Watervliet Arsenal

Watervliet, New York

Long-Term Monitoring Plan Update

Main Manufacturing Area (WVAA-32)
Siberia Area (WVAA-25)

Watervliet Arsenal
Watervliet, New York

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Report Prepared By:

Malcolm Pirnie, Inc.

855 Route 146, Suite 210
Clifton Park, New York 12065

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1. Introduction

1.1. Purpose

Malcolm Pirnie, Inc. (Malcolm Pirnie) has been retained by the Baltimore District of the US Army Corps of Engineers (USACE) to implement the Long-Term Monitoring Plan (LTM Plan) for the Watervliet Arsenal (WVA) in Watervliet, New York. Long-term monitoring is being conducted at the WVA in support of investigations and corrective measures that have been conducted at the WVA under a United States Environmental Protection Agency (USEPA) Administrative Order on Consent (Docket No. II RCRA-3008(h)-93-0210). The purpose of LTM Plan is to act as an interim/long-term monitoring program for the Main Manufacturing and Siberia Areas of the WVA. This LTM Plan Update was requested by the New York State Department of Environmental Conservation (NYSDEC) to consolidate the approved changes that have been made to the program since the original plan was approved.

1.2. Facility Description

The WVA encompasses approximately 140 acres in and around the City of Watervliet, New York, approximately 3.5 miles northeast of the City of Albany (Figure 1-1). To the east of the WVA, Broadway Street and a six-lane interstate highway (I-787) separate the WVA from the Hudson River. To the west, the WVA extends beyond the limits of the City of Watervliet into the Town of Colonie. Residential areas border the WVA to the north and south.

The WVA consists of two primary areas: (1) The "Main Manufacturing Area" (MMA), where manufacturing and administrative operations occur, comprises about 125 acres, and, (2) The "Siberia Area" (SA), which is chiefly used for the storage of raw and hazardous materials, comprises about 15 acres. These areas are shown on Figure 1-2.

1.3. Previous and Ongoing Studies

1.3.1. Main Manufacturing Area

Several environmental studies have been conducted at the MMA of the WVA. The most comprehensive investigation, an RFI, was conducted by MPI and Louis Berger & Associates, Inc. from 1995 to 1998. Previous investigations are summarized in the RFI. Two ICM studies involving in-situ groundwater remedial techniques were conducted at the MMA in the area of Buildings 25 and 40 between 2001 and 2003. Final corrective measures, in the form of in-situ chemical oxidation, were conducted at Building 40 in accordance with the Corrective Measures Work Plan – Building 40 Groundwater, dated

July 2004 (Malcolm Pirnie, 2004) from 2004 through 2007. Monitoring of the wells in the Building 40 area was conducted separately under the Corrective Measures Monitoring Plan, Building 40 Groundwater, dated August 2004 (Malcolm Pirnie, 2004a) (CMMP) during that time. Based on an evaluation of the performance of the Building 40 groundwater corrective measures (Malcolm Pirnie, 2009 & 2010), which concluded that additional corrective measures were not feasible, wells in the Building 40 area were added to the LTM Plan in May 2010.

1.3.2. Siberia Area

An RFI was conducted by Malcolm Pirnie at the Siberia Area from 1994 to 1995. Additional investigations and ICMs were completed by Malcolm Pirnie from 1996 to 2002. The CMS Report for Siberia was approved in August 2003. The CMS Certification Report was approved by the NYSDEC and USEPA in 2007. The ICMs are summarized in the CMS report.

1.4. Generalized Site Geology and Hydrogeology

1.4.1. Main Manufacturing Area

The major overburden unit identified in the MMA is fill, consisting of brown or dark gray silty sand with angular gravel. The fill material is the only unit consistently found throughout the site, with the thickest amount of fill being in the eastern portion of the MMA. Underlying the fill are the following native overburden units: a fine-grained alluvium, a coarser alluvium, and glacial till. These units are not present in all areas of the site.

The bedrock underlying the site is a black, medium-hard laminated shale, showing some characteristics of minor metamorphism. This shale is part of the Snake Hill Formation. The bedrock can be described in three ways based on the degree of weathering observed. The first is an extremely weathered zone approximately four feet thick. This extremely weathered bedrock unit was encountered at depths ranging from near ground surface to approximately 20 feet below ground surface (bgs). Beneath this extremely weathered bedrock is a zone of less weathered shale showing minimal competency. Competent bedrock is generally encountered at depths ranging from approximately 1.5 feet bgs to 18 feet bgs.

The majority of the MMA is relatively impervious to rainfall except at the residential and recreational areas of the northeastern portion of the WVA. Due to the shallow depth of bedrock and the limited amount of overburden in several areas of the WVA, groundwater is encountered within different geologic units (overburden, weathered bedrock, or bedrock) depending on the location. For instance, groundwater is encountered in the bedrock at the western end of WVA (topographic high and local recharge area);

progressing eastward toward the Hudson River, groundwater is encountered in the weathered bedrock and then in the overburden deposits.

Groundwater flow in bedrock in the MMA is primarily controlled by the degree of fracturing within the bedrock itself and in the local recharge area, which is coincident with a topographic high along a bedrock ridge in the central portion of the facility. The most prominent feature on the potentiometric surface is a groundwater divide trending approximately north to south through Buildings 135 and 125. This feature appears to mirror the bedrock ridge. The primary discharge area for groundwater from the Main Manufacturing Area is the Hudson River, which is located to the east of WVA. For the area surrounding Building 25, groundwater in each of the hydrostratigraphic units flows from west to east towards the Hudson River, with a component of flow to the northeast. In the Building 40 area, groundwater in the bedrock unit flows to the east-southeast. West of the groundwater divide, shallow groundwater flow discharges toward the Kromma Kill.

1.4.2. Siberia Area

According to the "Surficial Geologic Map of New York - Hudson-Mohawk Sheet, 1987", a majority of the SA is underlain by recent alluvial deposits. These are defined as fine sand and gravel deposits overlain by silt. The SA, which is at a lower elevation than the MMA of the WVA located to the east, is generally underlain by a layer of fill (sand, shale fragments, slag, cinders, brick, wire, wood and concrete). Alluvium, lenses of peat, and lacustrine clay deposits were encountered beneath the layer of fill material. Bedrock beneath the SA is also the Snake Hill shale. During the SA investigation, highly weathered shale was encountered from approximately 3.5 feet bgs to 31 feet bgs. In general, competent bedrock was encountered at approximately 12 feet bgs. The upper portion of the competent bedrock was found to be fissile and highly fractured with 45 to 60 degree bedding planes.

Groundwater flows generally to the north-northwest in the NE Quadrant of the SA, and generally to the west across the remainder of the SA. The water table responds quickly to recharge events, and during times of low precipitation the water table may be present in the shale bedrock over portions of the SA. However, on the average, the water table is encountered in the overburden. Surface water in the SA that does not infiltrate is generally directed into the existing storm sewers.

2. Field Sampling Plan

The Field Sampling Plan presents the current groundwater sampling locations, sample analyses, sampling frequency, and sampling methodology for the groundwater monitoring program at the WVA.

2.1. Main Manufacturing Area

There are a total of 58 groundwater monitoring wells in the MMA that are sampled under this LTM Plan. Of these, 14 wells monitor the saturated overburden; six wells monitor either the overburden and weathered bedrock saturated zones (hybrid wells) or the weathered bedrock; and 38 wells monitor the bedrock at varying depths. Monitoring wells currently sampled in the MMA as part of the LTM are listed in Table 2-1, with selection rationale, analytes, and sampling frequency, and are also shown on Figure 2-1. Wells sampled annually are sampled during the spring (typically in May). Wells sampled pent-annually are sampled every five years during the spring sampling event. These pent-annual wells were last sampled in 2006, and will be sampled again in 2011.

2.2. Siberia Area

There are a total of 28 monitoring wells in the Siberia Area that are sampled under this LTM Plan. Of these, six wells monitor the saturated overburden, 12 monitor either weathered bedrock or the overburden and weathered bedrock (hybrid wells), and 10 monitor the bedrock at varying depths. In addition to the monitoring wells, three storm sewer locations and one sanitary sewer bedding monitoring point are sampled as part of the long-term monitoring program. Monitoring wells currently sampled in the SA as part of the LTM are listed in Table 2-2, with selection rationale, and are shown on Figure 2-2. All SA wells are sampled annually during the spring.

2.3. Water Level Measurements

Water levels are measured during purging in those wells which will be sampled for chemical analysis in both the MMA and the Siberia Area prior to groundwater sampling using a decontaminated water level probe. If any significant changes in water levels relative to past measurements are noted, the water level in the anomalous well will be re-measured after adequate time to return to static level, and the NYSDEC notified if the anomalous condition remains. In consultation with the NYSDEC, a site-wide potentiometric map may be required for that year's monitoring report. Water level measurement procedures are described in more detail in Section 3.0.

2.4. Sample Collection

All wells are sampled according to the USEPA protocol for Low Stress (Low Flow) Purging and Sampling (USEPA, 1998). Dedicated, permanently installed bladder pumps are installed in each of the wells included in the long-term sampling program. The permanent installation of the bladder pumps has eliminated the need for decontamination of pumps and allows for more efficient sampling. A flow-through cell is used to measure field parameters during well purging and after sample collection. All non-dedicated equipment and instrumentation is decontaminated before and after use. In accordance with the USEPA letter dated September 20, 2002 (USEPA, 2002), the reactive wall monitoring wells are sampled using Passive Diffusion Bag (PDB) samplers. Water levels are measured in all sampled wells and compared to historic measurements to evaluate potential changes in groundwater flow conditions. Sample collection methods and equipment decontamination procedures are described in more detail in Section 3.0.

2.5. Sample Analyses

Groundwater samples are analyzed by a NYSDEC Analytical Services Protocol (ASP)-certified laboratory, for Target Compound List (TCL) volatile organic compounds (VOCs), TCL semi-volatile organic compounds (SVOCs), dissolved sulfide, dissolved organic carbon (DOC), and dissolved gases, as listed in Tables 2-1 and 2-2. Samples collected from reactive wall wells are analyzed for VOCs only. Additional laboratory analyses, including Resource Conservation and Recovery Act (RCRA)-listed metals, are also performed at select locations listed in Tables 2-1 and 2-2.

Groundwater samples collected as part of the long-term monitoring program are analyzed for VOCs and SVOCs by SW-846 Methods 8260 and 8270, respectively, and RCRA-metals by SW-846 Methods 6010 and 7470, by the analytical laboratory under a standard turnaround time with NYSDEC ASP Category A deliverables. Quality Assurance (QA) and Quality Control (QC) samples in the form of blind duplicates are collected at a rate of one per 20 environmental samples.

Field parameters, consisting of temperature, pH, specific conductivity, dissolved oxygen, oxidation-reduction potential, and turbidity are measured during purging using a Horiba U-22 (or equivalent) water quality meter equipped with a flow-through cell. Natural attenuation parameters (NAP) consisting of dissolved oxygen, redox potential, chloride, nitrite, nitrate, sulfate, ferrous iron, alkalinity, dissolved sulfide, dissolved organic carbon, and dissolved gases (methane, ethane, ethene, and carbon dioxide) are also analyzed. Dissolved sulfide, dissolved organic carbon, and the dissolved gases are analyzed by the off-site analytical laboratory, while ferrous iron, nitrate, nitrite, sulfate, chloride, and alkalinity, are measured at each location listed in Tables 2-1 and 2-2 using Hach®-brand field analysis kits. Sample analysis methods are described in more detail in Section 3.0.

2.6. Investigation Derived Waste

Groundwater that is purged from monitoring wells will be discharged to the ground surface within 50 feet of each monitoring well location in accordance with the NYSDEC Proposed Technical and Administrative Guidance Memorandum (TAGM) - Disposal of contaminated groundwater generated during Site Investigations, if the following criteria are met:

1. There is a defined site which is the source of the groundwater contamination;

2. There is no free product observed such as DNAPLs or LNAPLs;

3. The infiltrating groundwater is being returned to the same water bearing zone from which it is being purged.

If there is no recharge surface (i.e., grass, uncovered soil, etc.) located within 50 feet of a well, then the purge water will be containerized, brought to the Siberia Area, and discharged to the ground in a designated area up-gradient of the reactive wall area.

For the Building 40 monitoring wells and other wells that do not meet the above criteria, the materials will be containerized onsite in a polyethylene storage tank and disposed off-site in accordance with federal, state, and local regulations. Some disposable personal protective equipment (PPE) and decontamination fluids will be generated. Attempts will be made to wash surface contamination off so that PPE (i.e., gloves and other disposable items) may be disposed of as ordinary solid waste. If contamination is suspected, these materials will be collected and containerized in DOT-approved, 55-gallon steel drums (separately from contaminated groundwater and disposed of off-site). IDW control procedures are discussed in more detail in Section 3.0.

2.7. Monitoring Well Maintenance

All monitoring wells at the MMA and the Siberia Area are inspected as part of the monitoring well maintenance program during the sampling event. Monitoring well inspection takes place during groundwater sampling activities. The monitoring well maintenance program consists of the following:

- Each monitoring well pad is inspected for cracks, heaving/subsidence, and deterioration of the concrete. Well pads requiring repair will be repaired before the next sampling event.

- Monitoring well surface casings or flush-mount casings/covers are inspected for physical damage, rust, and paint condition. If a casing or flush mount casing/cover is damaged or rusted to the point where well integrity is in question, the casing or flush-mount casing/cover will be replaced prior to the next sampling event. Wells which require repainting will be painted prior to the next sampling event.

- The total depth of each well is measured and compared to the constructed total depth to assess whether the screened or open portion of the well has become filled with silt/sediment. If a significant portion (i.e., more than 25 percent) of the screened or open section of the well has been filled in, then the well will be redeveloped to remove the sediment before the next sampling event.
- Damaged wells and/or pumps will be replaced at the original specifications.

3. Sampling Methods

One of the objectives of the LTM Plan is to ensure that all data collected during the long-term groundwater monitoring program are of acceptable quality. To meet this objective, the following topics are presented and discussed in this document:

- Sample collection procedures;
- Sample integrity;
- Other field data collection procedures; and
- Field instrument calibration and maintenance.

3.1. Sample Collection Procedures

The sampling procedures described in this plan are designed to ensure collection of representative samples for analysis, and are based on the following sources:

1. USEPA Region II GROUNDWATER SAMPLING PROCEDURE, LOW STRESS (LOW FLOW) PURGING AND SAMPLING, March, 1998.
2. USEPA Region II CERCLA QUALITY ASSURANCE MANUAL, October, 1989.
3. NYS Department of Environmental Conservation Analytical Services Protocol 9/89, Revisions 12/91, and any subsequent modifications.
4. RCRA Quality Assurance Project Plan Guidance, NYS Department of Environmental Conservation, Division of Hazardous Substances Regulation, 3/29/91.
5. USEPA RCRA Ground Water Monitoring Technical Enforcement Guidance Document, September 1986.

The objectives for each field team member are to:

1. Collect a sample that is representative of the matrix being sampled; and
2. Maintain sample integrity from the time of sample collection to receipt by the laboratory.

3.1.1. Decontamination of Field Equipment

Cross-contamination of samples from any source is to be avoided. All sampling equipment must be clean and free from the residue of any previous samples. To accomplish this, the following procedures will be followed:

- All non-dedicated sampling equipment must be cleaned initially and prior to being reused. The following is the procedure for decontamination.
- Wash and scrub with low phosphate detergent;
- Rinse with tap water;
- Rinse thoroughly with deionized water;
- Air dry; and
- Wrap in aluminum foil for transport.

Field filtration equipment will be decontaminated prior to use using a deionized water rinse. Field instrumentation should be cleaned per manufacturer's instructions. Probes, such as those used in pH and conductivity meters, and thermometers must be rinsed prior to and after each use with deionized water.

3.1.2. Water Level Measurements

Water levels in the groundwater monitoring wells will be measured and used in conjunction with horizontal and vertical ground survey data to determine horizontal components of groundwater flow. Water level measurements will also be used to determine the volume of standing water in the wells for purging activities.

3.1.2.1. Measurement Equipment

The following equipment will be used for the measurement of water levels:

- Electronic water level indicator
- Oil/Water interface probe
- Field logbook and pen
- Photoionization Detector (PID)
- Deionized Water
- Low Phosphate Detergent

3.1.2.2. Measurement Procedure

At each monitoring well, the PVC cap will be removed and the head space and breathing zone's air quality will be monitored with a PID. The battery of the electric water level indicator will be checked by pushing the battery check button, and waiting for the audible signal to sound or the instrument light to come on. The water level indicator will be decontaminated before collecting a measurement in each well point by using an Alconox wash and deionized water rinse. The instrument will then be turned on and the probe will be slowly lowered into the monitoring well until the audible signal is heard or the instrument light goes on, indicating that the sensor in the probe has made contact with the water surface. The total depth of each well will be measured once the depth to water has been determined. The depth to water will be recorded to the nearest one-hundredth of a foot, from the top of the measuring mark on the monitoring well or well point riser. The date, time, well number, and depth to water will be recorded in the field book. Selected wells will also be gauged for the presence of LNAPL or DNAPL using an oil/water interface probe. The procedure for using the oil/water interface probe is identical to that of the electronic water level meter.

3.1.3. Groundwater Sampling

Groundwater samples will be collected for chemical quality analysis. Groundwater samples which will be collected at the WVA during each groundwater sampling event are summarized in Tables 2-1 and 2-2. A summary of the Contract Required Quantitation Limits for the groundwater samples is provided in Table 3-2.

3.1.3.1. Sampling Equipment

The following equipment will be needed to collect groundwater samples for analysis:

- Electric water level indicator
- Bladder pump
- Air compressor
- Generator
- Polyethylene discharge tubing
- Temperature, pH, dissolved oxygen, redox, specific conductivity and turbidity meters
- Photoionization Detector (PID)
- Field logbook and field logs
- Preservatives
- Laboratory prepared sample containers
- Roll of polyethylene sheeting
- Decontamination equipment

3.1.3.2. Sampling Procedures

Groundwater sampling will be conducted in accordance with the USEPA Region II Low-Flow Sampling protocol (USEPA 1998). The well will be purged using the permanent, dedicated bladder pump installed in each well at a steady rate of approximately 200 to 500 milliliters per minute (ml/min) while maintaining a drawdown of no more than 0.3 feet in the well. Measurements of field parameters consisting of pH, specific conductance, temperature, dissolved oxygen, reduction potential, turbidity, and water level will be made in each monitoring well prior to, during, and after purging (just before sampling) through the use of a flow-through cell. Both the pH and the specific conductivity meters will be calibrated for water temperature before each sampling event.

The volume of water removed from each monitoring well will be dependent upon the amount of time required for stabilization of the field parameters. In general, the well will be considered stabilized for sample collection when field parameters have stabilized for three consecutive readings as follows:

• pH:	+/- 0.1 standard units
• Specific Conductance:	+/- 3%
• Reduction Potential:	+/- 10 millivolts
• Dissolved Oxygen	+/- 10%
• Turbidity	+/- 10%

When the field parameters have stabilized, the volume of water will be recorded, and groundwater in the monitoring well will be sampled through the bladder pump at a flow rate between 100 and 250 ml/min. The purge water will be discharged in accordance with Section 3.4.

The two 40 ml vials for volatile organic analysis will be filled first, without leaving any head space. All other sample bottles will be filled such that some headspace remains in the bottle (with the exception of dissolved gases). The analytical parameters and order of sample collection for groundwater samples will be:

1. In-situ measurements: temperature, pH, specific conductance, turbidity, dissolved oxygen, reduction potential, and PID
2. Volatile organics
3. Semi-volatile organics
4. Metals (if required)

5. Natural attenuation parameters

Aqueous samples to be analyzed for dissolved organic carbon and dissolved sulfide will be filtered by the analytical laboratory. All paperwork accompanying samples to the analytical laboratory should clearly state that the samples should be filtered by the laboratory. The sample bottles will be pre-preserved by the laboratory according to the analytical protocols. The sample bottles will be immediately placed in a cooler held at 4°C.

The natural attenuation parameters, chloride, ferrous iron, sulfate, nitrate, and nitrite will be analyzed using a Hach® DR 800 Series colorimeter. Alkalinity will be analyzed using a Hach® drop titration kit.

Disposable gloves will be worn by the sampling personnel and changed between sampling points. While performing any equipment decontamination, phthalate-free gloves (neoprene or natural rubber) will be worn in order to prevent phthalate contamination of the sampling equipment by interaction between the gloves and the organic solvent(s).

Data to be recorded in the field logbook will include the purging and sampling methods, depth to water, volume of water removed during purging, pH, temperature and specific conductivity values, and PID readings.

3.1.4. Containers, Preservatives, and Holding Times

Sample integrity is preserved through the use of proper sample containers, addition of the correct preservatives to the samples, and meeting designated holding times (the time from sample collection to sample analysis). The field team leader is responsible for proper sample collection, labeling, preservation, and shipment to the laboratory to meet required holding times. Table 3-3 identifies the proper containers, preservation techniques, and maximum holding times.

The analytical laboratory will supply Malcolm Pirnie with commercially-cleaned sample containers. The containers will meet or exceed cleaning and quality control requirements of USEPA OSWER Directive 9240.0 05, Specifications for Obtaining Contaminant Free Sample Containers. Sample containers will be stored in clean, dust free areas that are segregated from the analytical laboratory and solvent/reagent storage areas.

3.1.5. Quality Control Samples

Sample blanks and field duplicate samples will be collected to ensure proper QA/QC, and will be prepared and submitted for analysis along with the actual samples. The collection procedures and frequency of collection of these samples are presented below.

- ***Trip Blanks*** - When collecting environmental aqueous samples for volatile organic compound analysis, a trip blank is taken into the field as part of the sampling kit (the set of appropriate containers used to collect the samples). Trip blanks consist of demonstrated analyte free water sealed in 40 ml Teflon®-lined septum vials. A clean pair of latex gloves must be worn when preparing a trip blank. These blanks are used to determine whether collected samples have been contaminated by outside sources during shipment or storage. One trip blank sample will be prepared and carried with every shipment of aqueous samples that are to be analyzed for volatiles.

- ***Field duplicate***s - are collected in such a manner that they are equally representative of parameters of interest at a given point in space and time. They are separate from laboratory duplicates, which demonstrate analytical precision. Field duplicates will be collected at a rate of one per 20 environmental samples. The field duplicate samples will be "blind" duplicates, meaning that the laboratory must not know that the sample is a duplicate; therefore, the duplicates will be numbered in the same manner as the other samples, and may be numbered randomly. The duplicate samples will be identified in the field notes, but not on the chain of custody recorded by the field team at the time of collection.

3.2. Sample Custody

An essential part of any program that requires sampling and analysis is ensuring sample integrity from collection to data reporting. This includes the ability to trace the possession and handling of samples from collection through analysis and final disposition. The documentation of the history of the sample is referred to as chain-of-custody. This section addresses the following sample custody procedures:

- Sample Identification and Labeling
- Sample Custody in the Field
- Sample Shipping
- Sample Custody in the Laboratory
- Document Control

3.2.1. Sample Identification and Labeling

All samples collected will be identified by affixing a unique sample label to each sample container. Indelible ink will be used to complete sample labels. After they are affixed to the containers, the labels will be covered with clear plastic waterproof tape. Each sample will have a unique designation, using the well IDs on Tables 2-1 and 2-2. The labels will not indicate that a sample is a duplicate or a blank.

Each label will contain the following information:

1. Site Name
2. Project Number
3. Sample Number
4. Sample Matrix
5. Company Name
6. Parameters to be Analyzed
7. Date of Collection
8. Time of Collection
9. Preservation Technique Employed
10. Sampler's Name

3.2.2. Sample Custody in the Field

Sample custody in the field consists of documenting all field activities related to sampling and establishing an accurate written record that traces the possession and handling of each sample from the moment of its collection, through shipment to the laboratory, and ultimately through analysis. The custody procedures described herein conform with US Army Corps of Engineers Guidance ER 1100-1-263, Chemical Data Quality Management for Hazardous Waste Remedial Activities, and are modeled after standard USEPA procedures.

Field activities will be documented in a field notebook. All field notes will be recorded in indelible ink on standard forms or in bound notebooks. All standard forms used during the field investigation will be bound in a notebook and centrally located on-site at the end of each day. The notebook will be signed and dated at the end of each day. Similarly, significant events occurring during the day will be reported to the project manager at the end of each day. All field notes will be reviewed by the project manager.

At a minimum, the notebook will contain the following:

- Sample number
- Date and time of sample collection
- Sample location
- Name of collector

- Analytical work to be done
- Type of sample, and whether the sample is a duplicate, quality assurance, or quality control sample
- Volume of sample taken
- Type of container, number of containers/samples
- Any field observations or measurements (e.g. pH, temperature, specific conductance)
- Type of concentration: low, medium, high
- Preservatives used
- Sampling methodology/special features
- Sampler's signature
- Method of shipment to the laboratory

After samples are collected, chain-of-custody records will be used to trace the possession and handling of the samples. A chain-of-custody record is a printed form that accompanies a sample or group of samples as custody is transferred from person to person. Figure 3-1 provides the typical chain-of-custody document.

As soon as practical after sample collection, the following information must be entered, in indelible ink, on the chain-of-custody record:

1. Project number.
2. Project name.
3. Sampler(s) signature(s).
4. Sample identification code for each sample contained in the shipment. This code appears on the sample label.
5. The date-of-collection of each sample, entered as six-digit number indicating the year, month, and day.
6. The time-of-collection of each sample, entered as a four-digit number indicating the military time of collection; for example, the time entered for a sample collected at 1:54 p.m. would be 13:54 hrs.
7. The matrix of each sample (e.g. soil, aqueous, sludge).
8. The analysis and analytical method to be performed for each sample.

9. The number of containers for each sample identification code (when analyzing for several chemical parameters, a number of containers are filled at each sampling location).

10. Remarks. Enter any appropriate remarks.

A person is in custody of a sample if the sample is:

- In that person's physical possession;
- In view after being in that person's physical possession;
- Placed in a locked repository by that person, or;
- Placed in a secure, restricted area by that person.

Custody of the samples may be transferred several times prior to their arrival at the laboratory. For example, a field team shipper may be designated to receive all samples from field team members. When transferring custody to another responsible individual, perform the following:

1. Enter the date and time of sample transfer on the chain-of-custody form, and sign the form, under the "Relinquished by:" entry.
2. Make certain that the individual receiving custody signs the "Received by:" entry.

When transferring custody to a common carrier (e.g. Federal Express), perform the following:

1. Enter the date and time of sample transfer on the chain-of-custody form, and sign the form, under the "Relinquished by:" entry.
2. Enter the name of the carrier under the "Received by:" entry.
3. Enter the bill-of-lading or Federal Express airbill number under the "Remarks:" entry.
4. Follow the packaging procedures presented in Section 3.2.3

3.2.3. Sample Shipping

The following procedures shall be followed for packaging and shipping of samples:

1. Coolers shall be used to ship samples.
2. All labels shall be written with indelible ink.
3. Approximately 3 inches of inert cushioning material such as vermiculite shall be placed in the bottom of the cooler.

4. Each sample container shall be enclosed in a clear plastic bag through which the labels are visible, and the bag sealed. The containers shall be placed upright in the cooler in such a way that they do not touch, and will not touch during shipping.

5. Additional vermiculite packing material shall be placed in the cooler to partially cover the sample containers (more than halfway). Bags of ice shall then be placed around, among, and on top of the sample containers.

6. The cooler shall then be filled with cushioning material.

7. The original chain of custody form shall be placed in a waterproof plastic bag and placed inside the cooler. Retain a copy of the form with the field records.

8. The drain of the cooler shall be taped shut.

9. The cooler lid shall be secured by taping. The cooler shall be wrapped completely with strapping tape at a minimum of two locations in such a way that no labels are covered.

10. The shipping label shall be attached to top of cooler.

11. "This Side Up" labels with arrows and "Fragile" labels shall be placed on at least two sides of the cooler.

12. Numbered and signed custody seals shall be affixed on the front right and back left sides of the cooler, across the lid and body of the cooler. These seals shall be covered with wide, clear tape.

3.2.4. Sample Custody in the Laboratory

Once the samples arrive at the laboratory, custody of the samples will be maintained by laboratory personnel. Each sample will be identified upon receipt by the laboratory and cross-referenced to the chain-of-custody record. Any inconsistencies will be noted on the custody record. Laboratory personnel will immediately notify the Malcolm Pirnie Quality Control Officer, field manager, or project manager if inconsistencies are identified.

The analytical laboratory will have written SOPs for maintaining security of samples and tracking the work performed on samples through the entire analytical process. The SOP requires that sample receipt, sample extraction/preparation, sample analysis, data reduction and data reporting be documented by the laboratory.

3.2.5. Document Control

Document control consists of maintaining a project file, an analytical laboratory batch file, a project field file, and a QA project file. The project file will be maintained by the Malcolm Pirnie Project Manager and will contain all original documents. Project personnel may keep their own files; however, all original documents will be kept in the project file. All laboratory records, including batch forms, log sheets, and computerized worksheets, will be kept by the analytical laboratory in a batch file in the sample control center. Field logs will be maintained by the project manager in a project field file. The project QA supervisor will independently maintain a QA project file. At the end of the project, the QA project file will be turned over to the project manager. The following documents will be placed in the QA project file:

1. QA records maintained throughout the investigation;
2. Documentation of QA system and performance audits;
3. Documentation of all unusual findings or observations;
4. Documentation of all QA corrective actions;
5. All official QA correspondence received or issued relating to the investigation, including records of telephone calls;
6. One copy of all QA deliverable review sheets; and
7. Any other QA documents related to the project or follow-up activities related to the investigation.

3.3. Equipment Calibration and Maintenance Procedures

Instruments must be properly calibrated to produce technically valid data. Documented calibration and calibration check results verify that the instruments used for measurement are in proper working order and the data produced are reliable. The calibration requirements described or referenced in this section are necessary to support the data quality objectives for this project. When calibration requirements are met, the data will support the focused investigation decisions dealing with the nature and extent of contamination and safety concerns. In the event that the data are used in court, documented calibrations are necessary to ensure that the data are legally defensible.

3.3.1. Field Equipment Calibration

The following table provides a list of the tasks that will require field equipment, and the specific field instruments that will be used for each task and which require calibration.

TASK	FIELD INSTRUMENT
Groundwater Sampling	MiniRae Photoionization Detector pH Meter Temperature Probe Specific Conductivity Meter Turbidimeter Hach DR 800 Series Colorimeter Reduction Potential Meter Dissolved Oxygen Probe

3.3.2. General Procedures

Field equipment to be used during groundwater sampling will be operated and maintened per the manufacturer's instructions. General calibration procedures and requirements are described below:

- All instruments will be calibrated at least once a month.
- All instruments will have the calibrations checked at a minimum at the start of each day before measurements are made.
- The calibration and calibration checks will indicate that the sensitivity of the instrument (practical detection limit) is adequate to meet project needs and that the instrument is accurate over the working range.
- All calibration information will be recorded in the field log book. This includes date and time, technician signature, calibration procedure, calibration results, calibration problems, recalibration and maintenance, and instrument serial numbers.
- All calibration standards will be of National Bureau of Standards (NBS) quality and their sources listed and documented so that standards are traceable. In addition, only technicians trained in the use of the field instruments will operate them. If the instrument readings are incorrect at the time of the initial calibration, the instrument will either be calibrated by the technician or returned to the manufacturer for calibration. If the instrument readings are incorrect after a continuing calibration check, the preceding sample results will be reviewed for validity, and reanalyzed if necessary.

3.4. Investigation Derived Waste

Groundwater that is purged from monitoring wells will be discharged to the ground surface within 50 feet of each monitoring well location in accordance with the NYSDEC Proposed Technical and Administrative Guidance Memorandum (TAGM) - Disposal of contaminated groundwater generated during Site Investigations, if the following criteria are met:

1. There is a defined site which is the source of the groundwater contamination;
2. There is no free product observed such as DNAPLs or LNAPLs;
3. The infiltrating groundwater is being returned to the same water bearing zone from which it is being purged.

If there is no recharge surface (i.e., grass, uncovered soil, etc.) located within 50 feet of a well, then the purge water will be containerized, brought to the Siberia Area, and discharged to the ground in a designated area up-gradient of the reactive wall area.

For the Building 40 monitoring wells and other wells that do not meet the above criteria, the materials will be containerized onsite in a polyethylene storage tank and disposed off-site in accordance with federal, state, and local regulations. Some disposable personal protective equipment (PPE) and decontamination fluids will be generated. Attempts will be made to wash surface contamination off so that PPE (i.e., gloves and other disposable items) may be disposed of as ordinary solid waste. If contamination is suspected, these materials will be collected and containerized in DOT-approved, 55-gallon steel drums (separately from contaminated groundwater and disposed of off-site). IDW control procedures are discussed in more detail in Section 3.0.

4. Contingency Evaluation Protocol

Due to the presence of chlorinated VOCs (CVOCs) in the compliance boundary monitoring wells in the Building 40 area, and monitoring wells in the Building 25 and Building 114 areas, a contingency monitoring plan has been developed. The contaminants of concern (COCs) in the wells are as follows:

- Trichloroethene (TCE)
- Tetrachloroethene (PCE)
- Cis-1,2-dichloroethene (cDCE)
- Vinyl chloride (VC)

4.1. Statistical Trigger

The proposed contingency evaluation protocol utilizes a well- and contaminant-specific statistical "trigger" concentration that initiates a contingency evaluation in the event groundwater monitoring data indicates a potential changes in site conditions. This method is currently utilized by the NYSDEC for solid waste landfill monitoring programs to evaluate if a statistically significant release from a landfill has occurred [6 NYCRR Part 360-2.11(c)(5)(i)]. The statistical trigger will be calculated as follows:

1. The results for the COCs in each of the wells from the period of the spring of 2004 through the spring of 2009 were averaged to determine the mean "background concentration". The standard deviation of the "background" data set was also established. The "background" mean and standard deviation will be the basis for all future comparisons.

2. Trigger values were established for each COC in each well as the sum of the background mean plus three times the background standard deviation. This test is commonly used to identify outlying data that fall outside the expected range of values based on a given baseline data set.

3. Monitoring events during which permanganate was present in the Building 40 compliance boundary wells (i.e, assumed zero concentrations) were not included in the calculations.

4. Monitoring events during which the compound was not detected were included as one half of the laboratory reporting limit for that compound.

Table 4-1 presents a summary of the minimum, maximum, average, and standard deviation for each compound in each well, and lists the statistical trigger concentrations calculated from the data.

4.2. Contingency Monitoring

Upon receipt of analytical data, the result for each of the COCs in the wells in Table 4-1 will be compared against the statistical trigger concentration. If the data for the COCs in a given well exceed the statistical trigger concentrations, the NYSDEC will be notified of the condition within 15 days and potential follow up actions will be determined in consultation with the NYSDEC. If samples from three or more of the Building 40 compliance boundary wells contain COCs at concentrations greater than the corresponding statistical trigger concentrations, verification sampling consisting of quarterly sampling for one year will be conducted, with sampling results provided to the NYSDEC each quarter. The objective of the verification sampling will be to evaluate the potential causes of the increase in COC concentrations; to assess whether changes to the monitoring program are required; and, if necessary, to perform a risk evaluation and technology screening to evaluate potential corrective measures technologies that may be applicable to the site. Based on the results of the verification sampling, potential follow-up actions will be determined in consultation with the NYSDEC. For wells in the Building 25 and Building 114 areas, the need for reinstatement of more frequent monitoring conditions will be determined in consultation with the NYSDEC. Significant increases in the levels of COCs will be discussed in the annual monitoring report and recommendations made for further actions, if necessary.

5. Reporting

Malcolm Pirnie will prepare an annual Data Summary Report and submit the report for review to the USACE - Baltimore District, Watervliet Arsenal, and the NYSDEC. The purpose of this report will be to present the field observations from that year's sampling event and summary figures and tables of the analytical data. The report will also present the recommendations for site activities to be completed prior to the next sampling event, and/or recommendations for adjustments to the LTM Plan.

6. References

Malcolm Pirnie, 2004, Corrective Measures Work Plan – Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2004a, Corrective Measures Monitoring Plan, Building 40 Groundwater, Watervliet Arsenal, Watervliet, New York.

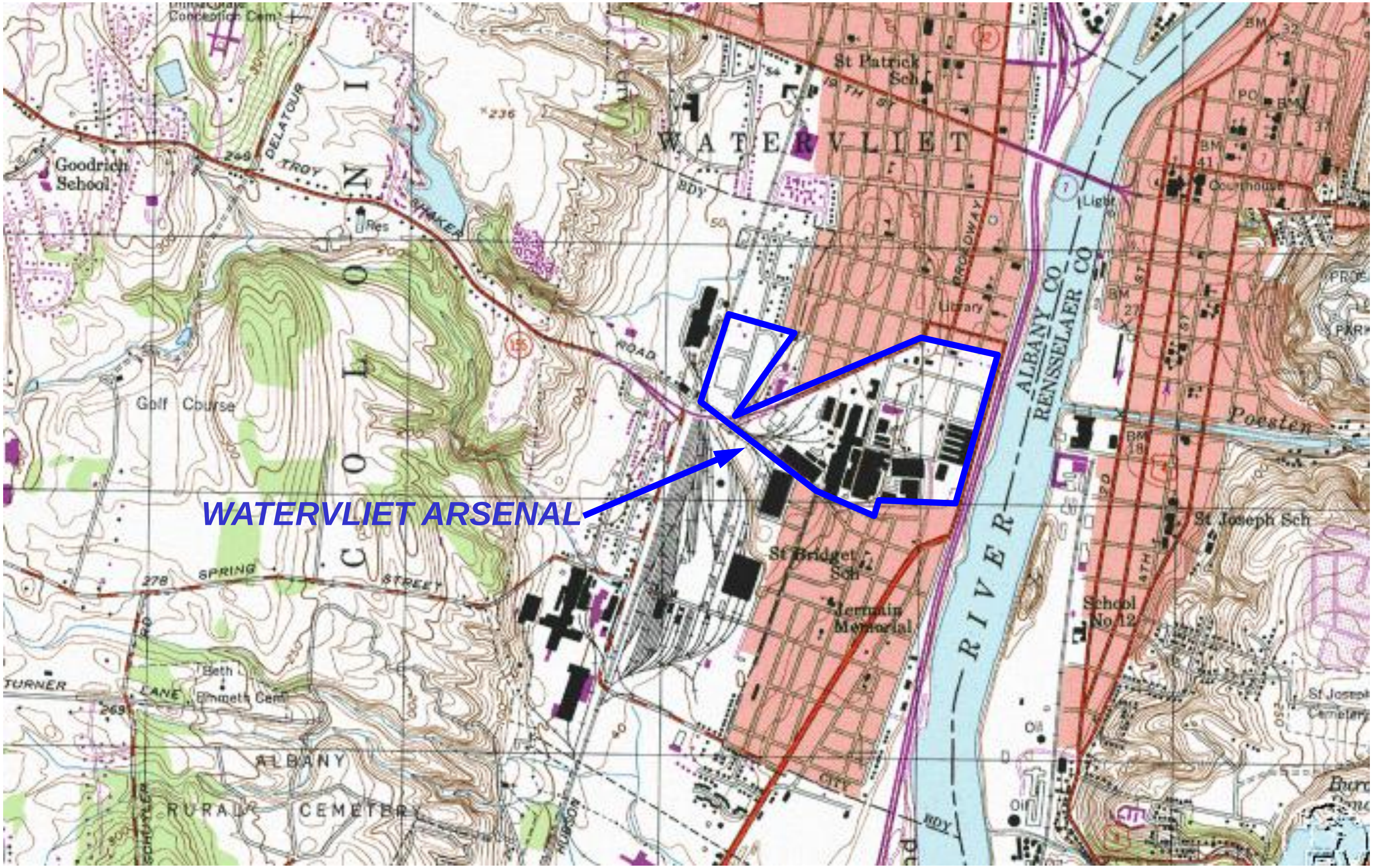
Malcolm Pirnie, 2009, Corrective Measures Performance Evaluation Report, Building 40 Bedrock Groundwater Corrective Measures, Main Manufacturing Area, Watervliet Arsenal, Watervliet, New York.

Malcolm Pirnie, 2010, VOC Mass Discharge Evaluation and Long-Term Monitoring Work Plan, Building 40 Bedrock Groundwater, Watervliet Arsenal, Watervliet, New York – Attachment B to the Response to Comments on Malcolm Pirnie, 2009.

USACE - Baltimore District
WVA Long-Term Monitoring Plan Update

Figures

MALCOLM
PIRNIE



SCALE IN FEET

0 1000 2000 4000

SOURCE: U.S.G.S 7.5 MIN. TROY SOUTH QUADRANGLE

US Army Corps
of Engineers
Baltimore District

WATERVLIET ARSENAL
WATERVLIET, NEW YORK

LONG-TERM MONITORING PLAN UPDATE

SITE LOCATION

FIGURE 1-1

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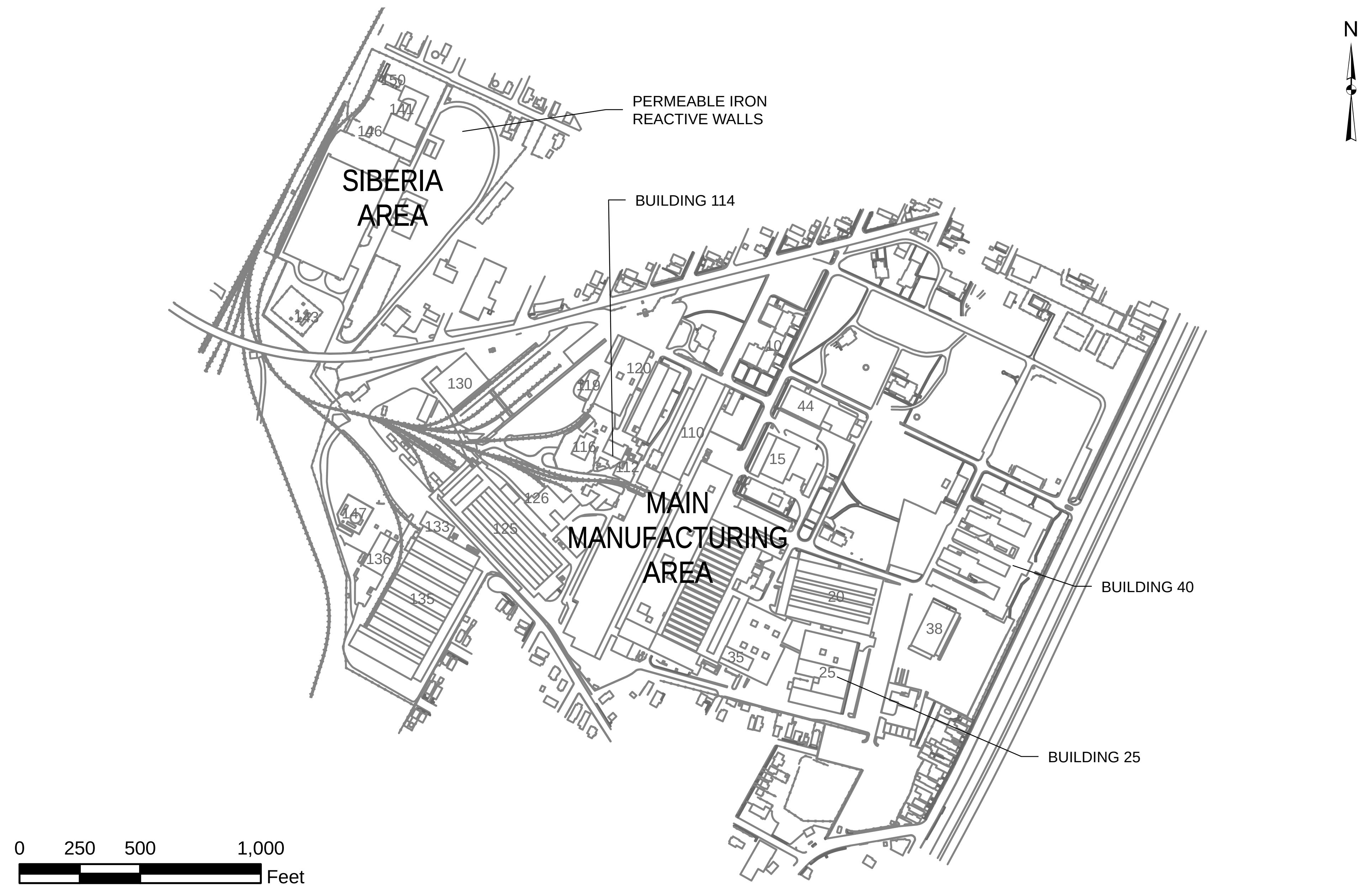


US Army Corps
of Engineers

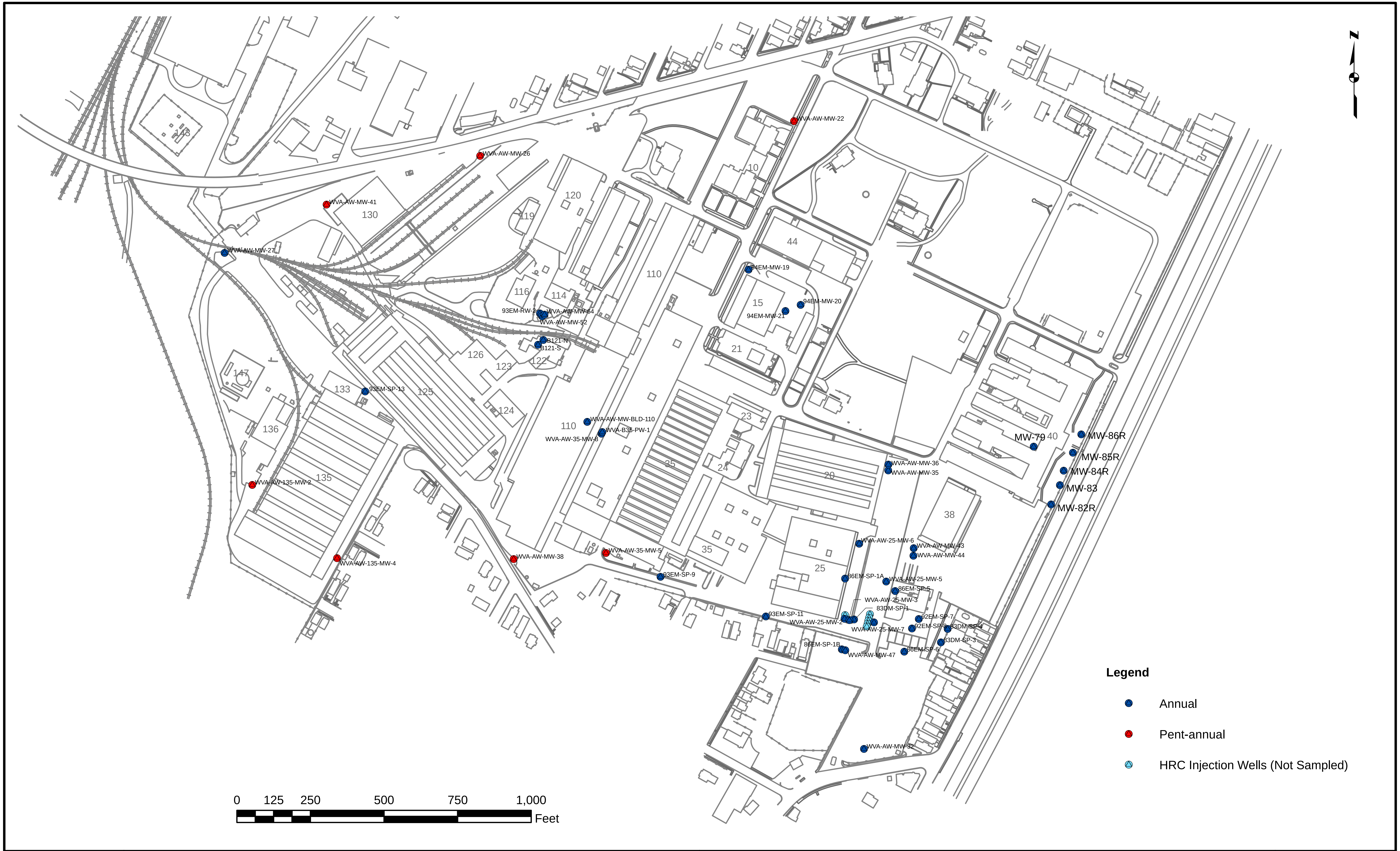
LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SITE MAP

MALCOLM PIRNIE, INC.

AUGUST 2010

FIGURE 1-2



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US Army Corps
of Engineers

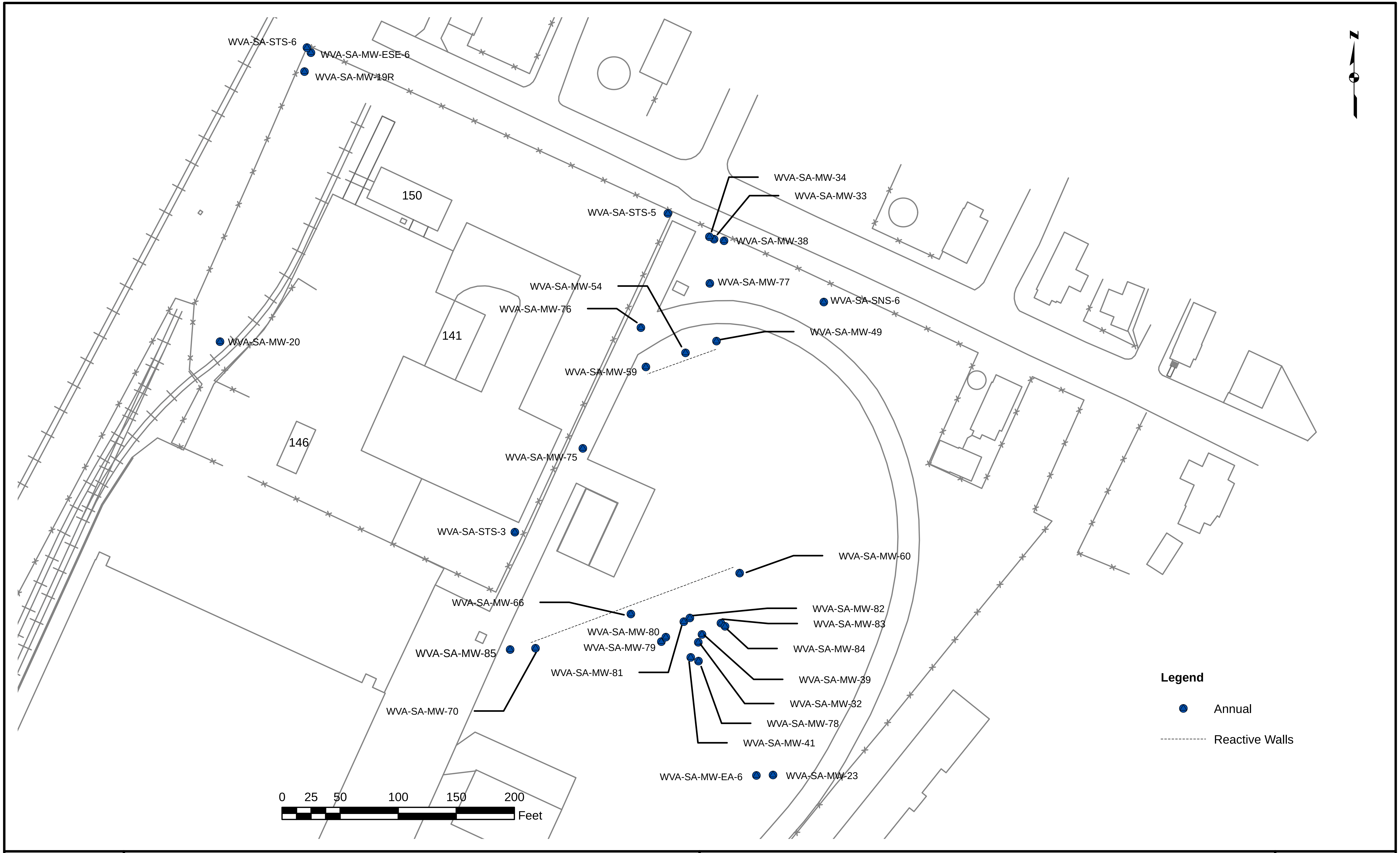
LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

MAIN MANUFACTURING AREA
GROUNDWATER MONITORING LOCATIONS

MALCOLM PIRNIE, INC.

AUGUST 2010

FIGURE 2-1



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US Army Corps
of Engineers

LONG-TERM MONITORING PLAN UPDATE
WATERVLIET ARSENAL
WATERVLIET, NEW YORK

SIBERIA AREA
GROUNDWATER MONITORING LOCATIONS

MALCOLM PIRNIE, INC.

AUGUST 2010

FIGURE 2-2

MALCOLM PIRNIE

CHAIN OF CUSTODY RECORD

518-782-2100
fax: 518-782-0500

MALCOLM PIRNIE, INC.
43 BRITISH-AMERICAN BOULEVARD
LATHAM, NEW YORK 12110
http://www.pirnie.com

CLIENT: ____________________

PROJECT: ____________________

PROJECT NUMBER: ____________________

LABORATORY: ____________________

LABORATORY CONTACT: ____________________

SPECIAL INSTRUCTIONS:

LAB ID	SAMPLE ID/ DESCRIPTION	DATE	TIME	MATRIX	GRAB/ COMPOSITE	No. of Cont.	ANALYSIS REQUIRED	NOTES / PRESERVATIVE

Matrix Identification:

- **S - SOIL**
- **SE- SEDIMENT**
- **SO - SOLID**
- **SL - SLUDGE**
- **DW - DRINKING WATER**
- **GW - GROUND WATER**
- **O - OIL**
- **SW - SURFACE WATER**
- **L - LEACHATE**
- **A - AIR**
- **WI - WIPE**
- **DS - DRUM SOLID**
- **DL - DRUM LIQUIDS**
- **X - OTHER**
- **WW - WASTE WATER**

LAB USE ONLY

SAMPLED BY (SINGATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
RELINQUISHED BY (SIGNATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
RELINQUISHED BY (SIGNATURE):	DATE/TIME	RECEIVED BY (SIGNATURE):	DATE/TIME:
METHOD OF SHIPMENT:	DATE/TIME	LAB USE ONLY:	
RECEIVED AT LABORATORY:	DATE/TIME		

US Army Corps
of Engineers
Baltimore District

WATERVLIET ARSENAL
WATERVLIET, NEW YORK

LONG-TERM MONITORING PLAN UPDATE

TYPICAL CHAIN-OF-CUSTODY

FIGURE 3-1

USACE - Baltimore District
WVA Long-Term Monitoring Plan Update

Tables

Table 2-1
Long Term Monitoring Wells (Updated July 2009)
Main Manufacturing Area
Watervliet Arsenal, Watervliet, New York

Well	Area Monitored	Geologic Unit	VOCs	SVOCs	Metals	NAP	Sampling Frequency
83DM-SP-1	Building 25	Hybrid (a)	**X**			**X**	Annual
83DM-SP-3	WWTP	Bedrock	**X**		**X** (b)	**X**	Annual
83DM-SP-4	WWTP	Bedrock	**X**				Annual
86EM-SP-1A	Building 25	Overburden	**X**				Annual
86EM-SP-1B	Building 25	Overburden	**X**				Annual
86EM-SP-5	Building 25	Overburden	**X**	**X**		**X**	Annual
86EM-SP-6	WWTP	Overburden	**X**		**X**	**X**	Annual
92EM-SP-7	WWTP	Overburden	**X**			**X**	Annual
92EM-SP-8	WWTP	Overburden	**X**	**X**		**X**	Annual
93EM-SP-9	WVA boundary	Overburden	**X**				Annual
93EM-SP-11	Building 25	Overburden	**X**				Annual
93EM-SP-13	Building 135	Bedrock	**X**	**X**			Annual
94EM-MW-19	Building 15	Bedrock	**X**		**X**		Annual
94EM-MW-20	Building 15	Bedrock	**X**		**X**		Annual
94EM-MW-21	Building 15	Bedrock	**X**		**X**		Annual
93EM-RW-2	Building 114	Bedrock	**X**			**X**	Annual
WVA-AW-25-MW-2	Building 25	Bedrock	**X**			**X**	Annual
WVA-AW-25-MW-3	Building 25	Overburden	**X**			**X**	Annual
WVA-AW-25-MW-5	Building 25	Hybrid (a)	**X**	**X**			Annual
WVA-AW-25-MW-6	Building 25	Overburden	**X**				Annual
WVA-AW-25-MW-7	Building 25	Bedrock	**X**			**X**	Annual
WVA-AW-35-MW-5	Building 35	Bedrock	**X**				Pent-annual
WVA-AW-35-MW-8	Building 35	Bedrock	**X**	**X**			Annual
WVA-AW-135-MW-2	Building 135	Bedrock	**X**				Pent-annual
WVA-AW-135-MW-4	Building 135	Bedrock	**X**	**X**		**X**	Pent-annual
WVA-AW-MW-22	WVA boundary	Bedrock	**X**				Pent-annual
WVA-AW-MW-26	WVA boundary	Bedrock	**X**				Pent-annual
WVA-AW-MW-27	WVA boundary	Overburden	**X**				Annual
WVA-AW-MW-32	WVA boundary	Weathered	**X**				Annual
WVA-AW-MW-35	Building 20	Bedrock	**X**				Annual
WVA-AW-MW-36	Building 20	Overburden	**X**				Annual
WVA-AW-MW-38	WVA boundary	Bedrock	**X**				Pent-annual
WVA-AW-MW-41	WVA boundary	Bedrock	**X**				Pent-annual
WVA-AW-MW-42	Building 120	Weathered					

Notes:
WWTP - Wastewater treatment plant.
(a) Overburden and weathered bedrock.
(b) Chromium only.

Table 2-1
Long Term Monitoring Wells (Updated July 2009)
Main Manufacturing Area
Watervliet Arsenal, Watervliet, New York

Well	Area Monitored	Geologic Unit	VOCs	SVOCs	Metals	NAP	Sampling Frequency
WVA-AW-MW-43	Building 25	Overburden	X	X			Annual
WVA-AW-MW-44	Building 25	Overburden	X	X			Annual
WVA-AW-MW-47	WVA boundary	Weathered	X			X	Annual
WVA-AW-MW-52	Building 114	Bedrock	X			X	Annual
WVA-AW-MW-64	Building 114	Bedrock	X			X	Annual
B121N	Building 121	Hybrid (a)	X			X	Annual
B121S	Building 121	Hybrid (a)	X			X	Annual
WVA-AW-MW-BLD-110	Building 110	Bedrock	X	X			Annual
WVA-B35-PW-1	Building 110	Bedrock	X	X			Annual
WVA-MW-79	Building 40	Bedrock	X				Annual
WVA-MW-82R-1	Building 40	Bedrock	X				Annual
WVA-MW-82R-2	Building 40	Bedrock	X				Annual
WVA-MW-82R-3	Building 40	Bedrock	X				Annual
WVA-MW-83-1	Building 40	Bedrock	X				Annual
WVA-MW-83-2	Building 40	Bedrock	X				Annual
WVA-MW-83-3	Building 40	Bedrock	X				Annual
WVA-MW-84R-1	Building 40	Bedrock	X				Annual
WVA-MW-84R-2	Building 40	Bedrock	X				Annual
WVA-MW-84R-3	Building 40	Bedrock	X				Annual
WVA-MW-85R-1	Building 40	Bedrock	X				Annual
WVA-MW-85R-2	Building 40	Bedrock	X				Annual
WVA-MW-85R-3	Building 40	Bedrock	X				Annual
WVA-MW-86R-1	Building 40	Bedrock	X				Annual
WVA-MW-86R-2	Building 40	Bedrock	X				Annual
WVA-MW-86R-3	Building 40	Bedrock	X				Annual

Notes:
WWTP - Wastewater treatment plant.
(a) Overburden and weathered bedrock.
(b) Chromium only.

Table 2-2
Long Term Monitoring Wells (Updated July 2010)
Siberia Area
Watervliet Arsenal, Watervliet, New York

Well	**Area Monitored**	**Geologic Unit**	**Sample in LTM**	**VOCs**	**SVOCs**	**Metals**	**NAP**	**Sampling Frequency**
WVA-SA-MW-19R	WVA boundary	Overburden	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-20	WVA boundary	Overburden	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-23	WVA boundary	Bedrock	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-32	Burn Pit	Overburden	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-33	WVA boundary	Overburden	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-34	WVA boundary	Bedrock	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-38	WVA boundary	Weathered	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-39	Burn Pit	Weathered	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-41	Burn Pit	Bedrock	**X**	**X**	**X**		**X**	Annual
WVA-SA-MW-49	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-54	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-59	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-60	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-66	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-70	Reactive Wall	Overburden	**X** (b)	**X**				Annual
WVA-SA-MW-75	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-76	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-77	Reactive Wall	Weathered	**X** (b)	**X**				Annual
WVA-SA-MW-78	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-79	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-80	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-81	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-82	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-83	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-84	Burn Pit	Bedrock	**X**	**X**			**X**	Annual
WVA-SA-MW-85	Reactive Wall	Hybrid (a)	**X** (b)	**X**				Annual
MW-EA-6	WVA boundary	Weathered	**X**	**X**	**X**		**X**	Annual
MW-ESE-6	WVA boundary	Overburden	**X**	**X**	**X**		**X**	Annual
STS-3	Sewer	Storm Sewer	**X**	**X**	**X**			Annual
STS-5	Sewer	Storm Sewer	**X**	**X**	**X**			Annual
STS-6	Sewer	Storm Sewer	**X**	**X**	**X**			Annual
SNS-6	Sewer	Sanitary Sewer	**X**	**X**	**X**		**X**	Annual

Notes:
(a) Overburden and weathered bedrock.
(b) Sampled using passive diffusion bags.

Table 3-1
Methods for Sample Analysis
Long-Term Groundwater Monitoring Program
Watervliet Arsenal, Watervliet, New York

ANALYTE	METHOD
Volatile Organics	SW-846 8260B
Semi-Volatile Organics	SW-846 8270C
Metals	SW-846 6010C & 7470A
Dissolved Sulfide	EPA 376.1
Dissolved Organic Carbon	SW-846 9060
Dissolved Gases (a)	AM15.01
Ferrous Iron	Hach® Field Colorimeter
Nitrate	Hach® Field Colorimeter
Nitrite	Hach® Field Colorimeter
Sulfate	Hach® Field Colorimeter
Chloride	Hach® Field Colorimeter
Alkalinity	Hach® Field Titration Kit

(a) Dissolved gases are methane, ethane, ethene, and carbon dioxide.

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8260B Liquid	
Analytes	RL ug/L
1,1,1-Trichloroethane	0.5
1,1,2,2-Tetrachloroethane	0.5
1,1,2-Trichloroethane	0.75
1,1-Dichloroethane	0.75
1,1-Dichloroethene	0.5
1,2-Dichloroethane	0.5
1,2-Dichloropropane	1.8
2-Butanone	5.0
Benzene	0.5
Bromodichloromethane	0.5
Bromoform	2.0
Bromomethane	1.0
Carbon disulfide	5.0
Carbon tetrachloride	0.5
Chlorobenzene	0.5
Chloroethane	1.0
Chloroform	0.75
Chloromethane	2.5
cis-1,3-Dichloropropene	0.5
Dibromochloromethane	0.5
Ethylbenzene	0.5
Methylene chloride	5
o-Xylene	1.0
p/m-Xylene	1.0
Tetrachloroethene	0.5
Toluene	0.75
trans-1,2-Dichloroethene	0.75
trans-1,3-Dichloropropene	0.5
Trichloroethene	0.5
Trichlorofluoromethane	2.5
Vinyl chloride	1.0

NY TCL EPA 8270C Liquid	
Analytes	RL ug/L
1,2,4-Trichlorobenzene	5
1,2-Dichlorobenzene	5
1,3-Dichlorobenzene	5
1,4-Dichlorobenzene	5
2,4,6-Trichlorophenol	5
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrophenol	30
2,4-Dinitrotoluene	6
2,6-Dinitrotoluene	5

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8270C Liquid	
Analytes	RL ug/L
2-Chloronaphthalene	6
2-Chlorophenol	6
2-Methylnaphthalene	5
2-Nitrophenol	20
3,3'-Dichlorobenzidine	50
4-Bromophenyl phenyl ether	5
4-Chlorophenyl phenyl ether	5
4-Nitrophenol	10
Acenaphthene	5
Acenaphthylene	5
Anthracene	5
Benzidine	50
Benzo(a)anthracene	5
Benzo(a)pyrene	5
Benzo(b)fluoranthene	5
Benzo(ghi)perylene	5
Benzo(k)fluoranthene	5
Bis(2-chloroethoxy)methane	5
Bis(2-chloroethyl)ether	5
Bis(2-chloroisopropyl)ether	5
Bis(2-Ethylhexyl)phthalate	5
Butyl benzyl phthalate	5
Chrysene	5
Dibenzo(a,h)anthracene	5
Diethyl phthalate	5
Dimethyl phthalate	5
Di-n-butylphthalate	5
Di-n-octylphthalate	5
Fluoranthene	5
Fluorene	5
Hexachlorobenzene	5
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	30
Hexachloroethane	5
Indeno(1,2,3-cd)Pyrene	7
Isophorone	5
Naphthalene	5
Nitrobenzene	5
NitrosoDiPhenylAmine(NDPA)/DPA	15
n-Nitrosodimethylamine	50
n-Nitrosodi-n-propylamine	5
Pentachlorophenol	10
Phenanthrene	5
Phenol	7
Pyrene	5

TABLE 3-2
Summary of Contract Required Quantitation Limits
Long-Term Monitoring Program
Watervliet Arsenal
Watervliet, New York

NY TCL EPA 8270CSIM Liquid	
Analytes	RL ug/L
2-Chloronaphthalene	0.2
2-Methylnaphthalene	0.2
Acenaphthene	0.2
Acenaphthylene	0.2
Anthracene	0.2
Benzo(a)anthracene	0.2
Benzo(a)pyrene	0.2
Benzo(b)fluoranthene	0.2
Benzo(ghi)perylene	0.2
Benzo(k)fluoranthene	0.2
Chrysene	0.2
Dibenzo(a,h)anthracene	0.2
Fluoranthene	0.2
Fluorene	0.2
Hexachlorobenzene	0.8
Hexachlorobutadiene	0.5
Hexachloroethane	0.8
Indeno(1,2,3-cd)Pyrene	0.2
Naphthalene	0.2
Pentachlorophenol	0.8
Phenanthrene	0.2
Pyrene	0.2

TAL Metals - 6010B/7471A	
Element	RL mg/L
Arsenic	0.005
Barium	0.010
Cadmium	0.005
Chromium	0.010
Lead	0.010
Mercury	0.0002
Selenium	0.010
Silver	0.007

Table 3-3

Sample Containers, Preservation, and Holding Time Requirements
Long-Term Monitoring Program
Watervliet Arsenal, Watervliet, New York

MATRIX	ANALYSIS	CONTAINER	PRESERVATION	HOLDING TIME
Groundwater	Volatiles - 8260	2 - 40 mL glass	HCl Cool to 4°C	7 days
Groundwater	Semi-Volatiles - 8270	1 - 1L amber glass	Cool to 4°C	7 days
Groundwater	Metals – 6010 & 7470	500 mL - plastic	HNO_3 Cool to 4°C	180 days
Groundwater	Dissolved Sulfide - EPA 376.1	500 mL - plastic	NaOH Cool to 4°C	5 days
Groundwater	Dissolved Organic Carbon - 9060	100 mL - plastic	H_2SO_4 Cool to 4°C	26 days
Groundwater	Dissolved Gases - AM15.01 (a)	4 - 40 mL glass	Cool to 4°C	14 days
Groundwater	Chloride, Nitrate, Nitrite, Sulfate	NA - Hach Field Colorimeter	NA	NA
Groundwater	Alkalinity	NA - Hach Drop Titration Kit	NA	NA

(a) Methane, ethane, ethene, carbon dioxide.

Table 4-1
Summary of Baseline Groundwater Data and Trigger Values
Long-Term Monitoring Plan Update
Watervliet Arsenal, Watervliet, New York

Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-82R-1	Building 40	Vinyl chloride	45	250	88	73	307
		cis-1,2 DCE	170	940	526	261	1,310
		TCE	20	480	177	141	599
		PCE	41	2,200	746	650	2,696
MW-82R-2	Building 40	Vinyl chloride	48	160	89	42	214
		cis-1,2 DCE	110	350	224	77	454
		TCE	1	10	4.7	4	17
		PCE	1	10	4.6	3.7	16
MW-82R-3	Building 40	Vinyl chloride	4.2	76	22	25	97
		cis-1,2 DCE	1.1	65	35	46	174
		TCE	2.5	2.5	2.3	0.4	4
		PCE	0.6	2.5	2.2	0.8	4
MW-83-1	Building 40	Vinyl chloride	120	1,000	396	307	1,318
		cis-1,2 DCE	4,300	6,000	5,278	626	7,156
		TCE	2,400	10,000	4,022	2,313	10,963
		PCE	6,100	29,000	10,078	7,320	32,039
MW-83-2	Building 40	Vinyl chloride	320	980	550	197	1,141
		cis-1,2 DCE	5,900	11,000	8,344	1,671	13,358
		TCE	960	5,300	3,473	1,530	8,064
		PCE	250	12,000	7,283	4,369	20,391
MW-83-3	Building 40	Vinyl chloride	49	670	320	203	928
		cis-1,2 DCE	1,300	6,350	2,979	1,659	7,955
		TCE	190	915	361	260	1,141
		PCE	410	2,600	943	776	3,272

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Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-84R-1	Building 40	Vinyl chloride	125	1,200	436	365	1,530
		cis-1,2 DCE	3,300	9,200	6,810	1,962	12,696
		TCE	1,300	5,100	2,085	1,125	5,461
		PCE	940	6,900	2,834	1,974	8,756
MW-84R-2	Building 40	Vinyl chloride	440	5,000	1,560	1,527	6,141
		cis-1,2 DCE	5,100	11,000	8,550	2,217	15,202
		TCE	8,150	20,000	13,675	3,583	24,423
		PCE	47,000	75,000	59,000	9,006	86,019
MW-84R-3	Building 40	Vinyl chloride	380	1,900	872	480	2,311
		cis-1,2 DCE	6,600	21,000	10,717	4,240	23,438
		TCE	3,400	14,000	7,333	3,319	17,290
		PCE	3,800	20,500	12,967	5,334	28,968
MW-85R-1	Building 40	Vinyl chloride	4	130	53	41	175
		cis-1,2 DCE	2	1,400	346	466	1,743
		TCE	0.5	235	30	77	261
		PCE	0.5	950	109	315	1,055
MW-85R-2	Building 40	Vinyl chloride	3	230	125	92	399
		cis-1,2 DCE	88	3,500	2,261	1,025	5,335
		TCE	16	730	436	275	1,261
		PCE	43	2,600	1,451	979	4,388

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Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
MW-85R-3	Building 40	Vinyl chloride	510	1,900	834	439	2,150
		cis-1,2 DCE	120	4,100	2,719	1,136	6,126
		TCE	255	3,400	1,346	928	4,130
		PCE	100	32,000	23,200	11,366	57,299
MW-86R-1	Building 40	Vinyl chloride	11	89	36	27	118
		cis-1,2 DCE	26	850	321	275	1,146
		TCE	1	305	45	99	342
		PCE	1.1	1,200	142	397	1,333
MW-86R-2	Building 40	Vinyl chloride	19	91	39	21	102
		cis-1,2 DCE	390	1,400	1,054	322	2,021
		TCE	92	440	240	128	625
		PCE	290	5,350	1,684	1,660	6,665
MW-86R-3	Building 40	Vinyl chloride	28	1,200	575	357	1,647
		cis-1,2 DCE	2,150	8,400	5,594	2,113	11,934
		TCE	240	1,800	753	564	2,445
		PCE	330	6,900	2,036	2,161	8,520

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Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
83DM-SP-1	Building 25	Vinyl chloride	0.4	25	4.1	7.4	26
		cis-1,2 DCE	1.2	89	14.5	27.0	95
		TCE	3.6	76	16	21.7	81
		PCE	0.25	2.5	1.6	1.1	5
86EM-SP-1A	Building 25	Vinyl chloride	0.4	2.5	1.7	1.0	5
		cis-1,2 DCE	1.5	3.2	2.3	0.6	4
		TCE	8.2	15	11.5	2.2	18
		PCE	0.25	2.5	1.4	1.1	5
WVA-AW-25-MW-2	Building 25	Vinyl chloride	2.8	15	7.8	3.8	19
		cis-1,2 DCE	9.4	64	22.7	15.8	70
		TCE	6	75	21.8	20.7	84
		PCE	0.3	2.5	1.6	1.1	5
WVA-AW-25-MW-3	Building 25	Vinyl chloride	13	27	20.7	5	36
		cis-1,2 DCE	100	190	143	33	242
		TCE	16	170	81.9	52.4	239
		PCE	0.25	5	2.3	1.7	7
WVA-AW-25-MW-6	Building 25	Vinyl chloride	0.8	12.5	4.9	3.8	16
		cis-1,2 DCE	0.6	12.5	4.7	4.1	17
		TCE	250	360	287	37.4	399
		PCE	0.5	12.5	3.8	3.8	15
WVA-AW-25-MW-7	Building 25	Vinyl chloride	0.5	2.5	1.5	0.9	4
		cis-1,2 DCE	0.25	16	3	4.8	17
		TCE	0.25	4	1.8	1.3	6
		PCE	0.25	14	2.8	4.1	15

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Monitoring Well	Area Monitored	Contaminant	Baseline Data (a)				Trigger Concentration (b)
			Minimum Concentration (ug/l)	Maximum Concentration (ug/l)	Average Concentration (ug/)	Standard Deviation (ug/l)	(ug/l)
WVA-AW-MW-52	Building 114	Vinyl chloride	0.4	2.5	1.7	1	5
		cis-1,2 DCE	0.5	2	1.2	0.5	3
		TCE	2	3.1	2.4	0.4	4
		PCE	2.5	7.4	5.4	1.4	10
WVA-AW-MW-64	Building 114	Vinyl chloride	58	780	503.8	214.8	1,148
		cis-1,2 DCE	380	2,500	1,648	569.1	3,355
		TCE	300	2,200	1,350	464.9	2,745
		PCE	990	5,300	3,619	1,218.8	7,275

Notes:
(a) Building 40 Baseline data calculated from 10 monitoring events (August 2004 through May 2009).
Building 25 and 114 baseline data calculated from 10 monitoring events (May 2004 through June 2009).
(b) Proposed trigger set at the 99% confidence interval (average plus 3 times standard deviation).
ug/l - micrograms per liter
DCE - Dichloroethene
TCE - Trichloroethene
PCE - Tetrachloroethene