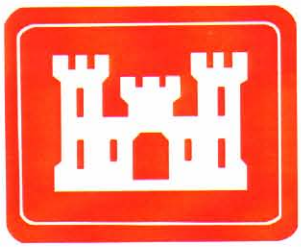
FINAL

SAMPLING AND ANALYSIS PLAN ADDENDUM FOR THE GROUNDWATER INVESTIGATION OF THE FORMER RAMSDELL QUARRY LANDFILL

at the

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

PREPARED FOR



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LOUISVILLE DISTRICT

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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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Prepared for

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Louisville District
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ABBREVIATIONS AND ACRONYMS

AOC	area of concern
D.O.	dissolved oxygen
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FID	flame ionization detector
HCl	hydrochloric acid (rinse)
IDW	investigative-detected waste
LL1	Load Line 1
MRD	Missouri River Division (Laboratory)
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
OVA	organic vapor analyzer
PCB	polychlorinated biphenyl
PID	photoionization detector
QA	quality assurance
QAMP	Quality Assurance Management Plan (Quanterra Environmental Services, Inc.)
QAPP	Quality Assurance Project Plan
QC	quality control
RQL	Ramsdell Quarry Landfill
RVAAP	Ravenna Army Ammunition Plant
SAP	Sampling and Analysis Plan
SAIC	Science Applications and International Corporation
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
USC	Unified Soil Classification
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance
VOC	volatile organic compound

INTRODUCTION

This Groundwater Investigation Sampling and Analysis Plan (SAP)Addendum for the Ramsdell Quarry Landfill (RQL) at Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio has been prepared for RVAAP by Science Applications International Corporation under contract DACA27-97-D-0025, Delivery Order No. 003, with the United States Army Corps of Engineers (USACE), Louisville District. This SAP Addendum has been developed to tier under and supplement the *Facility-wide Sampling and Analysis Plan for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996a) for the purpose of performing a Groundwater Investigation at RQL. The work to be performed includes the installation, testing, sampling, and instrumentation of new monitoring wells, as well as the sampling of existing monitoring wells, pond sediment, and surface water. The Facility-wide SAP provides the base documentation (i.e., technical and investigative protocols) for conducting the investigation in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act at RVAAP, whereas the SAP Addendum includes all of the investigation-specific sampling and analysis objectives, rationales, activities, and criteria necessary to perform specific phases of work. Consequently, both documents are necessary in order to implement the Groundwater Investigation. The Facility-wide SAP and this SAP Addendum have been developed following the USACE guidance document, *Requirements for the Preparation of Sampling and Analysis Plans,* EM 200-1-3, September 1994 (USACE 1994a), to collectively meet the requirements established by the Ohio Environmental Protection Agency, Northeast District, and the U.S. Environmental Protection Agency Region V.

As stated, this SAP Addendum contains only the project-specific details necessary to perform this Groundwater Investigation at RQL. Where appropriate, this SAP Addendum contains references to the Facility-wide SAP for base procedures and protocols.

SAMPLING AND ANALYSIS PLAN
ADDENDUM

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Sampling and Analysis Plan Addendum

FIGURES

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1.0 PROJECT DESCRIPTION

The Groundwater Investigation of the former Ramsdell Quarry Landfill (RQL) at Ravenna Army Ammunition Plant (RVAAP), in Ravenna, Ohio (Figure 1-1), will provide a supplemental characterization of shallow water table groundwater flow regimes and chemical water quality. With this evaluation, the U.S. Army Corps of Engineers (USACE) seeks to fulfill all Ohio Environmental Protection Agency (Ohio EPA) requirements regarding landfill closure and post-closure monitoring to address potential impacts upon groundwater from the former RQL and pre-landfill disposal activities.

1.1 RQL HISTORY AND CONTAMINANTS

A detailed history of process operations and waste processes for each area of concern (AOC) at RVAAP is presented in the *Preliminary Assessment for the Ravenna Army Ammunition Plant, Ravenna, Ohio* (USACE 1996b). The following is a summary of the history and related contaminants for RQL.

RQL (RVAAP-01) is located in the western portion of the abandoned Ramsdell Quarry (Figure 1-2), in the northeast corner of RVAAP. The quarry was excavated about (30 to 40 ft) below existing grade into the Sharon Member sandstone and conglomerate bedrock. The original unconsolidated glacial material overlying the sandstone was only a few feet (<10 ft) thick and appears to have been entirely removed. The quarry was abandoned before 1941, and was used as a landfill from 1941 until 1989. From 1946 to the 1950s, the bottom of the quarry was used to burn waste explosives from Load Line 1 (LL1). Approximately 18,000 226-kg (500-lb) incendiary or napalm bombs were reported to have been burned in the abandoned quarry. Liquid residues from annealing operations were also dumped in the quarry. There is currently no historical information on how the quarry was used from the 1950s to 1976.

From 1976 until the landfill was closed in 1989, only nonhazardous solid waste was deposited in the abandoned quarry. In 1978, a portion of the abandoned quarry was permitted as a sanitary solid waste landfill by the State of Ohio. The permit required a 30-m (100-ft) buffer be maintained between the landfill and a pond created by the infiltration of groundwater in the bottom of the quarry; the extent of the pond prior to this time is not known.

Based upon available information and past uses of the abandoned quarry, wastes may include domestic, commercial, and industrial solid and liquid wastes, including explosives (e.g., TNT, RDX, Composition B), napalm, gasoline, acid dip liquor, annealing residue (e.g., sulfuric acid, shell casings, sodium orthosilicate, chromic acid, and alkali), aluminum chloride, and inert material. Interviews with former RVAAP personnel have indicated that much of the landfilled wastes and debris at the abandoned quarry were removed in the early 1980s.

A much smaller quarry (also abandoned) is located directly southeast of RQL (Figure 1-2). Its maximum depth appears to be ~6 m (20 ft). No documentation about potential wastes disposed in this quarry is available. Characterization of the pond in this quarry is therefore included in this Groundwater Investigation.

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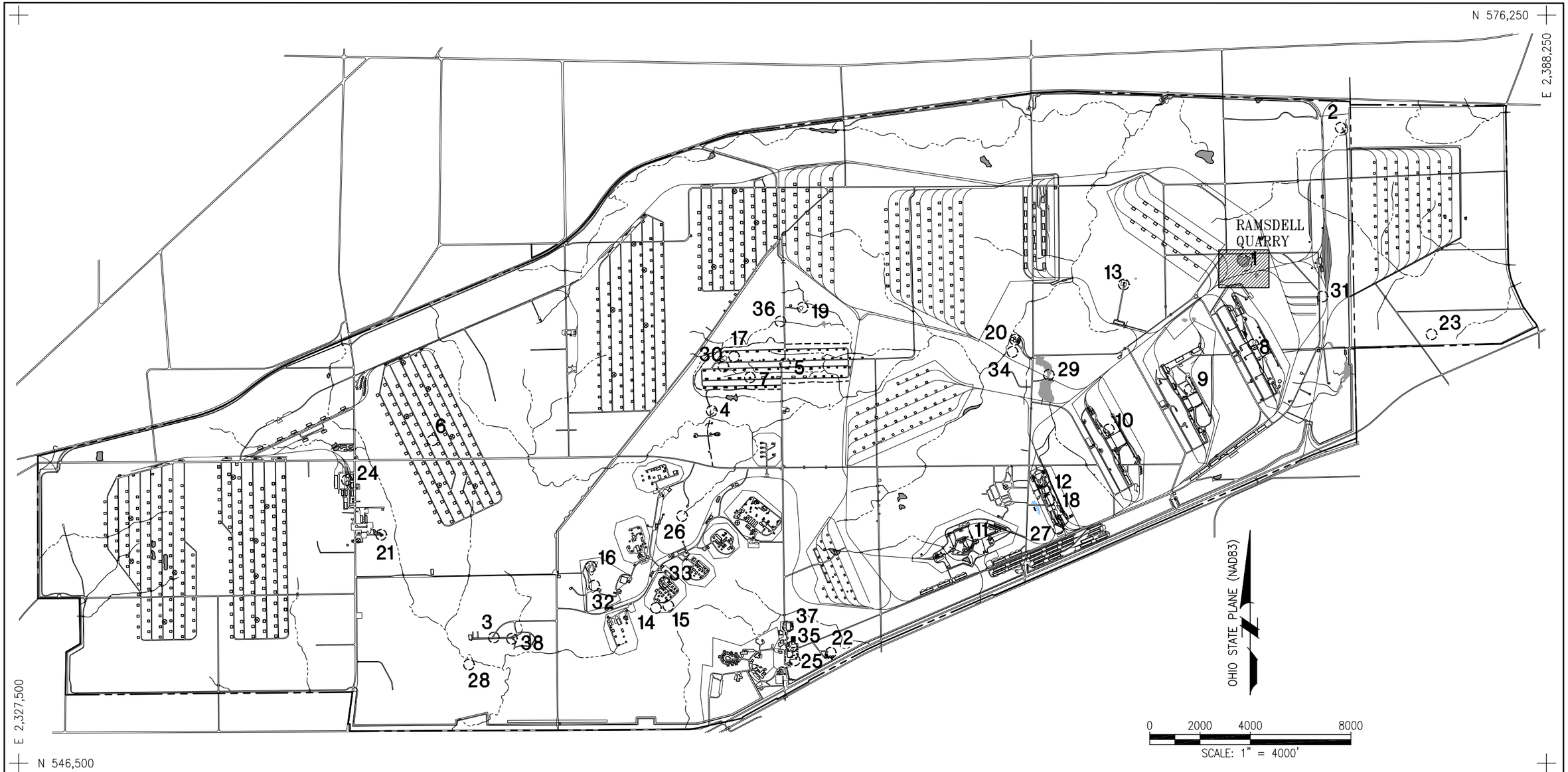

LEGEND OF SITES:

1 . . . . . **RAMSDELL QUARRY LANDFILL**
2 . . . . . ERIE BURNING GROUNDS
3 . . . . . DEMOLITIONS AREA #1
4 . . . . . **DEMOLITIONS AREA #2**
5 . . . . . **WINKLEPECK BURNING GROUNDS**
6 . . . . . C BLOCK QUARRY
7 . . . . . BLDG 1601 HAZARDOUS WASTE STORAGE
8 . . . . . **LOAD LINE 1 AND DILUTION/SETTLING POND**
9 . . . . . **LOAD LINE 2 AND DILUTION/SETTLING POND**
10 . . . . . **LOAD LINE 3 AND DILUTION/SETTLING POND**
11 . . . . . **LOAD LINE 4 AND DILUTION/SETTLING POND**
12 . . . . . **LOAD LINE 12 AND DILUTION/SETTLING POND**
13 . . . . . **BLDG 1200 AND DILUTION/SETTLING POND**
14 . . . . . LOAD LINE 6, EVAPORATION UNIT
15 . . . . . LOAD LINE 6, TREATMENT PLANT
QUARRY LANDFILL/FORMER
16 . . . . . FUZE & BOOSTER BURNING PITS
17 . . . . . DEACTIVATION FURNACE
18 . . . . . **LOAD LINE 12 PINK WASTE WATER TREATMENT**
19 . **LANDFILL NORTH OF WINKLEPECK BURNING GROUND**
20 . . . . . SAND CREEK SEWAGE TREATMENT PLANT
21 . . . . . DEPOT SEWAGE TREATMENT PLANT
22 . . . . . GEORGE ROAD SEWAGE TREATMENT PLANT
23 . . . . . UNIT TRAINING SITE WASTE OIL TANK
24 RESERVE UNIT MAINTENANCE AREA WASTE OIL TANK
25 . . . . . BLDG 1034 MOTOR POOL WASTE OIL TANK
26 . . . . . FUZE BOOSTER AREA SETTLING TANKS
27 . . . . . BLDG 854–PCB STORAGE
28 . . . . . MUSTARD AGENT BURIAL SITE
29 . . . . . **UPPER AND LOWER COBBS POND COMPLEX**
31 . . . . . ORE PILE RETENTION POND
32 . . . . . 40 AND 60 MM FIRING RANGE
33 . . . . . FIRESTONE TEST FACILITY
34 . . . . . SAND CREEK DISPOSAL ROAD LANDFILL
35 . . . 1037 BUILDING–LAUNDRY WASTEWATER SUMP
36 . . . . . PISTOL RANGE
37 . . . . . PESTICIDE BUILDING S–44S2
38 . . . . . NACA TEST AREA

US Army Corps of Engineers Nashville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
NASHVILLE, TENNESSEE

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
FACILITY MAP

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. 0/05–13–98	95021/DWGS/B45SITE

Figure 1-1. Ravenna Army Ammunition Plant Facility Map

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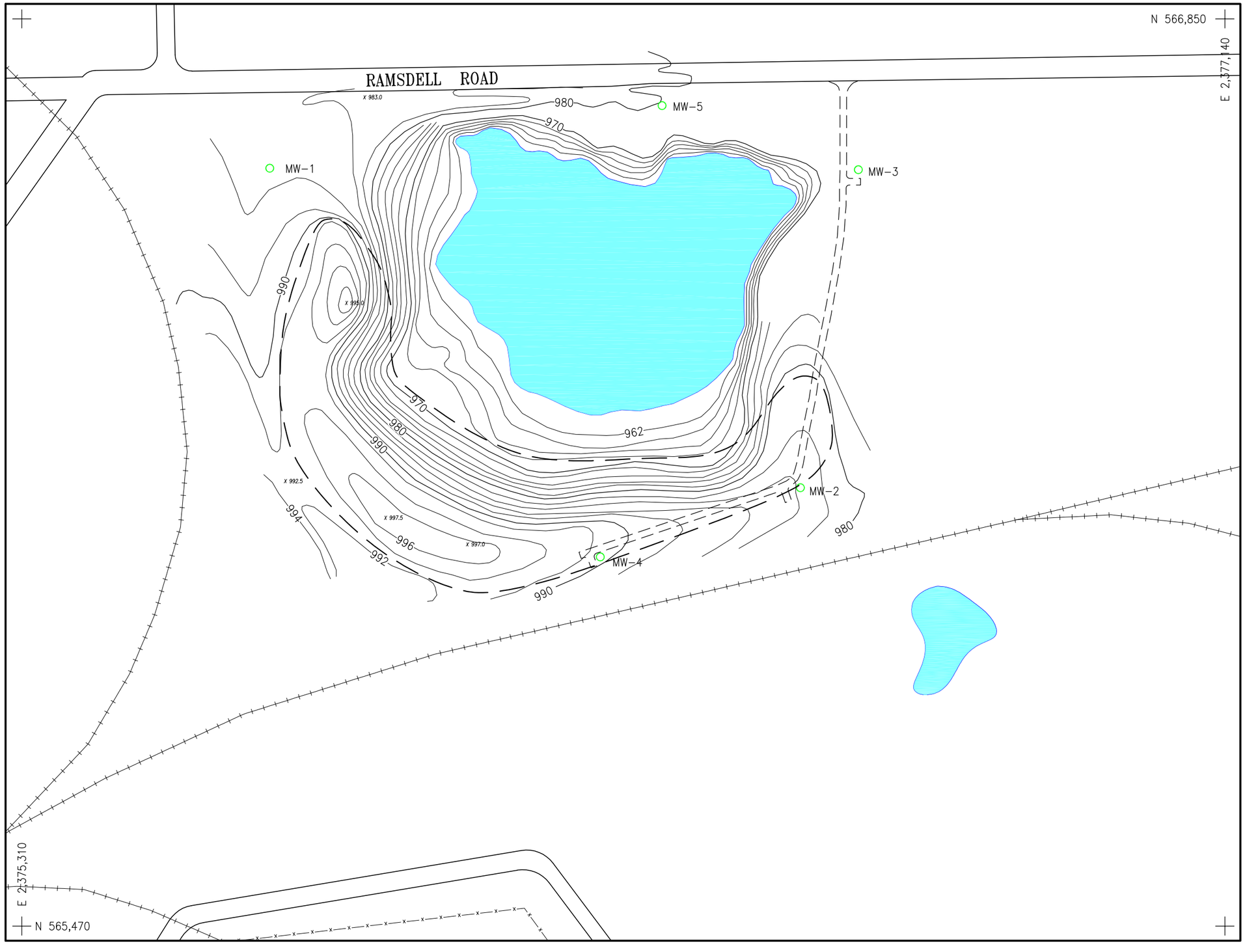


LEGEND:

- ASPHALT ROAD
- GRAVEL ROAD
- FENCE LINE
- RAILROAD TRACKS
- POND
- GROUND CONTOUR (2 FT. INTERVAL)
- GROUND CONTOUR (10 FT. INTERVAL)
- X 992.5 SPOT ELEVATION
- GRID TIC
- EXISTING MONITORING WELL
- APPROXIMATE LANDFILL BOUNDARY

OHIO STATE PLANE (NAD83)

0 50 100 150 300

SCALE: 1" = 150'

US Army Corps of Engineers Nashville District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
NASHVILLE, TENNESSEE

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO
RAMSDELL QUARRY LANDFILL
(RVAAP-01)

DRAWN BY:	REV. NO./DATE:	CAD FILE:
R. BEELER	REV. 0/05-21-98	95021/DWGS/B45RQ01

Figure 1-2. Ramsdell Quarry Landfill Location Map

Closure of the permitted sanitary landfill was completed in May 1990 under State of Ohio solid waste regulations [Ohio Administrative Code (OAC) 3745-27-10]. A requirement of closure was installation and semi-annual monitoring of five monitoring wells (see Figure 1-2).

1.2 SUMMARY OF EXISTING DATA

Groundwater samples from RQL have been collected since 1987, beginning with semiannual detection monitoring in five open boreholes. Monitoring wells MW-1 through MW-5 (shown in Figure 1-2) were completed in these boreholes in January 1988 (USAEHA 1992) and semiannual monitoring continued until November 1991, when quarterly sampling was initiated. Quarterly sampling continued through February 1993. The wells have been sampled semi-annually since February 1993. Unfiltered groundwater samples were analyzed for the volatile organic compounds (VOCs), five explosives, eleven metals, and indicator parameters listed in Table 1-1.

Semi-annual groundwater monitoring of these constituents was performed according to the requirements of OAC 3745-27-10 (March 1990), specified in a Groundwater Monitoring Program for the Ramsdell Quarry Landfill (Revised), dated October 1997. In addition, the Portage County Health Department has sampled and analyzed surface water from RQL pond.

Significant gaps in the semi-annual monitoring data have been identified by Ohio EPA (Ohio EPA, July 1997) that prevent the determination of whether closure requirements are being met. The most significant deficiencies are as follows:

- Placement of the monitoring wells (installed in 1988) is such that only one well (MW-5) is downgradient from the RQL. There are currently no monitoring wells located immediately downgradient of the toe of the landfill.

- Discrepancies in water level elevations in quarterly measurement events obscure whether a seasonal shift in groundwater flow direction is occurring.

- Monitoring wells installed for quarterly groundwater monitoring are screened 3 to 9 m (10 to 30 ft) below the water table, and there is a concern that the present upgradient wells do not monitor the same water-bearing interval as the downgradient well.

- There is no information to determine the relationship of water levels in the uppermost water-bearing zone and the surface of the pond.

- Explosives have been detected in groundwater from all five monitoring wells in at least three quarterly sampling events, thus casting some doubt as to the integrity of the "upgradient" well (MW-4).

- Indicator parameters such as specific conductance and total dissolved solids continue to be analyzed, and upgradient/downgradient differences may result from variations in the sandstone intervals in which wells are screened rather than from the impact of the landfill on groundwater.

Table 1-1. List of Analytes for Ramsdell Quarry Landfill Semi-Annual Monitoring

Metals (total)	Volatile Organic Compounds	Volatile Organic Compounds
Arsenic	Acetone	1,1,1-Trichloroethane
Barium	Acrolein	1,1,2-Trichloroethane
Cadmium	Acrylonitrile	Trichloroethene
Calcium	Benzene	Trichlorofluoromethane
Chromium	Bromodichloromethane	1,2,3-Trichloropropane
Iron	cis-1,3-Dichloropropene	Vinyl Acetate
Lead	trans-1,3-Dichloropropene	Vinyl Chloride
Magnesium	Ethylbenzene	Xylene
Mercury	Ethyl Methacrylate	
Selenium	Bromoform	
Sodium	Bromomethane	
Explosives	1-Butanone	
Trinitrotoluene	Carbon Disulfide	
2,4-Dinitrotoluene	Carbon Tetrachloride	
2,6-Dinitrotoluene	Chlorobenzene	
HMX	Chloroethane	
RDX	2-Chloroethyl Vinyl Ether	
Indicator Parameters	Chloroform	
Total Alkalinity	Chloromethane	
Chloride	Dichlorodifluoromethane	
Chemical Oxygen Demand	1,1-Dichloroethane	
Specific Conductivity	1,2-Dichloroethane	
Dissolved Fluoride	2-Hexanone	
MBAS, Colorimetric	Methylene Chloride	
Nitrate (as N)	4-Methyl 2-Pentanone	
Ammonia (as N)	1,1-Dichloroethene	
pH	Trans-1,2-Dichloroethene	
Total Dissolved Solids	Styrene	
Sulfate	1,1, 2,2-Tetrachloroethene	
Total Organic Carbon	Toluene	

Source: USAEHA 1992

In summary, the evaluation of groundwater monitoring at RQL has produced inconclusive results to date. Statistical analysis of water quality indicator parameters has shown some local impacts on the groundwater (e.g., specific conductance, total organic carbon, and total dissolved solids have been statistical triggers in both upgradient and downgradient wells).

The plan submitted to Ohio EPA for the closure of RQL in 1989 provides additional characterization information about the site. The closure plan contains stratigraphic information as well as lithologic cross-sections showing the elevation of the lower limit of waste placement for the sanitary landfill.

USACE recently completed (February 1998) a topographic survey of RQL, including collection of new elevation data on the existing monitoring wells at the site. Topography of the site is now accurate to within 0.006 m (0.02 ft). The re-surveying of the wells was performed to correct discrepancies in water level elevations noted in the semi-annual data. The elevations of the top of the surface casings and the top of the well riser pipes have been used to correct the groundwater elevation data from 1989 to the present.

Table 1-2. Revised Monitoring Well Elevations

	Ground Elevation	Top of Riser Pipe
MW-1	985.40	986.08
MW-2	982.71	981.92
MW-3	973.50	974.54
MW-4	990.64	991.75
MW-5	976.09	977.38

1.3 SPECIFIC SAMPLING AND ANALYSIS PROBLEMS

No specific sampling and analysis problems are anticipated. However, the presence of unexploded ordnance (UXO) in and around the RQL pond is a concern.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

The RQL Groundwater Investigation project organization and responsibilities are presented in Figure 2-1. The functional responsibilities of key personnel are described in Chapter 2.0 of the Facility-wide SAP and; therefore, are not presented here. Figure 2-1 shows the Project Organization Chart for the RQL Groundwater Investigation. Figure 2-2 presents the planned project schedule.

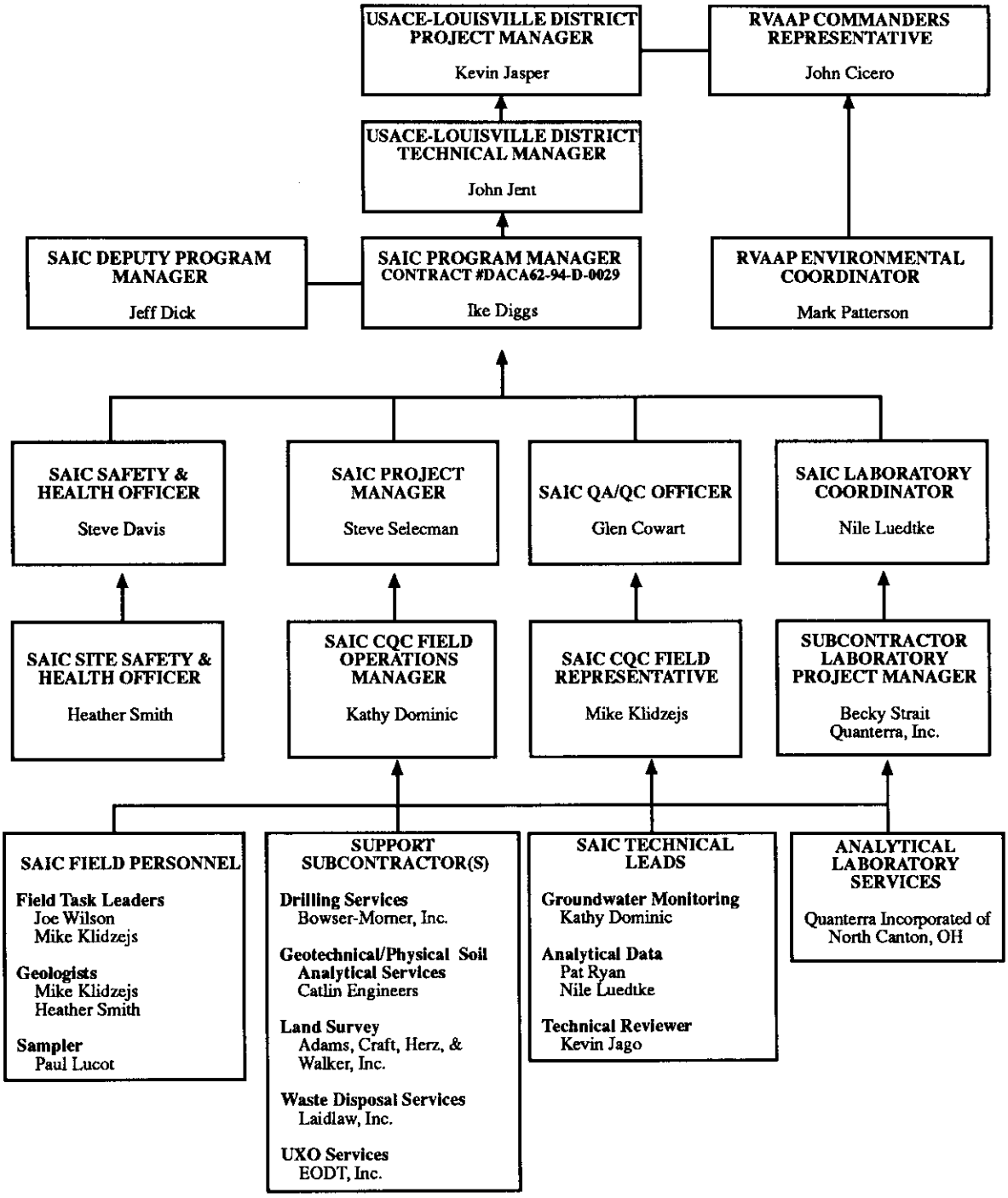
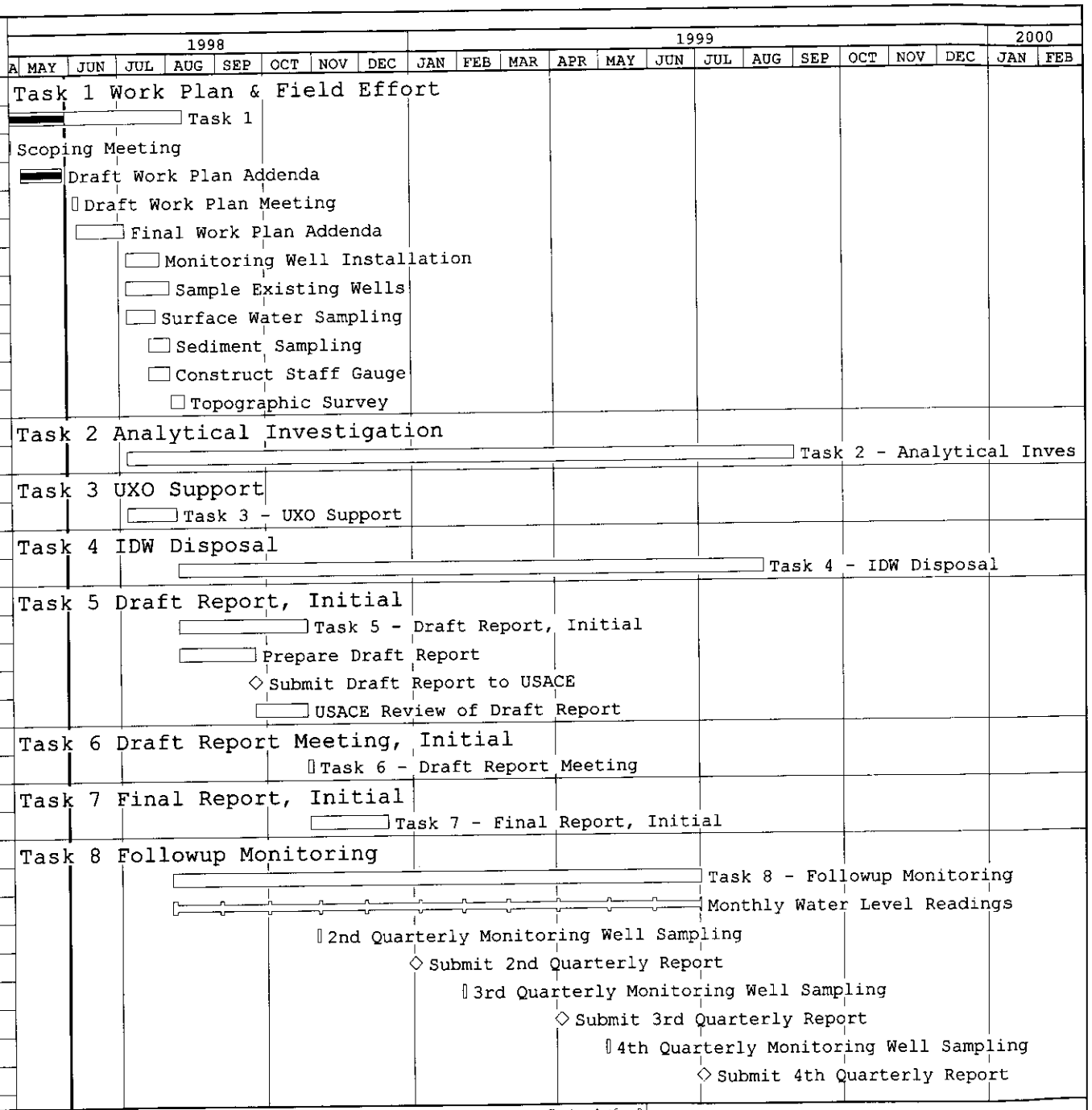


Figure 2-1. Project Organization Chart for the Groundwater Investigation at RQL, RVAAP

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR
RQ01.00.00	24APR98A	10AUG98	74
RQ01.01.00	24APR98A	24APR98A	0
RQ01.03.00	1MAY98A	26MAY98A	0
RQ01.02.00	3JUN98	5JUN98	3
RQ01.04.00	5JUN98	4JUL98	30
RQ01.05.00	6JUL98	26JUL98	21
RQ01.06.00	6JUL98	1AUG98	27
RQ01.07.00	6JUL98	23JUL98	18
RQ01.08.00	20JUL98	1AUG98	13
RQ01.09.00	20JUL98	1AUG98	13
RQ01.10.00	3AUG98	10AUG98	8
RQ02.00.00	6JUL98	30AUG99	421
RQ03.00.00	6JUL98	5AUG98	31
RQ04.00.00	7AUG98	10AUG99	369
RQ05.00.00	7AUG98	26OCT98	81
RQ05.01.00	7AUG98	23SEP98	48
RQ05.03.00		23SEP98	0
RQ05.05.00	24SEP98	26OCT98	33
RQ06.00.00	27OCT98	29OCT98	3
RQ07.00.00	28OCT98	15DEC98	49
RQ08.00.00	2AUG98	1JUL99	334
RQ08.04.00	2AUG98	1JUL99	24
RQ08.01.01	1NOV98	2NOV98	2
RQ08.03.01		1JAN99	0
RQ08.01.02	1FEB99	2FEB99	2
RQ08.03.02		3APR99	0
RQ08.01.03	2MAY99	3MAY99	2
RQ08.03.03		2JUL99	0



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Data Date 29MAY98
Project Start 24APR98
Project Finish 30AUG99

(c) Primavera Systems, Inc.

inactive
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

LCOE DO03

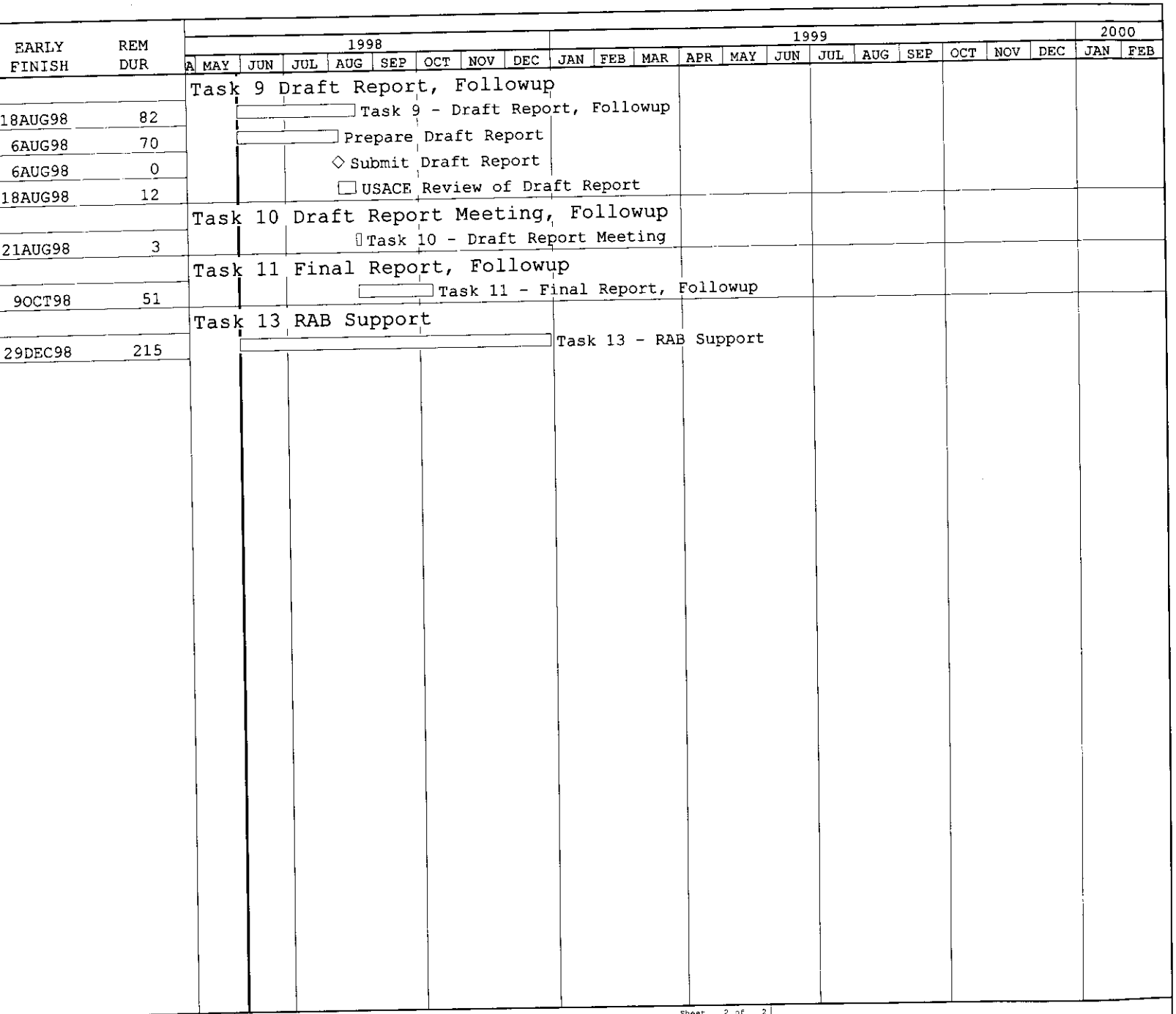
Sheet 1 of 2

Louisville Corps of Engineers
Ramsdell Quarry GW Investigation
DO 03: Project Schedule

Date	Revision	Checked	Approved

Figure 2-2. Project Schedule for the RQL Groundwater Investigation at RVAAP

ACTIVITY ID	EARLY START	EARLY FINISH	REM DUR
RQ09.00.00	29MAY98	18AUG98	82
RQ09.01.00	29MAY98	6AUG98	70
RQ09.02.00		6AUG98	0
RQ09.03.00	7AUG98	18AUG98	12
RQ10.00.00	19AUG98	21AUG98	3
RQ11.00.00	20AUG98	9OCT98	51
RQ13.00.00	29MAY98	29DEC98	215



Plot Date 15JUN98
Data Date 29MAY98
Project Start 24APR98
Project Finish 30AUG99

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inactive
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

LCOE D003

Sheet 2 of 2

Louisville Corps of Engineers
Ramsdell Quarry GW Investigation
DO 03: Project Schedule

Date	Revision	Checked	Approved

Figure 2-2 (continued)

3.0 SCOPE AND OBJECTIVES

3.1 RQL GROUNDWATER INVESTIGATION SCOPE AND OBJECTIVES

The overall scope and objectives of this Groundwater Investigation are as follows:

- Determine the shallow water table hydrogeologic conditions in and around the abandoned Ramsdell Quarry, including groundwater flow directions and the relationship between the pond and the landfill. This includes geotechnical sampling, installation, and groundwater sampling of six new monitoring wells for four quarters, sampling during two significant hydrogeologic events, and sampling of five existing wells once.

- Determine the environmental chemical character of the pond at RQL and the small pond immediately southeast of RQL. The RQL pond water will be sampled during every groundwater sampling event.

- Install dedicated continuous water level monitoring equipment in new wells and at the permanent staff gauge in the pond, to determine the interconnection between the pond and shallow groundwater, and responses to storm events.

- Determine the geologic and environmental chemical character of the pond bottom, including the topography of rock beneath the pond and the environmental and geotechnical properties of the pond sediment. Pond sediments will be collected in eight locations and all of these points will be surveyed.

- Determine a prudent course of action based on the above determinations.

Investigation-specific objectives have been developed using the Data Quality Objective (DQO) approach presented in the Facility-wide SAP. Project-specific sampling objectives are presented for each environmental medium in Chapter 4.0 of the Facility-wide SAP.

3.2 DATA QUALITY OBJECTIVES

The project DQO is to provide sufficient high-quality data to address the primary project objectives identified in Section 3.1. Note that because RQL is not currently an AOC with associated Comprehensive Environmental Response, Compensation, and Liability Act requirements on data collection, a rigorous DQO process is not necessary for this investigation. However, to the extent possible, all data gathering and reporting activities associated with this Groundwater Investigation will be consistent with guidelines already established for the Phase I and Phase II Remedial Investigations at RVAAP.

3.2.1 Conceptual Site Model

The conceptual site model for RQL and its adjacent pond consists of the following:

1. The RQL and its adjacent pond are underlain by porous and permeable sandstone and relatively impermeable shales of the Pennsylvanian Sharon Member.

2. The unconfined aquifer's elevation at the RQL is presumed to fluctuate seasonally, and shallow groundwater is presumed to be in hydraulic communication with the pond.

3. Potentiometric surface elevations decrease from south to north across the site, consistent with topography. The pond surface lies at an elevation of ~960 ft above mean sea level and provides a moderating influence on potentiometric gradients in the area.

4. LL1 is a potential source of contamination south (upgradient) of RQL. A monitoring well installed and sampled in the northeast corner of LL1 in 1996 does not indicate that contamination is migrating into the RQL area from this load line.

3.2.2 Problem Definition

Open burning of explosive wastes and munitions and dumping of liquid and solid wastes on the floor of the abandoned quarry, as well as percolation of water through the closed landfill, have potentially contaminated groundwater in the unconfined aquifer. There is a potential for contaminant migration via groundwater northward. Quarterly monitoring of groundwater has shown that indicator parameters intermittently exceed statistical triggers, and that the currently existing wells are not placed or screened appropriately to characterize groundwater flow or quality in the unconfined aquifer.

3.2.3 Remedial Action Objectives

Not applicable to this investigation.

3.2.4 Identify Decisions

The key decisions for all investigations at RVAAP have been identified in Table 3-1 of the Facility-wide SAP.

3.2.5 Define the Study Boundaries

The investigation area boundary for RQL is that presented in Figure 1-2.

3.2.6 Identify Decision Rules

Decision rules used to guide decision making are provided in Chapter 3.0 of the Facility-wide SAP. Current quarterly monitoring data are not sufficient to make a determination as to the compliance status of RQL groundwater.

3.2.7 Identify Inputs to the Decisions

Inputs to the decisions are analytical results that can be used to calculate statistically significant differences between upgradient and downgradient water quality at RQL. Comparison of analytical data will be based on background analytical data from the one upgradient monitoring well located at RQL and not facility-wide background data.

3.2.8 Specify Limits on Decision Error

Limits on decision errors are addressed in Section 3.2.8 of the Facility-wide SAP.

3.2.9 Optimize Sample Design

The sample design for the Groundwater Investigation at RQL will be described in detail in Chapter 4.0 of this SAP Addendum.

3.3 DATA EVALUATION METHODS

All data evaluation activities associated with this Groundwater Investigation shall be consistent with those specified in the Facility-wide SAP.

4.0 FIELD ACTIVITIES

The field activities associated with the Groundwater Investigation at Ramsdell Quarry Landfill include an initial phase with the following components:

1. drilling, geotechnical sampling of soils, installation, groundwater sampling, and slug testing of six new monitoring wells;

2. sampling of five previously installed monitoring wells;

3. slug testing of five previously installed monitoring wells;

4. sampling of sediment in RQL pond at eight locations;

5. sampling of water in RQL pond and the adjacent pond southeast of RQL;

6. construction of a staff gauge at RQL pond for a continuous water level monitoring device;

7. UXO support for pond sampling activities;

8. surveying of all monitoring wells, sediment sampling locations, and the staff gauge;

9. installation of pressure transducers and data recorders in six new monitoring wells for continuous water table monitoring and at the pond staff gauge; and

10. establishment of a rain gauge at Building 1036.

Follow-up field activities include:

- three quarters of groundwater sampling and sampling during two hydrologic events (i.e., prolonged wet or dry period) at the six newly installed monitoring wells;

- three quarters of surface water sampling at RQL pond and sampling during two hydrologic events;

- routine downloading and maintenance of all data recorders; and

- monthly manual measurements of water levels in the five previously existing monitoring wells.

The rationales and procedures for the field activities listed are described below. Specific procedures are discussed in detail in the Facility-wide SAP (USACE 1996a).

4.1 GROUNDWATER

4.1.1 Rationale

The rationale for installation and sampling of six new monitoring wells is to provide a monitoring system of known integrity with which to characterize groundwater flow and quality in the shallow water table aquifer at RQL. The existing 5-well network at the site will be sampled once during this investigation, to compare groundwater chemistry between these wells (identified as MW-1 through MW-5), believed to be screened 10 to 30 ft below the water table, and the six new wells. Thereafter, the six new wells will be used to collect samples and water level measurements for the quarterly monitoring requirements at RQL for three consecutive quarters and during two significant hydrologic events (e.g., a prolonged dry or wet period), for a total of five additional sampling events. Six sampling events are required for performing valid statistical tests on the analytical data. Quarterly samples shall be collected and analyzed identically to those collected during the initial sampling event. The RQL pond water will be sampled quarterly for three quarters, simultaneously with the groundwater sampling, to determine whether groundwater in RQL is discharging to the pond and having an impact on surface water quality.

Semi-annual monitoring of the previously installed wells has been conducted under the OAC 3745-27-10 rules of March 1, 1990. The June 1, 1994, revisions to this regulation allow for the analysis of alternative parameters (e.g., explosives or others specific to the solid waste unit) and may be the framework for future monitoring at RQL.

4.1.1.1 Monitoring Well Locations and Installation

Six monitoring wells will be installed in this investigation to monitor the shallow water table at RQL, as shown in Figure 4-1. Based on the water level data gathered from the existing wells, the groundwater flow direction in the shallow aquifer is assumed to be generally northward, away from the landfill. Three of the monitoring wells will be located below the toe of RQL, two will be located downgradient of the pond, and one will be located upgradient from the landfill. Should the proposed locations at the toe of the landfill prove inaccessible, alternate well locations will be selected in the field with the concurrence of Ohio EPA. This placement of wells will allow the evaluation of potential contaminant migration via shallow groundwater from the landfill and an evaluation of the pond's impact upon groundwater. The screened interval in all new wells will be located to monitor the top of the water table zone.

The five existing wells at RQL will be sampled in addition to the six new wells as a part of the initial field activities in this investigation.

4.1.1.2 Sample Collection for Field and Laboratory Analysis

All eleven monitoring wells will be field screened for VOCs using a hand-held photoionization detector (PID) or flame ionization detector (FID) organic vapor analyzer (OVA) during groundwater sample collection. Screening will be accomplished by monitoring the headspace vapors at the top of the riser pipe. Field measurements of pH, temperature, specific conductance, and dissolved oxygen (D.O.) will be recorded for each groundwater sample. No samples will be collected for additional headspace analysis. Water level measurements will be collected immediately prior to groundwater sampling.

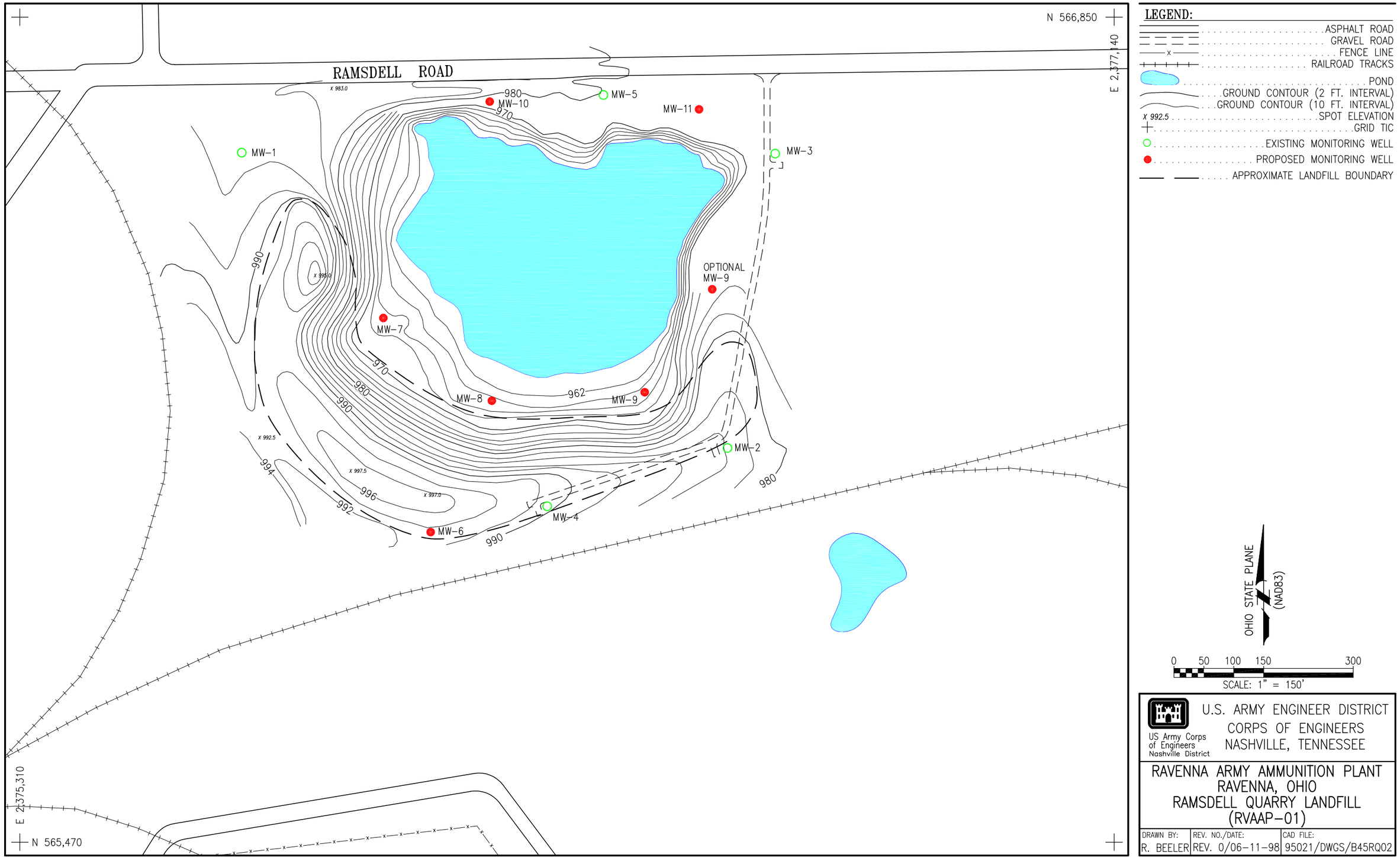

Figure 4-1. Ramsdell Quarry Landfill Proposed Monitoring Well Locations

One filtered and one unfiltered groundwater sample will be collected from each monitoring well. Unfiltered samples will be submitted for laboratory analysis of explosives, propellants (nitrocellulose, nitroglycerine, and nitroguanidine), Target Analyte List (TAL) metals, cyanide, VOCs, and semivolatile organic compounds (SVOCs). The filtered samples will be analyzed for TAL metals. Table 4-1 summarizes the number of samples and the types of analyses to be performed for this investigation.

4.1.1.3 Quality Assurance/Quality Control, Blank Samples, and Frequency

Quality assurance (QA)/quality control (QC) duplicate and split groundwater samples, equipment rinsate samples, and trip blanks will be collected during this groundwater investigation. Duplicates and rinsates will be selected on a random statistical basis and analyzed for the same parameters as the environmental samples. Duplicate samples will be collected at a frequency of 10% of environmental samples. Split groundwater samples and equipment rinsate samples will be collected at a frequency of 5% of environmental samples. Trip blanks will accompany shipment of all VOC groundwater samples, and will be analyzed for VOCs only.

A source blank will be collected from the potable water source only if it changes from the sources currently in use for the RVAAP Phase II Remedial Investigation at Winklepeck Burning Grounds and the Facility-wide Background Investigation (the source at Post #1 and the City of Newton Falls). One source blank will also be collected from the deionized/distilled (ASTM Type I) water source used. The source blanks will be analyzed for the same constituents as the environmental samples.

4.1.2 Monitoring Well Installation

4.1.2.1 Drilling Methods and Equipment

4.1.2.1.1 Equipment Condition and Cleaning

Requirements for the condition and cleaning of equipment used for well installation are described in Section 4.3.2.1.1 of the Facility-wide SAP. These requirements, as applicable, will be employed for all equipment used to install monitoring wells in the RQL Groundwater Investigation.

4.1.2.1.2 Drilling Methods

Conventional drilling techniques (hollow-stem auger and air rotary) will be used to install the new monitoring wells, as described in Section 4.3.2.1.2 of the Facility-wide SAP. It is anticipated that the third drilling scenario, described under Section 4.3.2.1.3, will be applicable for the installation of the six monitoring wells. Monitoring well boreholes will be installed to screen across the top of the water table. It is anticipated that the depth to bedrock will be shallow [<3 m (10 ft)] in all six wells. It is anticipated that the depth to the water table will vary from about 15 cm to 10 m (6 in to 35ft) below ground surface, based on existing monitoring well information and assuming that the water level in the pond is indicative of the groundwater potentiometric surface. The maximum depth of each monitoring well is expected to be ~9.1 m (30 ft) or less.

In all groundwater monitoring well borings, NX-size coring shall be performed in the bedrock interval prior to 15.2-cm (6-in.) diameter air-rotary overdrilling to install wells. The purpose of the coring is to determine lithologies and the degree and nature of weathering and fracturing in bedrock. All rock cores will be stored in plastic core boxes in such a manner as to preserve their relative

Table 4-1. Ramsdell Quarry Landfill Groundwater Investigation Chemical and Geotechnical Analyses

Sampling Media	Chemical Analyses											Geotechnical Analyses			
	Sample Stations	Sampling Method	Depth Interval (ft)	Samples/Station	Total No. of Samples	Explosives (8330) Modified	Propellants (8330 mod./EPA 353.2)	TAL Metals (6010B/7471A/7470A)	Cyanide (9010)	VOCs (8260B)	SVOCs (8270C)	Grain Size (ASTM D422)	Moisture Content (ASTM D2216)	Atterberg Limits (ASTM D4318)	Unified Soil Classification
Initial Sampling															
Subsurface Soils	6	Grab	Representative	1	6							7	6	7	6
Pond Sediment	8	Grab	0-0.5	1	8	8	8	8	8	8	8	8		8	8
	8	Grab	0.5 - 2.0	1	8	8	8	8	8	8	8	8		8	8
	2	Grab	2.0 - 4.0	1	2	2	2	2	2	2	2	2		2	2
Pond Water Filtered	5	Grab	-	1	5			5							
Pond Water Unfiltered	5	Grab	-	1	5	5	5	5	5	5	5				
Groundwater Filtered	11	Grab	-	1	11			11							
Groundwater Unfiltered	11	Grab	-	1	11	11	11	11	11	11	11				
TOTAL					56	34	34	50	34	34	34	25	6	25	24
Quarterly Sampling (per quarter for 3 quarters)															
Groundwater Filtered	6	Grab	-	1	6			6							
Groundwater Unfiltered	6	Grab	-	1	6	6	6	6	6	6	6				
Pond Water Filtered	1	Grab	-	1	1			1							
Pond Water Unfiltered	1	Grab	-	1	1	1	1	1	1	1	1				
TOTAL					14	7	7	14	7	7	7				

Table 4-1 (continued)

Sampling Media	Chemical Analyses											Geotechnical Analyses			
	Sample Stations	Sampling Method	Depth Interval (ft)	Samples/Station	Total No. of Samples	Explosives (8330) Modified	Propellants (8330 mod./EPA 353.2)	TAL Metals (6010B/7471A/7470A)	Cyanide (9010)	VOCs (8260B)	SVOCs (8270C)	Grain Size (ASTM D422)	Moisture Content (ASTM D2216)	Atterberg Limits (ASTM D4318)	Unified Soil Classification
Event Sampling (per event for 2 events)															
Groundwater Filtered	6	Grab	-	1	6			6							
Groundwater Unfiltered	6	Grab	-	1	6	6	6	6	6	6	6				
Pond Water Filtered	1	Grab	-	1	1			1							
Pond Water Unfiltered	1	Grab	-	1	1	1	1	1	1	1	1				
TOTAL					14	7	7	14	7	7	7				

positions by depth. Intervals of lost core shall be noted in the core sequence with wooden or styrofoam blocks. Boxes will be marked on the outside with the boring number, cored interval, and box number, if there are multiple boxes. All cores will be documented, including photographing the core after it has been properly placed and labeled in core boxes, and stored at RVAAP in accordance with Ohio EPA *Technical Guidance for Hydrogeologic Investigations and Groundwater Monitoring* (1995) and *Monitoring Well Design, Installation, and Documentation at Hazardous and/or Toxic Waste Sites,* EM-1110-4000 (USACE 1994b). The cores will be temporarily stored at RVAAP in Building 1036.

4.1.2.2 Materials

4.1.2.2.1 Casing/Screen

The casing and screen materials for monitoring wells will be as presented in Section 4.3.2.2.1 of the Facility-wide SAP.

4.1.2.2.2 Filter Pack, Bentonite, and Grout

The filter pack, bentonite, and grout materials for monitoring wells will be as presented in Section 4.3.2.2.2 of the Facility-wide SAP.

4.1.2.2.3 Surface Completion

All wells will be constructed as above-ground installations, as described in Section 4.3.2.2.3 of the Facility-wide SAP.

4.1.2.2.4 Water Source

Potable water from the City of Newton Falls will be used during this investigation for monitoring well installation and equipment decontamination purposes. The collection and evaluation of any samples from new water sources will follow Section 4.3.2.2.4 of the Facility-wide SAP.

4.1.2.2.5 Delivery, Storage, and Handling of Materials

All monitoring well construction materials will be delivered, stored, and handled as described in Section 4.3.2.2.5 of the Facility-wide SAP.

4.1.2.3 Installation

All monitoring well installation will be in accordance with procedures for above-ground installations as presented in Section 4.3.2.3 of the Facility-wide SAP. Unconsolidated surficial material in each location will be drilled using a 16.5-cm (6.5-in.) inside diameter hollow-stem auger. Soil samples will be collected continuously from the surface to borehole termination, using a split-barrel or like sampler, for lithologic logging and collection of geotechnical grab samples. If necessary, the borehole will be overdrilled using air rotary equipment or a tricone roller bit to achieve the optimum borehole diameter or depth for well installation.

All monitoring wells are to be installed with a 3-m (10-ft) screen, with the top of the screen approximately 1 m (3 ft) above the water level at the time of well installation. Because of the

likelihood of groundwater occurring at or near the ground surface in wells located at the toe of the landfill, these wells will be drilled deep enough to allow for 0.30 m (1 ft) of sand pack above the well screen, followed by a 0.60-m (2-ft) bentonite seal, and 1 m (3 ft) of grout above the seal as a minimum.

4.1.2.4 Documentation

4.1.2.4.1 Logs and Well Installation Diagrams

4.1.2.4.1.1 Field Boring Logs

Field boring logs will be completed in the field for all monitoring well boreholes following Section 4.3.2.5.1.1 of the Facility-wide SAP. Visually determined Unified Soil Classification (USC) of each soil sample will be recorded on each field boring log.

4.1.2.4.1.2 Well Construction Diagrams

All monitoring well activities will be documented according to the procedures presented in Section 4.3.2.4 of the Facility-wide SAP.

4.1.2.5 Well Abandonment

Any boreholes or monitoring wells abandoned during the RQL Groundwater Investigation will be abandoned according to the procedures presented in Section 4.3.2.5 of the Facility-wide SAP.

4.1.2.6 Water Level Measurement

Water level measurements will follow the procedure presented in Section 4.3.3.6 of the Facility-wide SAP.

4.1.2.7 Well Development

Well development shall follow construction of the well pad by a minimum of 48 hours but within 7 days. Development of monitoring wells will be accomplished with a pump. Pumps may be replaced with bottom-filling bailers where well size or slow recharge rates restrict pump use. Development will proceed until the following criteria are met:

- the water is clear to the unaided eye;
- the sediment thickness remaining in the well is less than 1% of the screen length or less than 30 mm (0.1 ft);
- a minimum of five times the standing water volume in the well (to include the well screen and casing plus saturated annulus, assuming 30% porosity); and
- indicator parameters (pH, temperature, and specific conductance) have stabilized to ±10% over three successive well volumes.

For each monitoring well developed during the RQL Groundwater Investigation, a record will be entered in the field logbook to include the following information, per the Facility-wide SAP:

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

Groundwater sampling at a monitoring well may follow well development by a minimum of 24 hours, in accordance with procedures adopted during the Phase II Remedial Investigation of Winklepeck Burning Grounds in 1998, with the concurrence of Ohio EPA and USACE.

4.1.3 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 4.3.3 of the Facility-wide SAP.

4.1.4 Sampling Methods for Groundwater

Groundwater sampling from monitoring wells will follow the procedures presented in Section 4.3.4 of the Facility-wide SAP. All samples should be collected with dedicated Teflon bailers, as prescribed in the Facility-wide SAP.

4.1.4.1 Well Purging Methods

Purging of all monitoring wells installed and/or sampled during the RQL Groundwater Investigation will be conducted in accordance with procedures discussed in Section 4.3.4 of the Facility-wide SAP. Dedicated pumps may be used to purge the monitoring wells prior to sampling. If a well exhibits slow recharge, a dedicated bailer will be used for purging.

4.1.4.2 Filtration

Groundwater samples collected for dissolved metals will be filtered by negative pressure using a hand-operated pump, collection flask, polytetrafluoroethylene tubing, and a factory-decontaminated, disposable 0.45-μm pore size filter assembly. Filtering will be conducted immediately after sample collection in the field. Groundwater will be transferred from the bailer to a decontaminated collection flask, and poured into the filter funnel portion of the filter assembly. Care will be taken to avoid transferring solids that may have settled to the bottom of the collection flask. The hand-operated pump will be used to create a vacuum in the assembly to start filtration. Sample bottles will be filled with the filtered water. Filters will be replaced as they become restricted by solids buildup. The filter assembly will be decontaminated between sample collection sites.

4.1.5 Sample Containers and Preservation Techniques

Requirements for sample containers and preservation techniques for groundwater samples are presented in Section 4.3.6 of the Facility-wide SAP.

4.1.6 Field Quality Control Sampling Procedures

Quality control samples for monitoring well groundwater sampling activities will include duplicates and split groundwater samples, equipment rinsates, and trip blanks as described in Section 4.1.1.3 above. Split samples will be sent to the USACE Missouri River Division (MRD) Laboratory for independent analyses.

4.1.7 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, except that 2% hydrochloric acid (HCl) rinse will be used instead of a 10% solution.

Field measurement instruments will also be decontaminated between sampling locations. Only those portions of each instrument that come in contact with potentially contaminated water will be decontaminated.

4.1.8 In Situ Permeability Testing

A slug test will be performed in each of the six monitoring wells installed as part of the investigation, to determine the hydraulic conductivity of the geologic material surrounding each well. The five previously installed monitoring wells will also be slug tested as part of this investigation.

The slug test method involves lowering or raising the static water level in a well bore by the removal or insertion of a cylinder (slug) of known volume. The return of the water level to a pre-test static level is then measured over time. The change in water level over time is plotted on a logarithmic scale to determine hydraulic conductivity (K), which is a function of the formation permeability and the fluid in the formation and is influenced by well construction.

The slug removal (rising head) test will be used for this investigation. All tests will be performed after the groundwater has been sampled as described in Section 4.1.4, and will be contingent upon a monitoring well containing sufficient water to allow testing.

Slug tests will only be initiated after the well has recovered from groundwater sampling, or a minimum of 12 hours has elapsed since sampling. The pressure transducer and decontaminated slug will be inserted into the well and the water level allowed to equilibrate to static conditions, or until at least six hours have elapsed. A slug that displaces 0.3 m (1 ft) of water should be sufficient to provide an adequate response for the analysis.

Prior to the start of the test, plastic sheeting will be placed around the well in a manner to minimize water contact with the ground surface. The static water level will be measured with an electronic water level indicator and recorded to the nearest 0.003 m (0.01 ft) below top of casing. The total depth of the well will be measured with an electronic water level indicator and recorded to the nearest 0.003 m (0.01 ft) below top of casing. These measurements will be used to calculate the water column height in the well. Use of the electronic water level meter will follow procedures outlined in Section 4.3.3.1 of the Facility-wide SAP.

To begin the test, the slug will be withdrawn quickly from the well without surging, The time of the test will begin as soon as the slug leaves the water column. Water level measurements will be recorded continuously during the test with a pressure transducer and data logger programmed to make measurements to within 0.003 m (0.01 ft) and record them on a logarithmic scale. Water level change will be recorded for a period of six hours or until the well re-equilibrates to 90% of the pre-test water level, whichever occurs first.

The test data will be evaluated by the Bouwer and Rice method (1976, 1989) or the Cooper et al. method (1967). If the test data are not conducive to analysis to either of these two methods, an alternate method will be used.

4.1.9 Continuous Water Level Data Collection

Following collection of the initial round of groundwater samples from the monitoring wells at RQL, pressure transducers and automated data recorders will be installed at each of the six newly installed wells only. Water levels in the unconfined aquifer are presumed to mimic the water level in the pond. The rationale for placement of continuous data loggers is to obtain accurate water level data daily, establish whether a hydraulic communication exists between the groundwater and the pond, and evaluate the degree to which storm events influence water levels in the unconfined aquifer.

The data loggers will be configured to collect and record water level data as depths below top of casing [to the 0.0003 m (0.01 ft)] on a daily basis until the completion of all groundwater sampling activities under this delivery order. Water level data will be downloaded to a personal computer on site, at a minimum, during every groundwater sampling or manual water level measurement event. The measurement of pond water elevations will be consistent with groundwater measuring.

Water levels will be measured to the 0.0003 m (0.01 ft) manually each month for one year at the five previously installed monitoring wells (MW-1 through MW-5). Five of these measurements will be performed by field personnel when they collect the three quarterly and two hydrologic event samples from the new monitoring wells. The additional seven months of water level readings will be accomplished independently from groundwater sampling events.

4.2 SUBSURFACE SOILS

4.2.1 Rationale

Subsurface samples from monitoring well boreholes will be collected during this investigation to corroborate existing stratigraphic data, evaluate geotechnical properties, and determine the degree and nature of weathering and fracturing in rock. Table 4-1 summarizes the planned subsurface sampling for this investigation. Note that no chemical analyses are planned for the soils in monitoring well boreholes.

Continuous subsurface soil sampling will be conducted in each of the monitoring well borings. The primary purpose of continuous sampling is for lithologic logging and collection of geotechnical grab samples. One discrete, representative sample is to be collected from each of the six boreholes, and analyzed for geotechnical properties, including moisture content, Atterberg limits, grain size, and Unified Soil Classification.

4.2.2 Procedures

4.2.2.1 Drilling Methods

4.2.2.1.1 Equipment Condition and Cleaning

Requirements for the condition and cleaning of equipment used for well installation and sampling of subsurface soils are described in Section 4.3.2.1.1 of the Facility-wide SAP. These requirements, as applicable, will be employed for equipment used to collect all subsurface soil samples in the RQL Groundwater Investigation.

4.2.3 Field Measurement Procedures and Criteria

All field measurement procedures and criteria will follow Section 4.4.2.3 of the Facility-wide SAP, with the following exception. Headspace gases will not be screened in the field for organic vapors during subsurface soil collection.

4.2.4 Sampling for Geotechnical Analysis

Subsurface soil samples collected for geotechnical analysis in the RQL Groundwater Investigation are considered disturbed samples. Therefore, geotechnical analysis will be limited to grain size, Atterberg limits, moisture content, and USC. Each soil sample will be visually classified according to the USC in the field. Procedures for sampling for geotechnical analysis are provided in the Facility-wide SAP, Section 4.4.2.4. Efforts will be made to provide geotechnical data from the various types of soil encountered over the depth ranges sampled in the six boreholes, e.g., impervious soil (CL, CH, ML, MH, SC, GG, OH, or OL) and permeable soil (SO, SM, GP, GM, SW, or GW).

4.2.5 Sampling for Chemical Analysis

No subsurface soils will be submitted for chemical analysis in this investigation.

4.2.6 Sample Containers and Preservation

Requirements for sample containers for subsurface soil samples are presented in Section 4.4.2.6 of the Facility-wide SAP and the Quality Assurance Project Plan (QAPP). Disturbed geotechnical samples will be placed in sealed plastic bags and stored on site until the conclusion of the well installation task. Then they will be shipped to the subcontracted geotechnical laboratory.

4.2.7 Decontamination Procedures

Decontamination of equipment used for sample collection is presented in Section 4.4.2.8 of the Facility-wide SAP. However, a 2% solution of HCl will be used instead of a 10% solution.

4.3 SEDIMENT

4.3.1 Rationale

Sampling of sediments is restricted to eight locations in the pond at RQL, in order to determine if the former landfill or pre-landfill waste disposal activities have resulted in a release of contaminants to the pond. Pond sediment samples will be collected once, in two discrete depth intervals, wherever possible: 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). If the pond sediment is deeper than 60 cm (24 in.), sampling will proceed in 2-ft increments down to the bedrock surface. It is assumed that two stations will require samples from the 0.6- to 1.6-m (2- to 4-ft) interval (Table 4-1). Proposed sediment sampling locations in the pond are shown in Figure 4-2.

Sampling of sediment in the small unnamed pond southeast of RQL is not included in this investigation. A June 1998 walkover of the site revealed that the pond is dry and no sediment is present.

4.3.1.1 Discrete/Composite Sediment Sampling Requirements

All pond sediment samples will be discrete samples collected with either a stainless-steel hand auger or sediment coring device. Sample material will be homogenized in a stainless steel bowl prior to placement in an air-tight sampling container.

4.3.1.2 Sample Collection for Field and Laboratory Analysis

All sediment samples will be screened for VOCs using a hand-held PID or FID OVA during collection, prior to homogenizing a sample. No samples will be collected for additional headspace analysis of VOCs.

All sediment samples will be analyzed for TAL metals, cyanide, explosives, propellants, VOCs, and SVOCs.

4.3.1.3 QA/QC, Blank Samples, and Frequency

Environmental samples will be collected according to Table 4-1. QA/QC samples will also be collected. Duplicate sediment samples will be collected at a frequency of 10%. Split samples will be submitted to the USACE MRD Laboratory for independent analysis. Split samples will be collected at a frequency of 5%. Duplicate and split samples will be selected on a random statistical basis and submitted for the same analyses as the environmental samples. No field or rinsate blanks will be collected for sediments.

4.3.2 Procedures

Because of the possibility for UXO submerged in the pond, all sediment sampling activity logs will document and, if possible, describe any objects of debris encountered during sampling (e.g., timbers, pipe fragments, etc.) that may obstruct the sampling devices. UXO clearance will be required during the sampling of sediment at RQL pond.

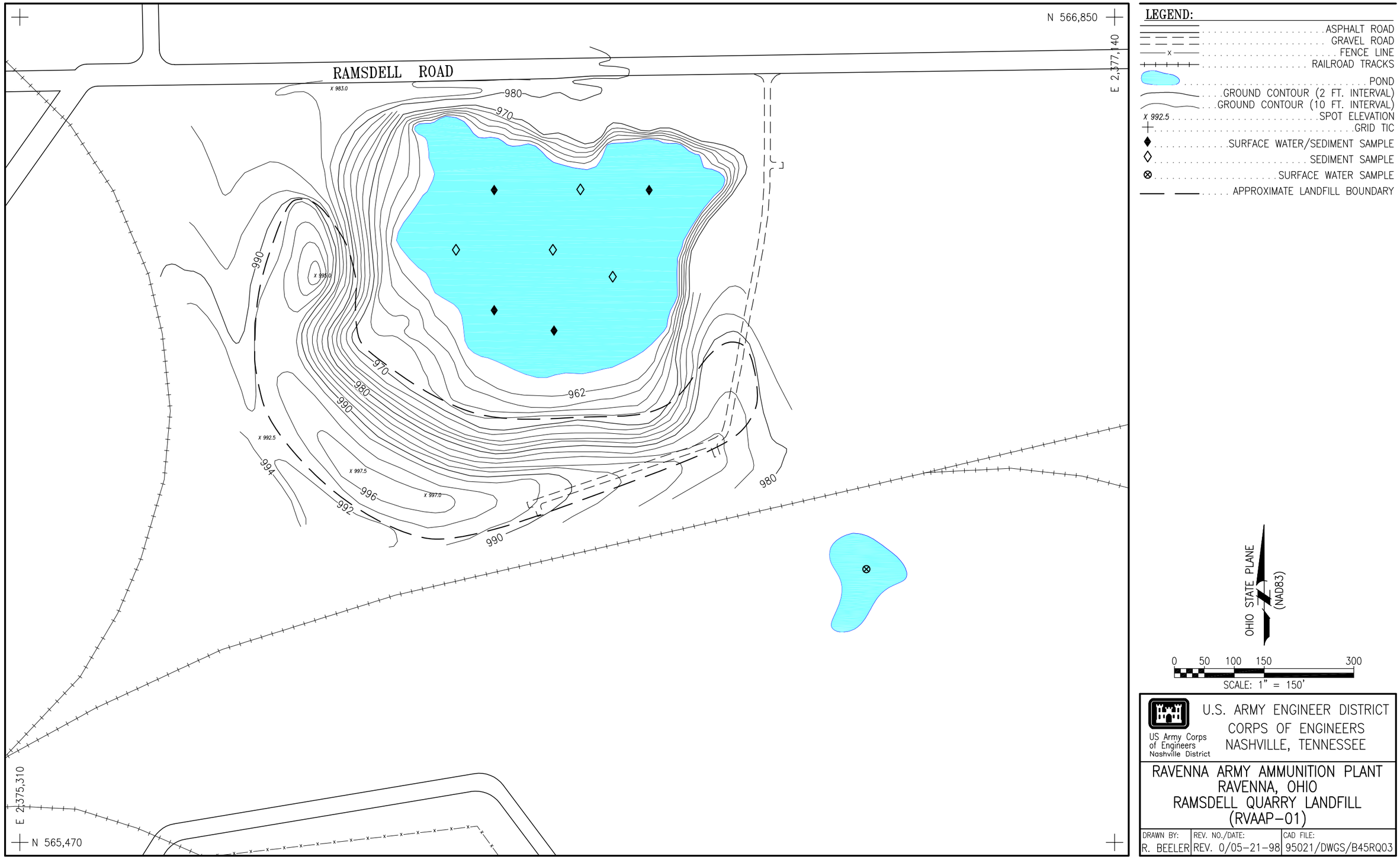

Figure 4-2. Ramsdell Quarry Landfill Proposed Surface Water/Sediment Samples

4.3.2.1 Sampling Methods for Underwater Sediments from Ponds

Note that locations for the sediment samples will be spotted in the field to take advantage of areas with the greatest accumulations of sediment. Because sediment sampling points are to be surveyed as part of this project, all eight sediment sampling locations shall be clearly marked, either by staking or by deploying floating markers. Sediment samples will be collected from these eight locations in the initial phase of field work only.

All sediment samples will be collected only after surface water samples have been collected, in order to reduce the likelihood of sediment suspension affecting surface water quality.

Representative photographs of investigative measures and of any debris observed in RQL pond will be taken during the field investigation. Photographs will be documented as described in Section 5.2 of this SAP Addendum.

4.3.2.1.1 Trowel Method

Sediment samples, in locations where water depth does not exceed 15 cm (6 in.), will be collected with a stainless steel trowel. The trowel will be used to manually obtain sediment to a depth of 15 cm (6 in.) below the sediment surface. Where VOC fractions are to be collected, the VOC containers are filled with the first sediment obtained. Sample containers for remaining analytes will be filled with sediment that has been mixed and composited from the entire interval, as described in Section 4.4.2.5.1 of the Facility-wide SAP.

4.3.2.1.2 Hand Core Sampler Method

A sludge sampler will be used to collect sediment at locations where the depth of the surface water exceeds 15 cm (6 in.), and for sampling the depth interval from 15 to 60 cm (6 to 24 in.), and, if necessary, the 60 to 120 cm (24 to 48 in.) interval. Samples will be collected following guidelines in Section 4.5.2.5 of the Facility-wide SAP.

The sludge sampler consists of a stainless steel, 8.26-cm (3.3-in.) long capped tube which can be fitted with either an auger- or core-type sampler end. Each sampler end is equipped with a butterfly valve to prevent loss of sample upon retrieval. In this investigation, the core-type end will be used. The auger-type sampler will be used only in the event that the sediment is too coarse or consolidated for use of the core-type end. The sludge sampler will be extended to the sampling depth by connecting 0.6, 0.9, 1.2, or 1.5 m (2, 3, 4, or 5 ft) stainless steel extension rods to the sampler. The rods will be attached to a handle and pushed or augered by hand.

4.3.2.2 Sampling for Geotechnical Analysis

Samples collected from the pond with either the trowel or sludge sampler are considered disturbed samples. Therefore, geotechnical analysis of samples collected using these methods will be limited to grain size, Atterberg limits, moisture content, and Unified Soil Classification. Analysis of moisture content will be omitted for any obviously saturated sediment samples. Procedures for sediment sampling for geotechnical analysis are presented in Section 4.4.2.4 of the Facility-wide SAP. Eight representative samples will be submitted for geotechnical analysis, i.e., one sample from each location.

4.3.2.3 Sampling for Chemical Analysis

Procedures for sampling of sediment for chemical analysis are presented in Section 4.4.2.5 of the Facility-wide SAP. All sediment samples will be analyzed for TAL metals, cyanide, explosives, propellants, VOCs, and SVOCs, as shown in Table 4-1.

4.3.2.4 Sample Containers and Preservation

Requirements for sample containers for sediment samples are presented in Section 4.4.2.6 of the Facility-wide SAP and the RQL Groundwater Investigation QAPP Addendum attached to this SAP Addendum.

4.3.2.5 Field Quality Control Sampling Procedures

Sediment QA/QC samples will be collected during the investigation. Duplicate sediment samples will be collected at a frequency of 10% (or 2 samples). One split sample will be submitted to the USACE MRD Laboratory for independent analysis. Split samples will be collected at a frequency of 5%. The duplicate samples will be selected on a random statistical basis and submitted for the same analyses as the environmental samples. No field or rinsate blanks will be collected for pond sediments.

4.3.2.6 Decontamination Procedures

Decontamination of equipment used for sediment sample collection is presented in Section 4.4.2.8 of the Facility-wide SAP. However, a 2% solution of HCl will be used instead of a 10% solution.

4.4 SURFACE WATER

4.4.1 Rationale

The rationale for sampling surface water at the RQL pond and the smaller pond immediately southeast of RQL is to determine whether contamination has reached the ponds via the groundwater and/or surface water runoff pathways. To this end, the RQL pond water will be sampled at four locations as a part of this investigation. One additional surface water sample will be collected from the small quarry pond southeast of RQL, if water is present at the time of the field investigation. Surface water samples will be collected from these five locations during the initial phase of field work only.

The RQL pond water will also be sampled at one location for three quarters, concurrent with the quarterly groundwater sampling events, and during two significant hydrologic events, for a total of five additional samples. The location to be sampled will be the same for every event, and will be determined based upon the results from the initial sampling event. Quarterly samples shall be collected and analyzed identically to those collected during the initial sampling event.

In addition to characterizing the water quality at the pond at the base of the former landfill, this investigation will also provide a means for continuous measurement of the water level in the RQL pond. This goal will be accomplished by constructing and installing a permanent instrumented staff gauge at the pond. UXO clearance will be required during the installation of the staff gauge.

4.4.2 Sampling Requirements–General

All surface water sampling will be conducted as described in Section 4.6.2.1.1 of the Facility-wide SAP. The hand-held bottle method will be used to sample the pond water. The sample container will be submerged, with the cap in place, into the pond. The container will then be slowly and continuously filled, using the cap to regulate the rate of sample flow into the container. The sample container will be removed from the pond with minimal disturbance to the sample. Immediately after collection of the sample and proper labeling, the container will be placed into a sealed plastic bag and in an ice-filled cooler for proper preservation.

All pond water samples will be collected before the commencement of pond sediment sampling (RQL pond only), to minimize sediment turbidity and its impacts on water sample quality.

Because the surface water sampling points are to be surveyed as a part of this project, all surface water sampling locations shall be clearly marked, either by staking or by deploying floating markers.

4.4.2.1 Sampling Collection for Field and Laboratory Analysis

4.4.2.1.1 General Requirements

One filtered and one unfiltered surface water sample will be collected from each location. Four of the surface water sampling locations will be coincident with the locations of four of the eight RQL pond sediment samples. Unfiltered samples will be submitted for laboratory analysis of explosives, propellants (nitrocellulose, nitroglycerine, and nitroguanidine), TAL metals, cyanide, VOCs, and SVOCs. The filtered samples will be analyzed for TAL metals. Table 4-1 summarizes the number of samples and the types of analyses to be performed for this investigation.

4.4.2.1.2 Filtration

An ample volume of pond water will be collected at each location to provide both filtered and unfiltered samples. Filtering will be performed as soon as possible after the sample is collected, using a hand-held pump and filtration unit with 0.45-micron filters, as described in Section 4.1.4.2. Care will be taken to avoid transferring any solids that may have settled to the bottom of the collection flask into the filter apparatus. The hand-operated pump will be used to create a vacuum in the assembly to start filtration. Sample bottles will be filled with the filtered water. Filters will be replaced as they become restricted by solids buildup. The filter assembly will be decontaminated between sample collection sites.

4.4.2.2 Field Measurement Procedures and Criteria

Surface water field measurements to be performed during the collection of pond surface water will include pH, specific conductance, D.O., and temperature. These measurements will be performed in the same manner as described in Section 4.3.3 of the Facility-wide SAP.

4.4.2.3 Sample Containers and Preservation Techniques

Information regarding sample containers and preservation techniques for surface water samples is presented in Chapter 4.0 of the QAPP portion of the Facility-wide SAP. All sample containers will

be provided by the contracted analytical laboratory, including pre-preserved containers for VOC samples.

4.4.2.4 Field Quality Control Sampling Procedures

Surface water QA/QC samples will be collected as part of this investigation. One duplicate sample and one split sample will be collected, on a random statistical basis, and submitted for the same analyses as the environmental samples. Field and rinsate blanks are not required for surface water.

4.4.2.5 Decontamination Procedures

Decontamination of any equipment used for surface water sample collection during this investigation of RQL will be conducted in the same manner as described for nondedicated sampling equipment in Section 4.3.8 of the Facility-wide SAP, except that a 2% HCL rinse will be used instead of a 10% solution. The use of non-dedicated sampling equipment for surface water is not anticipated.

Field measurement instruments will also be decontaminated between sampling locations. Only those portions of each instrument that come in contact with potentially contaminated surface water will be decontaminated.

4.4.3 Continuous Water Level Data Collection

A staff gauge will be constructed and a data logger installed to measure water levels in RQL pond. The staff gauge and data logger will have the following general specifications:

- durable enough to last 4 years;
- measures water levels that range from 0.3 to 3.3 m (1 to 11 ft) above the bottom of the pond;
- marked so that water levels may be read/recorded to the nearest 0.0003 m (0.01 ft);
- equipped with a continuous data logger to monitor pond elevation for the duration of field activities as specified in Section 4.1;
- positioned such that its location can be referenced to the existing control monument RAV-8;
- positioned such that it is accessible to field maintenance teams without a boat.

The staff gauge data logger will be configured to collect and record water level data on a daily basis until the completion of all groundwater and surface water sampling activities. Water level data will be downloaded to a personal computer on site, at a minimum, during every groundwater sampling or manual water level measurement event.

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 RQL is presented in Section 4.3.2.4.3 of the Facility-wide SAP.

5.3 SAMPLE NUMBERING SYSTEM

The sample numbering system that will be used to identify samples collected during the RQL Groundwater Investigation is explained in Section 5.3 of the Facility-wide SAP. The specific identifying information that will be used to implement this system during the Groundwater Investigation is presented in Figure 5-1 of this SAP Addendum.

5.4 SAMPLE DOCUMENTATION

All sample label, field logbook, field record, and field form information will follow structures identified in Section 5.4 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 QUARTERLY AND MONTHLY REPORTS

Quarterly reports will be submitted during implementation of the field investigation and through the data analysis phase of the project. In addition, monthly reports will be submitted during the period of performance. Monthly report information will follow structures identified in Section 5.7 of the Facility-wide SAP.

Sampling Location Identification: XXXmm-NNN(n)

XXX = Area Designator	Examples TNT - TNT Manufacturing Area P11 - Pond #11
mm = Sample Location Type	Examples MW - Groundwater Monitoring Well SB - Soil Boring SW - Surface Water Location SD - Sediment Sample Location SS - Surface Soil Location TR - Trench Location SP - Seep Sample WP - Groundwater Well Point
NNN(n) = Sequential Sample Location Number [must be unique for each designator]	Examples 004 012 099

(n) can be used as a special identifier and is optional. For example:

Use a D to identify the well as an adjacent deep zone/aquifer well (004D)
Use a B to identify the well as a background location (012B)
Use an A to identify an abandoned well (099A)

Sample Identification: XXXmm-NNN(n)-####-tt

### = Sequential Sample Number [must be unique for entire project site]	Examples 0001 0002 0003
tt = Sample Type	Examples GW - Groundwater Sample (unfiltered) GF - Groundwater Sample (filtered) SO - Soil Sample SW - Surface Water Sample SD - Sediment Sample PR - Free Product Sample SP - Seep Sample TB - Trip Blank FB - Field Blank ER - Equipment Rinsate

Figure 5-1. Ramsdell Quarry Landfill Groundwater Investigation Location/Sample Identification Naming Conventions

6.0 SAMPLE PACKAGING AND SHIPPING REQUIREMENTS

Sample packaging and shipping shall generally follow Chapter 6.0 of the Facility-wide SAP. Because the analytical laboratory is located less than 50 miles from the site, the contract laboratory will provide same-day pickup of coolers containing samples. This will reduce the need for some of the packaging measures described in the Facility-wide SAP, which are intended for air-shipped coolers. Specifically:

- Chain of custody forms can be hand-carried by the courier to the laboratory.
- No airbills will be attached to couriered coolers.
- "THIS END UP" and "FRAGILE" stickers will not be required for couriered containers.

Sample coolers shipped to the USACE's QA laboratory will be prepared and shipped in accordance with the Facility-wide SAP.

7.0 INVESTIGATION-DERIVED WASTE

All investigation-derived waste (IDW) will be managed in accordance with Chapter 7.0 of the Facility-wide SAP. At the conclusion of field activities in the RQL Groundwater Investigation, a letter report will be submitted documenting characterization and classification of the wastes, and all solid and liquid IDW will be removed from the site and disposed of by a licensed waste disposal contractor (AETS).

Any shipment of IDW materials off site shall be coordinated through RVAAP's Environmental Coordinator.

7.1 SOIL/SEDIMENT IDW

Any excess soil/sediment not utilized for sampling shall be placed in lined drums and labeled in accordance with provisions in the Facility-wide SAP. Saturated soils shall be segregated from unsaturated soils for each borehole. Any drums of soil IDW shall be temporarily stored at RQL or LL1. A composite sample from each well boring shall be prepared and subjected to Toxicity Characteristic Leaching Procedure (TCLP) analysis. This analysis is to be performed within eight weeks of the conclusion of the initial field effort.

7.2 LIQUID IDW

Liquid IDW includes development and purge water from monitoring wells and decontamination wash and rinse fluids.

Any excess water from well development and purging prior to sampling shall be placed in 500-gallon polytanks to be staged adjacent to Building 1036 at RVAAP. Laboratory analyses of the corresponding groundwater samples will be used to characterize the liquid IDW from monitoring wells.

TCLP analysis of decontamination wash and rinse fluids will be required for characterization. As with the soil IDW characterization, TCLP analysis of liquid IDW shall take place within eight weeks of the conclusion of the initial field effort.

7.3 IDW DISPOSITION

All IDW shall be properly handled, labeled (with type, amount, source, and generation dates), and secured at RVAAP until its disposition is determined. Within twelve weeks of the conclusion of the initial field effort, the waste hauler shall dispose of all IDW in accordance with all federal and state characterization criteria.

8.0 REFERENCES

Bouwer, H. and R.C. Rice. 1976. A *Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Well Walls.* Water Resources Research, v. 12, no. 3, pp. 423-428.

Bouwer, H. 1989. *The Bouwer and Rice Slug Test - An Update.* Groundwater, v. 27, no. 3, pp. 304-309.

Cooper, Jr., H.H., J.D. Bredehoeft, and I.S. Papadopulos. 1967. *Response of a Finite-Diameter Well to an Instantaneous Charge of Water.* Water Resources Research, v. 3, no. 1, pp. 263-269.

Ohio EPA (Ohio Environmental Protection Agency). 1995. *Technical Guidance Manual for Hydrogeologic Investigations and Groundwater Monitoring.* February.

USACE (U.S. Army Corps of Engineers). 1994a. *Requirements for the Preparation of Sampling and Analysis Plans.* EM 200-1-3.

USACE. 1994b. *Monitoring Well Design, Installation, and Documentation of Hazardous and/or Toxic Waste Sites.* EM-1110-1-4000.

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

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

USAEHA (U.S. Army Environmental Health Agency). 1992. *Ground-Water Consultation No. 38-26-KF95-92, Ground-Water Quality Assessment Plan Outline, Ramsdell Quarry Landfill, Ravenna Army Ammunition Plant, Ravenna , Ohio.* February.

QUALITY ASSURANCE PROJECT PLAN
ADDENDUM

CONTENTS

Quality Assurance Project Plan Addendum

TABLES

INTRODUCTION

This Quality Assurance Project Plan (QAPP) addendum addresses supplemental project specific information pertaining to the Ramsdell Quarry Landfill (RQL) Groundwater Investigation in relation to the Facility-wide QAPP (USACE 1996) for the Ravenna Army Ammunition Plant (RVAAP), Ravenna, Ohio. Each QAPP section is presented documenting adherence to the Facility-wide QAPP or stipulating project-specific added requirements.

1.0 PROJECT DESCRIPTION

1.1 SITE HISTORY/BACKGROUND INFORMATION

This information is contained in Section 1.1 of the Sampling and Analysis Plan (SAP) Addendum for the Ramsdell Quarry Landfill (RQL) Groundwater Investigation.

1.2 PAST DATA COLLECTION ACTIVITY/CURRENT STATUS

This information is contained in Section 1.2 of the SAP Addendum for the RQL Groundwater Investigation.

1.3 PROJECT OBJECTIVES AND SCOPE

This information is contained in Chapter 3.0 of the SAP Addendum for the RQL Groundwater Investigation.

1.4 SAMPLE NETWORK DESIGN AND RATIONALE

This information is contained in Chapter 4.0 of the SAP Addendum for the RQL Groundwater Investigation.

1.5 PARAMETERS TO BE TESTED AND FREQUENCY

Sample matrix types, analytical parameters, and analytical methods are discussed in Chapter 4.0 of the SAP Addendum for the RQL Groundwater Investigation. These are summarized in Tables 1-1 through 1-3 of this Quality Assurance Project Plan (QAPP) Addendum, in conjunction with anticipated sample numbers, quality assurance (QA) sample frequencies, and field quality control (QC) sample frequencies.

1.6 PROJECT SCHEDULE

The project schedule is discussed in Chapter 2.0 of the SAP Addendum for the RQL Groundwater Investigation.

Table 1-1. Ramsdell Quarry Landfill Groundwater Monitoring Initial Phase - Soil/Sediment Sampling

Parameter	Analytical Method	Field Samples	Duplicate Samples	Site Source Water[a]	Sampler Rinsates	Trip Blanks[b]	Total A-E Samples	USACE QA Split Samples	Ohio EPA QA Split Samples
Subsurface Soils									
Grain Size	ASTM D422	6	-	-	-	-	6	-	-
Moisture Cont.	ASTM D4318	6	-	-	-	-	6	-	-
Atterberg Lts.	ASTM D4318	6	-	-	-	-	6	-	-
Soil Classification		6	-	-	-	-	6	-	-
Sediments									
VOCs	SW-846, 5035/8260A	18	2	-	-	-	20	2	-
SVOCS	SW-846, 8270B	18	2	-	-	-	20	2	-
Explosives	SW-846 8330	18	2	-	-	-	20	2	-
Propellants	SW-846 8330	18	2	-	-	-	20	2	-
Metals, TAL	SW-846, 6010/7471	18	2	-	-	-	20	2	-
Cyanide	SW-846, 9011/9010	18	2	-	-	-	20	2	-
Soil Classification		18	-	-	-	-	18	-	-

[a] Site source waters = one potable water source and one ASTM water supply lot for the project.
[b] Surface waters and groundwaters will be combined relative to trip blank association.

EPA = U.S. Environmental Protection Agency
PCB = Polychlorinated biphenyl
QA = Quality assurance
RVAAP = Ravenna Army Ammunition Plant
SVOCs = Semivolatile organic compounds
TAL = Target analyte list
USACE = U.S. Army Corps of Engineers
VOCs = Volatile organic compounds

Table 1-2. Ramsdell Quarry Landfill Groundwater Monitoring Initial Phase - Surface Water/Groundwater Sampling

Parameter	Analytical Method	Field Samples	Duplicate Samples	Site Source Water[a]	Sampler Rinsates	Trip Blanks[b]	Total A-E Samples	USACE QA Split Samples	Ohio EPA QA Split Samples
Surface Waters									
VOCs	SW-846, 8260A	5	1	-	-	-	6	1	-
SVOCS	SW-846, 8270B	5	1	-	-	-	6	1	-
Explosives	SW-846 8330	5	1	-	-	-	6	1	-
Propellants	SW-846 8330	5	1	-	-	-	6	1	-
Metals, Total	SW-846, 6010/7470A	5	1	-	-	-	6	1	-
Metals, Filt.	SW-846, 6010/7470A	5	1				6	1	
Cyanide	SW-846, 9010	5	1	-	-	-	6	1	-
Groundwaters									
VOCs	SW-846, 8260A	11	1	1	1	3	17	1	-
SVOCS	SW-846, 8270B	11	1	1	1	-	14	1	-
Explosives	SW-846 8330	11	1	1	1	-	14	1	-
Propellants	SW-846 8330	11	1	1	1	-	14	1	-
Metals, Total	SW-846 6010/7470A	11	1	1	1	-	14	1	-
Metals, Filt.	SW-846 6010/7470A	11	1	1	1		14	1	
Cyanide	SW-846, 9010	11	1	1	1	-	14	1	-

[a] Site source waters = one potable water source and one ASTM water supply lot for the project.
[b] Surface waters and groundwaters will be combined relative to trip blank association.

EPA = U.S. Environmental Protection Agency
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TAL = Target analyte list
USACE = U.S. Army Corps of Engineers
VOCs = Volatile organic compounds

Table 1-3. Ramsdell Quarry Landfill Follow-Up Groundwater Monitoring 1998-99

Parameter	Analytical Method	Field Samples	Duplicate Samples	Site Source Water[a]	Sampler Rinsates	Trip Blanks[b]	Total A-E Samples	USACE QA Split Samples	Ohio EPA QA Split Samples
Surface Waters									
VOCs	SW-846, 8260A	5	1	-	-	-	6	1	-
SVOCS	SW-846, 8270B	5	1	-	-	-	6	1	-
Explosives	SW-846 8330	5	1	-	-	-	6	1	-
Propellants	SW-846 8330	5	1	-	-	-	6	1	-
Metals, Total	SW-846, 6010/7470A	5	1	-	-	-	6	1	-
Metals, Filt.	SW-846, 6010/7470A	5	1	-	-	-	6	1	-
Cyanide	SW-846, 9010	5	1	-	-	-	6	1	-
Groundwaters									
VOCs	SW-846, 8260A	30	3	1	3	10	47	3	-
SVOCS	SW-846, 8270B	30	3	1	3	-	37	3	-
Explosives	SW-846 8330	30	3	1	3	-	37	3	-
Propellants	SW-846 8330	30	3	1	3	-	37	3	-
Metals, Total	SW-846, 6010/7470A	30	3	1	3	-	37	3	-
Metals, Filt.	SW-846, 6010/7470A	30	3	-	-	-	33	3	-
Cyanide	SW-846, 9010	30	3	1	3	-	37	3	-

[a] Site source waters = one potable water source and one ASTM water supply lot for the project.
[b] Surface waters and groundwaters will be combined relative to trip blank association.

EPA = U.S. Environmental Protection Agency
PCB = Polychlorinated biphenyl
QA = Quality assurance
RVAAP = Ravenna Army Ammunition Plant
SVOCs = Semivolatile organic compounds
TAL = Target analyte list
USACE = U.S. Army Corps of Engineers
VOCs = Volatile organic compounds

2.0 PROJECT ORGANIZATION AND RESPONSIBILITY

The functional project organization and responsibilities are described in Chapter 2.0 of the Facility-wide SAP and the SAP Addendum for the RQL Groundwater Investigation.

Analytical support for RQL has been assigned to Quanterra Environmental Services, Inc. The majority of analysis will be completed by Quanterra's North Canton, Ohio facility, with explosive determinations being performed by the Knoxville, Tennessee facility. These laboratories have been validated by the U.S. Army Corp of Engineers (USACE) Missouri River District Hazardous, Toxic, and Radioactive Waste, Mandatory Center of Expertise, Omaha, Nebraska. Quanterra Environmental Services' Quality Assurance Management Plan (QAMP) Revision 2, June 30, 1997, is available for review upon request. The laboratory's organizational structure, roles, and responsibilities are identified in Chapter 1 of their QAMP and facility-specific appendices.

Analytical Facilities

Quanterra Environmental Services, Inc.
North Canton, OH
4101 Shuffel Drive, N.W.
North Canton, OH 44720

Tel: (330) 497-9396
Fax: (330) 497-0772

Quanterra Environmental Services, Inc.
Knoxville, TN
5815 Middlebrook Pike
Knoxville, TN 37921

Tel: (423) 588-6401
Fax: (423) 584-4315

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT

3.1 DATA QUALITY OBJECTIVES

Data quality objectives summaries for this investigation will follow Tables 3-1 and 3-2, as presented in the Facility-wide QAPP. All QC parameters stated in the specific SW-846 methods will be adhered to for each chemical listed. Laboratories are required to comply with all methods as written; recommendations are considered requirements.

3.2 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, and equipment rinsate blanks. Laboratory QC measurements will include method blanks, laboratory control samples, laboratory duplicates, and matrix spike/matrix spike duplicate samples.

3.3 ACCURACY, PRECISION, AND SENSITIVITY OF ANALYSIS

Accuracy, precision, and sensitivity goals identified in the Facility-wide QAPP Section 3.3 and Tables 3-1 through 3-3 will be imposed for these investigations.

3.4 COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

Completeness, representativeness, and comparability goals identified in the Facility-wide QAPP Section 3.4 and Tables 3-1 and 3-2 will be imposed for these investigations.

4.0 SAMPLING PROCEDURES

Sampling procedures are discussed in the Facility-wide SAP and Chapter 4.0 of the SAP Addendum for the RQL Groundwater Investigation.

Tables 4-1 and 4-2 summarize sample container, preservation, and holding time requirements for soil, sediment, and water matrices for these investigations. The number of containers required are estimated in these tables.

Table 4-1. Container Requirements for Soil and Sediment Samples at RVAAP

Analyte Group	Approx. No. of Containers	Container	Minimum Sample Size	Preservative	Holding Time
VOCs	80	EnCore type samplers	3/sample	Cool, 4°C preserve at lab	48 hr. to preservation
SVOCs	25	1—8 oz glass jar with Teflon®-lined cap	100 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
Explosive and Propellant Compounds	25	1—4 oz. Glass jar with Teflon®-lined cap	40 g	Cool, 4°C	14 days (extraction) 40 days (analysis)
Metals (other than mercury)	25	1—4 oz wide mouth polybottle	50 g	Cool, 4°C	180 days
Mercury		Use same container as other metals	10 g	Cool, 4°C	28 days
Cyanide		Use same container as metals	25 g	Cool, 4° C	14 days

SVOCs = Semivolatile organic compounds
VOCs = Volatile organic compounds

Table 4-2. Container Requirements for Water Samples at RVAAP[a]

Analyte Group	Approx. No. of Containers	Container	Minimum Sample Size	Preservative	Holding Time
VOCs	180	40 mL glass vials with Teflon®-lined septum (no headspace)	80 mL	HCl to pH <2 Cool, 4°C	14 days
SVOCs	90	L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 days (extraction) 40 days (analysis)
Explosive Compounds	90	L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 days (extraction) 40 days (analysis)
Propellant Compounds	90	L amber glass bottle with Teflon®-lined lid	1000 mL	Cool, 4°C	7 days (extraction) 40 days (analysis)
Metals (other than mercury)	90	1—L polybottle	500 mL	HNO_3 to pH <2 Cool, 4°C	180 days
Mercury		Use same container as other metals	200 mL	HNO_3 to pH <2 Cool, 4°C	28 days
Cyanide	90	500 mL polybottle	500 mL	NaOH to pH > 12 Cool, 4° C	14 days

[a] One sample will be tripled in volume for the laboratory to perform appropriate laboratory quality control analysis.

SVOCs = Semivolatile organic compounds

VOCs = Volatile organic compounds

5.0 SAMPLE CUSTODY

5.1 FIELD CHAIN-OF-CUSTODY PROCEDURES

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

5.2 LABORATORY CHAIN-OF-CUSTODY PROCEDURES

Laboratory chain-of-custody will follow handling and custody procedures identified in Section 8.5.3 of the Quanterra QAMP.

5.3 FINAL EVIDENCE FILES CUSTODY PROCEDURES

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

6.0 CALIBRATION PROCEDURES AND FREQUENCY

6.1 FIELD INSTRUMENTS/EQUIPMENT

Field instruments and equipment calibrations will follow those identified in Section 6.1 of the Facility-wide QAPP. Field laboratory equipment will be calibrated in accordance with Appendix B of the Facility-wide SAP.

6.2 LABORATORY INSTRUMENTS

Calibration of laboratory equipment will follow procedures identified in Section 8.5.4 of the Quanterra QAMP, corporate and facility-specific operating procedures.

7.0 ANALYTICAL PROCEDURES

7.1 LABORATORY ANALYSIS

Analytical methods, parameters and quantitation or detection limits are those listed in Table 3-3 of the Facility-wide QAPP. The only addition to this listing will be the implementation of SW-846 Method 5035 for soil volatile organic compound (VOC) analysis. Parameters and quantitation levels will remain the same.

Quanterra's QAMP Section 8.0 and the facility specific addenda for the North Canton and Knoxville facilities will be followed during the analysis of these samples and the following laboratory standard operating procedures will implement the defined U.S. Environmental Protection Agency (EPA) Methods.

- GC/MS Volatile Organics Analysis, Based on Methods 8240B and 8260A, SW846, CORP-MT-0002NC, rev 1.1, 04/18/97.

- GC/MS Semivolatile Analysis, Based on Methods 270B, SW846, CORP-MS-0001NC, rev. 1.3, 05/09/97.

- Gas Chromatographic Analysis, Based on Methods 8000A, 8010B, 8020A, 8021A, 8080A, 8081, 8150B, and 8051, SW846, CORP-GC-0001, rev. 2, 01/31/96.

- Extraction and Cleanup of Organic Compounds from Waters and Soils, Based on SW846 3500 Series, 3600 Series, 8150, 8151, and 600 Series Methods, CORP-OP-0001NC, rev. 2.2, 04/18/97.

- Total Organic Carbon and Total Inorganic Carbon, NC-WC-0017, rev. 1, 11/20/97.

- Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, Methods 6010A and 200.7, CORP-MT-0001NC, rev. 1.2, 04/17/97.

- Graphite Furnace Atomic Absorption Spectroscopy, SW846 Methods 7000A and MCAWW 200 series methods, CORP-MT-0003, rev. 1, 08/22/95.

- Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW846 7470A and MCAWW 245.1, CORP-MT-0005NC, rev. 1.1, 04/19/97.

- Mercury in Solid Samples by Cold Vapor Atomic Absorption, SW846 7471A and MCAWW 245.5, CORP-MT-0007NC, rev. 1.1, 04/17/97.

Quanterra facilities will at all times maintain a safe and contaminant free environment for the analysis of samples. The laboratories will demonstrate thorough instrument blanks, holding blanks, and analytical method blanks, such that the laboratory environment and procedures will not and do not impact analytical results.

Quanterra facilities will also implement all reasonable procedures to maintain project reporting levels for all sample analysis. Where contaminant and sample matrix analytical interferences impact the laboratory's ability to obtain project reporting levels, the laboratory will institute sample clean-

up processes, minimize dilutions, adjust instrument operational parameters, or propose alternative analytical methods or procedures. Elevated reporting levels will be kept to a minimum throughout the execution of this work.

7.2 FIELD SCREENING ANALYTICAL PROTOCOLS

Procedures for field analysis are identified in the Facility-wide SAP Chapter 6.0 and in the SAP Addendum for the RQL Groundwater Investigation, Chapter 4.0.

8.0 INTERNAL QUALITY CONTROL CHECKS

8.1 FIELD SAMPLE COLLECTION

Field QC sample types, numbers, and frequencies are identified in Chapter 4.0. In general, field duplicates will be collected at a frequency of 10%, field equipment rinsates and blanks will be collected at a frequency of 5% for samples collected with non-dedicated equipment, and volatile organic trip blanks will accompany all shipments containing volatile organic samples.

8.2 FIELD MEASUREMENT

Refer to Chapter 4.0 for details regarding these measurements.

8.3 LABORATORY ANALYSIS

Analytical QC procedures will follow those identified in the referenced EPA methodologies. These will include method blanks, laboratory control samples, matrix spike/matrix spike duplicate samples, laboratory duplicate analysis, calibration standards, internal standards, surrogate standards, and calibration check standards.

Quanterra facilities will conform to their QAMP, facility-specific appendices, and implement their established standard operating procedures to perform the various analytical methods required by the project. QC frequencies will follow those identified in Section 8.3 of the Facility-wide QAPP.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 DATA REDUCTION

Sample collection and field measurements will follow the established protocols defined in the Facility-wide QAPP, Facility-wide SAP, and Chapter 4.0 of the SAP Addendum for the RQL Groundwater Investigation. Laboratory data reduction will follow Quanterra's QAMP Section 8.6 guidance and conform to general direction provided by the Facility-wide QAPP.

9.2 DATA VALIDATION

Data validation will follow the direction provided in the Facility-wide QAPP.

9.3 DATA REPORTING

Analytical data reports will follow the direction provided in the Facility-wide QAPP.

10.0 PERFORMANCE AND SYSTEM AUDITS

10.1 FIELD AUDITS

A minimum of one field surveillance for each medium being sampled during the investigation will be performed by the Science Applications International Corporation (SAIC) QA Officer and/or the SAIC Field Team Leader. These audits will encompass the well installation, sediment sampling, and well sampling.

Surveillances will follow SAIC QAPP No. 18.3.

USACE, EPA Region V, or Ohio EPA audits may be conducted at the discretion of the respective agency.

10.2 LABORATORY AUDITS

Routine Missouri River District, Hazardous, Toxic, and Radioactive Waste, Mandatory Center of Expertise on-site laboratory audits will be conducted by the USACE. EPA Region V or Ohio EPA audits may be conducted at the discretion of the respective agency.

Internal performance and systems audits will be conducted by Quanterra's QA staff as defined in the laboratory QAMP, Section 9.2.

11.0 PREVENTIVE MAINTENANCE PROCEDURES

11.1 FIELD INSTRUMENTS AND EQUIPMENT

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

11.2 LABORATORY INSTRUMENTS

Routine and preventive maintenance for all laboratory instruments and equipment will follow the direction of Section 8.11 of Quanterra's QAMP.

12.0 SPECIFIC ROUTINE PROCEDURES TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

12.1 FIELD MEASUREMENTS DATA

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

12.2 LABORATORY DATA

Laboratory data will be assessed as outlined in Section 12.2 of the Facility-wide QAPP.

13.0 CORRECTIVE ACTIONS

13.1 SAMPLE COLLECTION/FIELD MEASUREMENTS

Field activity corrective action protocol will follow directions provided in Section 13.1 of the Facility-wide QAPP.

13.2 LABORATORY ANALYSES

Laboratory activity corrective action protocol will follow directions provided in Section 13.2 of the Facility-wide QAPP and Section 9.1 of Quanterra's QAMP.

14.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

Procedures and reports will follow the protocol identified in Chapter 14.0 of the Facility-wide QAPP and those directed by Section 9.4 of Quanterra's QAMP.

15.0 REFERENCES

Quanterra Environmental Services, Inc. 1997. Quality Assurance Management Plan, Revision 2, June 30.

USACE (U.S. Army Corps of Engineers). 1996. *Facility-wide Sampling and Analysis Plan for Ravenna Army Ammunition Plant, Ravenna, Ohio.*

15.1 PROCEDURES

GC/MS Volatile Organics Analysis Based on Methods 8240B and 8260A, SW846, CORP-MT-0002NC, rev 1.1, 04/18/97.

GC/MS Semivolatile Analysis Based on Methods 8270B, SW846, CORP-MS-0001NC, rev. 1.3, 05/09/97.

Gas Chromatographic Analysis Based on Methods 8000A, 8010B, 8020A, 8021A, 8080A, 8081, 8150B, and 8051, SW846, CORP-GC-0001, rev. 2, 01/31/96.

Extraction and Cleanup of Organic Compounds from Waters and Soils, Based on SW846 3500 Series, 3600 Series, 8150, 8151, and 600 Series Methods, CORP-OP-0001NC, rev. 2.2, 04/18/97.

Total Organic Carbon and Total Inorganic Carbon, NC-WC-0017, rev. 1, 11/20/97.

Inductively Coupled Plasma-Atomic Emission Spectroscopy, Spectrometric Method for Trace Element Analysis, Methods 6010A and 200.7, CORP-MT-0001NC, rev. 1.2, 04/17/97.

Graphite Furnace Atomic Absorption Spectroscopy, SW846 Methods 7000A and MCAWW 200 series methods, CORP-MT-0003, rev. 1, 08/22/95.

Mercury in Aqueous Samples by Cold Vapor Atomic Absorption, SW846 7470A and MCAWW 245.1, CORP-MT-0005NC, rev. 1.1, 04/19/97.

Mercury in Solid Samples by Cold Vapor Atomic Absorption, SW846 7471A and MCAWW 245.5, CORP-MT-0007NC, rev. 1.1, 04/17/97.

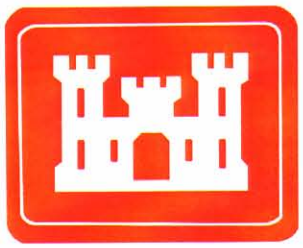
FINAL

SITE SAFETY AND HEALTH PLAN ADDENDUM FOR THE GROUNDWATER INVESTIGATION OF THE FORMER RAMSDELL QUARRY LANDFILL

at the

RAVENNA ARMY AMMUNITION PLANT
RAVENNA, OHIO

PREPARED FOR



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SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

FINAL

SITE SAFETY AND HEALTH PLAN ADDENDUM FOR THE GROUNDWATER INVESTIGATION OF THE FORMER RAMSDELL QUARRY LANDFILL AT THE RAVENNA ARMY AMMUNITION PLANT, RAVENNA, OHIO

Prepared for

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APPROVALS

SITE SAFETY AND HEALTH PLAN ADDENDUM
FOR THE
GROUNDWATER INVESTIGATION
OF THE
FORMER RAMSDELL QUARRY LANDFILL
AT THE
RAVENNA ARMY AMMUNITION PLANT,
RAVENNA, OHIO

Stephen B. Selecman, SAIC Project Manager — Date: 6/24/98

Stephen L. Davis, CIH, CSP, SAIC Health and Safety Manager — Date: 6/24/98

CONTENTS

TABLES

ACRONYMS

EOD	Explosive Ordnance Disposal
FSHP	Facility-wide Safety and Health Plan
HAZWOPER	Hazardous Waste Site Operations
PPE	personal protective equipment
PVC	polyvinyl chloride
RQL	Ramsdell Quarry Landfill
RVAAP	Ravenna Army Ammunition Plant
SAIC	Science Applications International Corporation
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
USACE	U.S. Army Corps of Engineers
UXO	unexploded ordnance

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 Facility-wide Safety and Health Plan (FSHP) and this Site Safety and Health Plan (SSHP) Addendum collectively set forth the specific procedures required to protect SAIC and SAIC subcontractor personnel involved in the field activities. All field personnel are required to comply with the requirements of these plans. In addition, subcontractors are responsible for providing their employees with a safe workplace and nothing in these plans relieves such subcontractors of this responsibility. If the requirements of these plans are not sufficient to protect the employees of a subcontractor, that subcontractor is required to supplement this information with work practices and procedures that will ensure the safety of its personnel.

The FSHP addresses program issues and hazards and hazard controls common to the entire installation. This SSHP Addendum to the FSHP serves as the lower tier document addressing the hazards and controls specific to this project. Copies of the FSHP and this SSHP Addendum will be present at the work site.

SAIC will perform field investigations at the former Ramsdell Quarry Landfill (RQL).

The following are tasks to be performed as part of this project.

- groundwater sampling,
- installation of groundwater monitoring wells with auger drill rigs,
- subsurface soil/rock sampling using drill rigs,
- well development,
- surface water sampling,
- installation of a water level monitoring station in the pond,
- sediment sampling in the pond, and
- sampling equipment decontamination.

Potential hazards posed by the tasks planned at these locations include unexploded ordnance (UXO), moving equipment (drill rig), fuel or decontamination solvent fires, chemical exposure, temperature extremes, noise, stinging/biting insects, poisonous plants, and snakes.

The potential for chemical overexposure appears to be very low given the nature of planned tasks. All of the expected contaminants have low vapor pressures, making overexposure through vapor inhalation very unlikely. All of the planned tasks, with the exception of air rotary drilling, pose minimal potential for creating airborne particulates. Air rotary drill discharge will be routed through a particulate control system to minimize airborne particulate and the spread of contamination. There is some potential for adverse effects due to dermal contact with contaminated soil. The crew 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) to prevent dermal contact with potentially contaminated materials. The SSHO will observe all site tasks during daily safety inspections and will use professional judgement, coupled with instrument readings, to

determine if upgrading PPE is required. A detailed analysis of these hazards and specific appropriate controls is presented in Chapter 2, Table 2-2.

This investigation will be performed in Level D PPE, plus chemical-resistant gloves when handling potentially contaminated materials, unless one of several action levels is exceeded or the potential for increased risk becomes apparent during the investigation. Protective procedures, including protective clothing, will be upgraded as necessary by the SSHO based on established action levels or judgment.

1. SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.1 SITE DESCRIPTION

Ravenna Army Ammunition Plant (RVAAP) is located in northeastern Ohio within Portage and Trumbull Counties, approximately 4.8 km (3 miles) northeast of the Town of Ravenna. The installation consists of 8668 ha (21,419 acres) in a 17.7-km (11-mile) long, 5.6-km (3.5-mile) wide tract bordered by a sparsely inhabited private residential area. The site is an inactive government owned Industrial Operations Command facility maintained by a contracted caretaker, Mason and Hanger-Silas Co., Inc.

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. Munitions handled on the installation included artillery rounds of 90 mm or more and 2000-lb bombs.

RQL (RVAAP-01) is located in the western portion of the abandoned Ramsdell Quarry, in the northeast corner of RVAAP. The abandoned quarry was excavated about 30 to 40 ft below existing grade into the Sharon Member sandstone and conglomerate bedrock. The original unconsolidated glacial material overlying the sandstone was only several feet thick. The quarry was abandoned before 1941 and was used as a landfill from 1941 until 1989. From 1946 to the 1950s, the bottom of the quarry was used to burn waste explosives from Load Line 1. Approximately 18,000 (500-lb) incendiary or napalm bombs were burned in the quarry. Liquid residues from annealing operations were also dumped in the quarry. There is currently no historical information on how the quarry was used from the 1950s to 1976.

From 1976 until the landfill was closed in 1989, only non-hazardous solid waste was deposited in the abandoned quarry. In 1978, a portion of the abandoned quarry was permitted as a sanitary landfill by the State of Ohio. The permit required a (100-ft) buffer be maintained between the landfill and a pond created by the infiltration of groundwater in the bottom of the quarry; the extent of the pond prior to this time is not known.

Based upon available information and past uses of the abandoned quarry, wastes may include domestic, commercial, and industrial solid and liquid wastes, including explosives (e.g., TNT, RDX, Composition B), napalm, gasoline, acid dip liquor, annealing residue (e.g., sulfuric acid, shell casings, sodium orthosilicate, chromic acid, and alkali), aluminum chloride, and inert material. Interviews with former RVAAP personnel have indicated that much of the landfilled wastes and debris at the abandoned quarry was removed in the 1980s.

A much smaller quarry (also abandoned) is located directly southeast of Ramsdell Quarry Landfill (RQL). Its maximum depth appears to be 20 ft. No documentation about potential wastes disposed in this quarry is available.

1.2 CONTAMINANTS

Table 1-1 lists contaminants known to occur. Inclusion in this table indicates the potential presence of a contaminant but does not necessarily indicate that the contaminant is present in sufficient quantity to pose a health risk to workers.

Table 1-1. Contaminants in Groundwater at RQL

Contaminant	Maximum Reported Concentration	Quantities to be Encountered
Chromium	0.03 mg/L	Small quantities contained in samples and adjacent surfaces
DNT (Dinitrotoluene)	1.6 μg/L	
HMX (Octogen)	27 μg/L	
RDX (Cyclonite)	20 μg/L	
TNT (Trinitrotoluene)	8.8 μg/L	

2. 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 2-1, 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 2-1. Hazards Inventory

Yes	No	Hazard
	X	Confined space entry
	X	Excavation entry (deeper than 1.2 m)
X		Heavy equipment (drill rigs and power augers)
X		Fire (fuels)
X		Explosion (UXO)
X		Electrical shock (utilities)
X		Exposure to chemicals
X		Temperature extremes
X		Biological hazards
	X	Radiation or radioactive contamination
X		Noise
X		Drowning

Specific tasks are as follows:

- Monitoring well installation (6 shallow wells) and subsurface soil sampling using drill rigs.
- Well development (6 wells).
- Groundwater sampling from 5 existing wells and 6 new wells.
- Construction of a pond water level monitoring station (staff gauge).
- Sediment sampling in the RQL pond.
- Surface water sampling at the RQL pond and the smaller pond southeast of the landfill.
- Equipment decontamination at the central equipment decontamination facility.

2.1 TASK-SPECIFIC HAZARD ANALYSIS

Six monitoring wells will be installed in the shallow water table at RQL. Three of the monitoring wells will be located downgradient of RQL and pond, and two will be located upgradient from the landfill. One additional monitoring well will be placed immediately north of the northeast corner of the Load Line 1 fence, upgradient of the Ramsdell Quarry area and downgradient from monitoring well LL1mw-067, installed and sampled in 1996. The maximum depth of each monitoring well is expected to be ~9.1 m (30 ft) or less. Subsurface soil sampling will be performed as part of this process. These activities pose physical hazards associated with the drill rigs which include noise in excess of 85 dBA, moving parts, falling parts, and overturned equipment. Temperature stress may also be a hazard. Chemical exposure is possible but overexposure appears to be unlikely.

The five existing wells at RQL will be sampled in addition to the six new wells as a part of this investigation. In addition to the initial sampling, the six new wells will be sampled for three consecutive quarters and during two significant hydrologic events, in order to compile statistics. All sampling and analysis activities (e.g., analytes list, sample packaging and handling, data validation and reporting, etc.) will be identical for each groundwater sampling event. These activities pose minimal hazards. Equipment involved poses few physical hazards and chemical overexposure is very unlikely.

Development of monitoring wells will be accomplished with a pump. Pumps may be replaced with bottom-filling bailers where well size or slow recharge rates restrict pump use. Development will proceed until the following criteria are met:

- the water is clear to the unaided eye;
- the sediment thickness remaining in the well is less than 1 percent of the screen length or less than 30 mm (0.1 ft);
- a minimum of five times the standing water volume in the well (to include the well screen and casing plus saturated annulus, assuming 30% porosity); and
- indicator parameters (pH, temperature, and specific conductance) have stabilized to +/- 10% over three successive well volumes.

This task poses minimal physical hazards. Chemical overexposure is unlikely.

A slug test will be performed in each of the six monitoring wells installed as part of the investigation, to determine the hydraulic conductivity of the geologic material surrounding each well. The previously installed monitoring wells will also be slug tested as part of this investigation. The slug test method involves lowering or raising the static water level in a well bore by the removal or insertion of a cylinder (slug) of known volume. The return of the water level to a pre-test static level is then measured over time. This task poses minimal physical and chemical exposure hazards.

Following collection of the initial round of groundwater samples from the monitoring wells at RQL, pressure transducers and automated data recorders will be installed at each of the six newly installed wells only. This task poses minimal physical and chemical exposure hazards.

Surface water samples will be collected at the RQL pond and the smaller pond immediately southeast of RQL to determine whether contamination has reached the ponds via the groundwater and surface water runoff pathways. The RQL pond water will be sampled at four locations as a part of this investigation. One surface water sample will be collected from the small quarry pond southeast of RQL. This task poses a very limited potential for drowning. Chemical overexposure is unlikely.

Sediment will be sampled at eight locations in the pond at RQL, in order to determine if the former landfill has resulted in a release of contaminants to the pond. Pond sediment samples will be collected in two discrete depth intervals, wherever possible: 0 to 15 cm (0 to 6 in.) and 15 to 60 cm (6 to 24 in.). If the pond sediment is deeper than 60 cm (24 in.), sampling will proceed in 2-ft increments down to the bedrock surface. It is assumed that samples from 2 to 4 ft will be required at two locations.

Sediment samples will be discrete samples collected with a stainless steel trowel, a stainless-steel hand auger or sediment coring device. Sample material will be homogenized in a stainless steel bowl prior to placement in an air-tight sampling container. A sludge sampler will be used to collect sediment at locations where the depth of the surface water exceeds 15 cm (6 in.), and for sampling sediments below 15 cm (6 in.). Samples will be collected following guidelines in Section 4.5.2.5 of the Facility-wide SAP. The sludge sampler consists of a stainless steel, 8.26-cm (3.3-in.) long capped tube which can be fitted with either an auger- or core-type sampler end. Each sampler end is equipped with a butterfly valve to prevent loss of sample. This task poses a limited potential for drowning. Chemical overexposure is very unlikely. There is an unknown potential to encounter unexploded ordnance (UXO) in the pond sediment.

A permanent staff gauge and data logger will be constructed and installed at the RQL pond. This gauge will continuously measure and record water level in the pond. The staff gauge will have the following general specifications:

- durable enough to last 4 years;
- extends (1 to 11 ft) above the bottom of the pond;
- marked so that water levels may be read/recorded to the nearest (0.1 ft);
- equipped with a continuous data logger to monitor pond elevation for the duration of field activities; and
- positioned such that its location can be referenced to the existing control monument RAV-8.

This activity poses physical hazards associated with light construction; cuts, bruises, etc. There is also some potential to encounter UXO in pond sediments.

Table 2-2 presents task-specific hazards, task-specific hazard analyses (Risk Assessment Code), relevant hazard controls, and required monitoring, if appropriate, for all of the planned site tasks. The Risk Assessment Codes in Table 2-2 are derived through a qualitative risk assessment process using probability codes and severity codes. The severity codes are:

- I = injuries/illnesses involving permanent total disability or death;
- II = injuries/illnesses with permanent partial disability or temporary total disability;
- III = injuries/illnesses resulting in temporary, reversible conditions with period of disability of less than 3 months; and
- IV = injuries/illnesses with reversible adverse effects requiring only minor treatment.

The probability codes are

- A = likely to occur immediately;
- B = probably will occur in time;
- C = possible to occur in time; and
- D = unlikely to occur.

2.2 POTENTIAL EXPOSURES

Environmental contamination is known to exist at RQL and controls will be used to minimize exposure.

Information on the significant contaminants and chemical tools that will be used for the project is contained in Table 2-3. This table includes potential contaminants that pose a potential to cause adverse effects in site workers during or after the execution of this project. It excludes potential contaminants that are unlikely to pose a threat to site workers.

Table 2-2. Hazards Analysis

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Well Development, Slug Testing, and Groundwater Sampling			
Safety hazards associated with equipment	D, IV	Level D PPE including hardhat (see Section 5). Hazardous Waste Site Operations (HAZWOPER) training. Buddy system. Medical clearance.	Daily safety inspections of SAIC operations.
Contact with unexploded ordnance (UXO)	D, II	On-site training in ordnance recognition for all field personnel. Visual surveillance for the presence of UXO. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.
Exposure to chemicals (see Table 2-3)	D, IV	Natural rubber, PVC or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. 15-minute eyewash in the immediate work area.	Daily safety inspections.
Animal hazards (bees, ticks, wasps, snakes)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Temperature extremes	C, II	Administrative controls (see Section 8).	Ambient temperature, heart rates as appropriate.
Sediment and Surface Water Sampling in Ponds			
General safety hazards (moving equipment, slips, falls)	D, IV	Level D PPE (see Section 5). Good housekeeping. HAZWOPER training. Buddy system. Medical clearance.	Daily site safety inspections.
Drowning	D, II	Personal flotation devices must be worn if within 1.5 m (5 ft) of water deeper than 1.2 m (4 ft).	Daily site safety inspections.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber, PVC, or similar gloves for contact with potentially contaminated material. Washing face and hands and any other exposed areas prior to taking anything by mouth. Gloves will be disposed after a single use. Minimal contact. 15-minute eyewash within immediate area.	Daily site safety inspections.
Contact with UXO	D, II	Clearance of sediment sampling locations by UXO experts. On-site training in ordnance recognition for all field personnel. Visual surveillance for UXO. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance
Animal hazards (bees, ticks, wasps, snakes)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary. Snake chaps if moving through underbrush.	Visual survey.
Temperature extremes	C, III	Administrative controls (see Section 8)	Ambient temperature, heart rates as appropriate.
Installation of Monitoring Wells and Subsurface Soil Sampling Using Drill Rigs			
General safety hazards (power machinery, moving equipment, slips, falls)	D, III	Level D PPE (see Section 5) plus hardhat. Personnel not involved with equipment will stand clear during operation. HAZWOPER training. Buddy system. Medical clearance.	Daily site safety inspections.
Contact with UXO	D, II	On-site training in ordnance recognition for all field personnel. Visual surveillance for UXO. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. Air rotary drill rigs will be equipped with dust suppression systems. 15-minute eyewash in the immediate area.	Photoionization detector, visual surveillance for dust generation, visual surveillance for significant contamination.
Noise	B, III	Hearing protection within 7.6 m (25 ft) of equipment during operation.	Daily safety inspections.
Fire (fuels)	D, III	Fuel in safety cans. Ignition sources excluded from fuel storage and fuel pouring areas. Fire extinguisher (see Chapter 9).	Daily safety inspection.
Animal hazards (bees, ticks, wasps, snakes)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Electric shock	D, II	Identification and clearance of aboveground and underground utilities.	Visual of all work areas.
Temperature extremes	C, II	Administrative controls (see Chapter 8).	Ambient temperature, heart rates as appropriate.
Disposal of Investigation-Derived Wastes (Soil Cuttings and Decontamination Rinsates)			
General safety hazards (power machinery, moving equipment, slips, falls)	D, III	Level D PPE (see Section 5) plus heavy duty work gloves. Hardhat if overhead hazards are present. Personnel not involved with equipment (trailer mounted liquid tank, manual drum truck, drum grappler, Tommy lift, etc.) will stand clear during operation. HAZWOPER training. Buddy system. Medical clearance. No personnel under lifted loads. Only adequately trained, experienced personnel will be allowed to operate equipment. Equipment used to lift or move drums will be used within its rated weight capacity.	Daily site safety inspections.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Contact with UXO	D, II	On-site training in ordnance recognition for all field personnel. Visual surveillance for UXO. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact	Daily site safety inspections.
Fire (fuels)	D, III	Fuel in safety cans. Exclude ignition sources from fuel storage and refueling areas. Fire extinguisher (see Section 9).	Daily safety inspection.
Animal hazards (bees, ticks, wasps, snakes)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Temperature extremes	C, II	Administrative controls (see Section 8)	Ambient temperature, heart rates as appropriate.
Equipment Decontamination (Hot Water Washing, Soap and Water Washing, Solvent Rinse)			
General equipment decontamination hazards (hot water, slips, falls, equipment handling)	C, III	Level D+ PPE (see Section 5) plus: Nitrile or PVC gloves, face shield and Saranax or rain suit (when operating steam washer). HAZWOPER training. Medical clearance.	Daily safety inspections.
Noise (spray washer)	B, II	Hearing protection as necessary.	Daily safety inspections.
Fire (flammable decontamination solvents and gasoline)	D, III	Exclusion of ignition sources during solvent use. Control of flammable materials (quantities in decontamination area limited to single day use, proper storage). Fire extinguisher (see Chapter 9).	Daily safety inspections.
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber, PVC or similar gloves for handling potentially contaminated materials. Adequate ventilation during solvent use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact.	None.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Temperature extremes	C, II	Administrative controls (see Chapter 8).	Temperature measurements as appropriate, heart rate monitoring as appropriate.
Construction and Installation of Pond Water Level Gauge			
General safety hazards (power machinery, moving equipment, slips, falls)	D, III	Level D PPE (see Section 5). Personnel not involved with equipment will stand clear during operation. HAZWOPER training. Buddy system. Medical clearance.	Daily site safety inspections.
Contact with UXO	D, II	Clearance of work area and installation area by UXO expert. On-site training in ordnance recognition for all field personnel. Visual surveillance for UXO. Withdrawal of all SAIC and subcontractor personnel and field marking of the area if ordnance or suspected ordnance is discovered. Notification of USACE Project Manager and facility EOD personnel if ordnance is discovered.	Visual surveys for ordnance.
Exposure to chemicals (see Table 2-3)	D, III	Natural rubber or similar gloves for contact with potentially contaminated material. Gloves will be disposed after single use. Washing face and hands and any other exposed areas prior to taking anything by mouth. Minimal contact. 15-minute eyewash in the immediate area.	Daily site safety inspections.
Fire (fuels)	D, III	Fuel in safety cans. Ignition sources excluded from fuel storage and fuel pouring areas. Fire extinguisher (see Chapter 9).	Daily safety inspection.
Animal hazards (bees, ticks, wasps, snakes)	C, III	PPE (boots, work clothes). Pants tucked into boots or wrapped with duct tape. Insect repellant, as necessary.	Visual survey.
Electric shock	D, II	GFCI for electrical tools.	Daily safety inspection.

Table 2-2 (continued)

Safety and Health Hazards	Risk Assess. Codes	Controls	Monitoring
Drowning	D, II	PFD for work over or on water deeper than 1.2m (4 ft).	Daily safety inspection.

EOD = Explosives ordnance disposal
HAZWOPER = Hazardous Waste Site Operations
PPE = Personal protective equipment
PVC = Polyvinyl chloride
SAIC = Science Applications International Corporation
USACE = U.S. Army Corps of Engineers
UXO = Unexploded ordnance

Table 2-3. Potential Exposures

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/ Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]	Location
Chromium	TLV/TWA: 0.5, A4 mg/m^3 IDLH: 25 mg/m^3	Eye irritation, sensitization	Solid; properties vary depending upon specific compound	Inhalation Ingestion Contact	RQL
DNT (dinitrotoluene)	TLV/TWA: 0.15, A2 mg/m^3 IDLH: Ca [50 mg/m^3]	Explosive; suspected human carcinogen, anorexia, cyanosis, reproductive effects	Orange-yellow solid, VP: 1 mm; FP: 404°F	Inhalation Absorption Ingestion Contact	RQL
Gasoline (used for fuel)	TLV/TWA: 300 ppm IDLH: Ca	Potential carcinogen per NIOSH, dizziness, eye irritation, dermatitis	Liquid with aromatic odor; FP: -45°F; VP: 38-300 mm	Inhalation Ingestion Absorption Contact	All
Hydrochloric acid (used for equipment decontamination)	TLV: 5 ppm ceiling IDLH: 50 ppm	Irritation of eyes, skin, respiratory system	Liquid; VP: fuming; IP: 12.74 eV; FP: none	Inhalation Ingestion Contact	Equipment decontamination area
Isopropyl alcohol (potentially used for equipment decontamination)	TLV/TWA: 400 ppm STEL: 500 ppm IDLH: 2000 ppm	Irritation of eyes, skin, respiratory system; drowsiness, headache	Colorless liquid with alcohol odor; VP: 33 mm; IP: 10.10 eV; FP: 53°F	Inhalation Ingestion Contact	Equipment decontamination area
Liquinox (used for decontamination)	TLV/TWA: None	Inhalation may cause local irritation to mucus membranes	Yellow odorless liquid (biodegradable cleaner); FP: NA	Inhalation Ingestion	Equipment decontamination area
HMX (octogen)	TLV/TWA: None established, toxicity assumed to be similar to RDX as compounds are very similar	Explosive; assumed irritation of eyes and skin, dizziness, weakness	Assumed similar to RDX- FP: explodes; VP: 0.0004 mm at 230°F	Assumed: Inhalation Absorption Ingestion Contact	RQL

Table 2-3 (continued)

Chemical[a]	TLV/PEL/STEL/IDLH[b]	Health Effects/ Potential Hazards[c]	Chemical and Physical Properties[c]	Exposure Route(s)[c]	Location
RDX (cyclonite)	TLV/TWA: 1.5 mg/m^3 Skin notation IDLH: none established	Explosive; irritation of eyes and skin, dizziness, weakness	White powder; FP: explodes; VP: 0.0004 mm at 230°F	Inhalation Absorption Ingestion Contact	RQL
TNT	TLV/TWA: 0.5 mg/m^3 Skin notation IDLH: 500 mg/m^3	Explosive; cluster headache; irritation of skin and mucus membranes, liver damage, kidney damage	Pale solid; FP: explodes; VP: 0.0002 mm	Inhalation Absorption Ingestion Contact	RQL

[a]The potential chemicals were obtained from the *Ravenna Army Ammunition Plant Phase I Remedial Investigation Report* (1997).
[b]From 1997 Threshold Limit Values, *NIOSH Pocket Guide to Chemical Hazards*, 1994.
[c]From 1994 *NIOSH Pocket Guide to Chemical Hazards, the Condensed Chemical Dictionary*, Tenth Edition.

A1 = confirmed human carcinogen
A2 = suspected human carcinogen
CNS = central nervous system
IP = ionization potential
TWA = time-weighted average
A4 = Not Classifiable as a human carcinogen
PEL = permissible exposure limit
VP = vapor pressure
FP = flash point
STEL = short-term exposure limit
NA = not available
IDLH = immediately dangerous to life and health
TLV = threshold limit value
NIOSH = National Institute for Occupational Safety and Health

3. 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 3-1 identifies the Science Applications International Corporation (SAIC) and subcontractor individuals who will fill key roles. See the Facility-wide Safety and Health Plan (FSHP) for information on the roles and responsibilities of key positions.

Table 3-1. Staff Organization

Position	Name	Phone
Program Manager	Ike Diggs	423-481-8710
Deputy Program Manager	Jeff Dick	614-791-3371
Health and Safety Manager	Steve Davis CIH, CSP	423-481-4755
Project Manager	Steve Selecman	423-481-8761
Field Operations Manager	Kathy Dominic	937-431-2239
Site Safety and Health Officer	Martha Clough	937-431-2249

4. TRAINING

See the FSHP. In addition to the FSHP's requirements at least two first aid/CPR trained personnel must be on site during field activities.

5. PERSONAL PROTECTIVE EQUIPMENT

See the FSHP and hazard/risk analysis section.

6. MEDICAL SURVEILLANCE

See the FSHP.

7. 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 actions, have been established for this monitoring. In addition to the specified monitoring, the Site Safety and Health Officer (SSHO) may perform, or require, additional monitoring such as organic vapor monitoring in the equipment decontamination area, personnel exposure sampling for specific chemicals, etc. 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 *CFR* 1910.20. The minimum monitoring requirements and action levels are presented in Table 7-1.

Table 7-1. Monitoring Requirements and Action Limits

Hazard or Measured Parameter	Area	Interval	Limit	Action	Tasks
Airborne organics with PID or equivalent	Breathing zone [0.9 m (3 ft) from source or 0.36 m (14 in.)] in front of employee's shoulder	At least once every 30 minutes during intrusive activities; continuously if readings exceed background	<5 ppm ≥5 ppm	Level D Withdraw and evaluate • identify contaminants • notify Project Manager and H&S Manager	All intrusive tasks; drilling, well development
Detector tubes	Breathing zone	If organic vapor >5 ppm	PEL/TLV	Withdraw and evaluate, controls may include engineering, administrative, or personal protective measures	Any indicated by organic vapor instrument readings
Flammability and oxygen content with combustible gas indicator	Near borehole and any area where flammable gases are suspected	Only if PID readings exceed 100 ppm or other indicators of flammability observed	<10% LEL >10% LEL	Continue and evaluate source Withdraw and allow area to ventilate; notify Project Manager and H&S Manager	Intrusive tasks
Noise	Exclusion zone around drill rigs, excavation equipment, power augers, and other motorized equipment.	Only if there is some doubt about noise levels	85 dBA and any area perceived as noisy	Require the use of hearing protection	Hearing protection will be worn during all drilling, and for excavation and power auger equipment use
Visible contamination	All	Continuously	Visible contamination of skin or personal clothing	Upgrade PPE to preclude contact; may include disposable coveralls, boot covers, etc.	All
Visible airborne dust	All	Continuously	Visible dust generation	Stop work; use dust suppression techniques such as wetting surface	All

Table 7-1 (continued)

H&S = Health and Safety
LEL = Lower explosive limit
PEL = Permissible exposure limit
PID = Photoionization detector
PPE = Personal protective equipment
SAIC = Science Applications International Corporation
TLV = Threshold limit value

8. HEAT/COLD STRESS MONITORING

See the FSHP.

9. STANDARD OPERATING SAFETY PROCEDURES

See the FSHP.

10. SITE CONTROL MEASURES

See the FSHP.

11. PERSONNEL HYGIENE AND DECONTAMINATION

See the FSHP.

12. EQUIPMENT DECONTAMINATION

See the FSHP.

13. EMERGENCY PROCEDURES AND EQUIPMENT

Emergency contacts, telephone numbers, directions to the nearest medical facility, and general procedures can be found in the FSHP. 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 sampling locations. The SSHO will verify that the emergency information in the FSHP is correct during mobilization for the Phase I.

14. LOGS, REPORTS, AND RECORD KEEPING

See the FSHP.