US Army, Engineering & Support Center
Huntsville, AL

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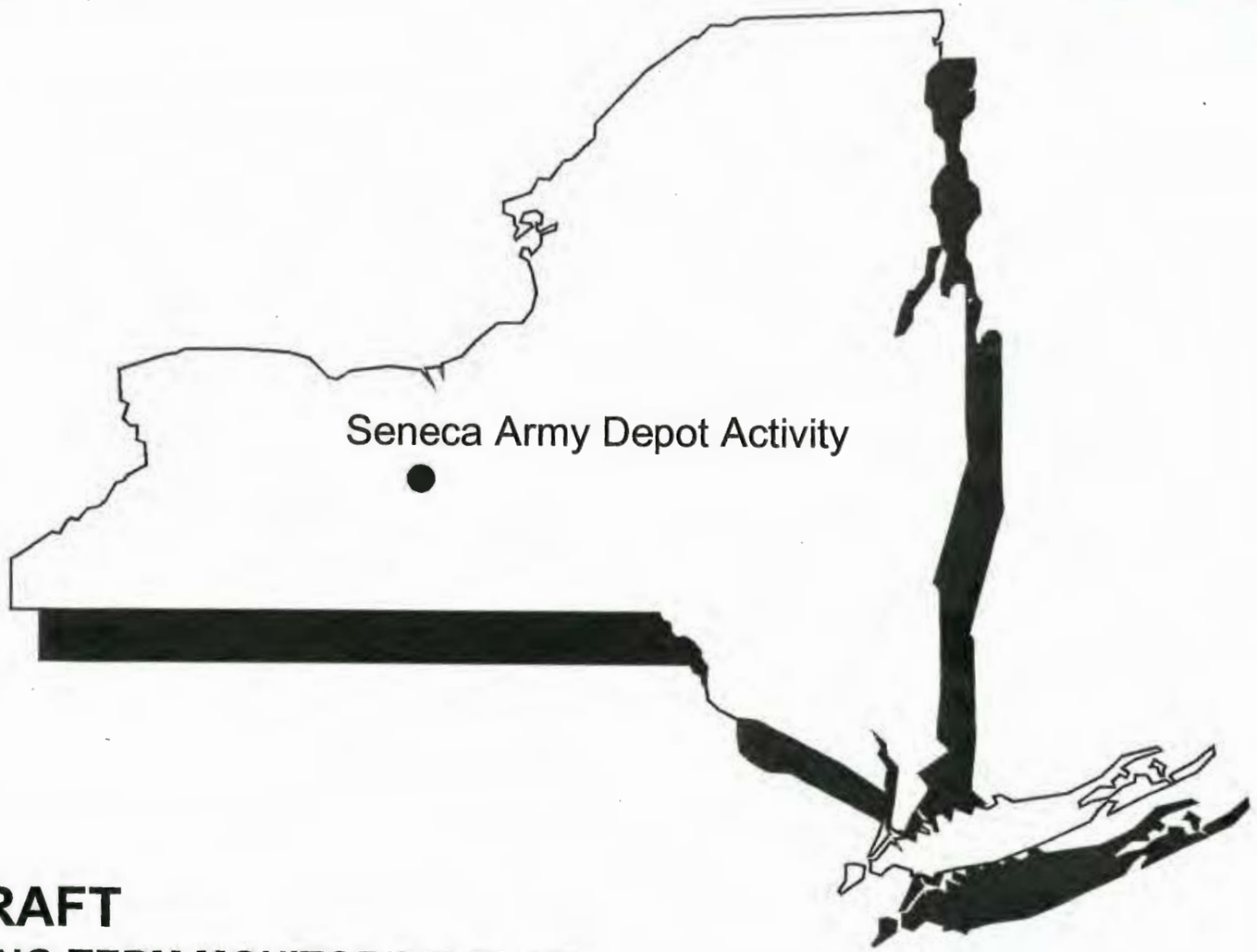
Seneca Army Depot Activity
Romulus, NY



DRAFT

LONG-TERM MONITORING PLAN FOR THE OPEN BURNING (OB) GROUNDS

SENECA ARMY DEPOT ACTIVITY

EPA Site ID# NY0213820830
NY Site ID# 8-50-006
CONTRACT NO. DACA87-02-D-0005
DELIVERY ORDER NO. 0029

DECEMBER 2005

LONG-TERM MONITORING PLAN FOR THE OPEN BURNING (OB) GROUNDS
SENECA ARMY DEPOT ACTIVITY
DRAFT
ARSONS
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LONG-TERM MONITORING PLAN FOR OPEN BURNING (OB) GROUNDS SENECA ARMY DEPOT ACTIVITY ROMULUS, NEW YORK

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December 2005

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS i

LIST OF TABLES iii

LIST OF FIGURES iii

LIST OF ACRONYMS iv

1.0 INTRODUCTION **1-1**

1.1 Background 1-1
1.2 Purpose 1-3
1.3 Scope of the Plan 1-4
1.4 Plan Overview 1-5

2.0 GROUNDWATER MONITORING OBJECTIVES **2-1**

3.0 MONITORING PLAN HYPOTHESIS **3-1**

4.0 MONITORING DECISION RULES **4-1**

4.1 Basic Decision Strategy 4-1
4.2 Evaluating and Limiting Decision Errors 4-2
4.2.1 Bounds on a Type I Error 4-2
4.2.2 Bounds on a Type II Error 4-3
4.3 Data Collection, Analysis and Decision Making 4-3

5.0 MONITORING PLAN DESIGN **5-1**

5.1 Introduction 5-1
5.2 Groundwater Monitoring Well / Location Network 5-1
5.3 Monitoring Analyte List 5-2
5.4 Monitoring Frequency 5-3
5.5 Additional Groundwater Assessments 5-3
5.5.1 Groundwater Level Measurements 5-3
5.5.2 Groundwater Quality and Sampling Parameters 5-4
5.5.3 Well Inspection and Maintenance 5-5
5.6 Reporting 5-5

TABLE OF CONTENTS (Cont.)

6.0 QUALITY ASSURANCE AND QUALITY CONTROL 6-1

7.0 MONITORING PLAN SUMMARY 7-1

7.1 Water Level Monitoring 7-1
7.2 Water Quality Monitoring 7-1
7.3 Vegetated Soil Cap and Drainage Swale Inspections 7-1
7.4 Data Evaluation and Reporting 7-2

8.0 REFERENCES 8-1

LIST OF TABLES
(Tables are included at the end of the section in which they are referenced)

5-1 Analyte List for Open Burning Grounds Groundwater and Sediment Samples

LIST OF FIGURES
(Figures are included at the end of the section in which they are referenced)

1-1 Seneca Army Depot Activity Location Map
1-2 Seneca Army Depot Activity Site Map
1-3 Former Open Burning Grounds Site Plan
1-4 Former OB Grounds Groundwater Flow Map
4-1 Decision Tree for Evaluation of Groundwater Monitoring Data
4-2 Example Monitoring Well Data Sets
5-1 OB Grounds Monitoring Network

LIST OF ACRONYMS

BCT	Base Clean-up Team
CERCLA	Comprehensive Environmental Responsibility, Compensation and Liability Act
CLP	Contract Laboratory Program
DQO	Data Quality Objective
USEPA	United States Environmental Protection Agency
FFA	Federal Facilities Agreement
FS	Feasibility Study
GA	NYSDEC groundwater classification suitable as a source for drinking water
L	Liter
LCL	Lower Confidence Limit
LRA	Land Redevelopment Authority
LTM	Long Term Monitoring
mg	milligrams
mg/L	milligrams per liter
mg/Kg	milligrams per kilogram
mL	milliliters
MSL	Mean Sea Level
NA	Not Available
NCP	National Contingency Plan
ND	Not Detected
NPL	National Priority List
NYSAWQS	New York State Ambient Water Quality Criteria Standard
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYCRR	New York Codes, Rules, and Regulations
OB	Open Burning
OE	Ordnance and Explosive
O&M	Operations and Maintenance
OSWER	Office of Solid Waste and Emergency Response
PQL	Practical Quantitation Limit
PRAP	Proposed Remedial Action Plan

LIST OF ACRONYMS (Cont.)

QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance /Quality Control
RAB	Restoration Advisory Board
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments Reauthorization Act
SEAD	Former acronym for the Seneca Army depot used to designate SWMU numbers
SEDA	Seneca Army Depot Activity
SOP	Standard Operating Procedure
SWMU	Solid Waste Management Unit
TCLP	Toxicity Characteristic Leaching Procedure
TIC	Tentatively Identified Compound
UCL	Upper Confidence Limit
µg/L	micrograms per liter
USACE	U.S. Army Corps of Engineers
UXO	Unexploded Ordnance

1.0 INTRODUCTION

This document presents and describes objectives and details of the Long-Term Monitoring (LTM) Plan that will be implemented by the U.S. Army at the former Open Burning (OB) Grounds located at the former Seneca Army Depot Activity (SEDA or Depot) in Varick and Romulus, New York. The *Final Record of Decision (ROD) Former Open Burning Grounds Site* (Parsons, 1999) at SEDA indicates that monitoring of groundwater and the vegetated, soil cap at the OB Grounds as well as the sediment in Reeder Creek are integral components of the approved remedy implemented at the OB Grounds. This LTM Plan has been prepared to:

- document the objectives of the monitoring program for each media;
- describe the steps that will be included in the monitoring program undertaken for each media;
- define the frequency of monitoring that will be performed;
- identify how results and observations of the monitoring program will be documented;
- indicate how the results and observations of the monitoring will be assessed and evaluated; and,
- define what corrective actions will be implemented if evaluation of the monitoring program results indicate that components of the approved remedy are found to not be performing as expected.

This plan was developed using the U.S. Environmental Protection Agency's (USEPA's) document *Guidance for Monitoring at Hazardous Waste Sites – Framework for Monitoring Plan Development and Implementation* (Office of Solid Waste and Emergency Response [OSWER] Directive No. 9355.4-28, January 2004). This LTM Plan has been prepared on behalf of the Seneca Army Depot Activity and the U.S. Army Base Realignment and Closure Division under Delivery Order 29, Contract No. DACA87-02-D-0005 with the U.S. Army Corps of Engineers (Army), Engineering and Support Center in Huntsville, Alabama. The Seneca Army Depot Activity is identified as USEPA CERCLIS Site No.: NY0213820830 and New York Inactive Waste Site No.: 8-50-006. The Open Burning (OB) Grounds is designated as Operable Unit (OU) 2.

1.1 BACKGROUND

The former OB Grounds site occupied approximately 30 acres within the 10,587 acres of land that once comprised the SEDA in the Towns of Varick and Romulus, New York. The former Depot is located between Seneca and Cayuga Lakes as shown in **Figure 1-1**. SEDA is located on an uplands area, at an elevation of approximately 600 feet above Mean Sea Level (MSL). This upland area forms an elongated divide separating the two Finger Lakes. New York State Highways 96 and 96A bound SEDA on the east and west, respectively. Sparsely populated

farmland covers most of the area surrounding the former Depot. At present, approximately 8,000 acres of land associated with the former Depot has been transferred to the US Coast Guard (Loran Station), the Seneca County Industrial Development Agency (SCIDA), and the State of New York for reuse and redevelopment, and current uses of the transferred land include conservation/recreation, State and local correctional facilities, and a child and family care center.

The former OB Grounds is located in the northwestern portion of the Depot where land is designated for future conservation purposes. The former site sits on gently sloping terrain as shown in **Figure 1-2**. The OB Grounds is bounded on the east by Reeder Creek, which is a perennial creek that is generally less than 1 foot deep and eventually flows into Seneca Lake. The quality of surface water in Reeder Creek has been designated by the State of New York as a Class C water body (best usage of fresh water is fishing; the waters shall be suitable for fish propagation and survival). Seneca Lake is located approximately 10,000 feet west of the OB Grounds site and is used as a source of drinking water for numerous surrounding communities and the SEDA.

The OB Grounds is sparsely vegetated with grasses and brush and there are no permanent structures within the area other than small concrete bunkers. The Open Detonation Area (SEDA-45) is located immediately north of the OB Grounds, and the Explosive Ordnance Disposal Area (SEAD-57) is located approximately 4,000 to 5,000 feet south of the former OB Grounds. A site plan of the former OB Grounds prior to the removal of contaminated soil is provided as **Figure 1-3**.

The stratigraphy of the OB Grounds generally consists of between 2 and 10 feet of glacially derived till below which is a zone of weathered bedrock. The depth to groundwater in the till/weathered shale aquifer varies seasonally between approximately 2 and 7 feet below the ground surface. Infiltration of precipitation is the sole source of groundwater for the overburden aquifer and the direction of groundwater flow in the till/weathered shale aquifer is generally to the east toward Reeder Creek as shown in **Figure 1-4**. A possible groundwater divide has been noted during various prior monitoring episodes. The location of the divide is highlighted on **Figure 1-4** and represents a high point of the upgradient groundwater flow regime. The divide diverts a portion of the groundwater to the west, away from Reeder Creek, which lies to the east. Historic sampling results from wells located west of the divide suggest that the quality of groundwater has not been impacted by soils at the OB Grounds.

All groundwater in the State of New York, including that underlying the former OB Grounds site, is classified as Class GA, which designates its best use as a suitable source for drinking water. Most shallow groundwater samples collected from the shallow aquifer at the former Depot contain entrained soil particles that contribute to elevated concentrations of selected metals found in unfiltered samples.

Surface water run-off flows at the former OB Grounds site move to the east-northeast via a series of drainage ditches and culverts where they either infiltrate into the ground or flow into Reeder Creek. The ditches and culverts were created during the construction of the burn pads and access roads. The Army reports that the culverts were plugged at the time of the remedial action at the OB Grounds to restrict the flow of surface water from the OB Grounds directly into Reeder Creek. A more comprehensive description of the OB Grounds and the associated groundwater resource is presented in the Remedial Investigation (RI) Report (Parsons Engineering Science, 1994).

The remedy specified in the ROD for the OB Grounds included removal of soil containing lead at concentrations above 500 mg/Kg and the construction of a 9-inch thick, compacted soil and vegetation cover over portions of the former OB Grounds site where soil containing residual lead concentrations at levels greater than 60 mg/Kg but less than or equal to 500 mg/Kg were buried. The final ROD also required excavation of sediment found in Reeder Creek containing concentrations of copper and/or lead above the New York State Department of Environmental Conservation (NYSDEC) guidance criteria of 16 mg/Kg and 31 mg/Kg, respectively. Although the ROD stated that the groundwater conditions at the OB Grounds did not require remedial action, long-term groundwater monitoring was required to ensure that the soil removal/interment action was protective of the groundwater. The remedy also included a monitoring program for sediment in Reeder Creek to ensure the sediments were not re-contaminated by run-off or from groundwater flow into the creek from the OB Grounds. Finally, the ROD required that the vegetated, compacted soil covering applied over buried soils at the OB Grounds site was inspected and maintained.

1.2 PURPOSE

Groundwater quality data are needed to monitor the effectiveness of the implemented remedy at the site for preventing future impacts to groundwater at the OB Grounds and to sediments in Reeder Creek. Additionally, monitoring of the vegetated, compacted soil cap placed over the buried soils at the OB Grounds site is needed to assure its long-term integrity and to prevent direct contact to, and incidental ingestion of, soils containing lead at concentrations up to 500 mg/Kg, by terrestrial wildlife at the site.

This Plan describes the comprehensive Long-Term Monitoring Program developed to provide the specific data needed to monitor groundwater, and the vegetated, compacted soil cap at the OB Grounds. This plan does not present a proposed monitoring plan for sediments in Reeder Creek at locations adjacent to the OB Grounds, as the Army has decided to reserve development of such a plan until it determines whether conditions present at the OB Grounds are potentially impacting sediment quality in the creek.

The Army's decision to reserve development of a sediment monitoring program for Reeder Creek was discussed with representatives of the USEPA and the NYSDEC during the Base Clean-up Team (BCT) meeting on October 18-19, 2005. The Army's decision is based on the fact that the sediment cleanup goals documented in the ROD (i.e., 16 mg/Kg for copper and 31 mg/Kg for lead) could not be achieved until all sediments found at locations within the creek and adjacent to the OB Grounds were excavated to the underlying bedrock. The Army further noted that it believed that sediment found in the creek adjacent to the OB Grounds resulted from the deposition of native soil and other debris that originates both from the immediate area of the OB Grounds as well as from other areas of the Depot that are upgradient of the OB Grounds. Previously, the Army has demonstrated that native soils at the SEDA contain background levels of copper that exceed the ROD identified sediment clean-up levels. Additionally, the soil clean-up level (i.e., less than or equal to 60 mg/Kg) for lead in soils at the OB Grounds exceeds the sediment cleanup level (i.e., 31 mg/Kg) specified in the ROD. Therefore, the re-deposition of soil from either the OB Grounds or other upgradient locations along Reeder Creek will most likely result in the exceedance of the sediment clean-up criteria specified in the ROD.

Given these concerns, the Army decided to reserve the development of a sediment monitoring plan until it had produced data from the groundwater monitoring and vegetated cap inspection components of the overall OB Grounds Long-Term Monitoring plan to indicate that releases from the OB Grounds might be or were occurring and could be impacting the sediments in Reeder Creek. The Army believes that such evidence would be obtained if the inspections of the vegetated soil cap used to cover lead-contaminated soils left buried at the OB Grounds indicate that the vegetated soil cap has been breached. Additionally, evidence of lead or copper contamination in groundwater originating from the OB Grounds and migrating towards the creek would also indicate the possible need to develop a sediment monitoring plan for Reeder Creek.

1.3 SCOPE OF THE PLAN

In accordance with the "*Guidance for Monitoring at Hazardous Waste Sites - Framework for Monitoring Plan Development and Implementation*" (USEPA, 2004), this LTM Plan describes the logic and rationale of the monitoring program including the monitoring objectives relative to the remedial action objectives and remedy components at the OB Grounds as well as the rules and procedures to be used to evaluate the monitoring data and support site management decisions.

The design of the monitoring program necessary to meet the monitoring objectives and provide the data necessary for site management decisions is also presented. The monitoring design details the monitoring well network, the soil/vegetative covering inspection requirements, analyte list, and monitoring frequency to be used for compliance monitoring. The monitoring design section also describes the water level monitoring, routine or contingent water quality monitoring, and

associated evaluations of the effectiveness of the individual remedy components. This LTM Plan includes, by reference, the Quality Assurance Project Plan (QAPP) for groundwater monitoring and Standard Operating Procedures (SOPs) for well installation, groundwater sampling, and other activities conducted as part of groundwater monitoring at the OB Grounds. These procedures and requirements are described in detail in the *"Draft Sampling and Analysis Plan, Seneca Army Depot Activity, Romulus, New York"* (Parsons, May 2005).

The basis for each element of the groundwater monitoring program is described in this LTM Plan. Detailed evaluations used to support the development of the monitoring design are presented in the appendices to this LTM Plan.

1.4 PLAN OVERVIEW

This LTM Plan includes a description of the groundwater and vegetated soil cap monitoring program objectives and a description and rationale for proposed monitoring network at the OB Grounds. Specifically, this LTM Plan contains the following sections and discussions:

1 Introduction
2 Monitoring Objectives
3 Monitoring Plan Hypotheses
4 Monitoring Decision Rules
5 Monitoring Plan Design
6 Quality Assurance/Quality Control
7 Summary of Monitoring Program
8 References

PARSONS

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

OPEN BURNING (OB) GROUNDS
LONG-TERM MONITORING PLAN

DEPT	DWG NO
ENVIRONMENTAL ENGINEERING	734516-01001

FIGURE 1-1

LOCATION MAP

SCALE	DATE
1"= 8 MILES APPROX.	SEPTEMBER 2005

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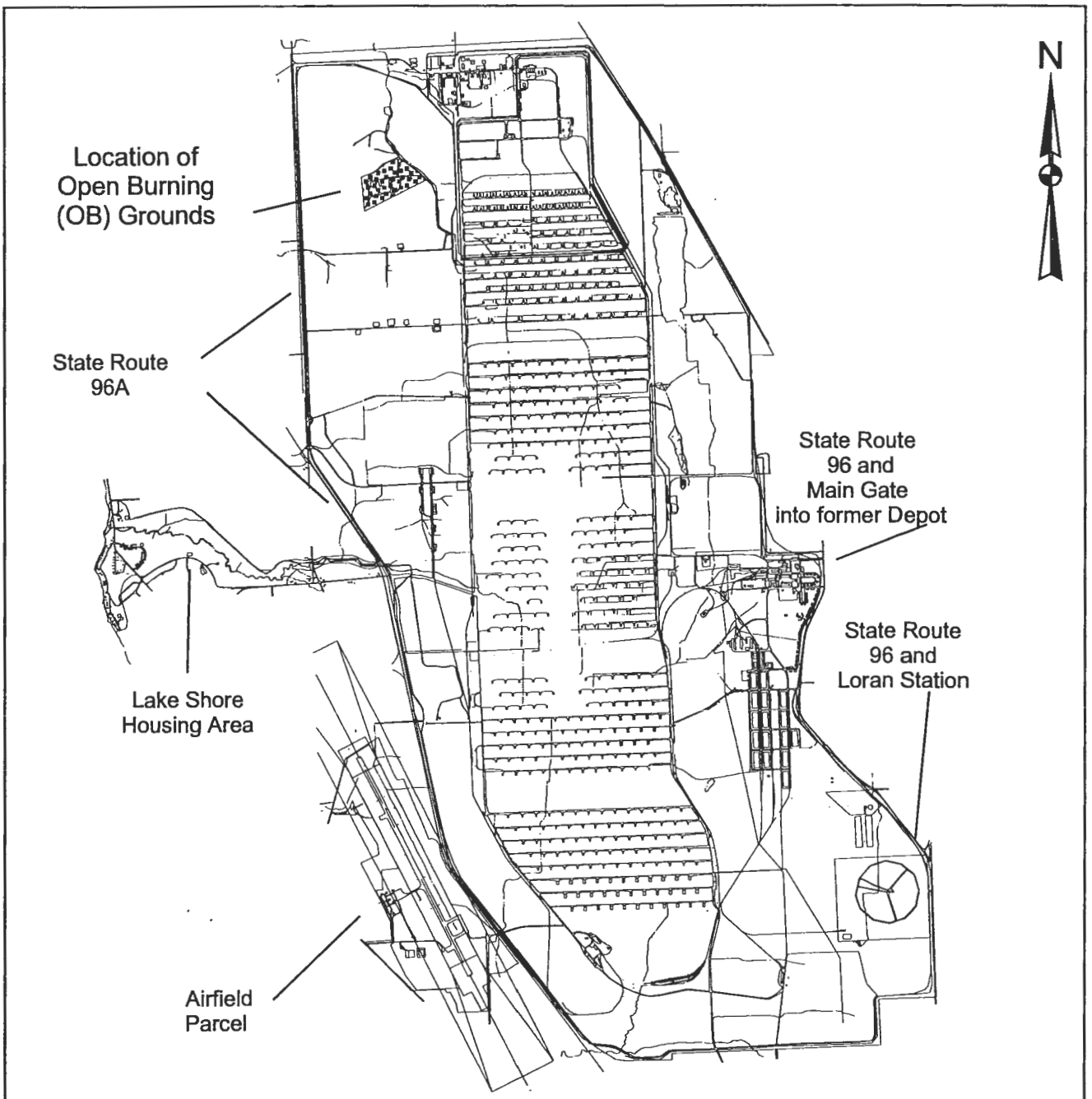

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SENECA ARMY DEPOT ACTIVITY
OPEN BURNING (OB) GROUNDS
LONG-TERM MONITORING PLAN

FIGURE 1-2
Seneca Army Depot Activity
Site Map

JOB NUMBER: 744493 | DATE: DECEMBER 2005

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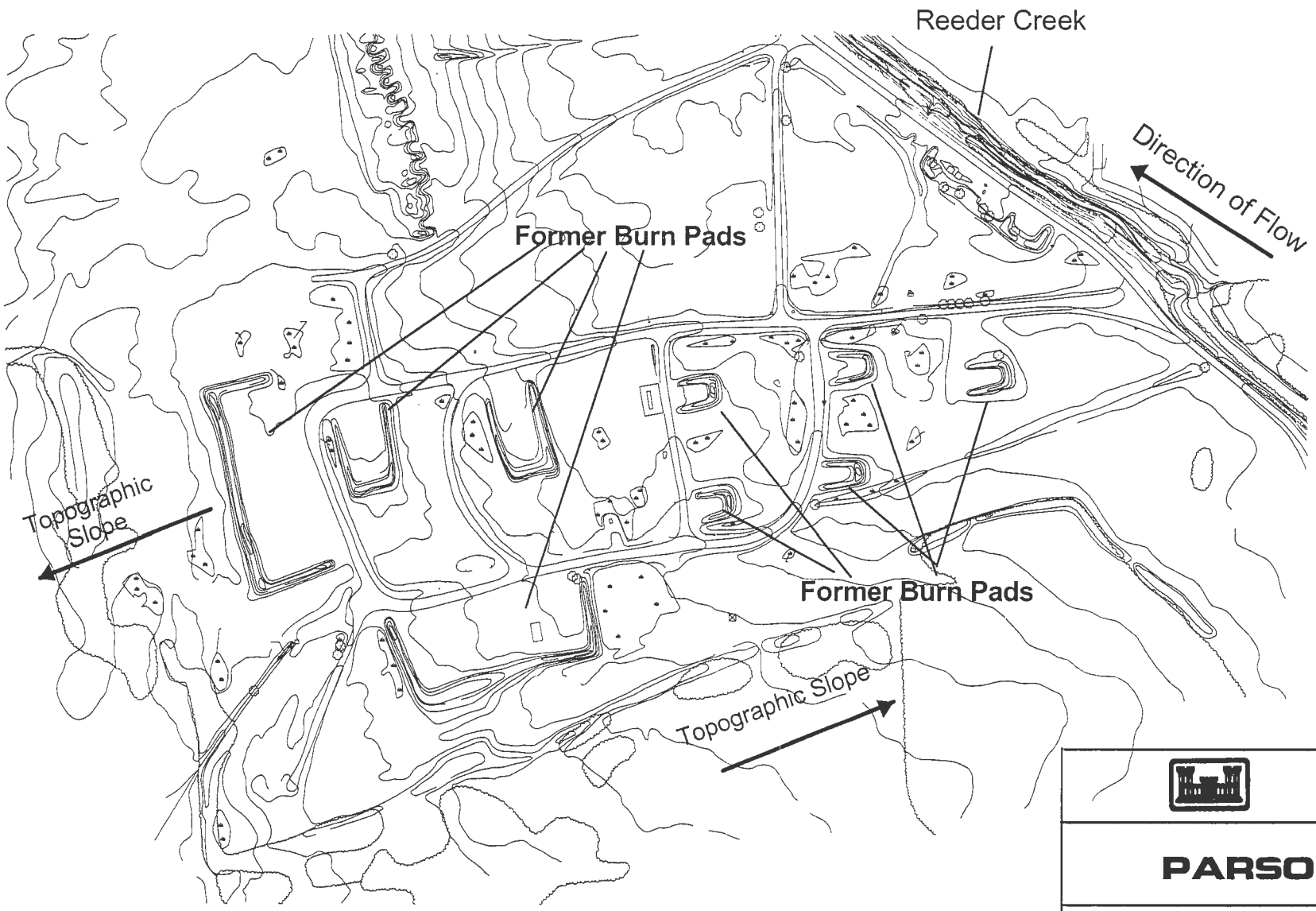

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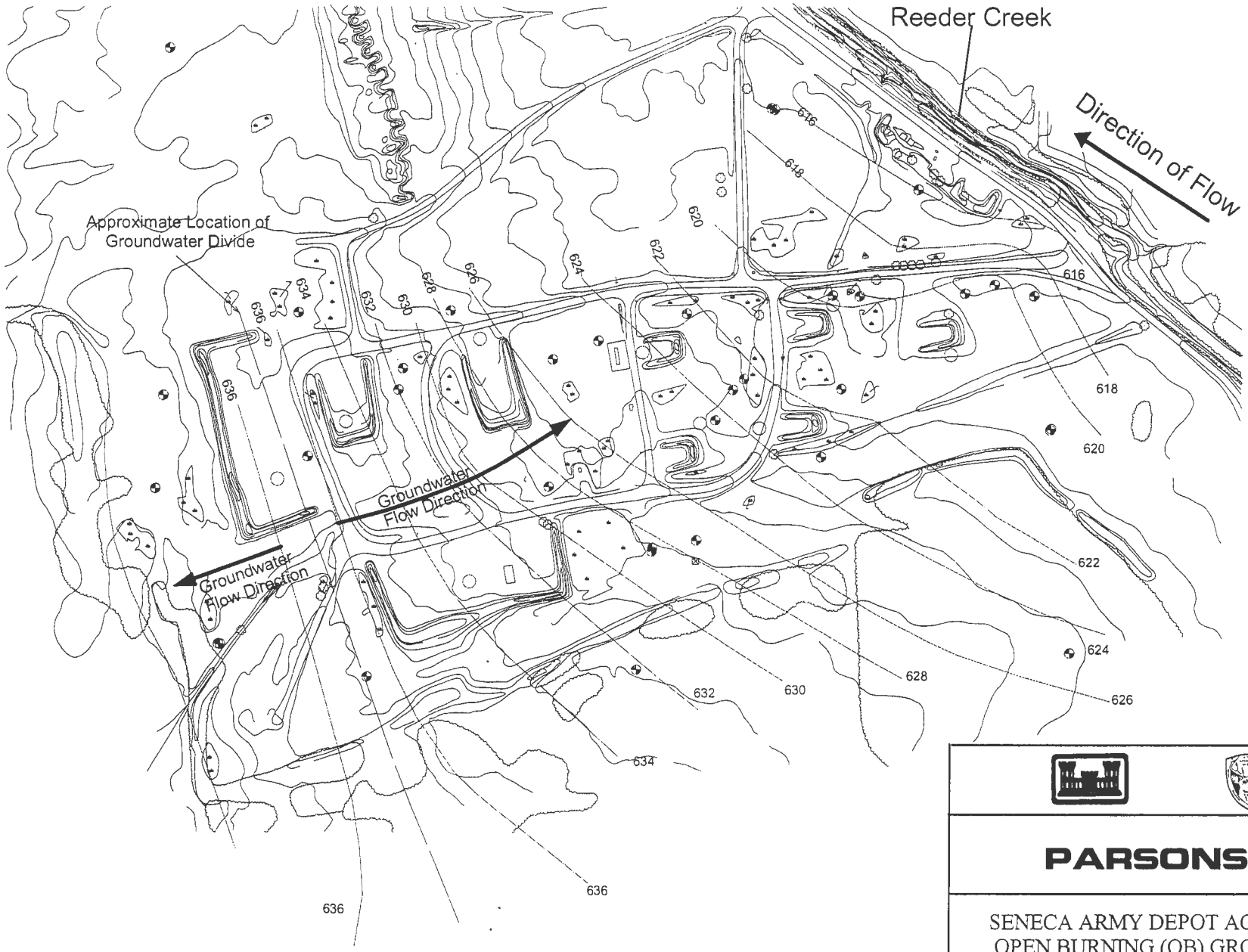
SENECA ARMY DEPOT ACTIVITY
OPEN BURNING (OB) GROUNDS
LONG-TERM MONITORING PLAN

FIGURE 1-3
Former Open Burning Grounds
Site Plan

JOB NUMBER: 744493

DATE: DECEMBER 2005



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OPEN BURNING (OB) GROUNDS
LONG-TERM MONITORING PLAN

FIGURE 1-4
Former OB Grounds
Groundwater Flow Map, April 1993

JOB NUMBER: 744493

DATE: DECEMBER 2005

2.0 MONITORING OBJECTIVES

The overall objectives of the monitoring program proposed for the OB Grounds site are to monitor the effectiveness of the actions completed in preventing future groundwater quality deterioration at the site, the recontamination of sediments within Reeder Creek, and the incidental contact and ingestion of contaminated soil left buried at the site by indigenous terrestrial wildlife.

As the groundwater conditions found at the OB Grounds prior to the remedial action did not require any treatment as part of the remedy, no Remedial Action Objectives (RAOs) were established for site groundwater. Although RAOs were not appropriate for groundwater at the OB Grounds, Section 11.0 - The Selected Remedy of the ROD required the following for groundwater at the site and for sediment in Reeder Creek:

> "Conducting a monitoring program for site groundwater and sediment in Reeder Creek. This program will monitor metals. For groundwater, the level of detection will be to below 15µg/L, the federal action level for lead in groundwater. For sediment, the detection limit for lead will be to 10 mg/Kg. Should a significant exceedance be noted, the exceedance will be confirmed through additional sampling and, if confirmed, appropriate corrective measures will be implemented to eliminate the threat posed by the exceedance. For groundwater, this action may include metals removal via filtering. A similar process will apply for a sediment exceedance observed in Reeder Creek. First, the source of the exceedance will be identified and confirmed. If the exceedance is determined to originate from the OB Grounds site, then maintenance of or improvements to the existing erosion control systems will be instituted to reduce the threat due to erosion of on-site soils to the Creek. This may include revegatation or the construction of drainage control swales or structures."

Based on these requirements, the following objectives have been developed for use in generation of this LTM Plan:

1. Monitor the effectiveness of the soil remedial action in preventing future impacts to groundwater at the OB Grounds. The effectiveness of implemented remedial action will be evaluated by measuring the dissolved lead and copper concentrations in groundwater.
2. Conduct periodic inspections of the vegetated, compacted soil cap placed over residual lead contaminated soil left at the site to assess its integrity and to ensure that indigenous terrestrial wildlife are not exposed via direct dermal contact or incidental ingestion.
3. Evaluate the results of groundwater quality monitoring and vegetated, soil cap inspections to assess whether there is sufficient evidence to indicate that conditions at the OB Grounds may be contributing to the degradation of sediment quality in Reeder Creek.

These objectives will be met through implementation of this LTM plan which includes:

- Periodic monitoring of groundwater quality at the OB Grounds; and,
- Periodic monitoring of the vegetated, compacted soil cap placed over the lead contaminated soil remaining at the OB Grounds.

No remedial action was required for groundwater under the OB Grounds ROD. The ROD did require groundwater monitoring, however, to ensure the continued protection of the groundwater after the burial of lead contaminated soils under a vegetated, compacted soil cap. Samples of groundwater will be analyzed for dissolved lead and copper. Per provisions stipulated in the ROD, the detection limit for lead in groundwater samples must be below 15 µg/L, which is equivalent to the federal Maximum Contaminant Level (MCL). If exceedances of the federal MCL for lead or the State of New York's GA groundwater standard for copper (i.e., 200 µg/L) are noted, further determinations will be made to define whether the observed exceedances are associated with entrained particles or dissolved metal contaminants, and whether there is evidence of migration of these metals away from the OB Grounds.

The integrity of the 9-inch vegetated, compacted soil cover will also be monitored. The soil cover was placed over soils containing lead concentrations at levels between 60 and 500 mg/Kg to prevent recontamination of drainage ditches and Reeder Creek by materials from the OB Grounds and to prevent contact and ingestion of the soil by terrestrial wildlife. The cover will be monitored for signs of erosion and animal borrows to ensure that the underlying soils are not exposed to the environment.

Sediment remediation was a component of the OB Grounds remedial action specified in the ROD, specifically focused on the removal of sediments from portions of Reeder Creek adjacent to the OB Grounds that contained levels of copper and lead above 16 mg/Kg and 31 mg/Kg, respectively. As is previously discussed in **Section 1.2** of this LTM plan, the Army determined that compliance with the remedial action goals for copper and lead in sediment could not be achieved until all sediment overlying the competent bedrock forming the creek's bottom was removed. The Army further determined that the sediment contamination was due to overland flow of contaminated soils from the OB Grounds and other upgradient locations washing into the creek and drainage ditches.

Background concentrations measured for copper in soil (up to 62.8 mg/Kg) at SEDA exceed the sediment clean-up criteria defined in the ROD. Soils containing lead at concentrations between 60 and 500 mg/Kg is interred under the vegetated, soil cap at the OB Grounds, per requirements of the ROD; however, soils containing concentrations of lead at levels up to 60 mg/Kg may still be exposed to the environment at the OB Grounds, and may wash into Reeder Creek and drainage

ditches via overland flow during precipitation and runoff events, even though the Army implemented measures as part of the OB Grounds remedial action to restrict the overland flow of soils from the former OB Grounds into Reeder Creek. Additionally, soils from upgradient locations will also continue to wash into Reeder Creek and its upgradient tributaries during precipitation and runoff events. Given this information, the Army believes that it is unlikely that the ROD-specified sediment clean-up levels can be maintained. In light of these considerations, and after discussions with the USEPA and NYSDEC, the Army has decided to delay the proposal of a monitoring plan for Reeder Creek sediments until additional data are collected and evaluated to assess the regional groundwater quality as well as the integrity of the soil cap.

If inspections of the vegetated soil cap placed over buried soils at the OB Grounds show evidence of erosion or integrity breaches, or if the groundwater monitoring indicates significant degradation of groundwater quality for lead or copper, a sediment monitoring plan for Reeder Creek at sites adjacent to, and upgradient of, the OB Grounds will be proposed, and once approved by the regulatory authorities, implemented.

3.0 MONITORING PLAN HYPOTHESIS

Monitoring hypotheses describe the relationship between the remedial actions and the expected outcomes of the remedial actions in terms of environmental media quality. Basically, the monitoring hypotheses may be generally stated as "The site activity has been successful in reaching its stated goals and objectives." The most basic monitoring question regardless of the monitoring objectives can be stated as "Has (is) the activity of interest reached (reaching) its stated objectives?" This LTM Plan focuses on identification of and development of procedures for collection and evaluation of the data necessary to answer this question.

For groundwater, the basic objective of the remedial action at the OB Grounds was the isolation of soils containing lead at concentrations ranging from 60 mg/Kg and 500 mg/Kg and the removal, stabilization and off-site disposal of all site soils containing concentrations of lead in excess of 500 mg/Kg to prevent future degradation of groundwater and re-contamination of sediments in Reeder Creek by lead. Remedial actions completed at the OB Grounds did not include any actions that were directly related to groundwater. The ROD did stipulate that detection limits for lead in groundwater may not exceed 15 µg/L, and that additional remedial actions may be imposed if this limit is exceeded. Therefore, the monitoring hypothesis for groundwater at the former OB Grounds is as follows:

> The average concentration of lead and copper in groundwater at each well at the OB Grounds will be determined. The maximum analytical detection limit that will be accepted for each determination of lead used in the computation of the average value is 15 µg/L. If the measured average groundwater concentration at any well exceeds the federal MCL (i.e., 15 µg/L) for lead, or the State of New York's GA groundwater standard (i.e., 200 µg/L) for copper, additional evaluations will be performed to determine if the elevated metal concentrations result from entrained particles or from sources not related to the contaminated soils left at the OB Grounds site.

The ROD also required that a soil cap consisting of at least 9 inches of compacted soil, vegetated with indigenous grass, be installed at the site to cover lead-contaminated soils left in place at the site. The cap was to be monitored to prevent erosion and to prevent direct contact and incidental soil ingestion by terrestrial wildlife. Therefore, the monitoring hypothesis for soil cap is as follows:

> The vegetated, compacted soil cap will be monitored to ensure that the integrity of the covering over contaminated soils containing lead at levels ranging between 60 mg/Kg and 500 mg/Kg is not compromised.

For Reeder Creek, the objective of the remedial action at the OB Grounds was the removal of sediments containing copper or lead concentrations at levels in excess of 16 mg/Kg and 31 mg/Kg, respectively. To achieve these levels, all sediments above competent bedrock found in Reeder Creek in the vicinity of the OB Grounds were removed. The ROD did stipulate that the analytical detection limit obtained for lead in sediment must be 10 mg/Kg or less. Therefore, the monitoring hypothesis for sediment is as follows:

> The accumulation of sediment in Reeder Creek adjacent to the OB Grounds will be monitored. If the integrity of the vegetated soil cap is breached, or if the groundwater quality at the OB Grounds is found to be affected by contaminated soil left at the site, then the Army will subsequently develop and submit for regulatory agency review and approval a sediment monitoring plan for Reeder Creek.

Periodic groundwater quality monitoring will demonstrate that the soil removal and interment remedial actions completed at the OB Grounds are protective of site groundwater. Periodic monitoring of the soil cap and the indigenous grass covering will ensure that the integrity of the cover is being maintained, and that indigenous terrestrial wildlife are not being subjected to incidental exposure to contaminated soils. The identified monitoring of groundwater quality and inspections of the soil cap at the OB Grounds will ensure that residual contaminants left at the site do not contribute to the re-contamination of sediments in Reeder Creek.

4.0 MONITORING DECISION RULES

This section presents the framework for decision-making that will be used to evaluate monitoring data against the monitoring hypothesis presented in **Section 3**. This evaluation will then be used to determine if the remedial actions already completed at the OB Grounds are protective of site groundwater and sediment in Reeder Creek, or if additional actions may be necessary to ensure these media are protected for future use. The decision process is presented and discussed below.

4.1 BASIC DECISION STRATEGY

The purpose of the soil cap, groundwater and sediment monitoring defined in the ROD is to demonstrate the continued effectiveness of the remedial actions performed (i.e., soil and sediment excavation, stabilization and disposal; and contaminated soil interment) at the former OB Grounds and to monitor groundwater for lead. **Figure 4-1** presents the overall decision strategy for evaluation of the results of the groundwater monitoring. The primary decision (evaluation) to be performed for the monitoring is comparison of the average values of selected metals at each well (i.e., lead and copper, only) to values identified in the ROD. The basis for use of average values is described below.

When the concentration value for a chemical detected in a well sampling location remains constant over time, then it is straightforward to compare that concentration to the performance standard and decide whether the sampling indicates compliance. However, the measured concentrations of chemicals in groundwater typically vary over time and may fluctuate up and down, often as a function of rainfall or snow melt near the site.

Further, if all of the values collected for a sampling location are either below or above the comparison value, then decision making is still relatively straightforward, despite concentration variability (**Figure 4-2**, panels A and B). The difficulty is deciding how to evaluate the data at a sampling location where concentrations are usually below, but occasionally above, the comparison value (**Figure 4-2**, Panel C).

USEPA guidance regarding comparison of monitoring data to standards (USEPA, 1992) recommends the average concentration as an appropriate basis for comparison to a numerical standard since most standards are based on protection of human health or the environment against potential adverse health effects from long-term or chronic exposure. The concentration values considered to be protective of human health are based on long-term average exposure levels. This is also the basic approach used under the Safe Drinking Water Act to determine when a

public drinking water system is out of compliance with MCL requirements, and is in general accord with methods used at RCRA sites.

The approach developed for use at the OB Grounds, and presented hereafter, is consistent with USEPA's general guidance. The approach is to use the best estimate of the mean concentration of samples collected from designated monitoring well sampling locations to compare to concentration limits, but requires that the uncertainty around the best estimate be sufficiently small that if any error is made that the magnitude of the error is within tolerable limits, as described in greater detail below.

4.2 EVALUATING AND LIMITING DECISION ERRORS

One of the difficulties in using a decision rule based on the long-term average value is that it is not possible to know with certainty the true long-term average concentration at a particular location based on a limited set of measurements from the well. That is, any long-term average calculated from a set of varying measurements has uncertainty, and the true long-term average value could be either lower or higher. Because of this uncertainty, two types of decision errors are possible:

Type I (False Negative). In this case, the measured long-term average is below the regulatory limit and the monitoring well is declared to be in compliance. However, the true long-term average is actually above the limit and the well is actually not in compliance.

Type II (False Positive). In this case, the measured long-term average is above the regulatory limit and the well is declared to be out of compliance. However, the true long-term average is actually below the limit and the well is actually in compliance.

Risk managers need to define the acceptable bounds on making a Type I and a Type II decision error. The choice of acceptable bounds on the magnitude and frequency of decision errors depends mainly of the expected consequences of making either type of decision error.

4.2.1 Bounds on a Type I Error

As noted above, a Type I error is a decision that declares a well location to be in compliance when it really is not. The potential harm done by a Type I decision error is that humans might be exposed to concentrations above the regulatory limits, potentially increasing the risk of adverse health effects. Thus, the tolerance for a Type I error (expressed in terms of the frequency and magnitude of an error) must be based on an assessment of the probability that human health would be harmed by the exceedance.

The tolerance for a Type I decision error at this site is defined as follows:

If a well location is declared to be in compliance, there shall be no more than a 5% chance that the true long term mean is greater than 1.5-times the limits set forth in the ROD.

If this tolerance rule is not satisfied, the sampling location may not be declared to be in compliance, and more data are required before a reliable decision can be made.

4.2.2 Bounds on a Type II Error

As noted above, a Type II error is a decision that declares a well location to be out of compliance when it really is in compliance. The tolerance for a Type II error must be based on an assessment of the relative cost of collecting more data to prevent the erroneous decision compared to the cost of making the decision error (e.g., cost of additional sampling to show compliance versus the cost of non-compliance and potential additional remedial actions).
The tolerance for a Type II decision error at this site is defined as:

If a well location is declared to be not in compliance, there shall be no more than a 10% chance that the true long term mean is less than 1/2 the standard.

If this tolerance rule is not satisfied, the sampling location should not be declared to be out of compliance, and more data should be collected before a reliable decision can be made

4.3 DATA COLLECTION, ANALYSIS AND DECISION MAKING

At each of the locations selected for groundwater monitoring, groundwater samples will be routinely collected and analyzed for lead and copper and those data will be used to compute the long-term mean concentration at each sampling location. **Figure 4-1** illustrates the process proposed to evaluate those data and make comparisons to the concentrations limits set forth in the ROD. An explanation of that process is as follows:

1. Collect samples from the monitoring well and analyze them for lead and copper. Compute the average concentration of each metal at each sampling location and evaluate the uncertainty of that computed value considering the variability in the concentration values by computing upper and lower confidence limits (95 percent upper confidence limit [UCL] and 90 percent lower confidence limit [LCL]) for the mean estimate.
2. Compare 95% UCL value to 1.5 times the performance standard and report result.
3. Compare 90% LCL value to 0.5 times the performance standard and report result.
4. If the 95% UCL is greater than 1.5 times the standard and the 90% LCL is less than 0.5

times the standard, conclude that additional data collection is necessary before deciding whether compliance is/is not achieved for the metal at the monitoring location.

5. If the 95% UCL is less than 1.5 times the performance standard, then compliance is achieved for the metal, continue to monitor for the metal at the location for future demonstration that the groundwater or sediment at that location remains in compliance over time.
6. If the 90% LCL is greater than 0.5x the standard and the 95% UCL is greater than the performance standard, conclude that compliance is not achieved for the metal at the monitoring location and evaluate conditions at location per Step 7.
7. For the case in number 6 above, evaluate factors that contribute to an "out-of-compliance" condition at the monitoring location and prepare a work plan for evaluation of temporal trends, potential for downgradient transport, potential for transport to the site boundary and potential risks to receptors at the site.
8. Obtain USEPA approval of work plan and implement.
9. If the findings are that there is a downward trend in concentration and there is minimal potential for migration off site at levels above the required limits, conclude that additional monitoring is warranted before other actions are required.
10. If the findings are that there is little or no downward trend in concentration over time but there is minimal potential for migration to site boundary, conclude that additional monitoring and evaluation of extent of migration is warranted before other actions are required.
11. If the findings are that there is little or no downward trend and there is potential for migration to the site boundary, conclude that additional actions are needed to prevent offsite migration at concentrations above the performance standard.

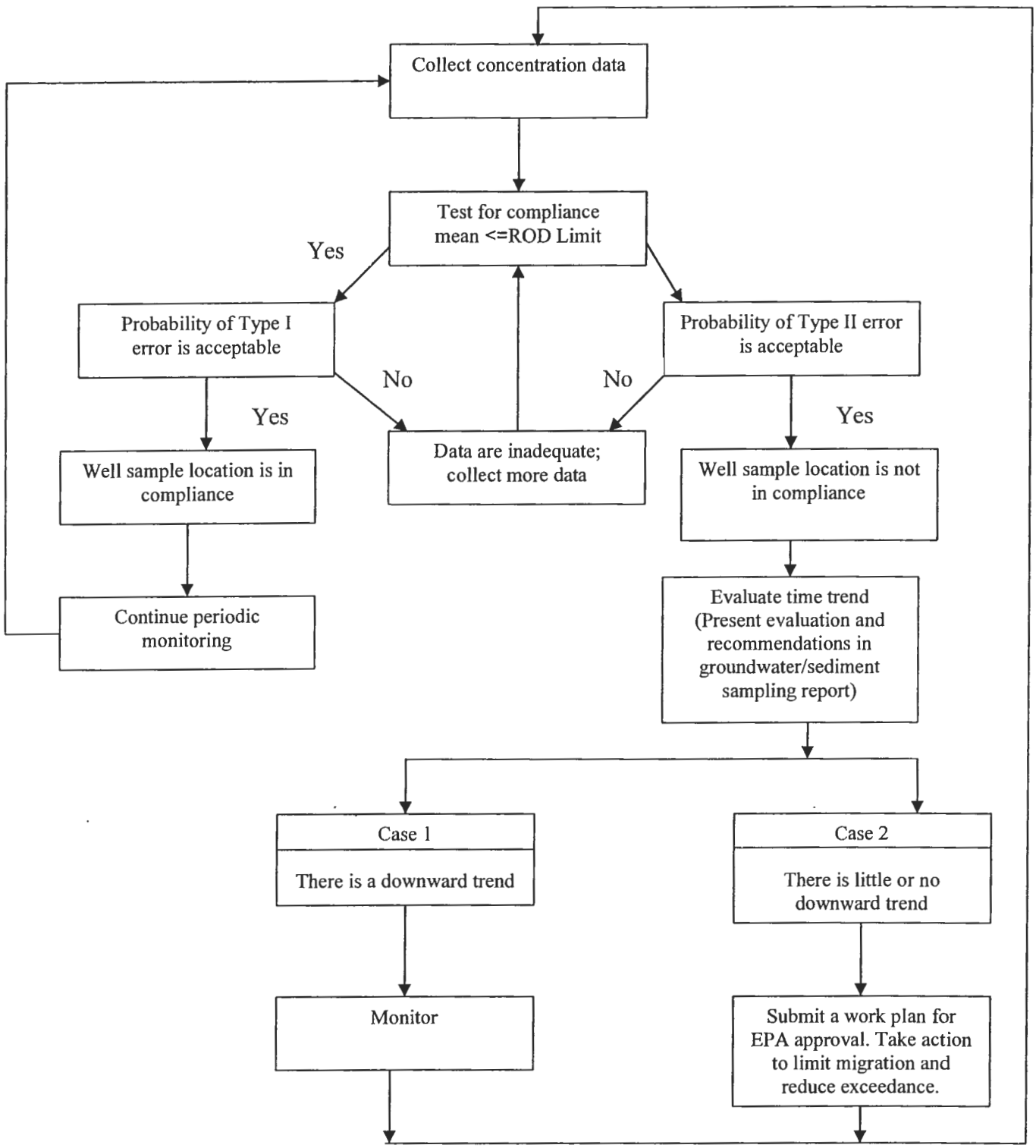
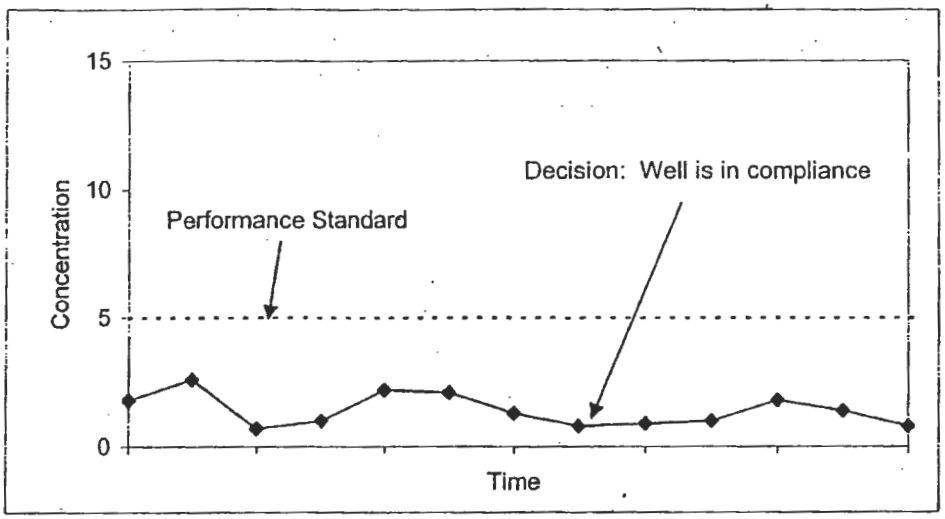


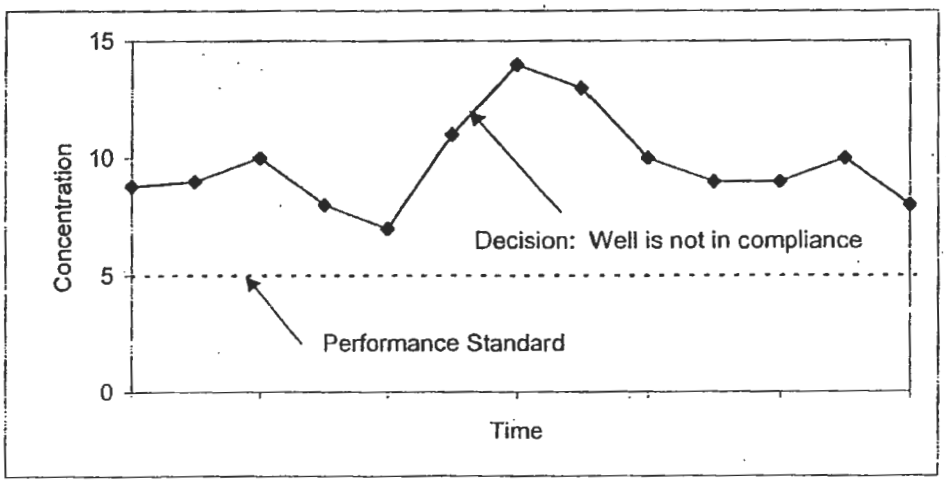
FIGURE 4-1

Decision Tree for Evaluation of Groundwater Monitoring Data



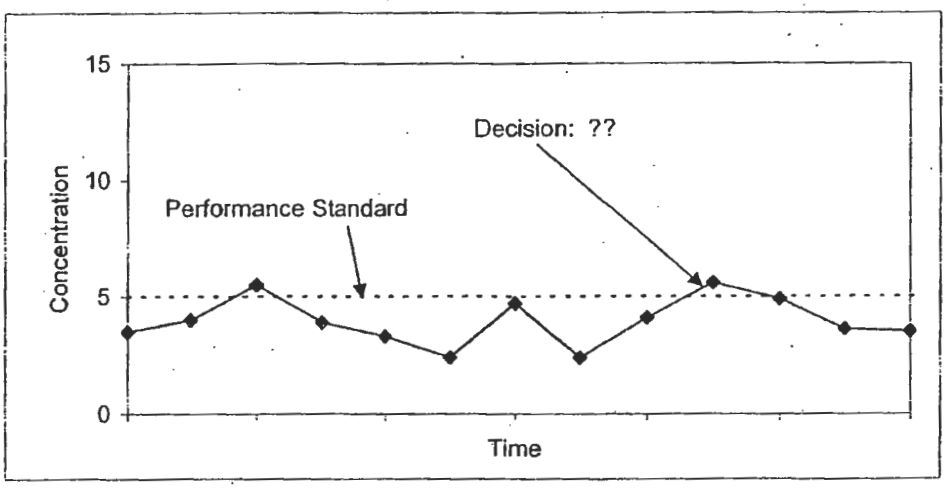
Panel A.

All Values Are
Below the Standard



Panel B.

All Values Are
Above the Standard



Panel C.

Most Values Are
Below the Standard
(But Some Are Above)

Figure 4-2

Example Compliance Monitoring Data Sets

5.0 MONITORING PLAN DESIGN

The monitoring plan design consists of identifying the data needs, the spatial and temporal boundaries of the groundwater monitoring program, and the data collection and analysis methods necessary to meet the monitoring objectives that were presented in **Section 2** and provide a basis for the decisions as described in **Section 4**.

5.1 INTRODUCTION

Excavation and disposal of soil contaminated with lead at concentration in excess of 500 mg/Kg and isolation of soils containing lead at concentrations ranging between 60 mg/Kg and 500 mg/Kg beneath a compacted, vegetated, soil cap at the former OB Grounds is expected to be protective of groundwater in limiting future impacts from metals contaminated soil. This action, in addition to excavation of contaminated sediment in Reeder Creek and the maintenance of a vegetated, 9-inch compacted soil cap, is also expected to prevent the recontamination of sediment in the creek by lead and copper, via site groundwater via storm water run-off transport or leaching of metals through the buried, contaminated soil left at the OB Grounds. The periodic inspection and maintenance of the vegetated, 9-inch compacted soil cap is also expected to limit future impacts to terrestrial wildlife via direct contact to, or incidental ingestion of, the contaminated soils left at the site.

Therefore, some of the data needed to verify the protectiveness of the remedial actions completed at the OB Grounds are average concentrations of lead and copper contained in the groundwater at, and upgradient of, the OB Grounds site. Of particular interest are the average concentration of lead and copper in groundwater. Additionally, information pertinent to the integrity of the vegetated, compacted soil cap is needed. The following discussion presents the process used to design the monitoring network, monitoring and inspection frequency, and sample analyte list that will collectively provide data and information needed to support the decisions regarding the protectiveness of the remedial actions completed at the OB Grounds.

5.2 GROUNDWATER MONITORING WELL/LOCATION NETWORK

Groundwater monitoring data collected during the 1993 RI indicated that groundwater flow across the majority of the OB Grounds site at the time was to the east northeast, towards Reeder Creek. A groundwater divide existed in the western portion of the site, beyond which point groundwater flow was to the west southwest. These hydrogeologic features are shown on **Figure 1-4**.

Groundwater data collected during the RI also indicated that, with the possible exception of two monitoring well locations, groundwater had not been impacted by metal contamination that was then present in the soil. Groundwater data from all but the two well locations indicated lead concentrations ranging from non-detectable to less than the 15 µg/L limit stipulated in the ROD. The two exceptions showed lead concentrations higher than 15 µg/L; however, these samples were highly turbid and results from filtered samples collected at these locations showed lead concentrations below 15 µg/L. Based on these findings, the Army indicated that the turbid nature of the samples resulted in the elevated concentrations of lead identified.

Based on the flow direction of groundwater, the existence of a groundwater divide, the lack of widespread metals contamination in groundwater at the OB Grounds, and the ROD requirement to prevent future degradation of Reeder Creek, the monitoring well network will consist of six wells, all of which will need to be constructed at the site. New wells are required due to abandonment of 32 during the OB Grounds remedial action (Weston Solutions, June 2005) and due to the lack of maintenance applied to the three remaining well sites at the OB Grounds. The locations of the six new proposed wells are shown on **Figure 5-1**, and they will be positioned as follows:

- Three wells will be installed on the east side of the OB Grounds, between the former grounds, the location of the buried lead contaminated soil, and Reeder Creek. These wells will be used to monitor the groundwater for possible future impacts to Reeder Creek.
- Two wells will be installed on the west side of the OB Grounds, west of the groundwater divide. These wells will be used to monitor groundwater flowing off the OB Grounds to the west southwest.
- One well will be installed south of the site, outside the area that formerly contained contaminated soil. This well will serve as a background well for comparison to the five other wells installed at the site.

These wells will adequately monitor the OB Grounds to assess future degradation of site groundwater and potential migration of affected groundwater towards Reeder Creek. Collection of groundwater levels and generation of potentiometric maps will be used to check the direction of groundwater flow and be used to evaluate the need for additional wells should the groundwater flow directions alter from that currently anticipated.

5.3 MONITORING ANALYTE LIST

The ROD stipulated that groundwater at the OB Grounds is required to contain less than 15 µg/L lead, and the sediment in Reeder Creek found to contain more that 16 mg/Kg copper and 31 mg/Kg lead was to be excavated. The ROD also required that these media be analyzed for

metals. In accordance with these requirements, the samples of groundwater from the OB Grounds will be analyzed initially for total lead and total copper. If preliminary results suggest that turbidity is potentially affecting the sample results, groundwater analyses will also include the determination of total and dissolved lead and copper in the samples. The State of New York Contract Required Quantitation Limits for lead and copper are shown in **Table 5-1** below.

5.4 MONITORING FREQUENCY

As is indicated above, all wells proposed for monitoring groundwater at the OB Grounds will be new; therefore, the initial sampling frequency will be once per quarter until it can be established that the wells meet or exceed the required concentrations limits, within the acceptable error tolerances specified in **Section 4.2**. After collection of this initial data set and the decision regarding whether the wells meet the ROD-specified concentration limits, the Army anticipates that the sampling frequency will be reduced to once per year. After a total of five years of sampling, a decision will be made whether the sampling should be terminated or continued into the next five-year period.

The vegetated, compacted soil cap overlying the lead contaminated soil that has been left at the former OB Grounds site will initially be inspected and documented once per quarter, concurrent to the quarterly groundwater monitoring events. Inspection of the surface will include observations pertinent to the integrity of the soil and indigenous vegetative covering, and the condition of surface water run-off channels, infiltration galleries, and swales. Any identified breach of the vegetated, soil cap or erosion in the run-off and infiltration galleries will be repaired within one month of being noted. After collection of this initial data set and the decision regarding whether the cap is effective in isolating the lead-contaminated soil, the cap inspections will be reduced to an annual basis. After a total of five years of inspections, a decision will be made whether the inspections should be terminated or continued into the next five-year period.

5.5 ADDITIONAL GROUNDWATER ASSESSMENTS

Several other groundwater related activities are will be performed as part of the overall LTM program. These include collection of water level measurements in each well and regular inspection and maintenance of the monitoring wells. These additional activities are discussed below.

5.5.1 Groundwater Level Measurements

Groundwater levels will be collected during each sampling round to confirm the direction of groundwater flow and to assess whether hydraulic gradients exist other than the anticipated east-west flow directions. Water levels will be collected at all six monitoring wells, during each

sampling event. These data will be entered on the groundwater sample collection form as required by the Quality Assurance Project Plan (QAPP). The QAPP is included the "*Sampling and Analysis Plan, Seneca Army Depot Activity, Romulus, New York* (Parsons, 2005)." Water level measurement will be conducted in accordance with the standard operating procedures (SOPs), which are also contained in the Sampling and Analysis Plan.

5.5.2 Groundwater Quality and Sampling Parameters

As part of the of the groundwater sample collection process, groundwater quality parameter and sampling data, including groundwater temperature, pH, specific conductance, dissolved oxygen content, oxidation-reduction potential, turbidity, purge/sample flow rate, will be collected and recorded during sampling activities. Sequential data collected during the purging process prior to sampling will be tabulated on field sampling forms. These data will be used to decide when the well is suitable for sampling.

Data recorded during the sequential purging operations will provide the basis for initiation of the required sample collection activities. Groundwater sample collection will commence if:

- The well is shown to have stabilized (see discussion below);
- The well has recharged sufficiently to support sample collection requirements after it has been pumped to dryness (requires approval of site/project manager); or
- On rare occasions, when all but one or two of the groundwater quality parameters have achieved stabilization levels listed below.

A monitoring well will be considered stabilized and suitable for sampling once three successive groundwater quality parameter readings, recorded no more frequently than once every three minutes indicate that:

- pH varies by not more than ± 0.5 standard units;
- specific conductance varies by not more than ± 3 percent;
- temperature, dissolved oxygen, oxidation-reduction potential vary by not more than 10 percent; and
- turbidity is less than 10 Nephelometric Turbidity Units (NTUs) and varies by not more than 5 NTUs.

Occasionally, one or two groundwater quality parameters have been found not to stabilize to the desired levels in wells at the SEDA, despite extended pre-sampling purging periods. In this case, samples may be collected with the permission of the Army. Sampling operations conducted at wells that are not fully stabilized should be fully documented and may involve the collection of replicate or filtered samples for additional analyses.

5.5.3 Well Inspection and Maintenance

The groundwater monitoring wells at the OB Grounds will be inspected during each sampling event. The general condition of the well will be determined and recorded on the groundwater sample collection form. Items addressed by the inspections include among other things; the presence and condition of the well label; the presence and condition of the well lock; condition of surface casing and locking cap; and the condition of surface seal and well pad. Any conditions warranting maintenance or repair will be noted and the necessary repairs or maintenance performed. Additionally, indications of the possible accumulation of sediment (e.g., changes in the bottom of well depth) at the bottom of the well point will also be noted. The results of the well inspection will be summarized in the groundwater sample reports along with a summary of any repairs or maintenance carried out or necessary.

5.6 REPORTING

The groundwater sample data and evaluations performed pursuant to the monitoring activities at the OB Grounds will be reported after each sampling event is completed. Inspection reports providing information about the integrity of the vegetated, soil covering will be provided along with each of groundwater sampling events. The following items related to the monitoring program will be included in the reports:

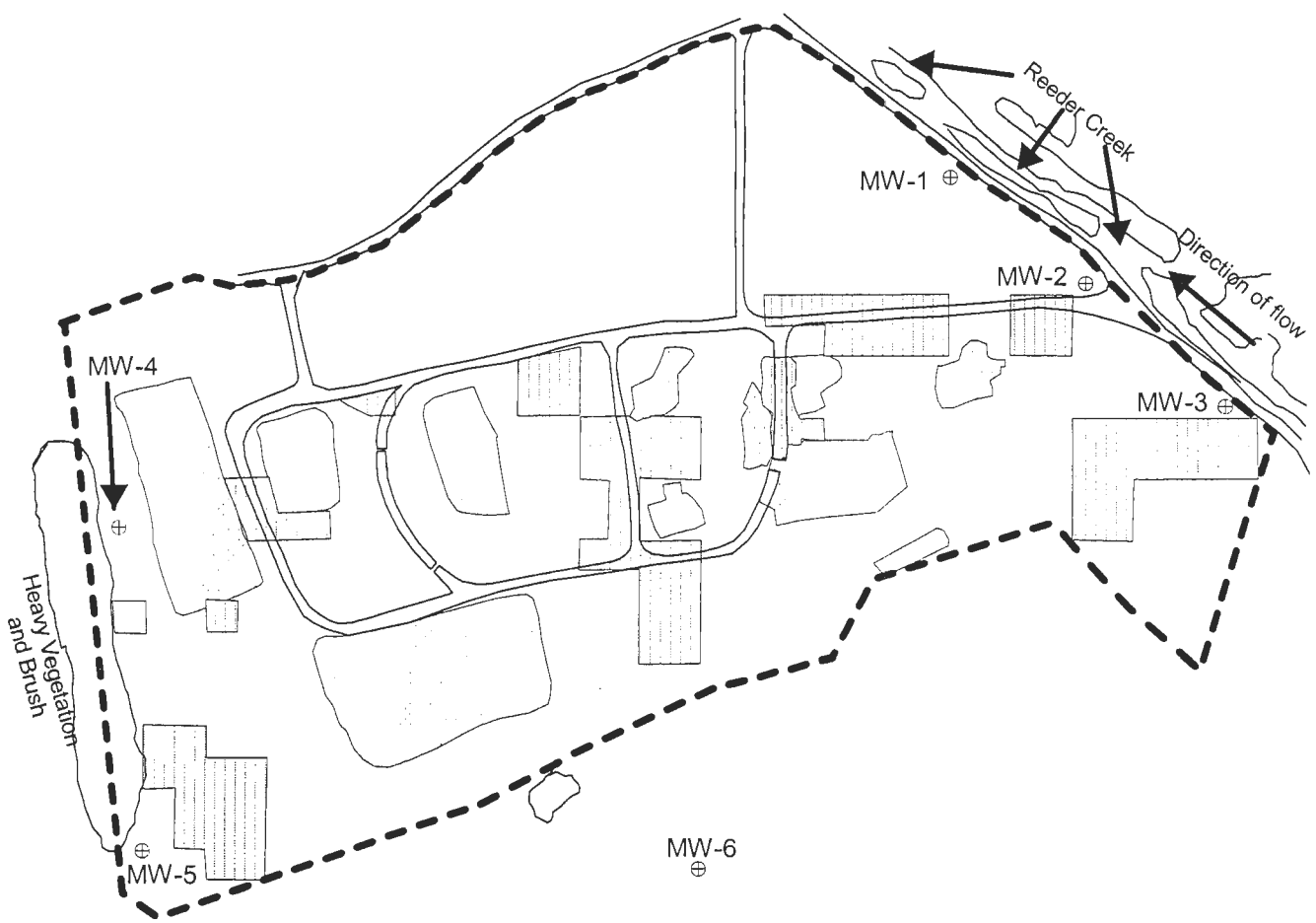
1. Summary table(s) of all water level measurements made during the sampling event;
2. A potentiometric map of site groundwater;
3. Summary table(s) of all water quality concentration data obtained during the reporting period;
4. Copies of the groundwater sampling forms completed for each well;
5. A CD-ROM of electronic copies of data validation reports for data obtained and validated during the reporting period;
6. A CD-ROM containing an electronic database of groundwater quality concentrations for the OB Grounds updated to include all additional data obtained and validated during the reporting period;
7. Summary table(s) or figures of the results of the statistical evaluations of the monitoring results (i.e., comparison of long-term mean values of water quality and sediment concentration data to performance standards, evaluation of the probability of Type I or Type II errors, and graphical plots and results of statistical tests of water quality and sediment concentration trends over time);
8. Summary table of instances of non-compliance, if any, and recommendations for additional actions, if any (i.e., restoration/modification of system operations, preparation of area-specific work plan, etc.); and,

9. A copy of the vegetated, soil covering inspection form.

During the period of monitoring associated with development of the baseline data, groundwater monitoring data will continue to be reported on a quarterly basis. After completion of baseline data collection, the frequency of monitoring of the will be once every year. During this period, status reports will be prepared and submitted on an annual basis.

TABLE 5-1
ANALYTE LIST FOR OPEN BURNING GROUNDS
GROUNDWATER AND SEDIMENT SAMPLES

ANALYTES	Contract Required Quantitation Limits	
	Water (µg/L)	Soil (mg/Kg)
Copper	25	2.5
Lead	10	1



N

Approximate Location of Interred Soils

Former Burning Pads

OB Grounds Boundary

Proposed Monitoring Well Location

Map not to scale. Site features derived from information presented in "Soil and Sediment Remediation, Open Burning Grounds, Completion Report." See Figure 4-13 . (Weston Solutions, Inc. June 2005)

PARSONS

SENECA ARMY DEPOT ACTIVITY
OPEN BURNING (OB) GROUNDS
LONG-TERM MONITORING PLAN

FIGURE 5-1
Open Burning (OB) Grounds
Monitoring Network

JOB NUMBER: 744493

DATE: DECEMBER 2005

6.0 QUALITY ASSURRANCE/QUALITY CONTROL

The QAPP is included the "*Sampling and Analysis Plan, Seneca Army Depot Activity, Romulus, New York* (Parsons, 2005)," and is included by reference only in this LTM Plan and will not be reproduced herein. The QAPP sets forth the analytical requirements, field QA/QC requirements, data validation procedures and requirements, as well as all other requirements and procedures to be employed to insure or evaluate the integrity and quality of the data that will be obtained from groundwater and sediment sampling activities at the OB Grounds.

The Sampling and Analysis Plan also contains all SOPs that will be used during sample collection activities. Specific SOPs pertinent to the LTM Plan include:

- Monitoring well drilling and installation
- Geologic logging
- Monitoring well development
- Monitoring well purging and sampling
- Water level measurement
- Monitoring well abandonment
- Monitoring well inspection and maintenance

7.0 SUMMARY OF MONITORING PROGRAM

This section presents a brief summary of the activities to be performed and requirements of the groundwater and vegetated soil cap monitoring program. This section has been prepared to serve as a brief summary of the Plan requirements for current and future field crews and office personnel who will conduct the work associated with the OB Grounds monitoring program. This section is only intended to provide a brief summary for staff personnel. Supervisory and management personnel are expected to review the entire Plan.

7.1 WATER LEVEL MONITORING

Water levels will be obtained from all wells at the OB Grounds during groundwater sampling events. Levels will be collected on a quarterly basis during the baseline period, which will last for at least the first year. Groundwater level monitoring may be reduced after the first year if the wells are shown to be in compliance with the ROD requirements. The locations of the wells to be installed at the OB Grounds are shown on **Figure 5-1**. All water level measurements will be obtained in accordance with the procedures identified in the SOPs included in the Sampling and Analysis Plan (Parsons 2005, included by reference only).

7.2 WATER QUALITY MONITORING

Water quality monitoring will be performed at six wells. These wells are shown on **Figure 5-1**. Samples will be obtained on a quarterly basis for at least the first year and analyzed for the parameters listed on **Table 5-1**. Sampling frequency after the first year may be revised depending on the results and evaluation of data collected during the first year.

Samples will be collected in accordance with the procedures described in the SOPs contained the Sampling and Analysis Plan. Quality control samples will be obtained in accordance with the requirements set forth in the QAPP, which is included in the Sampling and Analysis Plan. Laboratory analyses and data validation will be performed in accordance with the procedures set forth in the QAPP.

7.3 VEGETATED SOIL CAP AND DRAINAGE SWALE INSPECTIONS

The integrity of the vegetated, compacted soil cap placed over the OB Ground soils that contain lead in the range of 60 mg/Kg to 500 mg/Kg will initially be inspected quarterly; at the same time as the groundwater monitoring is performed. The compacted soil cap will be inspected for evidence of vegetation kill or stress, and breaching of the protective covering via erosion or

7. a chronological listing of any noted vegetated, soil cap breach or erosion and an indication of the correction action taken to alleviate the identified condition; and,
8. A recommendation of any changes (e.g., changing frequency of data collection to semi-annual or annual, development of a sediment monitoring program, etc.) that are proposed to be implemented for the OB Grounds LTM Plan.

8.0 REFERENCES

Parsons, 2005. Sampling and Analysis Plan, Seneca Army Depot Activity, Romulus, New York.

Parsons Engineering Science, Inc., 1994. Remedial Investigation Report at the Open Burning (OB) Grounds. September.

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USEPA, 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance, EPA/530/R-93/001, Office of Solid Waste, Washington DC.

USEPA, 2004, Guidance for Monitoring at Hazardous Waste Sites: Framework for Monitoring Plan Development and Implementation, OSWER Directive No. 9355.4-28, January 2004.

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