
| | | | Arsenic | **34.5** | **20.2** | **33.3** | **34.9** | - - | - - | - - | - - | 10 | 0 | 11.7 |
| | | | Barium | **82.3** | *78.4* | *71.8 J* | *78.1* | - - | - - | - - | - - | 2000 | 2600 | 82.1 |
| | | | bis(2-Ethylhexyl) phthalate | 10 U | 10 U | 2.1 J | 10 UJ | - - | - - | - - | - - | NS | 4.8 | * |
| | | | Calcium | *110000* | **116000 J** | **115000 J** | **120000** | - - | - - | - - | - - | NS | NS | 115000 |
| | | | Carbon disulfide | 1 U | 1 U | 1 U | 0.47 J | - - | - - | - - | - - | NS | 1000 | * |
| | | | Chromium | 5 U | 5 U | 5 U | **5.6 J** | - - | - - | - - | - - | 100 | NS | 0 |
| | | | Copper | 5 U | **2.8 J** | 5 U | 5 U | - - | - - | - - | - - | 1300 | 1500 | 0 |
| | | | Iron | **1220** | **830** | **1670 J** | **1460** | - - | - - | - - | - - | 300 | 11000 | 279 |
| | | | Magnesium | **44700** | **46200** | **46100** | **48400** | - - | - - | - - | - - | NS | NS | 43300 |
| | | | Manganese | *56.9* | *53.4 J* | *74.1 J* | *74.6* | - - | - - | - - | - - | 50 | 880 | 1020 |
| | | | Methoxychlor | 0.1 U | .012 J | 0.1 U | 0.1 U | - - | - - | - - | - - | 40 | 180.00 | * |
| | | | Nickel | 10 U | 10 U | 10 U | **5.1** J | - - | - - | - - | - - | NS | 730 | 0 |
| | | | Nitrate-Nitrite | 100 U | 100 U | 100 U | 20 J | - - | - - | - - | - - | 10000 | 1000 | * |
| | | | Nitroguanidine | 20 U | 20 U | 20 U | 20 U | - - | - - | - - | - - | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 73 | * |
| | | | RDX | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | NS | * |
| | | | HMX | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 1800 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2-Amino-4,6-Dinitrotoluene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | NS | * |
| | | | Tetryl | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 365 | * |
| | | | Nitroglycerin | - - | 0.65 U | 0.68 U | 0.64 U | - - | - - | - - | - - | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 36 | * |
| | | | PETN | - - | 0.65 U | 0.68 U | 0.64 U | - - | - - | - - | - - | NS | NS | * |
| | | | 2-Nitrotoluene | 0.48 U | 0.5 U | 0.52 U | 0.49 U | - - | - - | - - | - - | NS | 110 | * |
| | | | Nitrobenzene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 3.4 | * |
| | | | 3-Nitrotoluene | 0.48 U | 0.5 U | 0.52 U | 0.49 U | - - | - - | - - | - - | NS | 61 | * |
| | | | 1,3,5-Trinitrobenzene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | 0.097 U | 0.099 U | 0.1 U | 0.098 U | - - | - - | - - | - - | NS | 3.6 | * |
| | | | 4-Nitrotoluene | 0.48 U | 0.5 U | 0.52 U | 0.49 U | - - | - - | - - | - - | NS | 0.66 | * |
| | | | Nitrocellulose | 500 U | 500 U | 500 U | 500 U | - - | - - | - - | - - | NS | NS | * |
| | | | Potassium | **4920 J** | **3880 J** | **3800 J** | **3470** | - - | - - | - - | - - | NS | NS | 2890 |
| | | | Sodium | *20600* | *18700* | *17600* | *18100* | - - | - - | - - | - - | NS | NS | 45700 |
| | | | Zinc | *6.3 J* | *5 J* | *5.3 J* | *3.9 J* | - - | - - | - - | - - | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-184 | Unconsolidated | Arsenic | - - | - - | - - | - - | **13.5** | **16.7** | **11.9 B** | **18.4** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *10.9* | *9.9 J* | *10.2* | *8.4 J* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.28 JB | 5 | 0.35 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 2.5 J | 10 U | 2.6 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **203000** | **208000** | **224000** | **210000** | NS | NS | 115000 |
| | | | Chloromethane | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.33 J | NS | 160 | * |
| | | | Heptachlor epoxide | - - | - - | - - | - - | 0.03 U | 0.0082 J | 0.03 U | 0.03 UJ | NS | 0.0074 | * |
| | | | Iron | - - | - - | - - | - - | **2410 J** | **2680 J** | **3130 J** | **2940** | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **149000** | **157000** | **166000** | **155000** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *498* | *527* | *551* | *498* | 50 | 880 | 1020 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 70 JB | 100 U | 30 J | 100 U | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 1825 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.65 U | 0.63 U | 0.63 U | 0.68 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.65 U | 0.63 U | 0.63 U | 0.68 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.48 U | 0.48 U | 0.52 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.11 U | 0.097 U | 0.097 U | 0.1 U | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.48 U | 0.48 U | 0.52 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.097 U | 0.097 U | 0.1 U | NS | 3.6 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.48 U | 0.48 U | 0.52 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **3130** | *2670* | *2660* | *2390 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *37900* | *39000* | *39600* | *37600* | NS | NS | 45700 |
| | | | Zinc | - - | - - | - - | - - | *6 JB* | *7.4 J* | *6.6 J* | *6.6 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-185 | Unconsolidated | 4,4'-DDT | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.019 J | 0.03 U | NS | 0.2 | * |
| | | | Aluminum | - - | - - | - - | - - | 50 U | 50 U | 50 U | **61.3 JB** | 200 | 36000 | 0 |
| | | | Barium | - - | - - | - - | - - | *57.2* | *54.6* | *54.7* | *53.3* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | *0.3 JB* | 5 | 0.35 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 2.1 J | 3.2 JB | NS | 4.8 | * |
| | | | Cadmium | - - | - - | - - | - - | **0.24 J** | **0.27 J** | **0.25 J** | **0.23 JB** | 5 | NS | 0 |
| | | | Calcium | - - | - - | - - | - - | 714000 R | **695000** | **677000** | **1020000** | NS | NS | 115000 |
| | | | Carbon disulfide | - - | - - | - - | - - | 1 U | 1 U | 0.36 J | 1 U | NS | 1000 | * |
| | | | Chloromethane | - - | - - | - - | - - | 1 U | 1 U | 1 U | 1.6 | NS | 160 | * |
| | | | Cobalt | - - | - - | - - | - - | **2.6 J** | **2.3 J** | **2.7 J** | **3 J** | NS | 730 | 0 |
| | | | delta-BHC | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.021 J | 0.03 UJ | NS | 0.052 | * |
| | | | Magnesium | - - | - - | - - | - - | **304000** | **297000** | **308000** | **298000** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | **1780** | **1580** | **1530** | **1640** | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | **6.9 J** | **4.6 J** | **5.6 J** | **6.8 J** | NS | 730 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 220000 | 800 | 240000 J | 230000 J | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.096 U | 0.067 J | 0.097 U | 0.097 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.62 U | 0.68 U | 0.63 U | 0.63 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.62 U | 0.68 U | 0.63 U | 0.63 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.52 U | 0.48 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.071 J | 0.1 U | 0.075 J | 0.079 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.52 U | 0.48 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.1 U | 0.097 U | 0.097 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.52 U | 0.48 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 1400 J | 490 J | 3500 J | 500 UJ | NS | NS | * |
| | | | Perchlorate | - - | - - | - - | - - | NT | NT | 0.065 | NT | NS | 3.6 | * |
| | | | Potassium | - - | - - | - - | - - | **9220** | **7680 J** | **7730** | **7720 J** | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | **58300** | **55800** | **56200** | **54800** | NS | NS | 45700 |
| | | | Zinc | - - | - - | - - | - - | *5.3 JB* | *4 J* | *6 JB* | *21.2 B* | 5000 | 11000 | 60.9 |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Load Line 12 | LL12mw-186 | Unconsolidated | Barium | *47.3* | *46.9* | *45 J* | *45.9* | - - | - - | - - | - - | 2000 | 2600 | 82.1 |
| | | | beta-BHC | 0.03 U | 0.03 U | 0.03 U | 0.014 J | - - | - - | - - | - - | NS | 0.04 | * |
| | | | bis(2-Ethylhexyl) phthalate | 10 U | 2 J | .97 JB | 2.2 JB | - - | - - | - - | - - | NS | 4.8 | * |
| | | | Calcium | **141000** | **139000 J** | **135000 J** | **134000** | - - | - - | - - | - - | NS | NS | 115000 |
| | | | Iron | **699** | **820** | **941 J** | **861** | - - | - - | - - | - - | 300 | 11000 | 279 |
| | | | Magnesium | **65000** | **64100** | **61300** | **59100** | - - | - - | - - | - - | NS | NS | 43300 |
| | | | Manganese | *295* | *287 J* | *398 J* | *347* | - - | - - | - - | - - | 50 | 880 | 1020 |
| | | | Nitrate-Nitrite | 100 U | 100 U | 20 B | 600 | - - | - - | - - | - - | 10000 | 1000 | * |
| | | | Nitroguanidine | 20 U | 20 U | 20 U | 20 U | - - | - - | - - | - - | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 73 | * |
| | | | RDX | .053 J | 0.098 U | .12 J | 0.1 U | - - | - - | - - | - - | NS | 1 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | NS | * |
| | | | HMX | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | NS | * |
| | | | Tetryl | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 365 | * |
| | | | Nitroglycerin | - - | 0.65 U | 0.78 U | 0.68 U | - - | - - | - - | - - | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 36 | * |
| | | | PETN | - - | 0.65 U | 0.78 U | 0.68 U | - - | - - | - - | - - | NS | NS | * |
| | | | 2-Nitrotoluene | 0.48 U | 0.1 J | 0.6 U | 0.52 U | - - | - - | - - | - - | NS | 110 | * |
| | | | Nitrobenzene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 3.4 | * |
| | | | 3-Nitrotoluene | 0.48 U | 0.49 U | 0.6 U | 0.52 U | - - | - - | - - | - - | NS | 61 | * |
| | | | 1,3,5-Trinitrobenzene | 0.095 U | 0.031 J | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | 0.095 U | 0.098 U | 0.12 U | 0.1 U | - - | - - | - - | - - | NS | 3.6 | * |
| | | | 4-Nitrotoluene | 0.48 U | 0.49 U | 0.6 U | 0.52 U | - - | - - | - - | - - | NS | 0.66 | * |
| | | | Nitrocellulose | 500 U | 500 U | 500 U | 500 U | - - | - - | - - | - - | NS | NS | * |
| | | | Potassium | *1520 J* | *1340 J* | *1560 J* | *1450 J* | - - | - - | - - | - - | NS | NS | 2890 |
| | | | Sodium | *16600* | *16200* | *15300* | *15200* | - - | - - | - - | - - | NS | NS | 45700 |
| | | | Zinc | *5.2 J* | *6 J* | *4.3 J* | *4.3 J* | - - | - - | - - | - - | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-187 | Unconsolidated | Aluminum | - - | - - | - - | - - | **26.8 J** | 50.0 U | **20.7 J** | 50.0 U | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | **0.17 J** | **0.13 J** | 2 U | 2 U | 6 | 15 | 0 |
| | | | Barium | - - | - - | - - | - - | **339** | **338** | **301** | **339** | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.27 JB | 5 | 0.35 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 2.2 J | 1.7 J | 1.7 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | 969000 R | **932000** | **944000** | **1020000** | NS | NS | 115000 |
| | | | Chloromethane | - - | - - | - - | - - | 1 U | 1 U | 1 U | **0.32 J** | NS | 160 | * |
| | | | Cobalt | - - | - - | - - | - - | **10.1** | **9.1** | **10.4** | **10.9** | NS | 730 | 0 |
| | | | Iron | - - | - - | - - | - - | 50 U | 50 U | *33.5 J* | 50 U | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **295000** | **286000** | **306000** | **328000** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | **2110** | **2030** | **2130** | **2260** | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | **14.1** | **12.4** | **14.5 J** | **16.9** | NS | 730 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 1800000 | 200000 | 1600000 J | 200000 B | 10000 | 1000 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.62 U | 0.64 U | 0.64 U | 0.76 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.62 U | 0.64 U | 0.64 U | 0.76 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.49 U | 0.49 U | 0.58 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.49 U | 0.49 U | 0.58 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.098 U | 0.098 U | 0.12 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.49 U | 0.49 U | 0.58 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 4000 J | 6300 J | 18800 J | 2300 J | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **53500** | **51100** | **50700** | **52700 J** | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *35900* | *34600* | *36100* | *37100* | NS | NS | 45700 |
| | | | Thallium | - - | - - | - - | - - | **0.52 J** | **0.59 J** | **0.6 J** | 0.55 UJ | 2 | 2 | 0 |
| | | | Zinc | - - | - - | - - | - - | *9.7 JB* | *6 J* | *5.7 J* | *7.7 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-188 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 10 U | 0.68 J | 10 U | 10 U | NS | 1900 | * |
| | | | Aluminum | - - | - - | - - | - - | **1770** | **23.8 J** | **72.3** | 121 JB | 200 | 36000 | 0 |
| | | | Arsenic | - - | - - | - - | - - | 5 U | 5 U | 5 U | *4.5 J* | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *44* | *40.5* | *38* | *40.1* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | *0.4 JB* | 5 | 0.35 | * |
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.013 J | 0.017 J | 0.012 J | NS | 0.037 | * |
| | | | delta-BHC | - - | - - | - - | - - | 0.03 U | 0.011 J | 0.03 U | 0.03 UJ | NS | 0.052 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 0.94 J | 0.9 J | 1.3 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **116000** | **140000** | **151000** | **194000** | NS | NS | 115000 |
| | | | Chromium | - - | - - | - - | - - | **2.4 J** | **3.3 J** | 5 U | **2.6 J** | 100 | NS | 0 |
| | | | Cobalt | - - | - - | - - | - - | **2.4 J** | **4.7 J** | 5 U | **2.2 J** | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | **4.8 J** | 5 U | 5 U | 5 U | 1300 | 1500 | 0 |
| | | | Iron | - - | - - | - - | - - | **4120** | *227 J* | **362 J** | **1640** | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **89600** | **112000** | **112000** | **124000** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *485* | *664* | *646* | *1010 J* | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | **5.3 J** | **3.6 J** | 10 U | **4.8 J** | NS | 730 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 1300 | 50 J | 300 J | 800 JB | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 73 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | RDX | - - | - - | - - | - - | 0.083 J | 0.11 U | 0.1 U | 0.096 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.069 J | 0.11 U | 0.037 J | 0.096 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.64 U | 0.72 U | 0.65 U | 0.62 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.64 U | 0.72 U | 0.65 U | 0.62 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.56 U | 0.5 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.078 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.56 U | 0.5 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.098 U | 0.11 U | 0.1 U | 0.096 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.56 U | 0.5 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | *2570* | *2190* | *2220* | 2560 J | NS | NS | 2890 |
| | | | Silver | - - | - - | - - | - - | 5 U | **3.6 J** | 5 U | 5 U | NS | 180 | 0 |
| | | | Sodium | - - | - - | - - | - - | *27100* | *31800* | *30800* | *33200* | NS | NS | 45700 |
| | | | Vanadium | - - | - - | - - | - - | **1.8 J** | **2.2 J** | 10 U | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | *14.4 B* | *2.6 J* | *3 J* | *5.9 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-189 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 10 UJ | 0.7 J | 10 U | 10 U | NS | 1900 | * |
| | | | 4,4'-DDD | - - | - - | - - | - - | 0.03 UJ | 0.03 U | 0.013 J | 0.03 U | NS | 0.28 | * |
| | | | Acetone | - - | - - | - - | - - | 10 U | 10 U | 10 U | 1.5 JB | NS | 610 | * |
| | | | Aluminum | - - | - - | - - | - - | **49.9 J** | **37.2 J** | 50 U | 50 U | 200 | 36000 | 0 |
| | | | Arsenic | - - | - - | - - | - - | 5 U | *3.9 J* | 5 U | *11.1 J* | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | 14.4 | *18.7* | *15.1* | *16.7* | 2000 | 2600 | 256 |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 1.1 J | 10 U | 34 | 10 U | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **150000** | **162000** | **159000** | **145000** | NS | NS | 53100 |
| | | | Chloromethane | - - | - - | - - | - - | 1 U | 1 U | 1 U | 2.5 | NS | 160 | * |
| | | | Iron | - - | - - | - - | - - | *119* | *491* | *430* | 1960 J | 300 | 11000 | 1430 |
| | | | Magnesium | - - | - - | - - | - - | **70500** | **78500** | **75100** | 67700 | NS | NS | 15000 |
| | | | Manganese | - - | - - | - - | - - | *235* | *327* | *319* | 283 | 50 | 880 | 1340 |
| | | | Mercury | - - | - - | - - | - - | 0.2 U | 0.2 U | 0.2 U | **0.2** | 2 | 11 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 100 U | 100 U | 50 J | 100 U | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.044 J | 0.11 U | 0.097 U | 0.07 J | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 365 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitroglycerin | - - | - - | - - | - - | 0.62 U | 0.7 U | 0.63 U | 0.66 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.62 U | 0.7 U | 0.63 U | 0.66 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.54 U | 0.48 U | 0.51 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.08 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.54 U | 0.48 U | 0.51 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 1095 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.096 U | 0.11 U | 0.097 U | 0.1 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.54 U | 0.48 U | 0.51 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 UJ | 130 J | 500 UJ | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | *2230* | *1940 J* | *1920* | *1840 J* | NS | NS | 5770 |
| | | | Sodium | - - | - - | - - | - - | *49700* | *51200* | *48600* | *48100* | NS | NS | 51400 |
| | | | Thallium | - - | - - | - - | - - | 1 U | **0.17 J** | 1 U | 1 U | 2 | 2 | 0 |
| | | | Zinc | - - | - - | - - | - - | *6.4 JB* | 10 U | *4.6 JB* | 10 U | 5000 | 11000 | 52.3 |
| Load Line 12 | LL12mw-242 | Unconsolidated | Aluminum | - - | - - | - - | - - | **27300** | **36.5 BJ** | **1440** | 922 J | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | **0.73 J** | 2 U | 2 U | 2 U | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **53.5** | **19** | **24.7** | **18.3** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | **129** | *23.3* | *28.2* | *31.7* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 0.55 J | 1 U | 1 U | 0.49 JB | 5 | 0.35 | * |
| | | | Beryllium | - - | - - | - - | - - | **1.3** | 1 U | 1 U | 1 U | 4 | NS | 0 |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 2 J | 2.6 JB | NS | 4.8 | * |
| | | | Cadmium | - - | - - | - - | - - | **0.2 J** | 0.5 U | 0.5 U | 0.5 U | 5 | NS | 0 |
| | | | Calcium | - - | - - | - - | - - | *95700* | *69300* | *63000* | *69100* | NS | NS | 115000 |
| | | | Chloromethane | - - | - - | - - | - - | 1 R | 1 U | 1 U | 0.64 J | NS | 160 | * |
| | | | Chromium | - - | - - | - - | - - | **41.6** | 5 U | 5 U | 5 U | 100 | NS | 0 |
| | | | Cobalt | - - | - - | - - | - - | **27.5** | 5 U | **2 J** | 5 U | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | **53.3** | 5 U | 5 U | 5 U | 1300 | 1500 | 0 |
| | | | Iron | - - | - - | - - | - - | **65800** | **565 J** | **4390 J** | **3950** | 300 | 11000 | 279 |
| | | | Lead | - - | - - | - - | - - | **24.3** | 3 U | 3 U | 3 U | 15 | NS | 0 |
| | | | m&p-Xylenes | - - | - - | - - | - - | 0.31 J | 2.0 U | 2 U | 2 UJ | 10000 | 210 | * |
| | | | Magnesium | - - | - - | - - | - - | **59900** | **46500** | *41400* | **45400** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *1070* | *67.3* | *99.8* | *98.2* | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | **61.6** | 10 U | 10 U | 10 U | NS | 730 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 40 JB | 100 U | 100 U | 200 B | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.096 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 365 | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Nitroglycerin | - - | - - | - - | - - | 0.65 U | 0.68 U | 0.63 U | 0.63 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.65 U | 0.68 U | 0.63 U | 0.63 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.52 U | 0.48 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.051 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.52 U | 0.48 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.045 J | 0.1 U | 0.097 U | 0.097 U | NS | 1100 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.097 U | 0.097 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.5 U | 0.52 U | 0.48 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | o-Xylene | - - | - - | - - | - - | 0.17 J | 1 U | 1 U | 0.28 J | 10000 | 210 | * |
| | | | Perchlorate | - - | - - | - - | - - | NT | NT | 0.056 | NT | NS | 3.6 | * |
| | | | Potassium | - - | - - | - - | - - | **8310** | *1840 J* | *2090* | *1910 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *32400* | *33400* | *28200* | *26000* | NS | NS | 45700 |
| | | | Thallium | - - | - - | - - | - - | **0.29 J** | 1 U | 1 U | 1 U | 2 | 2 | 0 |
| | | | Toluene | - - | - - | - - | - - | 1 BJ | 1 U | 1 U | 0.29 J | 1000 | 720 | * |
| | | | Total Xylenes | - - | - - | - - | - - | 0.48 J | 1.4 J | 2 U | 0.28 J | 10000 | 210 | * |
| | | | Vanadium | - - | - - | - - | - - | **46.4 J** | 10 U | **2.5 J** | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | **159** | *4.2 J* | *12.3 J* | *10.2 B* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-243 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 10 U | 0.57 J | 10 U | 10 U | NS | 1900 | * |
| | | | alpha-BHC | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.0082 J | 0.03 U | NS | 0.011 | * |
| | | | Aluminum | - - | - - | - - | - - | **67.8** | **220 B** | 50 U | 50 U | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | 2 U | 2 U | **0.21 J** | **0.15 J** | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | *7.5* | **16.5** | **20.1** | **12** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *32.4* | *34.6* | *37.9* | *31.7* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.24 JB | 5 | 0.35 | * |
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.011 J | 0.017 J | 0.03 U | NS | 0.037 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 10 U | 1.2 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **125000** | **126000** | **129000** | **134000** | NS | NS | 115000 |
| | | | Cobalt | - - | - - | - - | - - | **2.1** | 5 U | 5 U | 5 U | NS | 730 | 0 |
| | | | Iron | - - | - - | - - | - - | **2460 J** | **2180 J** | **2540 J** | **1150** | 300 | 11000 | 279 |
| | | | m&p-Xylenes | - - | - - | - - | - - | 2 U | 0.9 J | 2 U | 2 U | 10000 | 210 | * |
| | | | Magnesium | - - | - - | - - | - - | **83000 J** | **84800** | **84200** | **90100** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | **1070** | *928* | *862* | *813* | 50 | 880 | 1020 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 1100 | 100 U | 40 J | 300 J | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | NS | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Tetryl | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.63 U | 0.75 U | 0.66 U | 0.72 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.059 J | 0.11 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.63 U | 0.75 U | 0.66 U | 0.72 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.58 U | 0.5 U | 0.56 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.051 J | 0.12 U | 0.1 U | 0.11 U | NS | 3 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.58 U | 0.5 U | 0.56 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 1100 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.58 U | 0.5 U | 0.56 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 160 J | 150 J | 500 U | 500 UJ | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **3640 J** | **3270 J** | **3090** | **3080 J** | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *23300* | *23200* | *22700* | *24000* | NS | NS | 45700 |
| | | | Total Xylenes | - - | - - | - - | - - | 2 U | 0.9 J | 2 U | 2 U | 10000 | 210 | * |
| | | | Zinc | - - | - - | - - | - - | *5.6 JB* | *3.2 J* | *5.8 J* | *6.1 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-244 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 10 U | 0.84 J | 10 U | 10 U | NS | 1900 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.11 U | 0.1 J | 0.11 U | 0.48 U | NS | 61 | * |
| | | | Aluminum | - - | - - | - - | - - | **83.5** | **9040** | **26.8 J** | 50 U | 200 | 36000 | 0 |
| | | | Antimony | - - | - - | - - | - - | **0.34 J** | **0.95 J** | **1.1 J** | **0.33 J** | 6 | 15 | 0 |
| | | | Arsenic | - - | - - | - - | - - | *7.5* | **21.4** | 5 U | *8.2* | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | **98.9** | **145** | **125** | **120** | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.46 JB | 5 | 0.35 | * |
| | | | Beryllium | - - | - - | - - | - - | 1 U | **0.4 J** | 1 U | 1 U | 4 | NS | 0 |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 10 U | 1.1 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | *79700* | *73500* | *83300* | *88100* | NS | NS | 115000 |
| | | | Chloromethane | - - | - - | - - | - - | 1 R | 1 U | 1 U | 1.8 | NS | 160 | * |
| | | | Chromium | - - | - - | - - | - - | 5 U | **12.4** | 5 U | 5 U | 100 | NS | 0 |
| | | | Cobalt | - - | - - | - - | - - | 5 U | **9.5** | 5 U | 5 U | NS | 730 | 0 |
| | | | Copper | - - | - - | - - | - - | 5 U | **14.2 J** | 5 U | 5 U | 1300 | 1500 | 0 |
| | | | Iron | - - | - - | - - | - - | *332* | **20700 J** | *61.8 J* | *46.3 JB* | 300 | 11000 | 279 |
| | | | Lead | - - | - - | - - | - - | 3 U | **6.9** | 3 U | 3 U | 15 | NS | 0 |
| | | | m&p-Xylenes | - - | - - | - - | - - | 2 U | 0.88 J | 2 U | 2 UJ | 10000 | 210 | * |
| | | | Magnesium | - - | - - | - - | - - | *25100* | *26300* | *25500* | *27400* | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *115* | *360* | *108* | *148* | 50 | 880 | 1020 |
| | | | Nickel | - - | - - | - - | - - | 10 U | **22** | 10 U | 10 U | NS | 730 | 0 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 40 JB | 100 U | 30 J | 300 | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 1800 | * |

Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.66 U | 0.67 U | 0.7 U | 0.63 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.66 U | 0.67 U | 0.7 U | 0.63 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.51 U | 0.52 U | 0.54 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 3 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.51 U | 0.52 U | 0.54 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 1100 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.1 U | 0.1 U | 0.11 U | 0.097 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.51 U | 0.1 J | 0.54 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 200 J | 500 UJ | 500 U | 500 UJ | NS | NS | * |
| | | | Perchlorate | - - | - - | - - | - - | NT | NT | 0.015 J | NT | NS | 3.6 | * |
| | | | Potassium | - - | - - | - - | - - | *2190* | **4340 J** | *2320* | *1800 J* | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *9120* | *7430* | *8210* | *9080* | NS | NS | 45700 |
| | | | Total Xylenes | - - | - - | - - | - - | 2 U | 0.88 J | 2 U | 2 U | 10000 | 210 | * |
| | | | Vanadium | - - | - - | - - | - - | 10 U | **14.1** | 10 U | 10 U | NS | 36 | 0 |
| | | | Zinc | - - | - - | - - | - - | *3 JB* | *46.4* | *3.2 J* | *7.9 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-245 | Unconsolidated | Acetone | - - | - - | - - | - - | 10 U | 1.1 J | 10 U | 2.7 JB | NS | 610 | * |
| | | | Aluminum | - - | - - | - - | - - | **27.6 J** | 50 U | **52.9 J** | 50 U | 200 | 36000 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **24.4 J** | 5 U | *7.3 B* | **20.4** | 10 | 0.045 | 11.7 |
| | | | Barium | - - | - - | - - | - - | *32.6* | *30.2* | *29* | *33.7* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.25 JB | 5 | 0.35 | * |
| | | | beta-BHC | - - | - - | - - | - - | 0.03 U | 0.03 U | 0.012 J | 0.03 U | NS | 0.032 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 3.9 J | 10 U | 0.012 J | 3.2 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | **150000** | **130000** | **146000** | **134000** | NS | NS | 115000 |
| | | | Cobalt | - - | - - | - - | - - | 5 U | 5 U | 5 U | **2 J** | NS | 730 | 0 |
| | | | Iron | - - | - - | - - | - - | **1670 J** | *73.5 J* | **426 J** | **994** | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **72100** | **63700** | **69800** | **65700** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *301* | *56.5* | *186* | *163* | 50 | 880 | 1020 |
| | | | Nitrate as N (NO3-N) | - - | - - | - - | - - | 100 | 80 J | 20 J | 100 U | 10000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.63 U | 0.81 U | 0.68 U | 0.74 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.097 U | 0.1 J | 0.1 U | 0.11 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.63 U | 0.81 U | 0.68 U | 0.74 U | NS | NS | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.62 U | 0.52 U | 0.57 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 3 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.62 U | 0.52 U | 0.57 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 1100 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.097 U | 0.12 U | 0.1 U | 0.11 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.48 U | 0.62 U | 0.52 U | 0.57 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 U | 500 U | 500 U | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **3640** | **3140 J** | **3280** | *2700 J* | NS | NS | 2890 |
| | | | Selenium | - - | - - | - - | - - | 5 U | 5 U | 4.7 J | 5 U | 50 | 180 | 0 |
| | | | Sodium | - - | - - | - - | - - | *24000* | *21300* | *22600* | *21600* | NS | NS | 45700 |
| | | | Zinc | - - | - - | - - | - - | 2.5 UJ | *2.9 J* | *2.8 J* | *3.9 JB* | 5000 | 11000 | 60.9 |
| Load Line 12 | LL12mw-246 | Unconsolidated | 2-Butanone | - - | - - | - - | - - | 10 U | 0.86 J | 10 U | 10 U | NS | 1900 | * |
| | | | Acetone | - - | - - | - - | - - | 10 R | 10 U | 10 U | 4.3 JB | NS | 610 | * |
| | | | Aluminum | - - | - - | - - | - - | 50 U | **19.7 JB** | 50 U | 50 U | 200 | 36000 | 0 |
| | | | Arsenic | - - | - - | - - | - - | **32.7** | **29.5** | **41.6** | **14.6** | 10 | NS | 11.7 |
| | | | Barium | - - | - - | - - | - - | *40.6* | *42.4* | *42.2* | *37.8* | 2000 | 2600 | 82.1 |
| | | | Benzene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.58 JB | 5 | 0.35 | * |
| | | | bis(2-Ethylhexyl) phthalate | - - | - - | - - | - - | 10 U | 10 U | 2.9 J | 5 JB | NS | 4.8 | * |
| | | | Calcium | - - | - - | - - | - - | *103000* | *108000* | *110000* | *92300* | NS | NS | 115000 |
| | | | Iron | - - | - - | - - | - - | **1430** | **1130 J** | **2120** | 50 U | 300 | 11000 | 279 |
| | | | Magnesium | - - | - - | - - | - - | **50900** | **53900** | **52900** | **50900** | NS | NS | 43300 |
| | | | Manganese | - - | - - | - - | - - | *73.2* | *78.6* | *69.3* | *28* | 50 | 880 | 1020 |
| | | | Mercury | - - | - - | - - | - - | 0.2 U | 0.2 U | **0.15 BJ** | 0.2 U | 2 | 11 | 0 |
| | | | Nitrate-Nitrite | - - | - - | - - | - - | 100 U | 100 U | 100 U | 100 B | 1000 | 1000 | * |
| | | | Nitroguanidine | - - | - - | - - | - - | 20 U | 20 U | 20 U | 20 U | NS | 3650 | * |
| | | | 2,4,6-Trinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 2.2 | * |
| | | | 2,4-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 73 | * |
| | | | RDX | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 0.61 | * |
| | | | 4-Amino-2,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | NS | * |
| | | | HMX | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 1800 | * |
| | | | 2-Amino-4,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | NS | * |
| | | | Tetryl | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 365 | * |
| | | | Nitroglycerin | - - | - - | - - | - - | 0.64 U | 0.68 U | 0.69 U | 0.62 U | NS | 4.8 | * |
| | | | 2,6-Dinitrotoluene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 36 | * |
| | | | PETN | - - | - - | - - | - - | 0.64 U | 0.68 U | 0.69 U | 0.62 U | NS | NS | * |
| | | | 2-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.52 U | 0.53 U | 0.48 U | NS | 0.049 | * |
| | | | Nitrobenzene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.074 J | NS | 3.4 | * |
| | | | 3-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.52 U | 0.53 U | 0.48 U | NS | 122 | * |
| | | | 1,3,5-Trinitrobenzene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 1100 | * |
| | | | 1,3-Dinitrobenzene | - - | - - | - - | - - | 0.098 U | 0.1 U | 0.11 U | 0.096 U | NS | 3.6 | * |
| | | | 4-Nitrotoluene | - - | - - | - - | - - | 0.49 U | 0.52 U | 0.53 U | 0.48 U | NS | 0.66 | * |
| | | | Nitrocellulose | - - | - - | - - | - - | 500 U | 500 UJ | 130 J | 500 UJ | NS | NS | * |

**Table A.1. Previous Groundwater Sampling Data For All Site Wells At Load Line 12 (continued)**

| Area | Well Number | Monitored Zone | Compound or Element Detected | Jan-07 Level (µg/L) | Apr-07 Level (µg/L) | Jul-07 Level (µg/L) | Oct-07 Level (µg/L) | Jan-08 Level (µg/L) | Apr-08 Level (µg/L) | Jul-08 Level (µg/L) | Oct-08 Level (µg/L) | MCL (µg/L) | Region 9 PRG (µg/L) | Facility-Wide Background (µg/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | o-Xylene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.29 J | NS | NS | * |
| | | | Potassium | - - | - - | - - | - - | **7430** | **7520 J** | **5250** | **6140 J** | NS | NS | 2890 |
| | | | Sodium | - - | - - | - - | - - | *22400* | *23300* | *22400* | *23300* | NS | NS | 45700 |
| | | | Toluene | - - | - - | - - | - - | 1 U | 1 U | 1 U | 0.23 J | 1000 | 720 | * |
| | | | Total Xylenes | - - | - - | - - | - - | 2 U | 2 U | 2 U | 0.29 J | 10000 | 210 | * |
| | | | Zinc | - - | - - | - - | - - | 3.7 UJ | *5.1 J* | *4.8* JB | 10 U | 5000 | 11000 | 60.9 |
| Jan 2008 Event | Equip Blank | QA | Nitrate-Nitrite | | | | | 50 | | | | | | |
| Oct 2008 Event | Method Blank | QA | Nitrate-Nitrite | | | | | | | | 50 | | | |

Notes:
NS = no standard NT = not tested
All inorganics are filtered, all organics are not filtered
* There are no background levels for organic constituents
- - Not Sampled During That Quarterly Sampling Event
J = estimated result. Results have been qualified "J" For more details refer to Data Verification/Validation Reports in in the FWGWMP January, April, July and October 2007 and January, April and July 2008 Sampling Reports
B = the analyte is found in the method blank or any of the field blanks
R = Rejected data
U = analyzed but not detected at or above the reporting limit
Bold = inorganic constituent detected above Facility-Wide background levels
Italics = inorganic constituent detected below the Facility-Wide background levels
Shaded boxes indicate any constituent, which does not have a background value, detected above the reporting limit.
Data for the October 2008 sampling event is draft data and is not in its final form

# PART II

# Final

# Quality Assurance Project Plan for the Sampling and Analysis Plan Groundwater Sampling at the RVAAP-12 Load Line 12 Addendum No. 1

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-04-D-0028
Delivery Order No. 0001

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

**Prepared by:**
SAIC Engineering of Ohio, Inc.
8866 Commons Boulevard, Suite 201
Twinsburg, Ohio 44087

April 14, 2009

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| DNX | Hexahydro-1.3-dinitroso-5-nitro-1,3,5-triazine |
| FSP | Field Sampling Plan |
| HMX | Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine |
| LCS | laboratory control sample |
| Ohio EPA | Ohio Environmental Protection Agency |
| MNA | Monitored Natural Attenuation |
| MNX | Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine |
| MS | Matrix Spike |
| MSD | Matrix Spike Duplicate |
| QA | Quality Assurance |
| QAPP | Quality Assurance Project Plan |
| QC | Quality Control |
| RDX | Hexahydro-1,3,5-trinitro-1,3,5-triazine |
| RVAAP | Ravenna Army Ammunition Plant |
| SAP | Sampling and Analysis Plan |
| SAIC | Science Applications International Corporation |
| TNX | Hexahydro-1,3,5-trinitroso-1,3,5-triazine |
| USACE | U.S. Army Corps of Engineers |
| USEPA | U.S. Environmental Protection Agency |

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# 1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12 addresses supplemental project-specific information and tiers under the Facility-Wide QAPP for the Ravenna Army Ammunition Plant (RVAAP) (USACE 2001). Each QAPP section documents adherence to the Facility-Wide QAPP or stipulates project-specific requirements.

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# 2.0 PROJECT DESCRIPTION

## 2.1 PROJECT DESCRIPTION

This information is contained in Section 1.0 of the Field Sampling Plan Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

## 2.2 PROJECT OBJECTIVES AND SCOPE

This information is contained in Section 3.0 of the Field Sampling Plan Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

## 2.3 PROJECT SCHEDULE

The project schedule for completing groundwater sampling at Load Line 12 is discussed in Section 2.2 of the Field Sampling Plan Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

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# 3.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The functional project organization and responsibilities are described in Section 2.0 of the Field Sampling Plan Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

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# 4.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

## 4.1 DATA QUALITY OBJECTIVES

Technical objectives and rationales for this groundwater sampling investigation are outlined in Section 3.0 of the Field Sampling Plan Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12. Groundwater samples collected under this project will adhere to the requirements of the Facility-Wide QAPP and applicable updated requirements specified in the Facility-Wide Groundwater Monitoring Program. All quality control (QC) parameters stated in the specific U.S. Environmental Protection Agency (USEPA) SW-846 methods and will be adhered to for each chemical to be sampled under this project. The SW-846 method references found in the Facility-Wide QAPP have been revised to the Update III methods (i.e., 8260A is now 8260B, 8270B is now 8270C). Laboratories are required to comply with all methods as written; recommendations are considered requirements. Concurrence with the Department of Defense Quality Systems Manual for Environmental Laboratories, January 2006 (DOD 2006) is expected.

## 4.2 LEVEL OF QUALITY CONTROL EFFORT

QC efforts will follow Section 3.2 of the Facility-Wide QAPP. Field QC measurements will include field source water blanks, trip blanks, field duplicates, split samples, and equipment rinsate blanks. Laboratory QC measurements will include method blanks, laboratory control samples (LCSs), laboratory duplicates, and matrix spike/matrix spike duplicate (MS/MSD) samples.

## 4.3 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

Accuracy, precision, and sensitivity goals identified in Section 3.3 and Tables 3-2 through 3-9 of the Facility-Wide QAPP will be imposed for this groundwater sampling investigation.

## 4.4 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Completeness, representativeness, and comparability goals identified in Section 3.4 and Table 3-2 of the Facility-Wide QAPP will be imposed for this groundwater sampling investigation.

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# 5.0 SAMPLING PROCEDURES

Sampling procedures are described in Section 4.0 of the Facility-Wide Sampling and Analysis Plan (SAP) as referenced in Section 4.0 of the Field Sampling Plan (FSP) Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

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# 6.0 SAMPLE CUSTODY

## 6.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

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

## 6.2 FINAL EVIDENCE FILES CUSTODY PROCEDURES

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

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# 7.0 CALIBRATION PROCEDURES AND FREQUENCY

Field instruments and equipment calibrations will follow procedures described in Section 6.1 of the Facility-Wide QAPP.

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# 8.0 ANALYTICAL PROCEDURES

## 8.1 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field measurements are identified in Section 4.3 of the Facility-Wide Sampling and Analysis Plan and in Section 4.0 of the FSP Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12.

## 8.2 LABORATORY ANALYSIS

Groundwater sampling will be performed as described in Section 4.0 of the FSP Addendum No. 1 for Groundwater Sampling at RVAAP-12 Load Line 12. Eight monitoring wells will be sampled for analysis of monitored natural attenuation (MNA) parameters. The total number of samples to be collected for each analysis is summarized in Table 8-1.

Sample containers and sample preservation requirements are presented in Section 4.3.6 of the Facility-Wide SAP. Quantitation levels for MNA parameter samples and sample containers are presented in Table 8-2 of this QAPP. The contract laboratory will provide sufficient containers of the proper size and with the proper chemical preservatives for the parameters to be collected. Samples will be collected and preserved as presented in Section 4.0 of the Facility-Wide QAPP.

**Table 8-1. Parameters, Methods and Number of Samples for Groundwater Sampling at Load Line 12**

| Parameter | Method | No. of Field Samples | No. of Field Duplicates | No. of Split Samples | No. of Rinsate Samples | Total No. Samples | Justification for Inclusion in MNA Sampling Suite |
|---|---|---|---|---|---|---|---|
| ***Groundwater*** | | | | | | | |
| DNX, MNX, TNX | SW846 8330 | 8 | 1 | 1 | 1 | 11 | The nitroso derivatives of RDX (DNX, MNX, and TNX) are first-stage degradation compounds. DNX and MNX are additionally first stage degradation compounds of HMX. These intermediates are also susceptible to subsequent degradation and are short-lived in the environment. |
| Dimethylhydrazines (1,1- and 1,2-) | Mod. 300.0 | 8 | 1 | 1 | 1 | 11 | Intermediate degradation products of RDX. Short-lived in the environment. |
| Hydrazine | Mod. 300.0 | 8 | 1 | 1 | 1 | 11 | End product indicator of RDX. Short-lived in the environment. |
| Ammonia | EPA 350.2 | 8 | 1 | 1 | 1 | 11 | End product indicator for explosives degradation. |
| Nitrate | EPA 300 | 8 | 1 | 1 | 1 | 11 | End product indicator. Nitrate is the most efficient electron acceptor in anaerobic biodegradation. Also, nitrate is reduced to nitrite when utilized by microorganisms as an electron acceptor. |
| Methane | RSK-175 | 8 | 1 | 1 | 1 | 11 | Methane is an end product indicator and an anaerobic biodegradation transformation product of explosives degradation. Ethane and ethylene results are also reported under the laboratory's organic gases suite, but these analytes are not considered significant to the evaluation of MNA processes. |

Table 8-1. Parameters, Methods and Number of Samples for Groundwater Sampling at Load Line 12 (continued)

| Parameter | Method | No. of Field Samples | No. of Field Duplicates | No. of Split Samples | No. of Rinsate Samples | Total No. Samples | Justification for Inclusion in MNA Sampling Suite |
|---|---|---|---|---|---|---|---|
| Methanol | SW 846 8015B | 8 | 1 | 1 | 1 | 11 | End product indicator and anaerobic biodegradation transformation product. |
| Phosphorous | EPA 365.4 | 8 | 1 | 1 | 1 | 11 | Limiting nutrient for microbial growth and activity. Low levels indicate decreasing potential for the maintenance of adequate habitats for degradative microorganisms. |
| Organic Nitrogen | EPA 300 | 8 | 1 | 1 | 1 | 11 | End product indicator; also supports co-metabolic microbial activity. |
| ***Groundwater*** | | | | | | | |
| Total Organic Carbon (TOC) | EPA 415.1 | 8 | 1 | 1 | 1 | 11 | Anaerobic studies suggest degradation of RDX in groundwater can utilize co-metabolic processes that incorporate organic carbon as a co-metabolite. |
| Ferrous Iron | NA | 8 | 0 | 0 | 0 | 8 | Iron is a common electron acceptor utilized in anaerobic biodegradation. |
| Sulfate and Sulfide | EPA 300 EPA 376.1 | 8 | 1 | 1 | 1 | 11 | Sulfate can be utilized by microbes as an electron acceptor in anaerobic biodegradation, resulting in the production of sulfide. |
| Alkalinity | EPA 310.1 | 8 | 1 | 1 | 1 | 11 | Indicator of feasibility and types of degradation processes possible. Alkaline conditions favor degradation of RDX. |
| Carbon Dioxide (Dissolved) | SM4500-$CO_2$-C | 8 | 1 | 1 | 1 | 11 | Microorganisms utilize carbon dioxide as an electron acceptor, once sulfate is exhausted. |

**Table 8-1. Parameters, Methods and Number of Samples for Groundwater Sampling at Load Line 12 (continued)**

| Parameter | Method | No. of Field Samples | No. of Field Duplicates | No. of Split Samples | No. of Rinsate Samples | Total No. Samples | Justification for Inclusion in MNA Sampling Suite |
|---|---|---|---|---|---|---|---|
| Oxidation-Reduction Potential | ASTM D1498 - 08 | 8 | 1 | 1 | 1 | 11 | Indicator of feasibility and types of degradation processes possible. Monitored as a field parameter. |

Sources for MNA selection include Sources: Brannon and Pennington 2002; SERDP 2004; and Pennington et. al., 1999.
MNA = monitored natural attenuation
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine
DNX = Hexahydro-1.3-dinitroso-5-nitro-1,3,5-triazine
MNX = Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
TNX = Hexahydro-1,3,5-trinitroso-1,3,5-triazine
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

**Table 8-2. MNA Analytical Parameters Containers for Groundwater Samples**

| Analyte Group | Container | Minimum Sample Size | Preservative | Project Reporting Levels | Holding Time |
|---|---|---|---|---|---|
| Additional Explosive Derivatives (DNX, TNX, MNX, and Hydrazines) | 2 - 1L amber glass bottle with Teflon-lined lid | 1000 mL | Cool, 4° C | 0.5 µg/L | 7 d (extraction) 40 d (analysis) |
| Phosphate–total, | 1 – 1L polybottle | 500 mL | $H_2SO_4$ to pH <2 Cool, 4° C | 0.2 mg/L | 28 days |
| Ammonia-N, and TKN | | | | 0.1 mg/L | |
| Dissolve Carbon Dioxide | 1 - 250 mL amber glass bottle | 500 mL | Cool, 4° C | 0.1 mg/L | 14 days |
| Methane | 3 – 20 mL vial | 60 mL | Cool, 4° C, HCL to pH<2 | 10 µg/L | 14 days |
| Methanol | 3 – 40 mL vial | 120 mL | Cool, 4° C | 5 mg/L | 7 days |
| Alkalinity (total) | 1 – 250 ml plastic | 250 mL | Cool, 4° C | 2 mg/L | 14 days |
| Ferrous Iron | Field Parameter no container requirements field test kit | NA | NA | NA | NA |
| Oxidation-Reduction Potential (ORP) | Field Parameter no container requirements collected during low-flow purging | NA | NA | NA | NA |

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# 9.0 INTERNAL QUALITY CONTROL CHECKS

## 9.1 FIELD SAMPLE COLLECTION

Field QC sample types, numbers, and frequencies are identified in Sections 4.0 and 5.0 of the FSP Addendum No. 1 for Groundwater Sampling at Load Line 12.

## 9.2 FIELD MEASUREMENTS

Refer to Section 4.0 of the FSP Addendum No. 1 for Groundwater Sampling at Load Line 12 for details regarding field measurements.

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# 10.0 DATA REDUCTION, VALIDATION, AND REPORTING

## 10.1 DATA REDUCTION

Data reduction will follow the established protocols defined in Section 9.1 in the Facility-Wide QAPP.

## 10.2 DATA REPORTING

Data reports will follow the established protocols defined in Section 9.3 in the Facility-Wide QAPP.

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# 11.0 Performance and System Audits

A minimum of one field surveillance for the investigation will be performed by the Science Applications International Corporation (SAIC) quality assurance (QA) Officer and/or the SAIC Field Team Leader. This surveillance will encompass the performance of monitoring well sampling activities and completion of field logs. Surveillances will follow SAIC QAPP No. 18.3. The U.S. Army Corps of Engineers (USACE) or Ohio EPA (Ohio Environmental Protection Agency) may conduct surveillances or audits at the discretion of the respective agency.

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# 12.0 PREVENTIVE MAINTENANCE PROCEDURES

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

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# 13.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

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

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# 14.0 CORRECTIVE ACTIONS

Corrective action protocol will follow directions provided in Section 13.1 of the Facility-Wide QAPP.

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# 15.0 QA REPORTS TO MANAGEMENT

Procedures and reports will follow the protocol identified in Section 14.0 of the Facility-Wide QAPP.

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# 16.0 References


Brannon, J.M., and Pennington, J.C., 2002. *Environmental Fate and Transport Process Descriptions for Explosives*, Final, U. S. Army Engineer Research and Development Center, Vicksburg, Mississippi, Document No. ERD/EL TR-02-10.

DoD (U.S. Department of Defense) 2006. Department of Defense Quality Systems Manual for Environmental Laboratories, January 2006.

MKM 2007. Final Characterization of 14 AOCs at Ravenna Army Ammunition Plant, Characterization of Load Line 12. March 2007.

Pennington J.C., Zakikhani M., and Harrelson D.W., 1999. *Monitored Natural Attenuation of Explosives in Groundwater – Environmental Security Technology Certification Program (ESTCP) Completion Report for U.S. Army Waterways Experiment Station, Vicksburg, Mississippi,* Final Report, 228pp.

SERDP (Strategic Environmental Research and Development Program) 2004. *Microbial Degradation of RDX and HMX*, Project CU1213, Final Report, December 2001 - December 2003, Performing organizations: Biotechnology Research Institute, National Research Council of Canada; Defense Research and Development Canada; and U. S. Air Force Research Laboratory, 221pp.

USACE (U.S. Army Corps of Engineers) 2001. *Facility-Wide Quality Assurance Project Plan for Environmental Investigations at the Ravenna Army Ammunition Plant, Ravenna, Ohio*, DACA62-00-D-0001, Delivery Order CY02, Final.

USACE 2002. Louisville Chemistry Guideline (LCG), Environmental Engineering Branch, Louisville District, U.S. Army Corps of Engineers, Version 5, June 2002.

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# Part III

# Final

# Site Safety and Health Plan
# for the Sampling and Analysis Plan
# Groundwater Sampling at the RVAAP-12 Load Line 12
# Addendum No. 1

Ravenna Army Ammunition Plant
Ravenna, Ohio

Contract No. W912QR-04-0028
Delivery Order No. 0001

**Prepared for:**
U.S. Army Corps of Engineers
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April 10, 2009

# APPROVALS

Final
Site Safety and Health Plan
for Groundwater Sampling at RVAAP-12 Load Line 12

**April 2009**

04/07/2009

Kevin Jago Phone 865-418-4614 Date
SAIC Project Manager

04/07/2009

Randy Hansen, CHP, CSP, Phone 314-770-3027 Date
SAIC Health and Safety Officer

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AOC | Area of Concern |
| BGS | Below Ground Surface |
| CPR | Cardiopulmonary Resuscitation |
| FOM | Field Operations Manager |
| FWSHP | Facility Wide Safety and Health Plan |
| HTRW | Hazardous, Toxic, and Radioactive Waste |
| HAZWOPER | Hazardous Waste Operations |
| IRP | Installation Restoration Program |
| NGB | National Guard Bureau |
| OEW | Ordnance and Explosive Waste |
| OHARNG | Ohio Army National Guard |
| OJT | On-the-Job Training |
| MEC | Munitions and Explosives of Concern |
| PID | Photoionization Detector |
| PM | Project Manager |
| PPE | Personal Protective Equipment |
| RDX | hexahydro-1,3,5-trinitro-1,3,5-triazine |
| RVAAP | Ravenna Army Ammunition Plant |
| SAIC | Science Applications International Corporation |
| SAP | Sampling and Analysis Plan |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| USACE | United States Army Corps of Engineers |

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# 1.0 INTRODUCTION

Science Applications International Corporation's (SAIC) formal policy, stated in the Environmental Compliance and Health and Safety Program manual, is to take every reasonable precaution to protect the health and safety of our employees, the public, and the environment. To this end, the Ravenna Army Ammunition Plant (RVAAP) *Facility-Wide Safety and Health Plan* (FWSHP) (USACE 2001) and this Site Safety and Health Plan (SSHP) collectively set forth the specific procedures required to protect SAIC and SAIC subcontractor personnel involved in the field activities. These plans are driven by requirements contained in the most current revisions of the Unites States Army Corps of Engineers (USACE) *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste (HTRW)* and *Ordnance and Explosive Waste (OEW) Activities, ER-385-1-92,* and the USACE *Safety and Health Manual, EM-385-1-1-1*, which are available online via the USACE web site. SAIC activities are also subject to the requirements of the SAIC Corporate Environmental Compliance and Health and Safety Program and associated procedures. All field personnel are required to comply with the requirements of these programs and plans.

The FWSHP addresses program issues and hazards and hazard controls common to the entire installation. This SSHP Addendum to the FWSHP serves as the lower tier document addressing the hazards and controls specific to the Sampling and Analysis (SAP) Plan Addendum No. 1 RVAAP-12 Load Line 12 Groundwater. Copies of the FWSHP and this SSHP Addendum will be present at the work site during all fieldwork.

SAIC will perform one round of groundwater sampling at selected groundwater monitoring wells within the Load Line 12 area of concern (AOC). SAP Addendum No. 1 addresses the sampling (using low-flow methods) activities to be performed.

Sampling crews will use protective gloves to handle potentially contaminated materials, and, if necessary, the Site Safety and Health Officer (SSHO) will upgrade the required personal protective equipment (PPE). The SSHO will observe all site tasks during daily safety inspections and will use professional judgment and appropriate monitoring results to determine if upgrading PPE is required. A detailed analysis of these hazards and specific appropriate controls is presented in Table 3-2 (Section 3.0). Details regarding PPE are contained in Section 7.0.

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# 2.0 SITE DESCRIPTION AND CONTAMINANT CHARACTERIZATION

## 2.1 SITE DESCRIPTION

When the RVAAP Installation Restoration Program (IRP) began in 1989, RVAAP was identified as a 21,419-acre installation. The property boundary was resurveyed by the Ohio Army National Guard (OHARNG) over a 2-year period (2002 and 2003) and the total acreage of the property was found to be 21,683.289 acres. As of February 2006, a total of 20,403 acres of the former 21,683-acre RVAAP has been transferred to the National Guard Bureau (NGB) and subsequently licensed to OHARNG for use as a military training site, the Camp Ravenna Joint Military Training Center (Camp Ravenna).

The current RVAAP consists of 1,280 acres scattered throughout Camp Ravenna. Camp Ravenna is in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 km (3 miles) east-northeast of the City of Ravenna and approximately 1.6 km (1 mile) northwest of the City of Newton Falls. The RVAAP portions of the property are solely located within Portage County. RVAAP/Camp Ravenna is a parcel of property approximately 17.7 km (11 miles) long and 5.6 km (3.5 miles) wide bounded by State Route 5, the Michael J. Kirwan Reservoir, and the CSX System Railroad on the south; Garret, McCormick, and Berry roads on the west; the Norfolk Southern Railroad on the north; and State Route 534 on the east (Figures A-1 and A-2). Camp Ravenna is surrounded by several communities: Windham on the north; Garrettsville 9.6 km (6 miles) to the northwest; Newton Falls 1.6 km (1 mile) to the southeast; Charlestown to the southwest; and Wayland 4.8 km (3 miles) to the south.

When RVAAP was operational, Camp Ravenna did not exist and the entire 21,683-acre parcel was a government-owned, contractor-operated industrial facility. The RVAAP IRP encompasses investigation and cleanup of past activities over the entire 21,683 acres of the former RVAAP. References to RVAAP in this document are considered to be inclusive of the historical extent of RVAAP, which is inclusive of the combined acreages of the current Camp Ravenna and RVAAP, unless otherwise specifically stated.

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

In addition to production and demilitarization activities at the load lines, other AOCs at RVAAP were used for the burning, demolition, and testing of munitions. These burning and demolition grounds consist of large parcels of open space or abandoned quarries. Potential contaminants at these AOCs include explosives, propellants, metals, waste oils, and sanitary waste. Other types of AOCs present at RVAAP include landfills, an aircraft fuel tank testing facility, and various general industrial support and maintenance facilities.

## 2.2 CONTAMINANTS

Table 2-1 lists contaminants known to occur in groundwater at Load Line 12. Inclusion in this table indicates the potential to encounter a contaminant during sampling activities, but it does not necessarily indicate that the contaminant is present in sufficient quantity to pose a health risk to workers.

**Table 2-1. Maximum Concentrations of Constituents of Potential Concern at Load Line 12**

| Chemical | Units | Maximum Detect |
|---|---|---|
| ***Groundwater*** | | |
| Nitrate | mg/L | 1800.00 |
| Aluminum | mg/L | 28.50 |
| Arsenic | mg/L | 0.65 |
| Barium | mg/L | 1.10 |
| Calcium | mg/L | 944.00 |
| Chromium | mg/L | 0.04 |
| Cobalt | mg/L | 0.04 |
| Copper | mg/L | 0.08 |
| Iron | mg/L | 88.30 |
| Lead | mg/L | 0.05 |
| Magnesium | mg/L | 308.00 |
| Manganese | mg/L | 4.41 |
| Nickel | mg/L | 0.08 |
| Potassium | mg/L | 60.00 |
| Selenium | mg/L | 0.01 |
| Sodium | mg/L | 58.30 |
| Vanadium | mg/L | 0.05 |
| Zinc | mg/L | 0.18 |
| Cyanide | mg/L | 0.06 |
| 2-Nitrotoluene | mg/L | 0.01 |
| Nitrocellulose | mg/L | 18.80 |
| Benzoic acid | mg/L | 0.02 |
| Bis(2-ethylhexyl)phthalate | mg/L | 0.06 |
| Phenol | mg/L | 0.03 |
| 2-Butanone | mg/L | 0.05 |
| 4-Methyl-2-pentanone | mg/L | 0.01 |
| Acetone | mg/L | 0.07 |
| Methylene chloride Nitrate | mg/L | 0.01 |

## 3.0 HAZARD/RISK ANALYSIS

The purpose of the task hazard/risk analysis is to identify and assess potential hazards that may be encountered by personnel and to prescribe required controls. Table 3-1, a general checklist of hazards that may be posed by this project, indicates whether a particular major type of hazard is present. If additional tasks or significant hazards are identified during the work, this document will be modified by addendum or field change order to include the additional information.

**Table 3-1. Hazards Inventory**

| Yes | No | Hazard |
|---|---|---|
| | X | Confined space entry |
| | X | Excavation entry (excavations will not be entered) |
| | X | Heavy equipment (drill rigs, backhoe) |
| | X | Fire and explosion (fuels) |
| | X | Electrical shock (utilities and tools) |
| X | | Exposure to chemicals (contaminants and chemical tools) |
| X | | Temperature extremes |
| X | | Biological hazards (poison ivy, Lyme disease, West Nile disease) |
| | X | Radiation or radioactive contamination |
| | X | Noise (drill rig) |
| | X | Drowning |
| X | | MEC (potential to encounter unexploded ordnance) |

MEC = munitions and explosives of concern

Specific tasks are as follows:

- Well re-development and groundwater sampling;
- Equipment decontamination; and
- Investigation-derived waste handling and disposition.

### 3.1 TASK-SPECIFIC HAZARD ANALYSIS

Table 3-2 presents task-specific hazards, relevant hazard controls, and required monitoring, if appropriate, for all of the planned tasks.

### 3.2 POTENTIAL EXPOSURES

Table 3-3 contains information on the reagents and chemicals that will be used for the project. Soil and groundwater contaminants are possible, but unlikely.  Exposure to chemical tools, such as corrosive sample preservatives, field laboratory reagents, or flammable fuels, is a possibility and will be controlled through standard safe handling practices.

**Table 3-2. Hazards Analysis**

| Safety and Health Hazards | Controls | Monitoring Requirements |
|---|---|---|
| ***Mobilize to Work Site*** | | |
| Traffic accident | Compliance with EC&HS Procedure 110, Vehicle Operation (valid drivers license, seat belt use, routine vehicle inspections, no cell phone use while driving). | None |
| ***Groundwater Well Development, Groundwater Monitoring, Groundwater Sampling, and Sample Preservation*** | | |
| Vehicle accidents | Compliance with EC&HS Procedure 110 "Vehicle Operation" to include verification of current drivers licenses, use of seat belts when vehicle is in motion, daily (undocumented) vehicle safety inspection, compliance with applicable laws and regulations, and defensive driving. | Verification of valid drivers licenses by FM |
| General safety hazards (moving equipment, lifting, slips, falls) | Level D PPE: long pants, shirts with sleeves, safety glasses, safety boots, hard hats if overhead hazards are present (see Section 5.0 of FWSHP). Buddy system. Site-specific training. Proper housekeeping. Lifts of >50 lbs will be performed by two or more personnel or with mechanical assistance, extensive heavy lifting will require additional lifting training. Exclusion zone if there is a potential for unauthorized entry. Compliance with SAIC EC&HS Procedure 150. | Daily site safety inspections |
| Noise | None, unless SSHO determines that equipment potentially exceeds 85 dBA | Daily safety inspection |
| Fire (fuels) | Fuel stored in safety cans with flame arresters. Fire extinguisher rated 2A and 5B (serviced annually and inspected monthly) in all fuel use areas. No ignition sources in fuel storage areas. Bonding (metal to metal contact) during pouring. Gasoline-powered equipment must be shut down and allowed to cool for 5 min. prior to fueling. | Daily site safety inspections |
| Exposure to chemicals | Level D PPE, including nitrile or PVC gloves, to handle potentially contaminated material. Minimal contact, wash face and hands prior to taking anything by mouth. Hazardous waste site operations training and medical clearance required by site workers. Fifteen-minute eyewash within 100 ft when pouring corrosive sample preservatives; eyewash bottle within 10 ft when adding water to pre-preserved sample containers. Site training must include hazards and controls of exposure to contaminants and chemicals used on-site. MSDSs for chemical tools kept on-site. All chemical containers will have contents and hazards labeled. | Daily site safety inspections. |
| Contact with MEC | Withdrawal of all SAIC and subcontractor personnel from immediate area and field marking of suspect area if potential MEC is discovered. | Visual surveys for ordnance |
| Electrical shock | GFCI for all electrical hand tools. | Daily safety inspection |

**Table 3-2. Hazards Analysis (continued)**

| Safety and Health Hazards | Controls | Monitoring Requirements |
|---|---|---|
| Temperature stress | If temperature is above 80°F or below 40°F, administrative controls will be implemented (cooled or warmed drinks, routine breaks in heated or shaded area, provisions for emergency heating or cooling). Administrative controls (see Section 8.0 of FWSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Section 8.0 of FWSHP). Chilled drinks if temperature exceeds 70°F. | Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing |
| Severe weather | Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lighting within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding (arroyo, ditch, etc.) if rain is forecast in immediate area or upstream of site. | Visual observation for lightning, strong winds, or heavy rain. Check forecast prior to starting work daily. |
| Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus) | PPE (boots and work clothes). Insect repellant on boots, pants, and elsewhere, as necessary, to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Inspect for ticks during the day and at the end of each workday (see Section 9.0 of FWSHP). Avoidance of accumulations of bird or bat droppings (see Section 9.0 of FWSHP). | Visual survey |
| ***Investigation-Derived Waste Handling*** | | |
| General hazards (lifting equipment, manual lifting, slips) | Level D PPE: long pants, shirts with sleeves, safety glasses, safety shoes or boots, and heavy-duty gloves for materials handling present (see Section 5.0 of FWSHP). Buddy system. Site-specific training. Proper housekeeping. Unnecessary personnel will stay well clear of operating equipment. Functional back-up alarm on fork trucks, Bobcats, trucks, etc. Ravenna O&M contractor personnel will provide any required fork truck services in the IDW staging area (Building 1036). IDW movement from field sites to Building 1036 will be conducted by the drilling subcontractor using a backhoe equipped with forks and drum dollys. No personnel allowed under lifted loads. Lifts of greater than 50 lbs will be made with two or more personnel or with lifting equipment in compliance with SAIC EC&HS Procedure 150. Hazardous waste safety training. Compliance with EM 385-1-1 Sections 14 and 16. | Daily safety inspections of operations. Daily inspection of equipment to verify brakes and operating systems are in proper working condition |
| Exposure to chemicals | Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Hazardous waste site operations training and medical clearance. Site training must include hazards and controls for exposure to site contaminants and chemicals used on-site. | Daily safety inspections |

## Table 3-2. Hazards Analysis (continued)

| Safety and Health Hazards | Controls | Monitoring Requirements |
|---|---|---|
| Vehicle accidents | Compliance with EC&HS Procedure 110 "Vehicle Operation" to include verification of current drivers licenses, use of seat belts when vehicle is in motion, daily (undocumented) vehicle safety inspection, compliance with applicable laws and regulations, and defensive driving. | Verification of valid drivers licenses by FM |
| Lifting injuries | Compliance with EC&HS Procedure 150 "Manual Lifting" to limiting individual lifts by SAIC personnel to 50 pounds. | Verification/observation of lifting by SAIC personnel by FM. |
| Fire (vehicle fuels and flammable contaminants) | Fuels stored in safety cans with flame arrestors. Bonding (metal to metal) and grounding during fuel transfers. Fuel storage areas marked with no smoking or open flames signs. Gasoline-powered equipment will be shut down and allowed to cool for 5 min before fueling. Fire extinguishers in all fuel use areas. | Daily safety inspection |
| Noise | Hearing protection within 7.6 m (25 ft) of any noisy drum moving equipment unless equipment-specific monitoring indicates exposures less than 85 dBA. | Daily safety inspections |
| Biological hazards (bees, ticks, Lyme disease, histoplasmosis, wasps, snakes, West Nile Virus) | PPE (boots, work clothes). Insect repellant on pants, boots, and elsewhere, as necessary, to repel ticks and mosquitoes. Pant legs tucked into boots or otherwise closed to minimize tick entry. Snake chaps if working in overgrown areas. Inspect for ticks during the day and at the end of each workday (see Section 9.0 of FWSHP). Avoidance of accumulations of bird or bat droppings (see Section 9.0 of FWSHP). | Visual survey |
| Electric shock | GFCI for all electrical hand tools. | Visual survey of all work areas |
| Temperature extremes | Administrative controls (see Section 8.0 of FWSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Section 8.0 of FWSHP). Chilled drinks if temperature exceeds 70°F. | Temperature measurements at least twice daily. Pulse rates at the start of each break if wearing impermeable clothing |
| Severe weather | Locate nearest severe weather shelter/strong structure before beginning fieldwork. Suspend fieldwork if lighting within 10 miles of site or tornado warning issued. Do not work in areas subject to flash flooding (arroyo, ditch, etc.) if rain is forecast in immediate area or upstream of site. | Visual observation for lightning, strong winds, or heavy rain. Check forecast prior to starting work daily. |
| ***Equipment Decontamination (Soap and Water Washing, HCl, and Methanol Rinse)*** | | |
| General equipment decontamination hazards (slips, falls, equipment handling) | Level D PPE plus nitrile or PVC gloves (see Section 5.0 of FWSHP). Site-specific training. Proper housekeeping. | Daily safety inspections |
| Fire (decontamination solvents and gasoline) | Flammable material stored in original containers or in safety cans with flame arrestors. Fire extinguisher kept near decontamination area. | Daily safety inspection |

**Table 3-2. Hazards Analysis (continued)**

| Safety and Health Hazards | Controls | Monitoring Requirements |
|---|---|---|
| Exposure to chemicals | Level D PPE plus nitrile or equivalent gloves for contact with contaminated material. Wash face and hands prior to taking anything by mouth. Minimal contact. Hazardous waste site operations training and medical clearance. Site training must include hazards and controls for exposure to site contaminants and chemicals used on-site. MSDSs on-site. All chemical containers labeled to indicate contents and hazard. | None |
| Temperature extremes | Administrative controls (see Section 8.0 of FWSHP). Cooled (shaded) or warmed break area depending on the season. Routine breaks in established break area (see Section 8.0 of FWSHP). Chilled drinks if temperature exceeds 70°F. | Temperature measurements at least twice a day. Pulse rates at the start of each break if wearing impermeable clothing |

EC&HS = Energy, Environment, & Infrastructure Environmental Compliance & Health and Safety
FM = Field Manager
FWSHP = Facility Wide Safety and Health Plan
GFCI = ground-fault circuit interrupter
IDW = investigation-derived waste
MEC = munitions and explosives of concern
MSDS = Material Safety Data Sheet
NRR= Noise Reduction Rating
O&M = operations and maintenance
PID = photoionization detector
PPE = personal protective equipment
PVC = polyvinyl chloride
RVAAP = Ravenna Army Ammunition Plant
SAIC = Science Applications International Corporation
SSHO = Site Saftey and Health Officer
UXO = unexploded ordnance

**Table 3-3. Potential Exposures**

| Chemical | TLV/PEL/STEL/IDLH[a] | Health Effects/ Potential Hazards[b] | Chemical and Physical Properties[b] | Exposure Route(s) |
|---|---|---|---|---|
| Hydrochloric acid (potentially used to preserve water samples or for equipment decontamination) | TLV: 2 ppm ceiling<br>IDLH: 50 ppm | Irritation of eyes, skin, respiratory system | Liquid; VP: fuming;<br>IP: 12.74 eV; FP: none | Inhalation<br>Ingestion<br>Contact |
| Nitric Acid (potentially used to preserve water samples) | TLV/TWA: 2 ppm<br>STEL: 4 ppm<br>IDLH: 25 ppm | Irritation of eyes, skin, respiratory system, and dental erosion | Colorless, yellow, or red, fuming liquid with an acrid, suffocating odor<br>VP: 48 mm; IP: 11.95 eV | Inhalation<br>Ingestion<br>Contact |
| Sulfuric Acid (potentially used to preserve water samples) | TLV/TWA: 1 $mg/m^3$.<br>STEL: 3 $mg/m^3$<br>IDLH: 15 $mg/m^3$ | Irritation of eyes, skin, respiratory system, and dental erosion | Colorless to dark-brown, oily, odorless liquid.<br>VP: 0.001 mm | Inhalation<br>Ingestion<br>Contact |
| Sodium Hydroxide (potentially used to preserve water samples) | TLV: 2 $mg/m^3$ ceiling<br>IDLH: 10 $mg/m^3$ | Irritation of eyes, skin, respiratory system | Colorless to white, odorless solid.<br>VP: 0 mm; VP: NA | Inhalation<br>Ingestion<br>Contact |
| Isopropyl alcohol (potentially used for equipment decontamination) | TLV/TWA: 200 ppm<br>STEL: 500 ppm<br>IDLH: 2,000 ppm | Irritation of eyes, skin, respiratory system; drowsiness; headache | Colorless liquid with alcohol odor; VP: 33 mm; IP: 10.10 eV;<br>FP: 53°F | Inhalation<br>Ingestion<br>Contact |
| Methanol (potentially used for equipment decontamination) | TLV/TWA: 200 ppm<br>Skin notation<br>IDLH: 6,000 ppm | Irritation of eyes, skin, respiratory system; headache; optic nerve damage | Liquid; VP: 96 mm;<br>IP: 10.84 eV; FP: 52°F | Inhalation<br>Absorption<br>Ingestion<br>Contact |
| Gasoline (used for fuel) | TLV/TWA: 300 ppm, A2<br>IDLH: Ca | Potential carcinogen per NIOSH, dizziness, eye irritation, dermatitis | Liquid with aromatic odor;<br>FP: -45°F; VP: 38-300 mm | Inhalation<br>Ingestion<br>Absorption<br>Contact |
| Liquinox (used for decontamination) | TLV/TWA: None | Inhalation may cause local irritation to mucus membranes | Yellow odorless liquid (biodegradable cleaner);<br>FP: NA | Inhalation<br>Ingestion |

[a]From 2008 Threshold Limit Values, American Conference of Governmental Industrial Hygienists.
[b]From NIOSH Guide to Chemical Hazards web site.

A2 = suspected human carcinogen
FP = flash point
IDLH = immediately dangerous to life and health
IP = ionization potential
NIOSH = National Institute for Occupational Safety and Health
PEL = Permissible Exposure Limit
ppm = parts per million
STEL = short-term exposure limit
TLV = threshold limit value
TWA = time-weighted average
VP = vapor pressure

# 4.0 MUNITIONS AND EXPLOSIVES OF CONCERN AVOIDANCE

A visual inspection for MECs around each well will be conducted by SAIC Field Operations Manager (FOM), prior to commencing work. Should any MEC be discovered, it will be avoided and the area will be vacated. No personnel will be tasked with disposal of MEC under this specific well sampling task. The SAIC FOM, will contact the SAIC Project Manager (PM), USACE and RVAAP Environmental Coordinator who will initiate the appropriate response actions.

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# 5.0 STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

This Section presents the personnel (and their associated telephone numbers) responsible for site safety and health and emergency response. Table 5-1 identifies the SAIC and subcontractor staff who will fill key roles. See the FWSHP for information on the roles and responsibilities of key positions.

**Table 5-1. Staff Organization**

| Position | Name | Phone |
|---|---|---|
| SAIC Health and Safety Manager | Steve Davis CIH, CSP | 865-481-4755 |
| SAIC Project Manager | Kevin Jago | 865-481-4614 |
| SAIC Field Operations Manager | Paul Parrish | 614-439-1812 |
| SAIC Site Safety and Health Officer | Amanda Trenton | 614-330-9857 |

Subcontractor Site Safety and Health Officer will be SSHO for all remedial activities.
CIH= Certified Industrial Hygienist.
CSP = Certified Safety Professional.
SAIC = Science Applications International Corporation.

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## 6.0 TRAINING

Training requirements, from Section 4.0 of the FWSHP, are summarized in Table 6-1 and in Table 3-2.

**Table 6-1. Training Requirements**

| Training | Worker | Supervisor | Site Visitor (exclusion zone) |
|---|---|---|---|
| HAZWOPER (40-hr, 3-day OJT) | √ | √ | √ |
| HAZWOPER Annual Refresher (8 hr) | √ | √ | √ |
| HAZWOPER Supervisors Training (8 hr) | | √ | |
| General Hazard Communication Training | √ | √ | √ |
| Respiratory Protection Training (required only if respirators are worn) | √ | √ | √ |
| Hearing Conservation Training (for workers in hearing conservation program) | √ | √ | √ |
| Pre-entry Briefing | √ | √ | √ |
| Site-Specific Hazard Communication (contained in pre-entry briefing) | √ | √ | √ |
| Safety Briefing (daily and whenever conditions or tasks change) | √ | √ | √ |
| CPR and First Aid Training | √ | √ | |

√ = Required.
HAZWOPER = Hazardous Waste Operations.
OJT = On-the-Job Training.
CPR = Cardio Pulmonary Resuscitation.

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# 7.0 PERSONAL PROTECTIVE EQUIPMENT

General guidelines for selection and use of PPE are presented in the FWSHP. Specific PPE requirements for this work are presented in the hazard/risk analysis section (Section 3.0).

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# 8.0 MEDICAL SURVEILLANCE

Medical surveillance requirements, as presented in Section 6.0 of the FWSHP, are summarized in Table 8-1.

**Table 8-1. Medical Surveillance Requirements**

| Baseline | Routine | Overexposure | Termination |
|---|---|---|---|
| Prior to work assessment | Every 12 months, unless greater frequency is deemed appropriate by attending physician. Not to exceed 2-year interval | Upon developing symptoms or where exposure limits have been exceeded or suspected to have been exceeded | Upon termination or re-assignment |

All medical exams shall include (see Section 6.2 of the Facility Wide Safety and Health Plan):

- Medical/work history;
- Physical exam by physician;
- Audiometry;
- Blood screening and blood count;
- Chest x-ray, as specified by physician;
- Electrocardiogram, as specified by physician;
- Spirometry; and
- Urinalysis.

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## 9.0 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Assessment of airborne chemical concentrations will be performed, as appropriate, to ensure that exposures do not exceed acceptable levels. Action levels, with appropriate responses, have been established for this monitoring. In addition to the specified monitoring, the SSHO may perform or require additional monitoring, such as organic vapor monitoring in the equipment decontamination area or personnel exposure monitoring for specific chemicals. The deployment of monitoring equipment will depend on the activities being conducted and the potential exposures. All personal exposure monitoring records will be maintained in accordance with 29 *Code of Federal Regulations* 1910.1020. The minimum monitoring requirements and action levels are presented in Table 9-1.

Most of the field activities are not expected to pose airborne exposure hazards for the following reasons:

- Work will be performed in open areas with natural ventilation;
- Prior site sampling indicated that contaminant concentrations are unlikely to pose an airborne hazard; and
- The most probable contaminants (RDX and nitrate) are materials with relatively low vapor pressures and exposure can be controlled through dust suppression techniques.

It is not anticipated to perform air monitoring of the breathing zone using a photoionization detector (PID) or equivalent during sampling. However, the SSHO will examine site conditions and will contact the Health and Safety Manager and initiate monitoring if there is any indication of potential airborne exposure.

**Table 9-1. Monitoring Requirements and Action Limits**

| Hazard or Measured Parameter | Area | Interval | Limit | Action | Tasks |
|---|---|---|---|---|---|
| Airborne organics with PID or equivalent | Breathing zone [14 in.] in front of employee's shoulder | At the wellhead and if site conditions, such as discolored soil or chemical smells, indicate that monitoring is necessary | <5 ppm<br><br>>5 ppm | Level D<br><br>Withdraw and evaluate<br>• evaluate need for PPE upgrade<br>• identify contaminants<br>• notify project manager and H&S manager | Groundwater Sampling |
| Noise | All areas perceived as noisy | Any area where there is some doubt about noise levels | 85 dBA<br>And any area perceived as noisy | Require the use of hearing protection | Hearing protection will be worn within the exclusion zone, around power augers, or other motorized equipment |
| Visible airborne dust potentially containing SRCs | All | Continuously | Visible dust generation | Stop work; use dust suppression techniques such as wetting surface | All |

H&S = health and safety
PID = photoionization detector
PPE = personal protective equipment
ppm = parts per million
SRC = site-related contaminant (e.g. PAHs, arsenic)

# 10.0 HEAT/COLD STRESS MONITORING

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

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# 11.0 STANDARD OPERATING SAFETY PROCEDURES

Standard operating safety procedures are described in the FWSHP.

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# 12.0 SITE CONTROL MEASURES

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

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# 13.0 PERSONNEL HYGIENE AND DECONTAMINATION

Personal hygiene and decontamination requirements are described in the FWSHP and in Section 2.0 of this addendum.

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# 14.0 Emergency Procedures and Equipment

Emergency contacts, telephone numbers, directions to the nearest medical facility, and general procedures can be found in the FWSHP. All emergencies onsite will be coordinated first through **Guard Post 1 [(330) 358-2017]** who will coordinate the response. The SAIC Field Operations Manager will remain in charge of all SAIC and subcontractor personnel during emergency activities. The SAIC field office will serve as the assembly point if it becomes necessary to evacuate one or more remedial locations. During mobilization, the SSHO will verify that the emergency information in the FWSHP is correct.

Each field team shall have a cellular phone and/or a 2-way radio capable of contacting Guard Post 1 for communications purposes.

During field operations all on-site personnel shall have CPR/first aid training.

**Emergency Phone Numbers**

| Position | Phone |
|---|---|
| RVAAP Guard Post 1<br>(Police, Fire, Emergency Medical) | (330)358-2017 |
| Hospital (Robinson Memorial, Ravenna) | (330) 297-2449/0811 |
| RVAAP Facility Manager<br>Mark Patterson | (330) 358-7311 |
| RVAAP Operation and Maintenance Contractor<br>Jim McGee, PIKA International, Inc. | (330) 358-3005 |
| USACE<br>Mark W. Nichter | (502) 315-6375 |
| Ohio EPA, Eileen Mohr | Office: (330) 963-1221 Cell: (216) 401-8382 |
| SAIC Project Manager,<br>Kevin Jago<br>Jed Thomas | <br>(865) 481-4614<br>Office: (330) 405-5802 Cell: (216) 214-2599 |
| SAIC Health and Safety Personnel,<br>Steve Davis CIH, CSP<br>Amanda Trenton | <br>(865) 481-4755<br>Office: (614) 330-9857 Cell: (614) 330-9857 |

RVAAP = Ravenna Army Ammunition Plant.
USACE = U.S. Army Corps of Engineers.
Ohio EPA = Ohio Environmental Protection Agency.
SAIC = Science Applications International Corporation, Inc.
CIH= Certified Industrial Hygienist.
CSP = Certified Safety Professional.

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# 15.0 LOGS, REPORTS, AND RECORD KEEPING

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

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# 16.0 REFERENCES

American Conference of Governmental Hygienists (ACGIH) 2008. Threshold Limit Values. 2008

NIOSH (National Institute for Occupational Safety and Health) 2005. *NIOSH Pocket Guide to Chemical Hazards*. September 2005.

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

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

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

USACE 2004. *Facility-Wide Groundwater Monitoring Program for the Ravenna Army Ammunition Plant, Ravenna, Ohio,* GS-10F-0350M, D.O. DACA27-03-F-0047, September 2004.

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# 17.0 FACILITY AND HOSPITAL MAPS

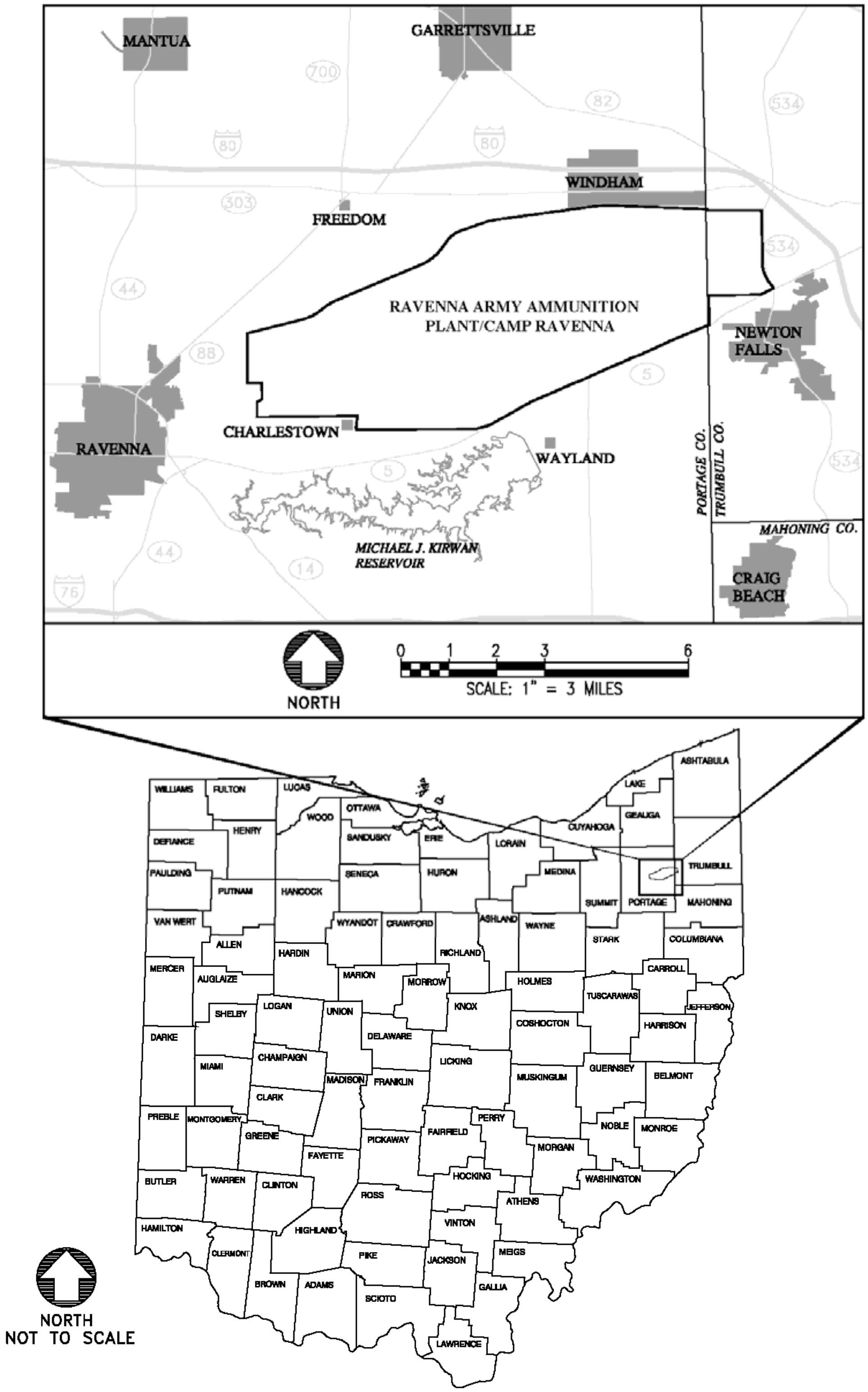


**Figure 17-1. General Location and Orientation of the RVAAP/Camp Ravenna**

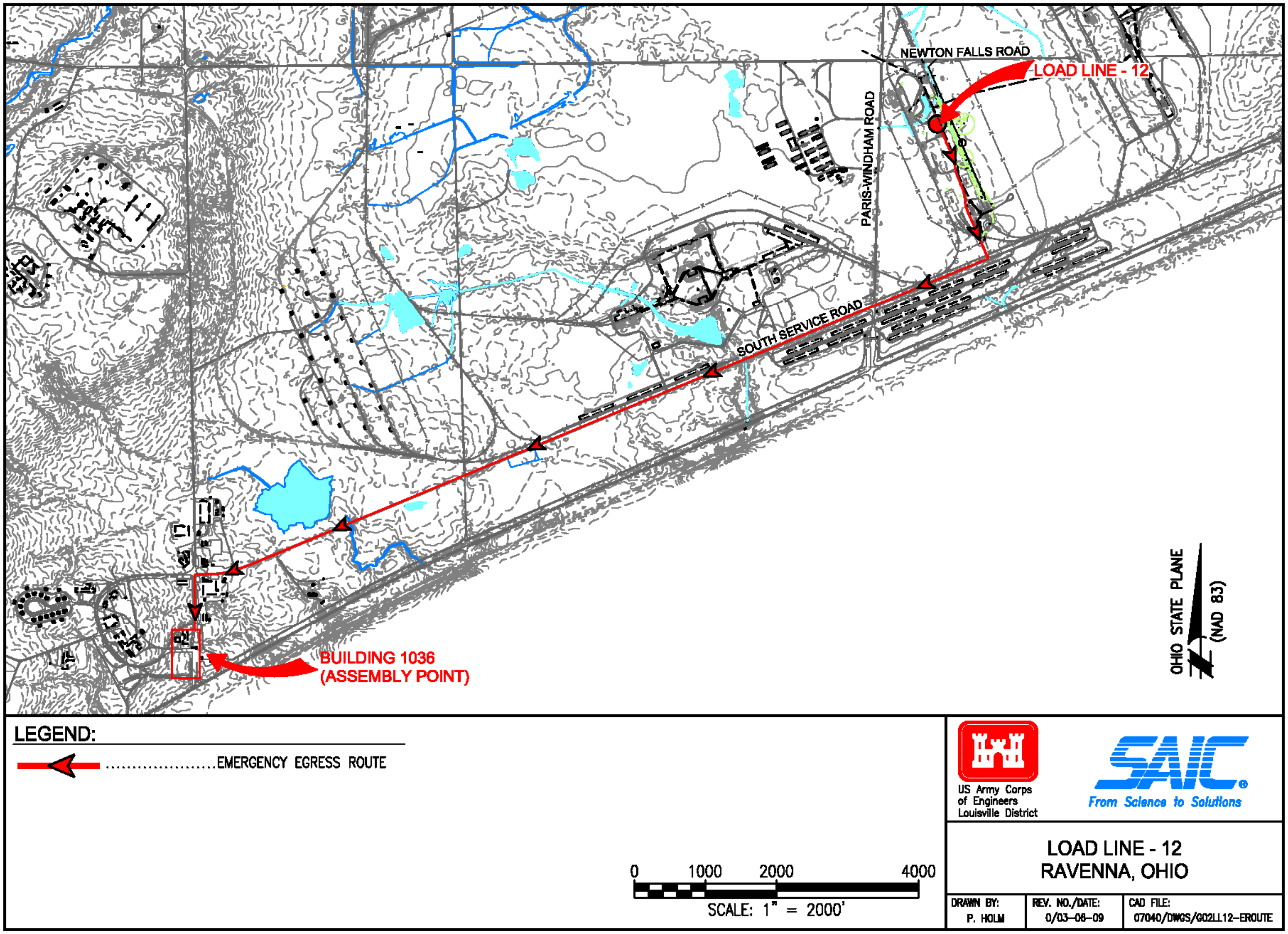


**Figure 17-2. RVAAP/Camp Ravenna Site Map and Egress Route**

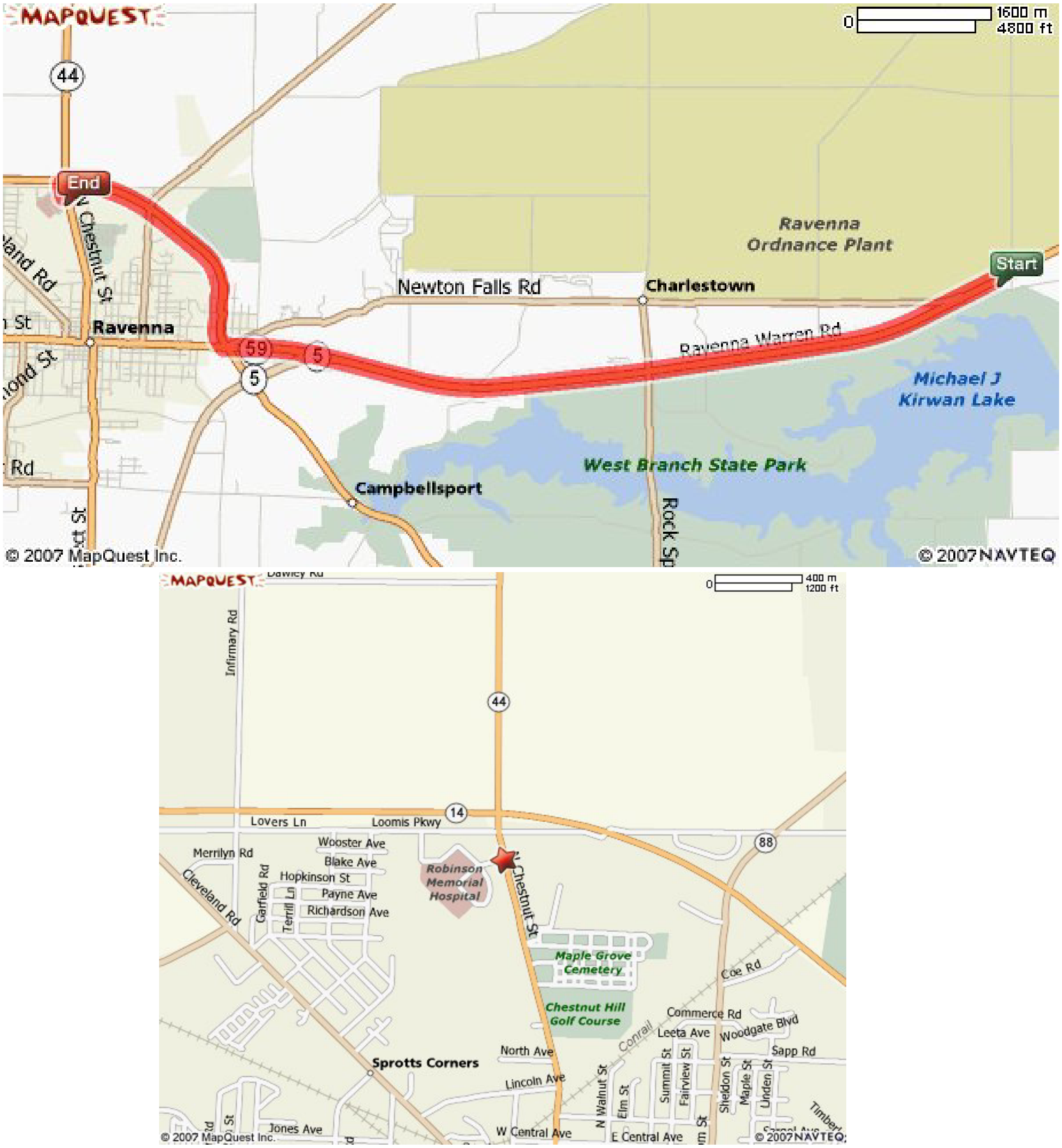


**Figure 17-3. Route Map to Pre-Notified Medical Facility**

**Robinson Memorial Hospital**
**6847 N. Chestnut Street**
**Ravenna, Ohio**
**(330) 297-0811**

**Directions: West on State Route 5. Stay straight onto OH-59 West. Turn Right onto OH-14/OH-44. Turn Left onto North Chestnut St.**

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| ***USACE - Louisville (Mark Nichter)*** | | | | | |
| A-1. | QAPP Section 4.2 and Table 8-1 | FSP p. 4-2<br>QAPP p.4-1 | Section 4.2 specifies that field duplicates will be collected for quality control (QC) purposes. However, Table 8-1 does not list duplicate samples. Please clarify whether field duplicates will be collected for QC purposes. | Include field duplicate (and QA Split Samples) samples on Table 8-1 if appropriate. | Concur. Field duplicate samples will be collected for MNA Parameters. Table 8-1 will be revised to reflect the collection of duplicate and split samples.<br>QAPP Section 4.2 text revised as follows:<br>trip blanks, field duplicates, split samples and equipment …<br>FSP Section 4.1.5 text revised as follows:<br>…will include duplicate groundwater samples , split samples and equipment rinsates as… |
| A-2. | QAPP Table 8-1 | QAPP p.8-3 | Correct the methanol method to EPA 8015B. Method 8015 may be confused with 8015A, which is not a correct analytical method for methanol. | Make recommended change accordingly. | Concur. Table 8-1 will be revised as follows:<br>SW 846 8015B<br>Revised Table 8-1 is included at the end of this CRT |
| A-3. | FSP Figure 2-1 and Part II QAPP | FSP Fig. 2-1 p.2-1 | The QAPP can not be considered "final" by the USACE until a laboratory has been selected for the project, and the appropriate laboratory QA/QC information has been submitted for review/approval. | Please identify the select laboratory and provide pertinent QA/QC information. | Concur. Figure 2-1 will be revised as follows:<br>***Analytical Laboratory***<br>~~To Be Determined~~ White Water Associates, Inc. |
| ***Ohio EPA (Conni McCambridge, DDAGW/NEDO; Vicki Deppisch, DERR/NEDO)*** | | | | | |
| O-1. | General | FSP Fig.3-1 | No flow maps were included. | Please provide all available flow maps for LL-12 (which may show seasonal | Concur. Potentiometric Surface Maps are available for November 2000, January 2005, |

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| | | through<br>3-5<br>p.3-4<br>through<br>3-8 | | flow variations). | February 2005, March 2005, and April 2005 and will be included in the final document and are attached to this CRT.<br><br>FSP Section 3.0 Text revised as follows:<br><br>…calculation purposes. ~~Below is a~~ The table below presents the list of ~~the~~ wells to be sampled during this investigation~~:~~ and the rationale for their inclusion. Figures 3-1 through 3-5 present the available potentiometric surface maps from previous investigations conducted at Load Line 12. |
| O-2. | Sections 3.1 and 3.3, Table 3-2 | FSP<br>p.3-1<br><br>Table 3-2<br>p.3-2 | <u>Section 1.0 (Project Description) and Section 3. (Project Scope and Description)</u>: The text indicates that "*samples will be collected and analyzed for groundwater chemistry necessary to evaluate remedial alternatives for monitored natural attenuation (MNA) parameters*" (Section 1.0, pg. 1-1).<br><br>The text also indicates that one round of ground water samples for MNA parameters *"…will be sufficient to evaluate the current site conditions…"* because of previous data (Section 3.0, pg. 3-1). The MNA parameters are listed on page 3-1 of Section 3.0. | The project scope in Section 3.0 did not present a summary of the known hydrogeochemical conditions found at the facility to indicate that natural attenuation is favorable at Load Line 12.<br><br>A discussion is needed to detail the criteria used in the selection of the MNA parameters that will be analyzed to evaluate whether natural attenuation is currently occurring at the site. This discussion should include how these parameters will be used to demonstrate the natural attenuation of explosives and organic compounds and address whether one round of sampling is adequate for this | i) Clarification. Samples to date collected at LL12 have been analyzed for only RVAAP standard analyte suites (e.g., metals, explosives, nitrate, etc.). The objective of sample collection for natural attenuation parameters is to provide data on the site-specific hydrogeochemical conditions to determine the suitability of MNA as a potential remedial alternative and to demonstrate if active MNA processes are already occurring at Load Line 12. The results of these geochemical and natural attenuation parameter analyses will be evaluated in the FS phase to determine the suitability of MNA as a remedial alternative at Load Line 12.<br><br>Text in Section 3.0 will be revised as follows: The MNA parameters selected for analysis are |

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| | | | | demonstration.<br>DDAGW recommends that the facility include the following information if natural attenuation is to be cited as a remedial alternative at Load Line 12:<br><br>i) A discussion addressing the suitability of site-specific hydrogeochemical conditions for natural attenuation processes beneath the Load Line 12 area.<br><br>ii) Appropriate documentation and discussion of the evidences and processes supporting natural attenuation beneath the Load Line 12 area.<br><br>iii) Provide literature references on MNA of explosive compounds. | based on and consistent with the Environmental Security Technology Certification Program's (ESTCP) *Natural Attenuation of Explosives in Groundwater* completion report (Pennington, Zakikhani, Harrelson and Allen 1999) where such an approach was utilized at Louisiana Army Ammunition Plant and Joliet Army Ammunition Plant. These parameters were also utilized in an MNA evaluation for explosives as part of the RCRA Facility Investigation for Site-Wide Groundwater at Holston Army Ammunition Plant (USACE 2007).<br><br>The bulleted list of MNA parameters on page 3-1, lines 23-37, of the FSP will be replaced with a table (Table 3-2) listing the proposed analytes and the justification for their inclusion in and significance to the MNA suite. Proposed Table 3-2 is shown at the end of this CRT.<br><br>Text of Sect. 3, second paragraph, last sentence has been revised as follows:<br><br>"Table 3-2 ~~B~~below presents ~~is~~ a list of the MNA parameters to be collected and the justification for inclusion for this investigation.<br><br>ii) See response to part i of this comment. |

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| | | | | | iii) Clarification. A comprehensive reference list of explosives MNA literature resources were transmitted to Ohio EPA on September 30, 2008 and the corresponding full-text pdf documents uploaded to an FTP site for access, as per request from the DQO meeting on September 23-24, 2008. These references and documents will be transmitted to Ohio EPA. No text change proposed. |
| O-3. | Section 3.0 | FSP Table 3-1 p.3-1 | No details/rationale was provided for inclusion and exclusion for each specific well for MNA. | Please provide rationale for inclusion and exclusion for each well at LL-12. | Concur. Table 3-1 will be included to provide the list of wells to be sampled and the rationale for their inclusion. The proposed Table 3-1 is shown at the end of this CRT.. |
| O-4. | Page 3-2, lines 4&5 | FSP p.3-3 | Document states "....areas will be used to assess the degradation rates for nitrate and other primary COCs." | Please specify what COCs. | Concur. Text revised as follows:<br><br>…rates for nitrate and RDX~~ other primary COCs~~. Groundwater… |
| O-5. | Section 7.0 | FSP p.7-1 | IDW waste characterization. | Re: Wastes for disposal: Please provide the results of the IDW wastes to Ohio EPA for approval prior to disposal. | Concur. Text revised as follows:<br><br>…a letter report will be submitted to the USACE~~, and~~ RVAAP Facility Manager, and Ohio EPA documenting… |
| O-6. | Table A-1, pg. A-4 | NA | RE: LL12mw-182 No nitrate sampling is included in the table. Was this sampled for nitrate? | Please verify and correct table if nitrate sampling was conducted for this well. | Clarification. Nitrate samples were collected during the four quarterly sampling events in 2007 at well L12mw-182. All four quarterly events showed non-detect for nitrate. |

| Comment Number | Page or Sheet | New Page or Sheet | Comment | Recommendation | Response |
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| | | | | | Table A-1 will be revised to include all nitrate and explosives data even non-detects. |
| O-7. | Table A-1, various wells | FSP p.3-1 | Many wells have B qualifiers for nitrate analysis:<br>LL12-154 Oct 08 100 B ug/L<br>LL12-186 July 07 at 20B ug/L<br>LL12-187 Oct 08 at 200,000B ug/L<br>LL12-188 Oct 08 at 800JB ug/L<br>LL12-242 Oct 08 at 200B ug/L<br>LL12-244 Jan 08 40JB ug/l<br>LL12-245 Jan 08 100B ug/l<br>LL12-246 Oct 08 100B ug/L | Please provide a concentration table for nitrate method blanks for all sampling events. Please discuss in the text of the document.<br><br>Please verify all B values in Table A-1 and correct if necessary. | Concur. Text revised in Section 3.0 as follows:<br><br>… as Appendix A to this SAP. Nitrate results for some sampling events were qualified "B" during the data verification process as nitrate was found in either the equipment rinse blank or the method blank. The results that were less than 5 times the blank contamination were flagged "B". The method blank or equipment rinse blank results are included at the end of the data summary in Appendix A. SAIC proposes not to collect…<br><br>B values were verified against the previously reported data and with the EQM who supplied the data. |
| O-8. | Table 8-1 | FSP p.8-1 | Degradation of explosives and nitrate. | Please provide complete degradation pathway diagram for explosives and nitrate and attenuation mechanism. Please provide the articles or publications, etc., used for MNA selection that is listed as references at the end of Table 8-1.<br><br>Ohio EPA was able to locate only a limited amount of information | Clarification. Please refer to response to part iii) of Comment O-2. A comprehensive discussion and pathway diagrams for the transformation processes for several explosive compounds are presented in several of the documents previously provided. A full discussion of these processes will be provided in the FS during the evaluation of MNA as a potential remedial alternative. As described in part i) of Comment O-2, the bulleted list of |

| Comment Number | Page or Sheet | New Page or Sheet | Comment | Recommendation | Response |
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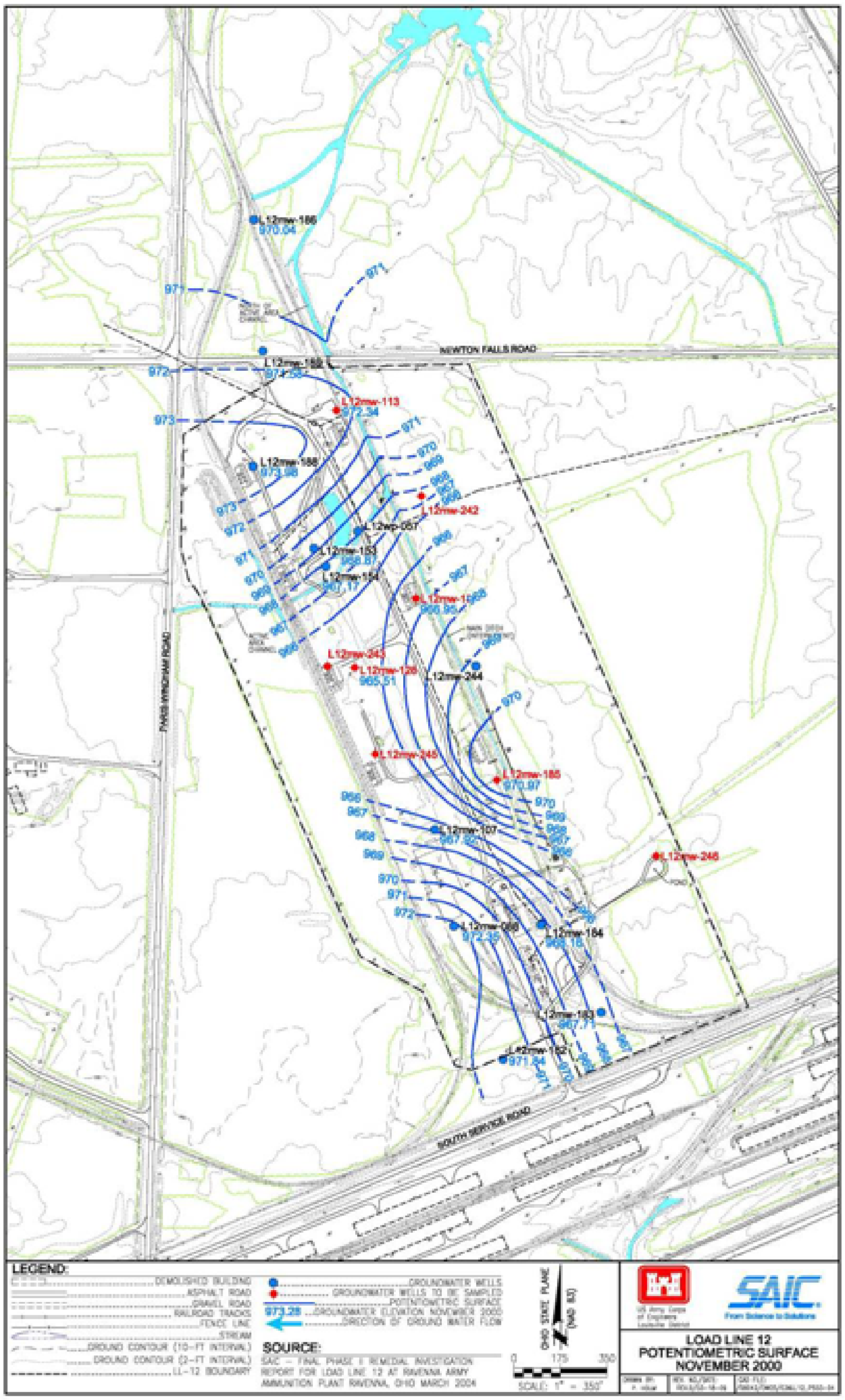
| | | | | regarding explosives degradation. Please provide any and all reference material that is used to evaluate MNA, degradation, etc., for explosives. | MNA parameters on page 3-1 of the FSP will be replaced with a table that provides a technical basis for the selection of the MNA analytical suite and their significance to explosives degradation processes.<br><br>The following references have been added to the FSP Section 8.0 text as follows:<br><br>Brannon, J.M., and Pennington, J.C., 2002. *Environmental Fate and Transport Process Descriptions for Explosives, Final*. U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi, Document No. ERD/EL TR-02-10.<br><br>Pennington, J.C., Zakikhani, M., and Harrelson, D.W. 1999. *Monitored Natural Attenuation of Explosives in Groundwater – Environmental Security Technology Certification Program (ESTCP) Completion Report for U.S. Army Waterways Experiment Station*, Vicksburg, MS. Final Report. 228pp.<br><br>Strategic Environmental Research and Development Program (SERDP). 2004. *Microbial Degradation of RDX and HMX*. SERDP Project CU1213, Final Report, December 2001 - December 2003. Performing organizations: Biotechnology |

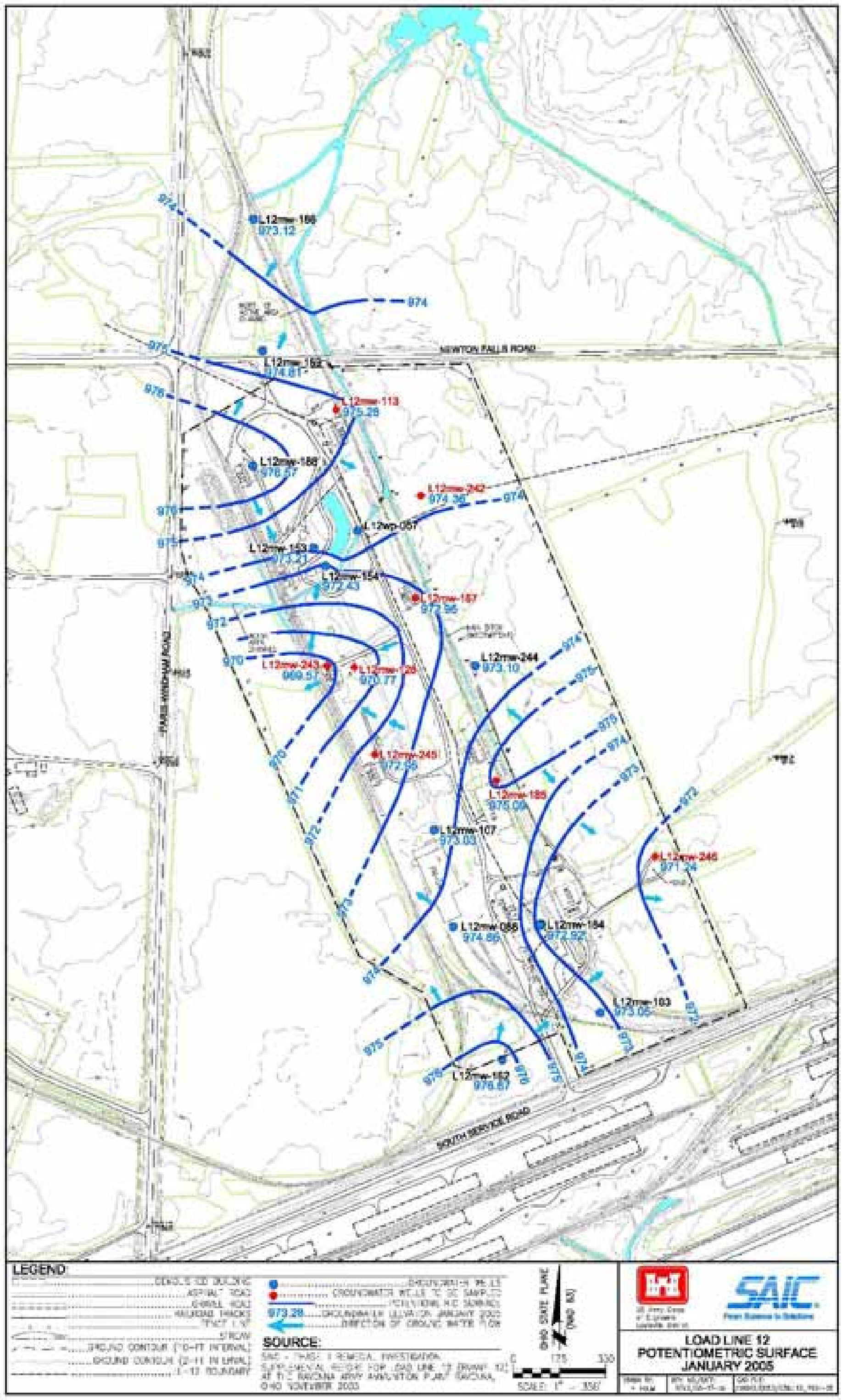
| Comment Number | Page or Sheet | New Page or Sheet | Comment | Recommendation | Response |
|---|---|---|---|---|---|
| | | | | | Research Institute, National Research Council of Canada; Defense Research and Development Canada; and US Air Force Research Laboratory. 221pp. |
| O-9. | Health and Safety Plan | NA | Please note that Ohio EPA does not approve Health and Safety Plans but does provide comments. | Ohio EPA suggests that all personnel do not work alone. In addition, please provide communication devices in the event of an emergency. | Clarification. Per Table 3-2 Hazards Analysis of the SSHP the buddy system will be used so that personnel do not work alone onsite unless it is for very short duration work such as a site check or site visit. If a person is onsite alone they are required to call in prior to starting work and to call once they complete their onsite work and leave the site. As noted in Section 14.0 of the SSHP, each field team shall have a mobile phone or 2-way radio to be able to contact Guard Post 1. No additional text changes proposed. |
| O-10. | General | NA | Please note that if selected, MNA will incur additional costs and work. This is not a "no-action" alternative. Some of the costs/work include the following: GW modeling (including future migration and attenuation), scheduled long term GW sampling, demonstration that MNA parameters are continuing (sampling), performance standards (long-term predictions of contaminant fate) and timetable, alternative remedial action if standards and timetable are not met, etc. | No response required. | Clarification. Agree that MNA is not a "no-action" alternative. It is noted that MNA will be evaluated in the FS along with other feasible alternatives. Evaluation of a potential MNA remedy will include presentation of degradation rates and contaminant fate and transport modeling. These will be evaluated as part of the FS. Relevant components of a MNA alternative would include performance monitoring and periodic remedy reviews. No text changes proposed. |
| ***OHARNG (Katie Elgin)*** | | | | | |

| Comment Number | Page or Sheet | New Page or Sheet | Comment | Recommendation | Response |
|---|---|---|---|---|---|
| R-1. | Figure 1-3 | FSP fig.1-2,1-3 p.1-3,1-5 | Figure 1-3 - Where did this AOC boundary come from? I think the AOC boundary is the fence line. Please verify. | | Concur. Figures 1-2 and 1-3 will be revised to show the AOC boundary as the fence line. |

Figures 3-1 through 3-5

Potentiometric Surfaces Nov 2000, Jan 2005, Feb 2005, Mar 2005 and Apr 2005.

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SOUTH SERVICE ROAD
PARIS-WINDHAM ROAD
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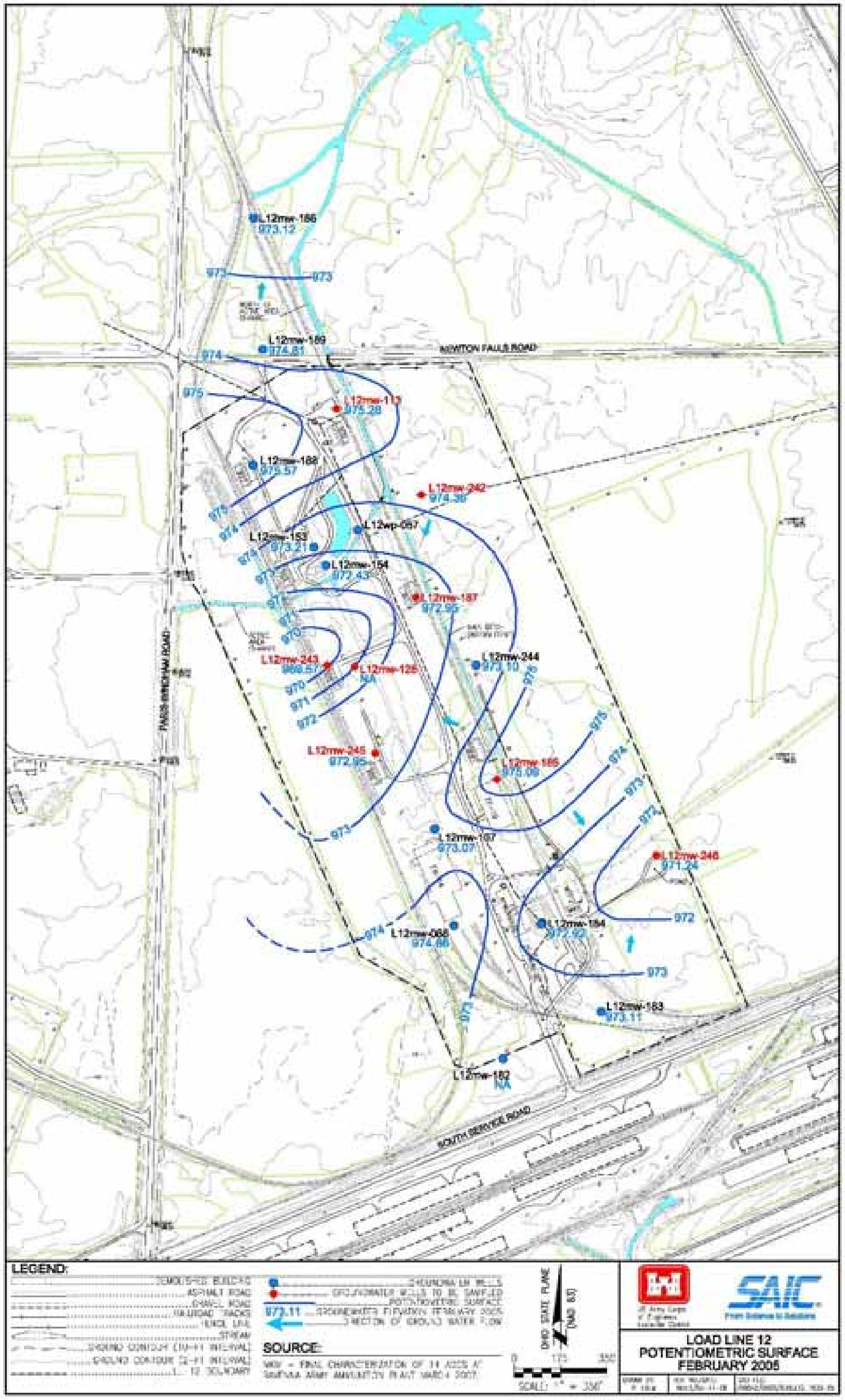
L12mw-242
974.36
L12wp-087
L12mw-244
973.10
L12mw-245
L12mw-185
975.09
L12mw-107
L12mw-246
971.24
L12mw-088
974.86
L12mw-184
972.92
L12mw-183
973.05
LEGEND
SOURCE:
LOAD LINE 12
POTENTIOMETRIC SURFACE
JANUARY 2005
SAIC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L12mw-189
974.81
NEWTON FALLS ROAD
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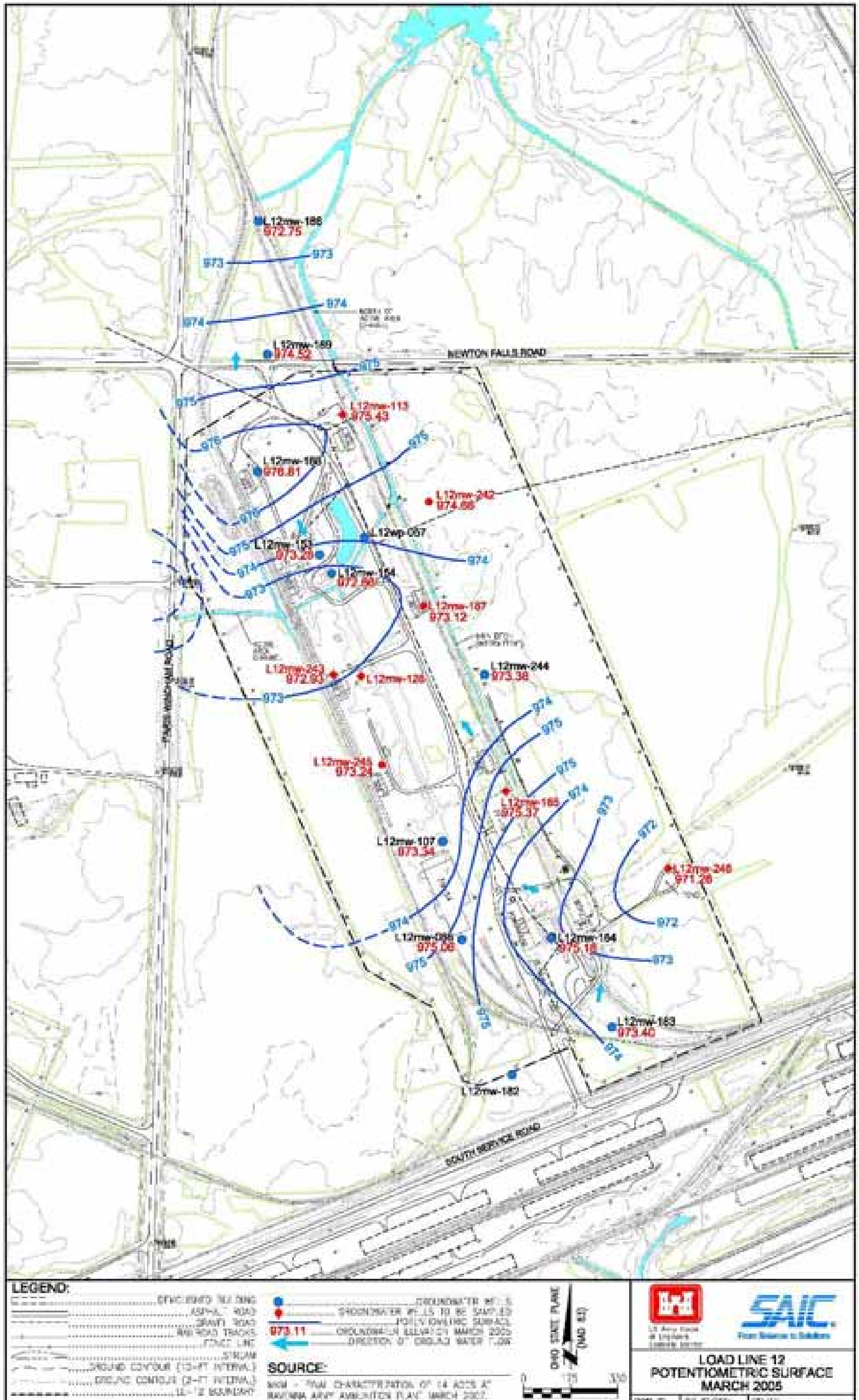
975.57
L12wp-057
L12mw-154
972.43
L12mw-187
972.95
L12mw-244
L12mw-243
L12mw-126
NA
L12mw-245
972.95
L12mw-185
975.09
L12mw-246
971.24
L12mw-184
L12mw-183
973.11
L12mw-182
NA
SOUTH SERVICE ROAD
LEGEND:
SOURCE:
LOAD LINE 12
POTENTIOMETRIC SURFACE
FEBRUARY 2005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974
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976.81
L12mw-242
974.66
L12wp-057
L12mw-153
973.28
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972.86
L12mw-187
973.12
L12mw-244
973.38
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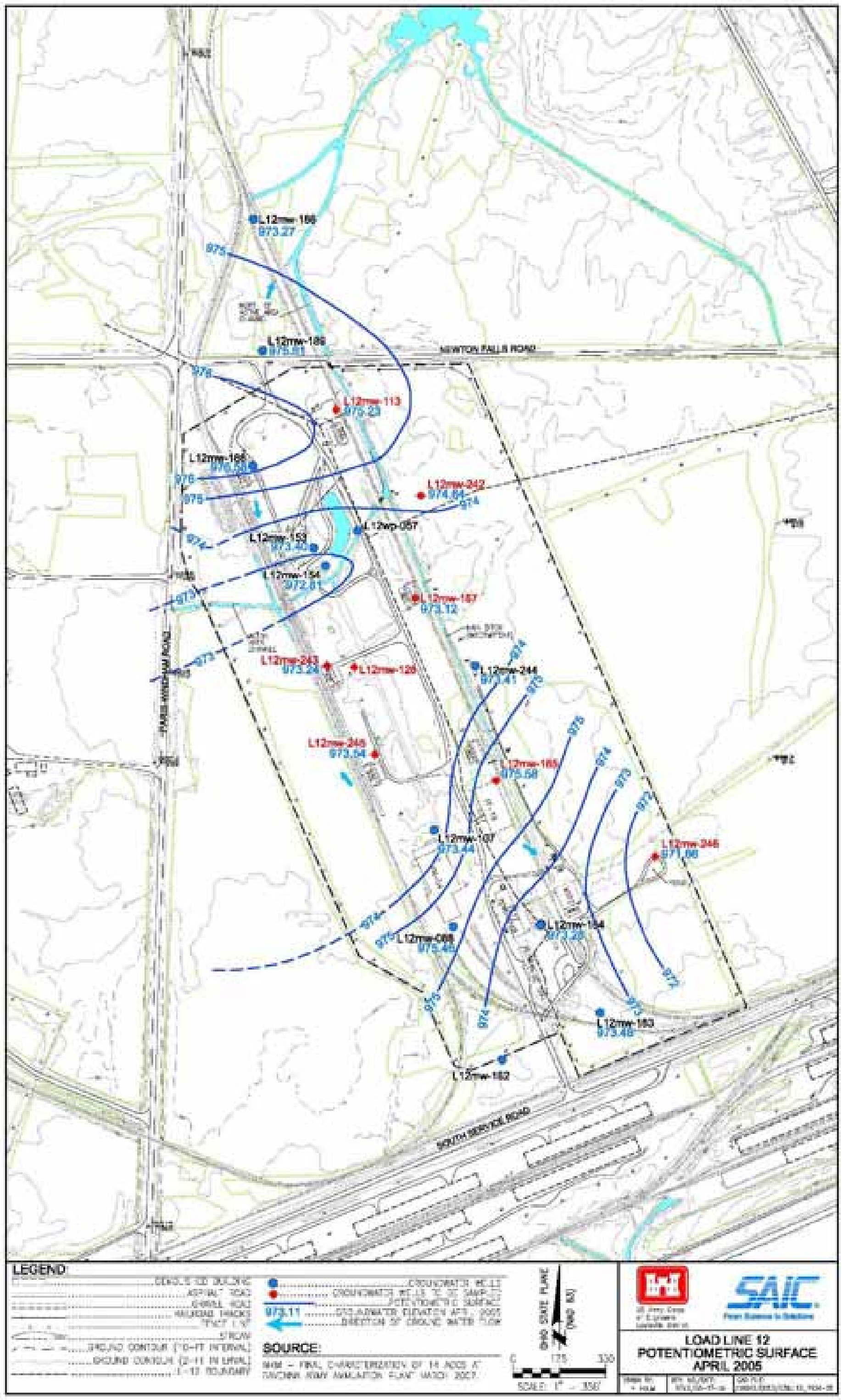
972.90
L12mw-128
L12mw-245
973.24
L12mw-185
975.37
L12mw-107
973.34
L12mw-246
971.26
972
L12mw-099
975.06
L12mw-184
975.18
L12mw-183
973.40
L12mw-182
SOUTH SERVICE ROAD
LEGEND:
973.11
SOURCE:
OHIO STATE PLANE
(NAD 83)
SAIC
LOAD LINE 12
POTENTIOMETRIC SURFACE
MARCH 2005


L12mw-186
973.27
NEWTON FALLS ROAD
L12mw-113
L12mw-242
L12wp-087
L12mw-153
L12mw-154
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L12mw-243
L12mw-244
L12mw-245
L12mw-185
L12mw-107
L12mw-246
L12mw-184
L12mw-183
L12mw-182
SOUTH SERVICE ROAD
LEGEND
SOURCE:
LOAD LINE 12
POTENTIOMETRIC SURFACE
APRIL 2005
SAIC

Table 3-1 For Ohio EPA Comment O-3

**Table 3-1 Wells to be Sampled and Rationale for Inclusion**

| Well | Rationale |
|---|---|
| L12mw-113 | Historic HMX contamination found in this well |
| L12mw-128 | Downgradient of L12mw-187 |
| L12mw-185 | Nitrate Source Area |
| L12mw-187 | Nitrate Source Area |
| L12mw-242 | Upgradient of L12mw-187 and Downgradient of L12mw-113 |
| L12mw-243 | Downgradient of L12mw-185 and L12mw-187 |
| L12mw-245 | Downgradient of L12mw-185 |
| L12mw-246 | Downgradient of L12mw-185 |

Wells closest to nitrate source areas were chosen so that degradation calculations can be made with respect to wells at different distances downgradient from those source area wells.

Table 3-2 For Ohio EPA Comment O-2

**Table 3-2 Description of MNA Analytical Suite**

| Analyte | Description and Justification for Inclusion in MNA Suite |
|---|---|
| DNX, MNX, TNX | The nitroso derivatives of RDX (DNX, MNX, and TNX) are first-stage degradation compounds. DNX and MNX are additionally first stage degradation compounds of HMX. These intermediates are also susceptible to subsequent degradation and are short-lived in the environment. |
| Dimethylhydrazines (1,1- and 1,2-) | Intermediate degradation products of RDX. Short-lived in the environment. |
| Hydrazine | End product indicator of RDX. Short-lived in the environment. |
| Ammonia | End product indicator for explosives degradation |
| Nitrate | End product indicator. Nitrate is the most efficient electron acceptor in anaerobic biodegradation. Also, nitrate is reduced to nitrite when utilized by microorganisms as an electron acceptor |
| Methane | Methane is an end product indicator and an anaerobic biodegradation transformation product of explosives degradation. Ethane and ethylene results are also reported under the laboratory's organic gases suite, but these analytes are not considered significant to the evaluation of MNA processes |
| Methanol | End product indicator and anaerobic biodegradation transformation product |
| Phosphorous | Limiting nutrient for microbial growth and activity. Low levels indicate decreasing potential for the maintenance of adequate habitats for degradative microorganisms |
| Organic Nitrogen | End product indicator. Also supports co-metabolic microbial activity |
| Total Organic Carbon (TOC) | Anaerobic studies suggest degradation of explosives in groundwater can utilize co-metabolic processes that incorporate organic carbon as a co-metabolite |
| Ferrous Iron | Iron is a common electron acceptor utilized in anaerobic biodegradation |
| Sulfate and Sulfide | Sulfate can be utilized by microbes as an electron acceptor in anaerobic biodegradation, resulting in the production of sulfide |
| Alkalinity | Indicator of feasibility and types of degradation processes possible. Alkaline conditions favor degradation of explosives |
| Carbon Dioxide | Microorganisms utilize carbon dioxide as an electron acceptor once sulfate is exhausted |
| Oxidation-reduction potential | Indicator of feasibility and types of degradation processes possible. Monitored as a field parameter |

Sources: Brannon and Pennington 2002; Strategic Environmental Research and Development Program 2004; and Pennington et. al., 1999.
MNA = Monitored natural attenuation.
RDX = 1,3,5-Trinitroperhydro-1,3,5-triazine.

**Table 8-1. Parameters, Methods and Number of Samples for Groundwater Sampling at Load Line 12**

| Parameter | Method | No. of Field Samples | No. of Field Duplicates | No. of Split Samples | No. of Rinsate Samples | Total No. Samples | Justification for Inclusion in MNA Sampling Suite |
|---|---|---|---|---|---|---|---|
| ***Groundwater*** | | | | | | | |
| DNX, MNX, TNX | SW846 8330 | 8 | 1 | 1 | 1 | 11 | The nitroso derivatives of RDX (DNX, MNX, and TNX) are first-stage degradation compounds. DNX and MNX are additionally first stage degradation compounds of HMX. These intermediates are also susceptible to subsequent degradation and are short-lived in the environment. |
| Dimethylhydrazines (1,1- and 1,2-) | Mod. 300.0 | 8 | 1 | 1 | 1 | 11 | Intermediate degradation products of RDX. Short-lived in the environment. |
| Hydrazine | Mod. 300.0 | 8 | 1 | 1 | 1 | 11 | End product indicator of RDX. Short-lived in the environment. |
| Ammonia | EPA 350.2 | 8 | 1 | 1 | 1 | 11 | End product indicator for explosives degradation. |
| Nitrate | EPA 300 | 8 | 1 | 1 | 1 | 11 | End product indicator. Nitrate is the most efficient electron acceptor in anaerobic biodegradation. Also, nitrate is reduced to nitrite when utilized by microorganisms as an electron acceptor. |
| Methane | RSK-175 | 8 | 1 | 1 | 1 | 11 | Methane is an end product indicator and an anaerobic biodegradation transformation product of explosives degradation. Ethane and ethylene results are also reported under the laboratory's organic gases suite, but these analytes are not considered significant to the evaluation of MNA processes. |
| Methanol | SW 846 8015B | 8 | 1 | 1 | 1 | 11 | End product indicator and anaerobic biodegradation transformation product. |
| Phosphorous | EPA 365.4 | 8 | 1 | 1 | 1 | 11 | Limiting nutrient for microbial growth and activity. Low levels indicate decreasing potential for the maintenance of adequate habitats for degradative microorganisms. |
| Organic Nitrogen | EPA 300 | 8 | 1 | 1 | 1 | 11 | End product indicator; also supports co-metabolic microbial activity. |

**Table 8-1. Parameters, Methods and Number of Samples for Groundwater Sampling at Load Line 12 (continued)**

| Parameter | Method | No. of Field Samples | No. of Field Duplicates | No. of Split Samples | No. of Rinsate Samples | Total No. Samples | Justification for Inclusion in MNA Sampling Suite |
|---|---|---|---|---|---|---|---|
| ***Groundwater*** | | | | | | | |
| Total Organic Carbon (TOC) | EPA 415.1 | 8 | 1 | 1 | 1 | 11 | Anaerobic studies suggest degradation of RDX in groundwater can utilize co-metabolic processes that incorporate organic carbon as a co-metabolite. |
| Ferrous Iron | NA | 8 | 0 | 0 | 0 | 8 | Iron is a common electron acceptor utilized in anaerobic biodegradation. |
| Sulfate and Sulfide | EPA 300<br>EPA 376.1 | 8 | 1 | 1 | 1 | 11 | Sulfate can be utilized by microbes as an electron acceptor in anaerobic biodegradation, resulting in the production of sulfide. |
| Alkalinity | EPA 310.1 | 8 | 1 | 1 | 1 | 11 | Indicator of feasibility and types of degradation processes possible. Alkaline conditions favor degradation of RDX. |
| Carbon Dioxide (Dissolved) | SM4500-$CO_2$-C | 8 | 1 | 1 | 1 | 11 | Microorganisms utilize carbon dioxide as an electron acceptor, once sulfate is exhausted. |
| Oxidation-Reduction Potential | ASTM D1498 - 08 | 8 | 1 | 1 | 1 | 11 | Indicator of feasibility and types of degradation processes possible. Monitored as a field parameter. |

Sources for MNA selection include Sources: Brannon and Pennington 2002; SERDP 2004; and Pennington et. al., 1999.
MNA = monitored natural attenuation
RDX = Hexahydro-1,3,5-trinitro-1,3,5-triazine

DNX = Hexahydro-1.3-dinitroso-5-nitro-1,3,5-triazine
MNX = Hexahydro-1-nitroso-3,5-dinitro-1,3,5-triazine
TNX = Hexahydro-1,3,5-trinitroso-1,3,5-triazine
HMX = Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine