Sampling and Analysis Plan for Long-Term Monitoring and Maintenance Program at 15 Landfills at United States Military Academy West Point, New York

Contract No. DACW41-01-D-0030
Task Order No. 0001

Prepared for

Department of the Army
Kansas City District, Corps of Engineers
601 East 12th Street, 700 Federal Building
Kansas City, Missouri 64106-2896

Prepared by

EA Engineering, P.C. and Its Affiliate
EA Engineering, Science, and Technology
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

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EA Engineering, P.C.

Michael S. Battle, P.G., Program Manager — 12/3/01 Date
EA Engineering, Science, and Technology

Charles E. McLeod, Jr., P.E., Project Manager — 12/3/01 Date
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SECTION C: SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN

1. OVERVIEW

Under Contract No. DACW41-01-D-0030, the U.S. Army Corps of Engineers (USACE)–Kansas City District issued Task Order No. 0001, dated 27 September 2001, to EA Engineering, P.C. and its affiliate EA Engineering, Science, and Technology to implement a long-term monitoring program consisting of annual ground-water monitoring and sampling, and monitoring well and landfill inspection and maintenance at 15 landfill sites at the United States Military Academy (USMA) at West Point, New York.

Long-term monitoring program activities will be conducted at the 15 landfills identified in the following table:

Landfill Identification No.	Landfill Name
WSTPT-01	PX Landfill
WSTPT-02	Michie Stadium – Lot A
WSTPT-03	Michie Stadium – Lot B
WSTPT-04	Michie Stadium – Lot C
WSTPT-05	Michie Stadium – Lot D
WSTPT-06	Michie Stadium – Lot E
WSTPT-7A	Michie Stadium – Lot F
WSTPT-09	Ski Lot Landfill
WSTPT-10	Post School Landfill
WSTPT-11	Motor Pool Landfill
WSTPT-11A	Motor Pool East Landfill
WSTPT-15B	High School Landfill
WSTPT-16	Organic Compost Landfill
WSTPT-35A	Camp Buckner Landfill
WSTPT-48	Building 706 Parking Lot Landfill

1.1 BACKGROUND

The background information contained in this section was excerpted from background materials provided by USMA. USMA is located in Orange County, New York, on the west bank of the Hudson River approximately 45 mi north of New York City. The military reservation at West Pont consists of 15,974 acres, of which the main Post comprises 2,520 acres. It is bounded by New York State Route 218, the Hudson River, the Village of Highland Falls, and U.S. Route 9W. USMA is a registered National Historic Landmark.

In November 1988, USMA submitted a Resource Conservation and Recovery Act Part B permit application to the U.S. Environmental Protection Agency for hazardous waste storage and a Subpart X permit for an open burn/open detonation site. USMA is considered a large quantity generator. Accumulated hazardous waste is moved to a central storage area where it is staged prior to shipment for up to 90 days. In December 1988, the application for the container storage facility was rescinded by USMA and the container storage sites underwent closure inspection and testing by the U.S. Environmental Protection Agency under "Closure Prior to Loss of Interim Status." Although the Part B permit had been rescinded, the corrective action provisions remain under Section 3004 (h) of the 1984 Hazardous and Solid Waste Amendments Act. The Subpart X permit application for the open burn/open detonation site has been withdrawn, although interim status still applies.

Because of corrective action requirements, various surveys and assessments were conducted to identify Solid Waste Management Units, abandoned underground storage tank locations, and other environmentally distressed areas. There are other sanitary landfills/sites in addition to the 15 landfill sites listed above; however, these sites are subject to Resource Conservation and Recovery Act Subtitle D requirements or contain clean construction and demolition debris with no evident releases. As a result, no further action is planned for these landfills/sites.

Sites covered under Section 3004(h) of the 1984 Hazardous and Solid Waste Amendments Act are subject to the Army's Installation Restoration Program requirements. USMA has completed or is close to completing most Installation Restoration Program initiatives. As a result, monitoring wells have been installed and corrective actions for landfills have been completed. An abbreviated Long-Term Monitoring Plan was prepared by USMA as one of the final phases of the Installation Restoration Program process. Monitoring well maintenance activities and landfill maintenance activities are also discussed in the Long-Term Monitoring Plan to ensure the success of the Installation Restoration Program.

Based upon the available analytical results, limited environmental impacts were identified in ground water. The contaminants of concern identified in previous studies, as well as a 17 February 1998 letter from the New York State Department of Environmental Conservation, are limited to Target Analyte List metals.

1.2 PURPOSE AND SCOPE

The purpose of the long-term monitoring program is to identify monitoring points and laboratory analyses to verify the effectiveness of the selected remedial actions (i.e., installing an impermeable cap on each landfill), and obtain data necessary to document the long-term changes in constituents of concern in ground water. The monitoring activities detailed in this Sampling and Analysis Plan include:

- Identification of sampling locations for ground water
- Procedures for sample collection
- Required analytical parameters and laboratory methods
- Reporting requirements to be followed to document the effectiveness of remedial actions
- Identification of engineering inspection activities
- Monitoring well and landfill maintenance actions and corrective measures to be undertaken should monitoring data indicate they are necessary.

The data collected during the performance of long-term monitoring will be used for the following purposes:

- Monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the site.

- Provide a tiered approach to attaining the New York State Department of Environmental Conservation water quality standards based on results of ground-water samples. Ground-water samples will be collected for trend assessment. In the event ambient water quality standards are exceeded, additional actions may be required. Conversely, consistent compliance with water quality standards may result in reduced sampling requirements.

- Assess the potential for adverse environmental impacts by monitoring for evidence of stressed vegetation.

- Evaluate the integrity of the ground-water monitoring wells.

- Monitor the condition of ground water to determine whether applicable or relevant and appropriate requirements are met.

A 5-year review will be conducted to assure that human health and the environment are protected. The purpose of the 5-year review is to organize, analyze, and present the data gathered during annual sampling events. The review will make recommendations regarding future actions at the 15 landfill sites. Periodic evaluations will provide a basis for continued sampling or refinements/alterations to the monitoring program or remedial activity, as appropriate. In the event analytical results are consistently below Class GA ground-water standards published by the State of New York and/or below maximum contaminant limits established by the U.S. Environmental Protection Agency, USMA will seek to have the sampling frequency either reduced, or discontinued.

Maintenance actions and corrective measures are also part of the Long-Term Monitoring Plan, and include conducting periodic engineering inspections, and where warranted, maintenance activities on ground-water monitoring wells and landfill caps and drainage systems.

1.3 SAMPLING AND ANALYSIS PLAN – FORMAT AND CONTENTS

The long-term monitoring program will be implemented as defined in this Sampling and Analysis Plan. The Sampling and Analysis Plan is comprised of three parts:

- Field Sampling Plan (Section A)
- Quality Assurance Project Plan (Section B)
- Safety, Health, and Emergency Response Plan (Section C).

The Field Sampling Plan provides guidance for all field work by defining in detail the sampling and field data-gathering methods to be used on the project. The Quality Assurance Project Plan describes the chemical data quality objectives, analytical methods and measurements, quality assurance/quality control protocols necessary to achieve the data quality objectives, and data assessment procedures for the evaluation and identification of any data limitations. The Safety, Health, and Emergency Response Plan provides personnel with protection standards and mandatory safety practices, procedures, and contingencies to be followed while performing field activities at the various landfill sites.

Section A

Field Sampling Plan

Field Sampling Plan for Long-Term Monitoring and Maintenance Program at 15 Landfills United States Military Academy West Point, New York

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1. INTRODUCTION

On 27 September 2001, the U.S. Army Corps of Engineers (USACE)–Kansas City District, issued Task Order No. 0001 under Contract No. DACW41-01-D-0030 to EA Engineering, P.C. and its affiliate EA Engineering, Science, and Technology. Under this Task Order, EA has been retained to conduct long-term ground-water monitoring, monitoring well and landfill engineering inspections, and maintenance at 15 landfills (Organic Compost Landfill, Post School Landfill, High School Landfill, Camp Buckner Landfill, Ski Lot Landfill, Motor Pool Landfill, Motor Pool East Landfill, Building 706 Parking Lot Landfill, PX Landfill, Michie Stadium Lot A Landfill, Michie Stadium Lot B Landfill, Michie Stadium Lot C Landfill, Michie Stadium Lot D Landfill, Michie Stadium Lot E Landfill, and Michie Stadium Lot F Landfill) at the United States Military Academy (USMA), West Point, New York.

This project is being performed to identify monitoring points and laboratory analyses to verify the effectiveness of the selected remedial action (installing caps on each landfill), and obtain data necessary to document the constituents of concern in ground water.

1.1 SITE BACKGROUND

1.1.1 U.S. Military Academy Site Description and Background

USMA is located in Orange County, New York, on the west bank of the Hudson River approximately 45 mi north of New York City. The military reservation at West Pont consists of 15,974 acres, of which the main Post comprises 2,520 acres. It is bounded by New York State Route 218, the Hudson River, the Village of Highland Falls, and U.S. Route 9W. West Point is crossed by the Hudson Highlands, a belt of steep-walled knobbed ridges, irregular hills, and mountains. USMA is a registered National Historic Landmark. Figure 1 illustrates the location of USMA. The area is dissected by several small streams and is the source for many ground-water springs (Frimpter 1970). Much of the original topography has been altered by construction of buildings and roads.

The USMA was established in 1802 as a training facility for officers in the military service, and continues to serve this purpose today. It currently consists of facilities and infrastructure that support the Academy's primary training mission. USMA has residents living permanently onsite and additional workers who commute to the Academy.

The sites included in this long-term monitoring program consist of 15 former landfills. These landfills are the Organic Compost Landfill, PX Landfill, Post School Landfill, High School Landfill, Ski Lot Landfill, Motor Pool Landfill, Motor Pool East Landfill, Camp Buckner Landfill, Building 706 Parking Lot Landfill, Michie Stadium Lot A Landfill, Michie Stadium Lot B Landfill, Michie Stadium Lot C Landfill, Michie Stadium Lot D Landfill, Michie Stadium Lot E Landfill, and Michie Stadium Lot F Landfill. Background information for each of these sites is provided in Section 1.1.2.

1.1.2 Landfill Backgrounds

1.1.2.1 Organic Compost Landfill

The Organic Compost Landfill (also called the Garrard Road Landfill) is approximately 0.5 acres in size and located adjacent to Building 743 (Figure 2). This area was used by the Land Maintenance Branch for the disposal of organic materials including leaves, mulch, limbs, and grass cuttings. During the 1960s, the site was also used for dumping construction debris. Based on interviews with a Post employee involved in landfill activities, it is suspected that unauthorized dumping has occurred in portions of the landfill (Law 1994). The types of materials reportedly disposed include large household appliances such as refrigerators and ovens, although no debris is currently present on the landfill surface. The depth of the landfill is estimated to be 20 ft based upon an interview and a visual inspection. The site is currently fenced, has a tar and chip surface, and is serving as a lumber yard.

A collection system was installed in 1990 to control leachate generated from the landfill. This system also reportedly collects surface water runoff from the area. The system consists of a 750-gal holding tank and perforated polyvinyl chloride (PVC) drainage pipe.

1.1.2.2 Post School Landfill

The Post School Landfill is approximately 1 acre in size and is located east of Washington Gate and north of Buildings 705-A and 705 (West Point Elementary School) (Figure 2). Former landfill activities are documented as having occurred between 1964 and 1969. The landfill was reported to have received domestic sanitary wastes only. Wastes were reportedly received from USMA and the surrounding municipalities. Wastes were placed in pits in 6-ft lifts and covered with soil. The landfill was closed by covering with 2 ft of soil and seeding.

The hydrogeology of the Post School Landfill appears to be defined by two water-bearing zones: a seasonal overburden unconfined zone and a fractured bedrock zone (Law 1994). In addition to the subsurface zones, the surface hydrology includes a poorly drained area near Well PS-1. A small stream flows from the poorly drained area along the western and northern boundaries of the playing field. Ground-water seeps have been observed from the gneiss bedrock outcrops adjacent to the Barnard Loop access road. Based on the water table elevation data from existing and new wells, overburden ground-water flow reflects the land surface topography of the site area. The dominant direction of overburden ground-water flow beneath the site is to the east-southeast (EA 1996a). A complete description of the Post School Landfill site history can be found in the Law (1994) final subsurface investigation report.

1.1.2.3 PX Landfill

The PX Landfill is an inactive sanitary landfill located east of Buckner Loop between the Post Exchange (PX) and the cemetery (Figure 2). This area served as the USMA landfill for domestic and sanitary wastes during the early years of waste disposal. In addition, the USMA Motor Pool, in this location prior to the 1950s, reportedly dumped vehicles, debris, and possibly waste oils, fuels, and chlorinated solvents in this area. Figure 2 shows the approximate boundaries of the landfill. The PX Landfill is approximately 2-3 acres in size and was used primarily during the 1940s to dispose of waste material. When the landfill was inactivated, the area was covered.

Ground water beneath the PX Landfill flows eastward to the toe of the landfill. Three site monitoring wells are located downgradient of the disposed materials (PXMW-02, PXMW-03, and PXMW-04).

The former landfill is now occupied by the PX service station and asphalt parking lot, which were built in the 1970s. The service station is supplied by two 10,000-gal fuel tanks and offers fueling and maintenance services. During a 1 October 1992 site visit, waste material observed to be stored beside the gas station building included an intact, 15-gal drum of waste oil, and several old car batteries (Woodward-Clyde 1995). According to USMA personnel, the waste materials generated were removed by the Defense Reutilization and Marketing Office. According to USMA personnel, there have been no releases of petroleum products from operations at the PX service station.

1.1.2.4 High School Landfill

The High School Landfill is located behind the James O'Neill High School, southeast of the Morgan Farm Road Landfill, along the west side of Route 9W (Figure 3). Two areas surrounding the high school appear to have been used for disposal (Woodward-Clyde 1995). The first location is where the track is presently located, southeast of the school building and adjacent to U.S. Highway 9W. The second is located in the area now occupied by the playing field.

During the time the track area was used for disposal, the landfilling and dumping operation progressed south. The disposed material was supposed to be construction debris; however, the USMA lost control of the site and uncontrolled dumping occurred. An area immediately south of the track appears to have been the most recent, and southernmost, location of the landfill that started at the track area. The area is not officially in use, and a chain gateway was installed to prevent vehicle access to the site. The equipment used during the rock crushing operation south of the track has been abandoned at the site along with a small front-end loader and other parts of heavy machinery. Household appliances, construction materials, scrap metals, steel cable, tires, partially empty grease tubs, and other miscellaneous debris have also been dumped, apparently by local residents, and are present on the surface. The area is lightly to moderately vegetated with tress, shrubs, grass, and weeds. The contaminants that may be present, based on available historical information, include metals, petroleum hydrocarbons, and volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs).

The history of the playing field is largely unknown. It was reported that the area was used to burn debris, and that other materials were disposed, including municipal garbage and automobiles (Woodward-Clyde 1995).

1.1.2.5 Camp Buckner Landfill

The Camp Buckner Landfill is located east of Popolopen Lake on the south side of Patton Road, west of Route 293 (Figure 4). Historical reports indicated that the area was used only in the summer months for the disposal of landscaping debris. Review of aerial photographs did not positively indicate that landfilling operations had occurred in the area (Woodward-Clyde 1995). However, the area was apparently graded or the surface reworked as evidenced by the change in the size and location of the adjacent pond. The Camp Buckner Landfill is used intermittently as a parking lot, which is fairly level with a steep slope rising to the west and a small stagnant pond to the southeast.

1.1.2.6 Ski Lot Landfill

The Ski Lot Landfill is approximately 0.7 acres in size and is located south of Highway 218 and north of Building 1227 (Figure 5). Two sites were originally identified as possible landfill areas: the golf green and the main parking area (USAEHA 1990). The golf course was completed in 1946, prior to the dates of landfill documented in the U.S. Army Environmental Hygiene Agency report. The parking lot has been identified as the site of the landfill by USMA employees associated with past landfill activities. The landfill was reportedly used to dispose sanitary/domestic waste and construction debris. Results of personnel interviews indicate that construction and sanitary wastes were segregated in different areas of the landfill (Meade 1992). The source of the sanitary wastes include USMA and nearby municipalities (Highland Falls and Newburgh). Waste oil was reportedly used for dust control activities. The pit and fill method of landfilling was employed with 6-ft lifts of waste. The landfill was closed by covering it with approximately 2 ft of soil and a gravel cover. No leachate collection system was installed; however, a suspected leachate seep location was noted in a drainage ditch near the Motor Pool. This leachate is believed to be associated with the Ski Lot Landfill based on the topography and inferred direction of ground-water flow. Previously, a drainage ditch beside the golf course contained iron-stained water and was suspected of being landfill leachate (EOC 1989a).

The hydrogeology of the Ski Lot Landfill area consists of two hydrostratigraphic units: an unconfined overburden/shallow bedrock zone and a confined deep fractured bedrock zone (Law 1994). Based on ground-water measurements collected in 1993 and 1995, the flow direction for the ground water in the overburden/shallow bedrock zones appears to be to the east, following site topography (EA 1996a). Surface water in the area includes a stream flowing east, passing along the southern boundary of the Ski Lot Landfill parking area. This stream intersects a smaller stream northwest of the Motor Pool Buildings 793 and 795. The smaller stream flows south along the eastern boundary of the Ski Lot Landfill (EA 1996a).

1.1.2.7 Motor Pool Landfill

The Motor Pool Landfill is located south of Washington Gate and east of Buildings 719 and 783 (Figure 5). This landfill was in use from approximately 1964 to 1969. It is reported to have received primarily sanitary and domestic wastes, although personnel at USMA indicated that wastes (oils, solvents, etc.) from the Motor Pool and/or the nearby dry cleaning facility may have been placed in the landfill. Personnel interviews indicate that trenching was employed but discontinued when compaction proved to be a problem (Meade 1992). Pit and fill methods of disposal were then used at the landfill.

In the 1970s, an odor and leachate problem prompted a U.S. Army Environmental Hygiene Agency study at this site. Positive results for methane gas and hydrogen sulfide were obtained at the north end of the landfill. Results of leachate and stream samples indicated that although the leachate contained reportable levels of several heavy metals, there was no measurable degradation to surface water quality (USAEHA 1990). The landfill was closed by covering it with 2 ft of soil and paving. The area is currently used for parking and vehicle storage at the Motor Pool Area.

The hydrogeology of the Motor Pool investigative area consists of two hydrostratigraphic units: an unconfined/semi-confined overburden zone and a fractured bedrock zone. Based on water level measurements collected in 1993 and 1995, the flow direction for ground water in the overburden appears to be toward the northeast, roughly following the topography (EA 1996a).

1.1.2.8 Motor Pool East Landfill

The Motor Pool East Landfill is located between Route 218 and Buildings 793 and 795 near Washington Gate (Figure 5). The site is fenced and paved, and is serving as the Motor Pool East Parking Lot. An unnamed stream approaches the landfill from the southwest and flows to the east along the southern perimeter of the landfill. A single orange-colored seep was observed on the southern portion of the site along the stream bed during a site visit (July 1994). The site occupies an estimated total area of 1.6 acres (approximate dimensions 420 ft × 170 ft) and was operated from 1964 to 1969. This site reportedly contains primarily garbage, household items, and trees and brush. Sources of the materials were from USMA and the surrounding towns. Depth of the waste material could range from 10 to 30 ft below ground surface. It was USMA practice to dig down to create a dump area and use the excavated soil as cover material. Some materials were separated with respect to initial dumping, however, materials were moved around with bulldozers and much mixing occurred on a regular basis. When the parking lot was constructed, large boulders (from gym construction) were used as fill material, then a soil cover was placed over the boulders, and finally a 2-ft sub-base of gravel was deposited.

Results of the magnetometer survey ground conductivity data indicate that two probable landfill cells exist at the Motor Pool East Landfill. However, due to the absence of corresponding elevated in-phase measurements, it is likely that both landfill cells contain mostly non-metallic, electrically conductive material.

Overburden ground-water flow reflects the land surface topography of the site area, and the dominant direction of overburden flow beneath the site is to the southeast. A small stream flowing to the east is located along the southern boundary of the landfill. An intermittent swale can be found along the northern and western boundaries of the landfill which drains into the stream. In addition, a small leachate seep (total stained area of approximately 230 cm^2) was observed along the southern side of the landfill, near the edge of the stream (EA 1996a).

1.1.2.8.1 Hydrogeologic Linkage of Motor Pool East and Ski Lot Landfills

The analytical results from the overburden monitoring wells at the Motor Pool East Landfill showed that the upgradient well had higher relative concentrations of metals when compared to the downgradient wells. This landfill is adjacent to the Ski Lot Landfill that exhibited elevated downgradient concentrations of metals (EA 1996a). In addition, there is a seep located between the Ski Lot Landfill and Motor Pool East Landfill that drains to the swale between the two landfills. The comparison of the ground-water elevations of the overburden wells from the Motor Pool East Landfill and the adjacent Ski Lot Landfill (EA 1996a) showed that the unconfined overburden zone within the Motor Pool East Landfill and there is a hydrogeologic connection between the Ski Lot Landfill unconfined overburden aquifer. Therefore, the metals present in the ground water at the Motor Pool East Landfill do not appear to be attributable to any waste disposed at this landfill, but rather ground water that is migrating from the Ski Lot Landfill.

1.1.2.9 Building 706 Parking Lot Landfill

The Building 706 Parking Lot Landfill is located adjacent to Parking Lot B Landfill and Building 706 off of Stony Lonesome Road (Figure 6). The area is unpaved and vertically installed culvert pipe is apparent at the surface. Building 706 was used as a forge in the late 1930s to make and repair tools used in cutting stone. This shop was closed in the 1940s.

The landfill reportedly contains mainly construction and demolition debris (Law 1994). The source of the materials was strictly from West Point prior to 1959. After 1959, materials were allowed in from the surrounding towns, including Highland Falls, Fort Montgomery, and Newburgh. Another building was formerly located to the west of the existing Building 706 (date of removal unknown). The concrete slab base from this building remains and was used to stockpile salt from 1980 to 1991. The area near this concrete base received only small store circa 1969. In the late 1960s, the land north of Building 706 (across Stony Lonesome Road) was used to store large materials to be recycled (motor parts, tank treads, etc.).

Results of a magnetometer survey showed that two probable landfill cells exist at the Building 706 Parking Lot Landfill. The first landfill cell is comprised of several anomalies which may be caused by metallic debris. One of the anomalies, located beneath and next to the edge of the concrete slab, may have been caused by an underground storage tank. The second landfill cell is found near the southeast corner of the concrete slab, and is suspected to contain buried metallic debris. In addition, the data show that an anomaly was located west of Building 706. This anomaly is suspected to be the location of a leachfield.

Based on the water table elevation data, overburden ground-water flow reflects the land surface topography of the site area, and the dominant direction of overburden ground-water flow beneath the site is generally to the southeast (EA 1996b).

1.1.2.10 Michie Stadium Lot Landfills A, B, C, and E

The Michie Stadium Lot landfills are located to the west of Michie Stadium and can be accessed from Stony Lonesome Road (Figure 6). A brief description of Stadium Lot Landfills A, B, C, and E are included below:

- **Michie Stadium Lot A Landfill**—Consists of approximately 0.6 acres of land that received materials sometime between 1952 and 1954. The average depth of fill is approximately 10 ft.

- **Michie Stadium Lot B Landfill**—Consists of approximately 0.3 acres of land that reportedly received materials around 1954. The average depth of the fill is approximately 15 ft.

- **Michie Stadium Lot C Landfill**—Consists of approximately 0.8 acres of land that were likely in use between 1955 to 1956. The average depth of the fill is approximately 15 ft.

- **Michie Stadium Lot E Landfill**—Consists of approximately 2.0 acres of land that may have received materials from 1952 to 1956. The average depth of the fill is approximately 15 ft.

Currently, these landfills are paved and used as parking lots. Wastes likely to have been disposed of in these lots included materials deposited by the USMA and the Town of Highland during the 1950s. Based on conversations with USMA personnel, the main purpose for filling these areas was the construction of additional parking space for Michie Stadium (Woodward-Clyde 1995). Disposal operations consisted of digging trenches, filling with materials, and covering with soil. Materials disposed of in this manner included sanitary and domestic waste, construction debris, small quantities of polychlorinated biphenyls (PCBs) and waste oil, and possibly medical wastes.

Ground water at the Michie Stadium Parking lots flows eastward (Lots C and E), and southeastward (Lots A and B). Monitoring wells are located downgradient wells of the respective landfills.

1.1.2.11 Michie Stadium Lot D Landfill

The Parking Lot D Landfill is approximately 2 acres in size and is adjacent to and west of Stoney Lonesome Road (Figure 6). The Landfill reportedly extends throughout the paved area (Meade 1992) and was reported to have been active from 1956 to 1957. The waste disposed of in this landfill reportedly contained sanitary/domestic wastes, construction debris, small amounts of oil-containing PCB, waste oil, and other liquid wastes (USAEHA 1990). The wastes were not segregated, and the landfill accepted wastes from USMA and nearby municipalities. Contents were disposed in pits using 5-ft lifts and covered with soil. Dust control was accomplished using waste oil. The depths of the landfill range from 6 ft on the south side to 20 ft on the north end. The landfill was closed by covering it with 2 ft of soil and a gravel cover (Law 1994).

The hydrogeology at the Parking Lot D Landfill consists of an unconfined upper and an unconfined deep fractured bedrock zone. Very little overburden was present at the site. Law (1994) reported the yield for the shallow bedrock wells (LD-l, LD-2, and LD-5) showed an almost immediate response to localized precipitation events, with the surface drainage through the network of rock fractures resulting in a direct flow to the shallow bedrock zone. The water levels measured in the nested wells are indicative of an apparent downward flow component between the lower and upper fractured rock zones, suggesting that the site is a zone of ground-water recharge (EA 1996a).

1.1.2.12 Michie Stadium Lot F Landfill

The Parking Lot F Landfill is approximately 2.5 acres in size and is located west of Fenton Road and southwest of Building 714 (Figure 6). The wastes disposed in one operating year (1965) included sanitary/domestic wastes, construction debris, small amounts of PCB, limited waste oil, and liquids (USAEHA 1990). Results of an interview with USMA personnel indicate that wastes were accepted from USMA and surrounding municipalities (Meade 1992). Dust control was accomplished through use of waste oils. Landfilling protocols consisted of the digging of a pit, depositing waste in 6-ft lifts, and covering with soil. The depth of the landfill is approximately 20 ft. The landfill was closed by covering it with 2 ft of soil and gravel cover. A stream is centrally located in an outcrop area on the western side of the lot. It was diverted beneath the landfill during activity and re-emerges east of and below the lot.

A 750-gal leachate collection tank has been installed at the site, the contents of which are routinely pumped when the tank clogs. However, normal overflow of the tank reportedly discharges to the storm sewer system.

The hydrogeology of the Parking Lot F area is characterized by three hydrostratigraphic units: an unconfined overburden zone (LF-1 and LF-4), an unconfined upper bedrock zone, and a confined deep bedrock zone (Law 1994). The ground water at LF-3 was under artesian conditions during both previous investigations. A true upgradient sample was not available at this site. The relative locations of the wells and the limited number of data points precluded determination of the ground-water flow direction for the overburden, shallow bedrock, or confined bedrock zone. However, based on topography and ground-water data interpretations from other sites, it is assumed that ground-water flow is toward the east-southeast (EA 1996a).

1.1.2.13 Village Farm Landfill

The Village Farm Landfill is located on the south side of Route 9W near the intersection with Stony Lonesome Road. The landfill and the surrounding area are shown on Figure 7. The landfill area, which is estimated to be less than 4 acres in size, is known as USMA Range 1 Argonne, is used as an ammunition firing practice range, and is located on a highland approximately 300 ft in elevation above Route 9W and on the west side of Bare Rock Mountain. The area slopes from the south toward the northeast. Landfilling operations were reported to have occurred in the 1950s and early 1960s. Two seeps, located on the northwest side of the access road, were observed during site visits. Test pits excavations revealed that the landfill contained clean fill, and materials such as metal, rubber tires, plastic, carpet, tile, and glass.

The Resource Conservation and Recovery Act (RCRA) Facility Assessment of Ten Landfills Report (Woodward-Clyde 1995) concluded that because the landfill was small (less than 4 acres and less than 10-ft thick), and since there is no evidence of a migration of hazardous constituents from this landfill, there is no threat to human health or the environment. Consequently, no further investigations have been or are scheduled to be conducted at this location.

1.2 PHYSICAL CHARACTERISTICS

1.2.1 Physiography and Topography

The USMA is located within the Hudson Highlands section of the New England physiographic province. Elevations range from near sea level to approximately 1,400 ft above mean sea level (USAEHA 1990).

The Hudson Highlands connect the southwest trending Reading Prong section with the main portion of the New England Province (Berkey and Rice 1921). The Hudson Highlands are located at the junction of four other physiographic provinces: the Appalachian Plateau and the Valley and Ridge provinces to the west, and the Piedmont and Coastal Plain provinces to the south (Kratochvil et al. 1983).

The topography of the Hudson Highlands is primarily controlled by bedrock structure (joint patterns and faulting) and lithology. The highly resistant metamorphosed igneous bedrock forms a rugged terrain with moderate to steep forested hillsides descending toward the Hudson River (Dodd 1965).

Erosional and depositional processes of Pleistocene glaciation have also exerted control on the topography of the Hudson Highlands. Glacial features resulting from these processes include terracing, scouring of the Hudson River channel, and deposition of a blanket of glacial till (Kratochvil et al. 1983).

1.2.2 Geology

The basic geology at the USMA consists of a crystalline base overlain by glacial deposits. Pre-Cambrian granite comprises most of the bedrock, supplemented with some gneiss. Within the bedrock, quartz, feldspar, and mica occur in a medium-grained configuration. The glacial deposits are unconsolidated Pleistocene era sediment comprised of a mixture of clay, sand, and gravel with boulders prevalent. In some areas, the glacial deposits are more fine-grained and act to confine ground-water movement (USAEHA 1990).

Two major normal faults traverse the USMA study area (Berkey and Rice 1921; Fisher et al. 1970). A northeast trending fault extends from Route 218, passing across the river, and terminating in the Town of Cold Spring. A north-northeast trending fault extends through the long axis of the Lusk Reservoir from Highland Falls and appears to terminate at the Hudson River near the North Dock.

The strike and dip of these Pre-Cambrian granites and gneisses are approximately north 60 degrees east and 60-80 degrees southeast (Dodd 1965). The attitude of the foliation typically corresponds to the strike and dip. Folds plunge gently northward and have vertical or east-dipping axial planes.

Fracture systems recorded within the West Point topographic quadrangle indicate that the rock strata contain joint systems, generally dipping 60 degrees to vertical (Isachsen and McKendree 1977; USGS 1967). This joint orientation may have environmental relevance as it could provide potential pathways for ground-water flow.

1.2.3 Soil

The dominant soil type at the USMA is Hollis-Rock outcrop (USDA 1981). The Hollis series consists of shallow, well drained gently sloping to very steep soil overlying schist, granite, and gneiss bedrock in mountainous uplands. The soil units mapped in the area, described as glacial till deposits, are composed of a heterogeneous mixture of very large boulders, cobbles, gravel, silt, sand, and clay. The maximum depth of frost penetration in these types of soil is approximately 60 in. (Sowers and Sowers 1970). Particle size segregation is typically confined to glacial features or modern stream development. Very large boulders, up to 10 ft in diameter, are common in the area.

1.2.4 Hydrogeology

Ground water is located in the unconsolidated Pleistocene deposits, as well as in the underlying bedrock, where it exists in faults and fractures of the weathered crystalline base. As with surface water, the general flow of the shallow unconsolidated aquifer is eastward toward the Hudson River, although localized flow may be toward nearby streams and lakes (USAEHA 1990). Most ground water is found in the secondary porosity features (fractures and joint systems) of the bedrock created by faulting of rock strata (Kantrowitz and Snavely 1982a). Because the fault zones are narrow and tabular in structure and nearly vertical in attitude, they may be easily missed by drilling. Fault zones in the area are not being used as water sources, and very little is known about their recharge characteristics (Frimpter 1970; USGS 1967).

The glacial till is termed "hardpan" by local drillers because it is characteristically difficult to drill. Due to its low permeability, the till is considered to be a poor aquifer (USGS 1967; Kantrowitz and Snavely 1982b). None of the glacial till water wells inventoried by the U.S. Geological Survey were capable of producing a water sample (Frimpter 1970). However, monitoring wells installed in the till overburden during the 1993 investigation by Law (1994), although slow to recharge, consistently yielded sufficient water for sampling purposes. It is believed that ground water enters the bedrock aquifer systems through the overlying permeable till deposits. Locally, seasonal perched zones may occur due to impermeable strata in the till. The perched zones, however, are discontinuous and, as such, are unreliable sources of ground water.

The ground-water yield for crystalline rocks in Orange and Ulster counties is approximately 0.12 gpm per ft of well exposed to the aquifer. Shallow bedrock wells with higher yields are a more frequent occurrence in areas where the overlying unconsolidated deposits consist of sand and gravel rather than low permeability tills (Frimpter 1972).

1.2.5 Surface Water

The Hudson Highlands in the vicinity of the USMA at West Point are located within the Hudson River drainage system. The Hudson River is located east of the USMA and flows south to New York City where it drains into the Atlantic Ocean. The section of the river near the USMA is also known as the Hudson Fiord, due to the steepness of the valley walls and cutting of the river channel by glacial ice (Van Diver 1985).

In addition, a number of ponds and small lakes are located within the boundaries of the USMA reservation. The raw water supply for the USMA is obtained from surface water contained in the 29 mi^2 Popolopen-Queensboro watershed. Storage of water is provided by Popolopen Lake Dam (total capacity 50 million gal), Mine Lake Dam (total capacity 65 million gal), and Stillwell Lake Dam (total capacity 720 million gal). This water supply is supplemented from Queensboro Dam. These dams are located approximately 1-3 mi southwest of the USMA. Prior to treatment, water is stored onsite at the USMA in Lusk Reservoir. The reservoir source is the direct source for the Lusk Treatment Plant. The Lusk Treatment Plant has been in service since 1932 and, along with the Stoney Lonesome Treatment Plant, is the source for potable water at the USMA.

1.3 PREVIOUS INVESTIGATIONS

Several investigations have been performed at the 15 landfills that are the focus of this Field Sampling Plan. Findings of these previous investigations are documented in the following reports:

- Analysis of Existing Facilities, Draft Environmental Assessment Report, USMA, West Point, New York (PSS 1985)
- Ground-Water Quality Survey, USMA, West Point, New York (USAEHA 1990)
- Environmental Program Review, USMA, West Point, New York (USAEHA 1990)
- Final Subsurface Investigation Report, U.S. Military Academy, West Point, New York (Law 1994)

- RCRA Facility Assessment of 10 Landfills Report, USMA, West Point, New York (Woodward-Clyde 1995)

- Phase II Investigation, Six Landfill, USMA, West Point, New York (EA 1996a)

- Final RCRA Facility Investigation of Ten Landfills (Malcolm Pirnie, Inc. 1997)

- Ten Landfills RCRA Facility Investigation, Phase II Groundwater Monitoring, USMA West Point, New York (Malcolm Pirnie Inc. 1999).

Notable findings for associated environmental sampling and analysis are summarized in the following subsections. Detailed descriptions of these investigations, including analytical data, can be found in the above referenced reports.

1.3.1 Organic Compost Landfill

Ground-water and leachate samples were collected and analyzed from this landfill. Notable results of previous investigations are as follows.

Ground Water

- Ground water in monitoring wells OC-1, OC-2, and OC-4 was slow to recharge in historical investigations.

- VOCs and SVOCs were not detected in the ground-water samples collected during previous investigations.

- Pesticides were detected during the 1995 Phase I Investigation. Concentrations of endrin exceeded New York State Department of Environmental Conservation (NYSDEC) Class GA standards.

- Iron and manganese were reported at concentrations in excess of NYSDEC standards.

Leachate

- No VOCs, SVOCs, or PCBs were detected in leachate seep samples collected from this site.

- Pesticides were detected during the 1995 Phase I Investigation at concentrations near applicable standards.

- Iron and manganese were detected at concentrations above applicable standards.

1.3.2 Post School Landfill

Samples were collected from site monitoring wells, surface water, leachate seeps, and the leachate collection tank during past investigations. A soil vapor survey is summarized below.

Soil Vapor Survey

- Soil vapor survey results detected VOCs in one sample on the eastern side of the landfill, however, samples collected adjacent to this area but off the landfill footprint were free of detectable chlorinated and non-chlorinated VOCs. The concentrations were below the lower explosive limit for these compounds.

Ground Water

- VOCs were reported in one ground-water sample at concentrations below NYSDEC Class GA standards. One SVOC, phenol, was reported at a concentration above the Class GA standard. Heptachlor was reported in a duplicate sample and in one well sample at concentrations in excess of Class GA standard for this parameter; however, the results were suspect based upon the laboratory quality control results.

- Cadmium, iron, and manganese were detected in ground-water samples at higher concentrations than "upgradient" or "background" conditions and regulatory standards.

Leachate

- No priority pollutant SVOCs, pesticides, or PCBs were reported in leachate samples.

- VOCs were detected in leachate samples at concentrations below regulatory standards. The pesticide 4,4'-DDE was detected at a concentration above the NYSDEC Class A standard for wildlife protection.

- Concentrations of iron and manganese exceeded the regulatory standards.

- Iron, manganese, and chlorobenzene were reported in excess of state and federal standards in the leachate collection tank samples. The tank collects water from the seep and is periodically pumped if clogged; otherwise, flow is directed to the base storm sewer system.

Surface Water

- There were no detectable VOCs, SVOCs, or pesticides/PCBs in the two surface water samples.

- Cadmium concentrations exceeded the surface water standard for wildlife protection in the upstream sample, but this analyte was not detected in the downstream sample or its duplicate. Lead concentrations were slightly greater than the surface water standard for wildlife protection.

- Water quality indicator parameters for surface water that were reported at concentrations above "upgradient" levels included ammonia, biochemical oxygen demand, chemical oxygen demand, total Kjeldahl nitrogen, total organic carbon, total alkalinity, and total hardness. However, the water quality parameters for surface water were reported at concentrations below NYSDEC Class A surface water standards.

1.3.3 High School Landfill

Ground-water and leachate seep samples were collected for analysis during previous investigations. Notable results are as follows.

Ground Water

- No VOCs, pesticides, PCBs, or herbicides were detected in ground-water samples at this site.

- SVOCs were detected in ground-water samples, but at concentrations below NYSDEC Class GA standards.

- Iron and manganese were also detected at concentrations in excess of applicable standards.

Leachate

- VOCs and SVOCs were detected in samples collected from the leachate seep location at concentrations below regulatory standards.

- There were no pesticides or PCBs detected in leachate.

- Iron and manganese concentrations exceeded regulatory standards.

1.3.4 PX Landfill

Ground-water, surface water, and leachate samples were collected for chemical analysis during previous investigations at this site. Notable results are summarized below.

Ground Water

- Concentrations of VOCs, SVOCs, and the pesticide, endosulfan sulfate, were detected in ground-water samples at concentrations below NYSDEC Class GA standards.

- Several metals, including arsenic, cadmium, copper, mercury, chromium, iron, lead, magnesium, manganese, sodium, and selenium, have been detected in one or more of the site monitoring wells during previous investigations at concentrations in excess of NYSDEC Class GA ground-water standards.

- Water quality parameters, including turbidity, total dissolved solids, chloride, and sulfate, have also been reported at concentrations in excess of regulatory criteria.

Leachate

- Trace amounts of VOCs and SVOCs were detected in leachate samples at concentrations below regulatory samples. Pesticides were not detected in any of the leachate samples collected at this site.

- Iron, sodium, lead, and the water quality parameters, turbidity, total dissolved solids, and chloride, were detected at concentrations above regulatory criteria.

1.3.5 Camp Buckner Landfill

Ground-water and surface soil samples were collected at the Camp Buckner Landfill during previous investigations. In addition, an explosive gas survey was conducted to determine the presence of explosive gases within the landfill. Notable results of previous investigations are summarized below.

Ground Water

- Concentrations of VOCs, SVOCs, and pesticides were below regulatory standards.

- Chromium and lead were reported at concentrations in excess of regulatory standards.

Surface Water

- No VOCs and SVOCs were detected in surface water samples.

- Metals and pesticides were detected in the samples, but at concentrations below applicable regulatory standards.

Explosive Gas Survey

The explosive gas survey detected lower explosive limit readings between 5 and 9 percent in 3 of 10 survey points. These results indicated a low level of explosive gas is being produced by the landfill.

1.3.6 Ski Lot Landfill

Ground-water, surface water, and leachate samples were collected for chemical analysis during previous investigations. In addition, an explosive gas survey was conducted to identify the presence of explosive gas production within the landfill. Notable results are summarized below.

Ground Water

- Benzene was detected in one monitoring well at a concentration slightly above the NYSDEC Class GA standard. There were no other VOCs, SVOCs, or pesticides/PCBs in ground-water samples.

- Low level concentrations of endosulfan sulfate were found at this site in the deep bedrock well sample (SL-3).

- Iron was reported at a concentration above "background" conditions at Well SL-3, and exceeded the secondary drinking water standards at upgradient Wells SL-1 and Well SL-3. Concentrations of total dissolved solids and sulfate at Well SL-4 were also reported in excess of their corresponding standards.

- The overburden samples generally contained a larger number of water quality parameter detections compared to the bedrock samples. However, none of the reported concentrations exceeded the NYSDEC Class GA ground-water standards.

Leachate Seep

- There were no detectable VOCs, SVOCs, or PCBs in leachate samples. The seep located on the west side slope of the landfill contained 4,4'-DDE; however, the reported result was suspect based upon the laboratory quality control results.

- Iron, lead, and manganese were reported at concentrations in excess of regulatory criteria.

- Water quality parameter results in leachate seep samples were reported at concentrations above "upgradient" and "background" levels but below the NYSDEC Class A surface water standards.

Surface Water

- Copper, iron, lead, manganese, mercury, silver, and zinc, and several water quality parameters, were reported in surface water samples at concentrations above "upgradient/background" concentrations. However, concentrations of these analytes were below applicable regulatory criteria.

Explosive Gas Survey

- Methane was detected 25 of 26 samples collected, with five of the results exceeding the lower explosive limit for methane (15 percent), and four of the results exceeding the upper explosive limit (25 percent) for methane. The highest methane concentration was reported on the southeast side of the landfill. Samples collected along the edge of the golf course or near Building 1227 showed methane at low concentrations (less than 0.5 percent).

- The soil vapor survey detected the presence of benzene, toluene, m/p-xylene, o-xylene, trichloroethene, and tetrachloroethene. These VOCs were noted in conjunction with the elevated methane concentrations observed on the east-southeast side of the landfill.

1.3.7 Motor Pool Landfill

Ground-water and leachate seep samples were collected for chemical analysis during past investigations at the Motor Pool Landfill. In addition, an explosive gas survey was conducted to identify the presence of explosive gas production within the landfill. Notable results of these investigations are as follows.

Ground Water

- VOCs were not detected in ground-water samples at this landfill. One SVOC, bis(2-ethylhexyl)phthalate, was detected in two wells and the laboratory method blank indicating that this analyte may be a laboratory contaminant. No PCBs were detected in ground water. Endrin and heptachlor were detected at concentrations that exceeded the Class GA standards.

- Ground-water samples collected at the Motor Pool Landfill were reported to contain iron, magnesium, manganese, at levels above "upgradient" and greater than several regulatory standards. Total dissolved solids and color values also exceeded applicable standards.

- Based on the indicator parameters, a measurable difference in ground-water quality was observed between the upgradient and deep bedrock well samples (MP-1 and MP-3, respectively) and the samples obtained from shallow overburden wells (MP-2 and MP-4). In general, indicator parameter concentrations were higher than USMA and regional "upgradient" levels in the shallow samples.

Leachate

- There were no detectable VOCs in the leachate seep samples. One SVOC, bis(2-ethylhexyl)phthalate, was detected in one sample and in the laboratory method blank, indicating that this analyte may be a laboratory artifact. PCBs were not detected in leachate samples. Endosulfan and endrin were reported at concentrations that exceeded the Class A standards, however, the reported results for both of these parameters were suspect based upon the laboratory quality control results.

- Leachate results that were reported above regulatory criteria included arsenic, iron, manganese, nickel, aluminum, vanadium, ammonia, and nitrate.

Explosive Gas Survey

- The methane survey detected methane in 26 of 31 samples collected, with 19 of the results exceeding the lower explosive limit (5 percent) and 17 of the results exceeding the upper explosive limit (15 percent) for methane. The highest methane concentrations were reported on the northeastern perimeter of the landfill.

- The soil vapor survey detected the presence of benzene, toluene, ethylbenzene, and xylene below the lower explosive limit for these compounds. The highest total VOC concentrations were reported on the western perimeter of the landfill.

1.3.8 Motor Pool East Landfill

Ground-water, surface water, sediment, and leachate samples were collected for chemical analysis during previous investigations. Notable results are summarized below.

Ground Water

- There were no VOCs, SVOCs, pesticides/PCBs, or chlorinated herbicides reported in the four ground-water samples.

- Iron, manganese, and sodium were reported at concentrations that exceeded their respective Class GA ground-water standards or guidance values in four ground-water samples (three wells plus one duplicate), while zinc exceeded the Class GA standard in all wells except MW11-03.

- One water quality indicator parameter (chloride) was reported at a concentration in excess of NYSDEC Class GA ground-water standards.

Surface Water

- There were no VOCs or SVOCs reported in the four surface water samples. Dieldrin was reported above the NYSDEC Class A standard for two samples (SW11-02 and SW11-03). Although the reported concentrations were above the Class A standard for this compound, the results are suspect since in all cases the results were flagged with a "P" by the laboratory indicating poor duplication between the two analytical columns used for sample analysis.

- Iron, manganese, aluminum, lead, and zinc were reported at concentrations in excess of regulatory standards at one or more sample locations.

- None of the observed water quality parameter concentrations exceeded the NYSDEC Class A surface water standards for either human consumption or wildlife protection.

Sediment

- Polycyclic aromatic hydrocarbons were identified in one or more of the downstream sediment samples at concentrations above regulatory standards. Polycyclic aromatic hydrocarbons are commonly found in road surface runoff. The proximity of the stream to the Motor Pool access road and parking lot suggests that this was the likely source of polycyclic aromatic hydrocarbon contamination in the sediments.

- Pesticides and PCBs were detected in the sediment samples. Comparison of the results to the sediment criteria (NYSDEC 1993) showed that the observed concentrations were below those concentrations that may induce acute or chronic toxic effects in benthic organisms. The pesticide results were also below the concentrations that may result in significant bioaccumulation of the chemicals by wildlife. Aroclor-1254 in the duplicate sample (SD11-02 Dup) and Aroclor-1260 in three samples (SD11-01, SD11-02, and SD11-02 Dup) were above the concentrations that may result in bioaccumulation by wildlife.

- Concentrations of metals in the stream sediment were generally consistent with anticipated background concentrations for the 10 analytes that background data were available. Concentrations of antimony, cadmium, iron, manganese, copper, nickel, and lead were detected in sediment samples in excess of regulatory criteria in one or more of the sediment samples.

Leachate

- No VOCs, SVOCs, pesticides, PCBs, or herbicides were detected in seep samples.

- Iron and sodium were detected at concentrations in excess of the NYSDEC Class A.

- A total of 11 water quality parameters were detected. None of the reported results exceeded applicable regulatory standards.

1.3.9 Building 706 Parking Lot Landfill

Ground-water samples were collected for chemical analysis during the 1995 Phase II Investigation (EA 1996b). Notable results are summarized below:

- No VOCs, SVOCs, or chlorinated herbicides were reported in the ground-water samples. Dieldrin was detected in one sample at a concentration above the Class GA ground-water standard for this chemical (non-detect).

- Iron, sodium, manganese, and zinc were detected above Class GA standards in ground water. For these four inorganics, higher concentrations were noted in the downgradient samples relative to the upgradient sample.

- Ammonia and chloride exceeded the Class GA ground-water standards in two of the downgradient wells.

1.3.10 Michie Stadium Lot A Landfill

Ground-water, surface water, and leachate samples were collected for chemical analysis during previous investigations at this site. In addition, an explosive gas survey was conducted to determine the presence of explosive gases within the landfill. Notable results are summarized below.

Ground Water

- No VOCs or SVOCs were detected in ground-water samples at this site. One pesticide, endosulfan sulfate, was detected at a concentration below regulatory criteria in one well.

- Iron, manganese, and sodium were detected at concentrations in excess of Class GA standards.

Surface Water

- VOCs, SVOCs, and metals were detected in surface water at concentrations below Class A standards.

- There were no detections of PCBs or pesticides.

Leachate

- VOCs, SVOCs, and one pesticide, 2,4,5 -T, were detected at concentrations below regulatory criteria in leachate samples.

- Target analytes, including iron, sodium, and antimony, were detected at concentrations in excess of regulatory criteria.
- Water quality indicator parameters including turbidity, total dissolved solids, and chloride were detected above regulatory criteria.

Explosive Gas Survey

The explosive gas survey detected 100 percent lower explosive limit in 2 of 10 locations. This indicates that explosive gases are being produced within the landfill.

1.3.11 Michie Stadium Lot B Landfill

Ground-water and leachate samples were collected for chemical analysis during previous investigations at this site. In addition, an explosive gas survey was conducted to determine the presence of explosive gases within the landfill. Notable results are summarized below.

Ground Water

- VOCs, SVOCs, and pesticides were detected in ground-water samples at concentrations below Class GA standards.
- Target analytes, including iron, lead, manganese, and cadmium, were detected at concentrations in excess of regulatory criteria. Water quality parameters, including turbidity, chloride, and total dissolved solids, were also detected in excess of regulatory criteria.

Leachate

- VOCs, SVOCs, and one pesticide, 2,4,5 -T, were detected at concentrations below regulatory criteria in leachate samples.
- Target analytes, including iron, sodium, and antimony, were detected at concentrations in excess of regulatory criteria.
- Water quality indicator parameters, including turbidity, total dissolved solids, and chloride, were detected above regulatory criteria.

Explosive Gas Survey

Results of the explosive gas survey indicated a lower explosive limit at 16 percent in 1 of 8 survey points. Based on these results, this landfill is not producing significant quantities of explosive gases.

1.3.12 Michie Stadium Lot C Landfill

Ground-water and leachate samples were collected for chemical analysis during previous investigations at this site. In addition, an explosive gas survey was conducted to determine the presence of explosive gases within the landfill. Notable results are summarized below.

Ground Water

- No VOCs were detected in ground-water samples. SVOCs and pesticides were detected at concentrations below Class GA standards.
- Antimony, iron, lead, manganese, and sodium were detected at concentrations in excess of regulatory criteria.
- Water quality parameters including turbidity, chloride, and total dissolved solids were reported at concentrations exceeding regulatory criteria.

Explosive Gas Survey

The explosive gas survey detected lower explosive limit concentrations between 24 and 94 percent at 3 of 11 survey locations and lower explosive limits of 100 percent at 8 of 11 locations. Results indicate the presence of relatively high levels of explosive gases within the landfill.

1.3.13 Michie Stadium Lot D Landfill

Ground-water and leachate samples were collected for chemical analysis during previous investigations at this site. Notable results are summarized below.

Ground Water

- Chlorobenzene was detected in one well at a concentration below the Class GA standard. There were no detectable SVOCs in any of the samples. Five pesticides (aldrin, alpha-BHC, beta-BHC, heptachlor, and heptachlor epoxide) were detected in ground-water samples. Although the aldrin and heptachlor results exceeded the Class GA standard, the reported concentration for heptachlor was suspect based upon the laboratory quality control results.
- Iron, cadmium, and sodium were reported at concentrations exceeding the Class GA standards. In general, concentrations of metals were higher in the three downgradient wells when compared to the upgradient well. The deep bedrock well (LD95-GW-04) showed lower metals concentrations compared to the nested upper bedrock well (LD95-GW-02) for all parameters except manganese and aluminum.

- Five water quality parameters (alkalinity, biochemical oxygen demand, chemical oxygen demand, nitrate, and total Kjeldahl nitrogen) were reported in the three downgradient wells but not in the upgradient well. Although these results suggest some impact on the ground-water quality due to the presence of waste material in the landfill, none of the reported concentrations exceeded the Class GA standards.

Leachate

- Leachate samples were collected in June 1989 and on 15 June 1992 beside Stoney Lonesome Road and analyzed for standard water quality parameters. The results of the analysis were described as "normal" (EOC 1989b). Other chemical results from this site were within the range of "upgradient" determinations or under regulatory limits, as applicable. Leachate samples were not collected at Parking Lot D, as no leachate was present during the sampling events.

1.3.14 Michie Stadium Lot E Landfill

Ground-water and leachate samples were collected for chemical analysis during previous investigations. In addition, an explosive gas survey was conducted to determine the presence of explosive gases within the landfill. Notable results area summarized below.

Ground Water

- Benzene and naphthalene were detected in one well at concentrations below Class GA standards. No pesticides or PCBs were detected in ground water.

- Iron, sodium, and manganese were detected at concentrations that exceeded regulatory criteria.

- Water quality parameters, including turbidity, total dissolved solids, and chloride, were also detected in excess of regulatory criteria.

Leachate

- Concentrations of VOCs and SVOCs were detected in leachate samples at concentrations below NYSDEC Class A standards. No pesticides or PCBs were detected in the samples.

- Manganese, iron, sodium, and water quality parameters turbidity, total dissolved solids, and chloride were detected at concentrations in excess of regulatory criteria.

Explosive Gas Survey

The explosive gas survey identified lower explosive limits of 100 percent at 15 of 20 locations. The remaining locations had lower explosive limits below 6 percent. Results indicated the presence of relatively high levels of explosive gases within the landfill.

1.3.15 Michie Stadium Lot F Landfill

Ground-water and leachate samples were collected for chemical analysis during previous investigations at this site. Notable results of these past investigations area summarized below.

Ground Water

- Trace organic concentrations reported in the samples from these monitoring wells included a pesticide, five VOCs, and five SVOCs. Benzene was detected at a concentration in excess of the Class GA standard in one ground-water sample. The pesticide endosulfan II was detected also detected in samples, however, NYSDEC has not established any ground-water criteria for this chemical.

- Iron, manganese, and sodium were detected at concentrations in excess of Class GA standards in ground water at this site.

- The overburden well located on the north side of the landfill showed higher concentrations for most of the water quality parameters when compared to the overburden well on the south side of the landfill. None of the water quality parameters were present at concentrations above Class GA standards.

Leachate

- There were no detectable VOCs, SVOCs, or pesticide/PCBs in any of the leachate seep samples.

- Aluminum and zinc were present at higher concentrations in leachate samples relative to the background spring. Reported concentrations of iron and manganese exceeded Class A standard in three samples. None of the remaining metals concentrations exceeded the Class A standards for wildlife protection based on hardness.

- General water quality parameters, including biochemical oxygen demand, chemical oxygen demand, total dissolved solids, total Kjeldahl nitrogen, total organic carbon, phenolics, alkalinity, and hardness, were also slightly above "background levels" in FLE-1. Site-specific "upgradient" levels of nitrate, chloride, sulfate, total dissolved solids, total organic carbon, alkalinity, and hardness were exceeded in FLE-2. None of the water quality parameters were present at concentrations above Class A standards.

1.4 OBJECTIVES AND DESCRIPTION OF LONG-TERM MONITORING AND MAINTENANCE PROGRAM

1.4.1 Objectives

The objectives of the long-term monitoring program are to identify monitoring points and laboratory analyses to verify the effectiveness of the selected remedial action (installing caps on each landfill), and obtain data necessary to document the long-term changes in constituents of concern in ground water. The monitoring activities summarized in this Field Sampling Plan include the following:

- Identification of sampling locations for ground water
- Procedures for sample collection
- Identification of visual inspection activities
- Reporting requirements to be followed to document the effectiveness of remedial actions
- Maintenance actions and corrective measures to be undertaken should monitoring data indicate they are necessary.

1.4.2 Field Activities

To satisfy the stated objectives, specific field activities to be conducted at the USMA landfills include the following:

- Rehabilitation of one monitoring well at the Post School Landfill (PS-4), and one monitoring well at Michie Lot D (LD-05).
- Sampling of 14 monitoring wells at 15 landfills.

1.4.3 Engineering Activities

The engineering activities for this project include inspection to assess: (1) landfill cap integrity, (2) integrity of the swales and drainage system of each landfill, (3) seeps, (4) condition of each monitoring well and integrity of locks, and (5) landfill condition. These engineering activities are discussed in detail in Section 3.

2. PROJECT ORGANIZATION AND RESPONSIBILITIES

This section lists key project personnel and identifies their respective responsibilities.

2.1 PROJECT PERSONNEL

The project personnel for this project are presented below and includes the Project Manager, Project Superintendent, Contractor Quality Control System Manager, Chemical Quality Control Coordinator, and additional internal and/or subcontracted chemical quality control personnel assigned to the project.

Mr. Chip McLeod, P.E., has been assigned as *Project Manager* for this contract. Mr. McLeod is responsible for the execution of the project in accordance with the requirements contained in the plans and specifications. He reports directly to Mr. Michael Battle, P.G., who, in his role as Program Manager, is ultimately responsible to USACE for the quality of the project. Mr. McLeod also serves as the Point-of-Contact for the USACE Contract Officer Representative.

Mr. Bob Haras has been assigned as *Project Superintendent* for the project, and reports to Mr. McLeod. Mr. Haras is responsible for ensuring that all field activities performed by EA and/or subcontractors under EA's control are conducted in conformance with project plans and specifications. Mr. Haras is also responsible for scheduling and coordinating all field efforts conducted by EA and its subcontractors.

Dr. Dan Hinckley has been assigned as *Contractor Quality Control System Manager* for the project, and is responsible for implementation of the Chemical Quality Control Plan. Mr. Hinckley reports to Mr. Michael Battle, P.G., Program Manager, on all project quality control matters that may require involvement at a corporate level. Mr. Hinckley will communicate with both the Project Manager and Project Superintendent on a daily basis regarding quality control aspects of the project and will be responsible for scheduling, coordinating, and implementing all aspects of the Chemical Quality Control Plan. In addition, Mr. Hinckley will be EA's Point-of-Contact for scheduling and coordinating chemical data quality control activities being implemented in the field.

Ms. Sherri Pullar has been designated as the *Chemical Quality Control Coordinator*. She is qualified to ensure proper sample management, quality control of sampling, chain-of-custody, and data management and evaluation. Ms. Pullar will be responsible for all aspects of chemical data quality control and will report to and coordinate with the Contractor Quality Control System Manager on all such matters.

Project chemists and environmental samplers will support the project as needed to implement field sampling.

2.2 ANALYTICAL LABORATORY

Analytical services will be provided by Katahdin Analytical Services, in Westbrook, Maine. The contracted laboratory will be responsible for:

- Performance of specified analyses for projects at prescribed levels of quality
- Custody control and traceability from sample delivery to reporting of results
- Implementation and maintenance of quality control procedures
- Documentation for those samples analyzed according to approved, written instructions and methods.

2.2.1 Laboratory Personnel

Roles and responsibilities of laboratory personnel are outlined below.

General Manager

- Provides resources and staffing to ensure data quality
- Provides resources and staffing to ensure laboratory safety
- Maintains an independent quality assurance staff.

Laboratory Operations Manager

- Responsible for all operational and support activities
- Ensures staff are qualified and trained
- Ensures all operations and support groups follow the Quality Assurance Program and work closely with the Quality Assurance Officer to maintain compliance
- Coordinates all client services group activities to ensure quality of services provided to clients
- Establishes and maintains a documented communication mechanism between Client Services and the laboratory to ensure that contractual and operational reporting requirements are met.

Quality Assurance Officer

- Develops Analytical Laboratory's Quality Assurance Program
- Manages state and federal laboratory certifications
- Maintains a document control system
- Reviews Non-Conformance Reports and verifies corrective actions
- Exercises authority to shut down any process or procedure that impacts data quality
- Assesses effectiveness of the quality system through performance, systems, and data audits
- Ensures personnel qualifications and training are documented.

Laboratory Project Manager

- Serves as client liaison through project duration
- Identifies analytical requirements for each project
- Ensures coordination of production efforts, and on-time delivery of data packages that meet all client specifications for parameters, methods, quality control, and report format.

Management Information Systems

- Responsible for the site preparation, and onsite configuration of hardware and software for the Laboratory Information Management System
- Identifies custom programming needs, and prepares protocols for system operation
- Responsible for user training and routine system maintenance.

Laboratory Supervisors

- Responsible for the implementation of their respective analytical programs operating in the inorganics and organics laboratories
- Responsible for data review against project requirements and internal quality control criteria
- Initiates and coordinates all quality control measures for the section

- Monitors and verifies the status and quality of analytical data within the section
- Responsible for coordinating and facilitating the section(s) interaction with the Quality Services and Client Services departments to ensure that clients' expectations and requirements are met and the section's performance meets and exceeds such criteria
- Reviews training documentation for section staff to ensure analysts have the qualifications and training to perform quality work and generate acceptable packages
- Ensures 100 percent technical review of data packages and preparation of the narrative
- Ensures section staff implementation of and compliance with all applicable Standard Operating Procedures and Method Standard Operating Procedures.

Sample Custodians

- Receives, logs, and assigns control numbers to incoming samples
- Inspects sample shipping containers for custody seals and container integrity
- Records condition of both shipping containers and sample containers
- Signs documents shipped with samples (i.e., air bills, chain-of-custody records, etc.)
- Verifies and records discrepancies in information on sample documents (i.e., sample tags, chain-of-custody records, traffic reports, air bills, etc.) in appropriate logbooks or on appropriate forms; notifies the Laboratory Project Manager for direction
- Controls samples in storage and assures that laboratory Standard Operating Procedures are followed when samples are removed from and returned to storage
- Monitors storage conditions for proper sample preservation such as refrigerator/freezer temperatures and checks for cross-contamination through maintenance and evaluation of volatile storage blanks.

Chemical Quality Control Coordinator

- Proper chain-of-custody, sample handling, and decontamination procedures followed.
- Quality control samples collected as required (e.g., blanks, duplicate).
- Review laboratory analytical quality control program and state the methods by which the laboratory analyzed the samples as well as analyses that may have deviated from those listed in the QAPP.

- Sample holding times will be reviewed to determine if there are potential impacts on the sample data results from holding time anomalies.

- The precision of the laboratory results will be assessed by comparing duplicate relative percent difference data against the control limits identified in the QAPP. These data will be used to determine if biases exist in the data.

- The accuracy of the data will be assessed by comparing the results of surrogate compounds used by the laboratory against the control limits listed in the QAPP. The matrix spike recoveries and laboratory control sample recoveries compared to the control limits to check for analytical accuracy and method bias will also be assessed.

- Analytical and field completeness are evaluated.

- Field quality control blanks are evaluated.

2.3 QUALITY ASSURANCE ANALYTICAL LABORATORY

In accordance with USACE guidelines and the project specification, the samples will be sent to Katahdin Analytical Services, 340 Country Road, Westbrook, Maine 04092, for analysis. The triplicate samples (quality control split) will be sent to the USACE Missouri River Laboratory in Omaha, Nebraska, for analysis.

3. FIELD SAMPLING PROGRAM

This section presents the overall approach and details the field sampling activities that will be performed at the site to meet the stated objectives of the field investigation for the West Point long-term monitoring program. The field sampling program will address the following elements:

- Sampling objectives
- Sample designation
- Sampling locations and frequency
- Sampling equipment and procedures
- Sample handling and analysis.

This section also presents sampling objectives, number and location of samples, sample rationale, and field sampling procedures. Analytical procedures and quality assurance/quality control provisions are addressed in the Quality Assurance Project Plan (Section B of the Sampling and Analysis Plan). Site safety, health, and emergency response provisions are addressed in the site-specific Safety, Health, and Emergency Response Plan (Section C of the Sampling and Analysis Plan).

3.1 SAMPLING OBJECTIVES

The purpose of this long-term monitoring program is to conduct activities to support the following objectives:

- Monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the site.

- Provide a tiered approach to attaining the NYSDEC water quality standards based on results of ground water samples. Ground-water samples will be collected for trend assessment. In the event ambient water quality standards are exceeded, additional actions may be required. Conversely, consistent compliance with water quality standards may result in reduced sampling requirements

- Assess the potential for adverse environmental impacts by monitoring for evidence of stressed vegetation

- Evaluate the integrity of the ground-water monitoring wells

- Monitor the condition of ground water to determine whether applicable or relevant and appropriate requirements are met.

Data quality objectives are developed to ensure that the data collected will be of sufficient quantity and quality for their intended uses (U.S. EPA 1987). Data use is defined by the types of decisions made with the data; required quantity; precision, accuracy, representativeness, comparability, and completeness; and methods by which data will be collected and analyzed.

3.2 FIELD PROGRAM ACTIVITIES

The field program activities for this project includes three specific activities:

1. Monitoring well installation and well development
2. Installation of dedicated sampling pumps
3. Ground-water sampling.

3.2.1 Monitoring Well Installation and Well Development

One new bedrock monitoring well will be installed and constructed in accordance with the procedures presented in this section and with the U.S. Environmental Protection Agency guidelines as specified in the *Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells* (Document No. EPA/600/4-89/034) (U.S. EPA 1991). The procedure for installing the well is summarized below:

- The new bedrock well will be installed using hollow-stem auger (4.25-in. inner diameter) drilling methods through the overburden until refusal. Standard split-spoon samples will be collected over 2-ft intervals for field screening for VOCs using a hand-held photoionization detector.

- Soil samples will be screened in the field utilizing the closed-container headspace analysis. Soil samples will not be collected for laboratory analysis.

- Up to 10 ft of bedrock will be cored (using 3-15/16-in. diameter HQ core barrel) and characterized at each well location. Rock cores will be described in accordance with the procedures detailed in Section 3.3 of this Field Sampling Plan. It is assumed that the total depth of the bedrock well (including up to 10 ft of core) will not exceed 56 ft below ground surface.

- The bedrock well will be constructed with either a 10-ft or 20-ft screen interval, which will be determined by the EA field geologist and project geologist as site conditions warrant. If bedrock is determined to be competent, the well may be constructed as an open hole.

- The monitoring wells will be constructed in accordance with the details provided Section 3.2.2 of this Field Sampling Plan.

- The newly installed bedrock monitoring well will be developed (for a maximum of 2 hours) using pump and surge methods until ground-water parameters (pH, temperature, and conductivity) stabilize and turbidity is minimized (i.e., less than 10 nephelometric turbidity units). The well will be developed by the drilling subcontractor. EA will provide oversight of well development activities, and will monitor ground-water parameters during development activities. Well development procedures are detailed in Section 3.2.3 of this Field Sampling Plan.

- Up to 10 ft of bedrock core from each well may be collected for description and Rock Quality Designation analysis. Descriptions of the rock core and details specific to each core run will be recorded on the Soil Boring Log field form provided as Figure 8. Rock cores will be identified and visually described by the field geologist for the following parameters:

  — Lithology
  — Grain size and texture
  — Color
  — Bedding/foliation/banding/schistocity
  — Weathering/fractures
  — Solution or void conditions/staining.

- In addition to the visual description of each core, the EA field geologist/field manager will record the following:

  — The total elapsed time for each core run will be recorded. Interruptions in coring will be documented by time of occurrence and description of the problem and the resolution. Coring rates and depths of significant changes in coring rate will be recorded. The intervals of any non-recovered core will be estimated, along with an explanation for no recovery.

  — Changes in color of circulating water/drilling fluid will be recorded. Quantitative estimates of discernable fluid losses and gains to the geological formation and the estimated interval over which they occur will be indicated.

  — Total core recovery will be measured to within 0.1 ft, and total core recovery as a percent of the length of the core run will be determined for each 5 ft core run.

  — The angles of any bedding planes and schistocity will be recorded as a dip angle (as measured from perpendicular to the core axis).

  — The angle of any fractures, joints, faults, or seam surfaces will be measured from the perpendicular to the core axis and graphically illustrated.

— Any dominant coatings or fillings (i.e., slickensides) present in fractures or seams will be recorded.

— The Rock Quality Designation as a percent of the length of the core run will be calculated for each core run and recorded in the field notebook and the Log of Core Boring field form. The Rock Quality Designation method of determining rock quality is as follows:

- The sum of the total length of core pieces recovered in each run that are at least 4-in. in length and which are hard and sound, divided by the total length of the run, represented as a percentage. If the core is broken by handling or by the drilling process, the fresh broken pieces will be fitted together and counted as one piece.

- Rock cores will be placed in wooden core boxes with the top and bottom of each run clearly labeled. Core boxes will be clearly marked on the inside and outside, and will identify the boring number, date, numerical sequence of the box (e.g., 2 of 7), and the footage interval contained within the box.

3.2.2 Monitoring Well Construction

Following soil boring, well construction will be performed according to the procedures described in this section. Actual well completion data will be recorded on the Field Record of Monitoring Well Construction forms provided on Figure 9. The procedure for construction of the new monitoring well is described below:

- The bedrock monitoring well will be installed using new PVC riser casing and well screens. Material will be delivered directly to the field in packaging from the manufacturer. After the borehole has been drilled to refusal (estimated 47 ft below ground surface), 4-in. outer diameter, Schedule 80 PVC protective casing will be set approximately 3 ft into a competent rock socket that will be reamed out using a roller bit. This protective casing will be grouted in place, and allowed to cure overnight prior to HQ coring.

- Once bedrock is encountered and the protective casing has set, a maximum of 10 ft of rock will be cored using HQ coring and percussion rotary drilling techniques. The bedrock lithology will be characterized and logged by the field geologist in accordance with the procedures described in Section 3.3 of this Field Sampling Plan.

- After the borehole has been drilled to completion depth within bedrock, 2-in. inner diameter Schedule 40, threaded, flush-jointed PVC riser casing and attached screen will be set through the protective PVC outer casing into the borehole. The screen interval will be placed at the bottom of the boring at the proper depth within bedrock. The bedrock monitoring wells will be completed with 10-20 ft linear ft of well screen (0.010 slot) and filter pack, depending on site-specific conditions as determined by the field geologist/field manager. Alternatively, the well may be constructed as an open hole well if the bedrock is determined to be competent based on field observations and calculated Rock Quality Designation. No sediment traps will be used to cap the screen bottom.

- The riser casing will be finished and constructed with 8-in. diameter protective steel casing (2-ft stickup) grouted in place with cement collar and a lockable cap. The well will be capped with an expandable and lockable well cap. A vent hole will be drilled in the cap to permit equalization at atmospheric and interior well pressure and to allow access to dedicated pump equipment. A bedrock monitoring well schematic construction diagram is provided as Figure 10.

- The filter pack of the monitoring well will consist of inert silica sand, certified as chemically clean by the manufacturer, and texturally clean as seen through a 10X hand lens. Nominal grain size will be No. 1 silica sand unless geologic conditions, in the judgement of the field manager or project geologist, dictate differently. Prior to installing the well screen, a bedding of filter pack up to 1-ft thick will be placed in the bottom of the hole. Sand will extend approximately 2 ft above the top of the well screen. The 2 ft of filter pack above the top of the screen allows for some settlement of the filter pack and a buffer between the top of screen and the annular seal. The depth to the top of the filter pack will be sounded frequently with a weighted measuring tape. If bridging of the material does occur, a small amount of potable water may be used to remove the bridge and allow the filter pack to settle correctly.

- The bentonite seal for the monitoring well will include the use of commercially available pellets (or chips). Pellet seals will be a minimum of 2-ft thick as measured immediately after placement, without allowance for swelling. The bentonite seal will be placed directly above the filter pack of each well. Following placement of the pellets, potable water will be poured down the annular space to hydrate the pellets. The bentonite will be allowed to hydrate for 30 minutes prior to grouting the remainder of the borehole.

- The annular seal of the monitoring well will consist of cement-bentonite grout, composed by weight of 10 parts cement (Portland cement, any Type I-V) to one-half part bentonite with a maximum of 7 gal of potable water per 94-lb bag of cement. Bentonite will be added after the required amount of cement is mixed with water. Additives or borehole cuttings will not be mixed with the grout. Annular seal materials will be combined in an aboveground rigid container and mixed onsite to produce a thick, lump-free mixture. The annular seal will be placed utilizing a tremie pipe, initially located within 1 ft of the top of the bentonite seal. The tremie pipe should be placed in the annulus between the protective casing and the riser pipe. Grout will be pumped through this pipe to the bottom of the open annulus until a continuous, undiluted column of grout is formed from the top of the bentonite seal to approximately 2-3 ft below ground surface.

- The surface completion of the monitoring well will be constructed with an 8-in. diameter steel protective casing, 5 ft long (2-ft stickup above ground surface with a lockable cap), placed such that the bottom of the protective casing extends into the grout. At the ground surface, the cement collar will form a 3-ft diameter, 6-in. thick concrete pad sloping outward around the well. The top outer edge of the pad will be flush with the ground. An internal grout collar will be placed in the annular space between the inner casing and the outer protective PVC casing from below the frost line to the ground surface. Brass locks that are keyed alike will be used to secure the outer lids of the protective casing of the wells. The protective casing will be washed with clean water or steam-cleaned prior to placement, so it is free from extraneous openings, encrusting, and/or coating material (except primer/paint applied by the manufacturer). Each well will be provided with vented well caps.

3.2.3 Well Development

The new bedrock well will be developed in order to remove silt from the well screen and to ensure that representative ground-water samples can be collected. Wells will be developed for a maximum of 2 hours and will be performed by the drilling subcontractor. During development, EA will provide oversight of the subcontractor, and will monitor ground-water parameters. Wells will be developed within 2 weeks of the completion of well construction (no sooner than 48 hours after grouting is completed). The procedure for well development is described below:

- The well will be alternately mechanically surged with a surge block and pumped clear of sediment with a submersible pump. If the addition of water is required to facilitate surging, water from the well or water from an approved potable water source will be used, and at least as much water that was introduced during development will be removed from each well. Care will be taken during surging to ensure that low pressures within the well casing and screened interval do not cause implosion of the well screen.

- Surging will continue until little or no sediment enters the well. Following surging, the well will be continuously pumped using a submersible pump (i.e., Grundfos® pump). Temperature, pH, specific conductivity, and turbidity will be monitored during pumping at a rate of one reading per well casing volume removed. Water quality data will be recorded on the Field Record of Well Development form provided in Figure 11. Turbidity will be measured as soon as the sample is brought to the surface. Pumping will continue until these parameters have stabilized (less than 0.2 pH units or a ±10 percent change for the other parameters between three consecutive readings) and the turbidity does not exceed 5 nephelometric turbidity units, or for a maximum of 2 hours. Failure to obtain satisfactory results (parameter stabilization) will be noted on the well development record sheet (the project manager will be notified should this occur). A copy of the Field Record of Well Development form to be completed during the development program is provided on Figure 11.

- The purged ground water derived from well development will be temporarily containerized in U.S. Department of Transportation-approved 55-gal drums and discharged into the sanitary sewer prior to the end of the working day.

3.2.4 Installation of Dedicated Pump Assembly

Dedicated submersible pump assembles will be installed into each of the existing and new monitoring wells to facilitate ground water sample collection. New decontaminated Grundfos submersible pumps and new, factory cleaned polyethylene tubing will be installed into each well. The procedures for installing the pump assemblies are described below:

- Connect new dedicated polyethylene tubing to Grundfos pump.

- Lower pump assembly to depth corresponding with the midpoint of the screened interval. Table 1 shows a summary of well depths, screened interval, and suggested pump assembly depths for each monitoring well.

- Thread tubing and pump electrical cord through the pre-drilled hole in the well cap and secure with wire fasting to hold pump in place.

- Allow sufficient tubing and electrical cord at the surface for hook up to control box, and for sampling. Tuck additional tube and electrical cord length into well casing between sampling events.

3.2.5 Ground Water

This subsection presents the ground-water sample location and number, sample location numbering system, and sampling procedures.

The ground-water sampling program is designed to provide information to characterize ground water collected in the perimeter area of the landfill in question. The data collected during the performance of long-term monitoring will be used for the following purposes:

- Monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the site.

- Provide a tiered approach to attaining the NYSDEC water quality standards based on results of ground-water samples. Ground-water samples will be collected for trend assessment. In the event ambient water quality standards are exceeded, additional actions may be required. Conversely, consistent compliance with water quality standards may result in reduced sampling requirements.

- Evaluate the integrity of the ground-water monitoring wells.

- Monitor the condition of ground water to determine whether applicable or relevant and appropriate requirements are met.

3.2.5.1 Ground-Water Sample Location and Number

Samples of ground water will be collected from the monitoring well locations listed in Table 2. The total number of discrete ground-water samples to be collected is shown in Table 2. In addition, triplicate samples and rinsate blanks for quality control and quality assurance sample (split) will be collected and analyzed by the USACE-Missouri River Laboratory in Omaha, Nebraska.

Data to be obtained from the ground-water sampling program will include water level, analytical results for chemical parameters, and general water characteristics. Samples (both filtered and unfiltered) will be analyzed for Target Analyte List metals (U.S. Environmental Protection Agency Method 6000/7000 Series).

Ground-water samples will provide information to characterize ground-water quality and potential downgradient migration and contaminant transport from source areas via ground water.

3.2.5.2 Ground-Water Sampling Procedures

The following procedures will be used for monitoring well ground-water sampling:

- Wear appropriate personal protective equipment as specified in the Safety, Health, and Emergency Response Plan. In addition, samplers will use new sampling gloves for the collection of each sample.

- Visually examine the exterior of the monitoring well for signs of damage or tampering and record in the field logbook.

- Unlock and remove well cap.

- Place polyethylene sheeting around well casing to prevent contamination of sampling equipment in the event sampling equipment is dropped.

- Obtain combustible gas and organic vapor analyzer readings and record in field logbook.

- Measure the static water level in the well with an electronic water level indicator. The water level indicator will be washed with Alconox® detergent and water, rinsed with deionized water, rinsed with methanol, and then rinsed with deionized water again between individual wells to prevent cross-contamination.

- Utilizing the dedicated submersible pump with polyethylene tubing, set intake at the surface level of the ground water and start pump; continue to lower the intake line ensuring that standing water in the well has been purged. Standard operating procedures for low-flow sampling are included in Attachment A.

- If insufficient water is available to sample using the dedicated submersible pump, no sample will be collected during that monitoring event.

- While purging, allow field parameters of pH, conductivity, and temperature to stabilize before sampling. Record data on Field Record of Well Gauging, Purging, and Sampling form (Figure 12). Purging will be considered complete after 10 consecutive readings or when readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 nephelometric turbidity units, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Collect the sample aliquot for unfiltered inorganic analysis directly into the appropriate sample bottles. Sample bottles will be received from the laboratory for the parameter to be analyzed.

- Attach a single sample, high capacity disposable ground-water filter cartridge (45 μm) to the polyethylene tubing and allow to fill. Let the ground water purge for 30 seconds, then collect the sample aliquot for filtered inorganic analysis directly into the appropriate bottles.

- The instruments will be decontaminated between wells to prevent cross-contamination.

- Place analytical samples in cooler and chill to 4°C. Samples will be shipped to the laboratory at the conclusion of the sampling event.

- Replace dedicated tubing and electrical cord inside casing.

- Re-lock well cap.

- Fill out field logbook, sample log sheet, labels, custody seals, and chain-of-custody forms.

3.3 SAMPLE TRACKING SYSTEM

3.3.1 Sample Designation

Field samples collected from the landfills will each be assigned a unique sample tracking number. Sample designation will be an alpha-numeric code that will identify each sample by the landfill matrix sampled, location, and sequential sample number. Location will be a code representing the landfills, followed by a matrix identifier type (matrix sampled) that will be identified by a 2-letter code (e.g., monitoring well) followed by a 2-digit numeric designation. Each matrix sampling location will be identified with a 2-digit number. Sequential sample numbers at each location for each sample type will begin with 01 and increase accordingly.

The following is a guide for sample identification:

AA	(-01-) -	AA	NN	F
Location Identifiers	Year (MW Only)	Matrix Identifiers	Location Number	Filtered

where

A = Alphabetic
N = Numeric
F = Filtered
UF = Unfiltered.

Location Identifiers:

OC = Organic Compost Landfill
SL = Ski Lot Landfill
PX = PX Landfill
LA = Michie Stadium Parking Lot A Landfill
LC = Michie Stadium Parking Lot C Landfill
LD = Michie Stadium Parking Lot D Landfill
LE = Michie Stadium Parking Lot E Landfill
LF = Michie Stadium Parking Lot F Landfill
MP = Motor Pool Landfill
ME = Motor Pool East Landfill
PS = Post School Landfill
HS = High School Landfill
CB = Camp Buckner Landfill
PL = Building 706 Parking Lot Landfill.

Matrix Identifiers:

GW = Ground water
RB = Rinsate blank
FB = Field blank
DX = Field duplicate
MS = Matrix spike
MSD = Matrix spike duplicate.

For example, the filtered ground-water sample collected from monitoring well OC-GW-1 at the Organic Compost Landfill will be identified as OC-01-GW-01-F.

The location identification will be cross-referenced with the actual sample identifications according to Table 2. The sampling and chemical analysis table allows the samples to be tied directly to the analytical tasks required for each sampling point. The field quality control samples (e.g., duplicates, rinsate blanks, and trip blanks) remain anonymous to the analytical laboratory (Table 3). Two triplicate (quality assurance split) samples will be collected and sent to the external quality assurance laboratory at the following address:

- U.S. Army Corps of Engineers
  Missouri River Laboratory
  420 S. 18th Street
  Omaha, Nebraska 68102

NOTE: The triplicate samples will be determined on the field based on well volume yield.

As the field program progresses, a sampling master log will be maintained. As each sample is collected, it will be referenced by the sampling location and matrix, if appropriate, in the master log and on a detailed site map. Duplicate samples will also be referenced by their matrix type and location in the master log (OC-01-DX-01). These data will be maintained in the site logbook.

3.3.2 Sample Packaging and Shipping

Samples will be packaged and shipped in accordance with the USACE requirements specified in EM 200-1-6 and EM 200-1-3 (USACE 1997, 2001). The following records are associated with the labeling and shipping process:

- Sample tag or label
- Custody seal
- Chain-of-custody form
- Bill of lading (airbill or similar document).

Samples are physical evidence collected from a facility or the environment. Laboratory chain-of-custody procedures have been established to ensure sample traceability from the time of receipt through completion of analysis.

Chain-of-custody originates as samples are collected. Chain-of-custody documentation accompanies the samples as they are moved from the field to the laboratory with shipping information and appropriate signatures indicating custody changes along the way.

Chain-of-custody sample forms will be completed to the fullest extent possible prior to sample shipment. The forms will include the following minimum information:

- Project name
- Sample number (includes location and type)
- Matrix of the sample
- Type of sample (grab, composite, etc.)
- Sample time and date
- Preservation applied (or "None" if no preservation)

- Name of the person collecting the sample
- Analyses requested for each sample
- USACE–Missouri River Laboratory project number (split samples only).

Site-specific procedures for sample packaging and shipping are detailed in the Quality Assurance Project Plan.

3.3.3 Field Documentation

Field personnel will be issued weatherproof logbooks. The site manager and field staff are responsible for recording pertinent project information including, but not limited to, field work documentation; field instrumentation readings; calculations; calibration records; work plan distributions; photograph references; sample tag/label numbers; meeting information; and important times and dates of teleconferences, correspondence, or deliverables. This site logbook will also contain an abbreviated version of notes listed in the team or individual field logbooks. The sample team or individual performing a particular sampling activity is required to maintain a field logbook that will be filled out at the location of sample collection immediately after sampling. It will contain sample particulars including sample number, sample collection time, sample location, sample descriptions, sampling methods used, daily weather conditions, field measurements, name of sampler, and other site-specific observations. It will address deviations from the Field Sampling Plan; Quality Assurance Project Plan; or Safety, Health, and Emergency Response Plan, including authorization obtained and the rationale for the deviation, visitors' names or community contacts during sampling, and geologic and other site-specific information determined by the field team leader as appropriate.

3.4 DECONTAMINATION PROCEDURES

As detailed below, non-dedicated equipment involved in field sampling activities will be decontaminated prior to, between, and after sampling to minimize the potential for cross-examination. Decontamination of sampling equipment will be kept to a minimum in the field and, whenever possible, dedicated sampling equipment will be used. Decontamination water generated at the site will be temporarily containerized in drums and discharged into sanitary sewer as per USMA personnel at the end of each work day. Personnel directly involved in equipment decontamination will wear appropriate personal protective equipment as stated in the Safety, Health, and Emergency Response Plan. Used personal protective equipment will be bagged and disposed as general refuse.

3.4.1 Field Measurement Equipment Decontamination

Prior to performing a measurement at each well, the probe of the water level indicator (e.g., QED) will be cleaned following the following protocol:

- Wash with water (from an approved source) and laboratory-grade detergent (e.g., Alconox® detergent)

- Rinse with deionized water
- Rinse with methanol or isopropyl (laboratory-grade)
- Rinse with deionized water
- Air dry; decontamination of measurement equipment will be kept to a minimum in the field and, wherever possible, dedication sampling equipment will be used.

Personnel directly involved in equipment decontamination will wear protective clothing, as stated in the Safety, Health, and Emergency Response Plan.

3.5 PROGRAM-DERIVED WASTES

Program-derived waste will be managed to ensure the safety and health of personnel and the environment. Wastes that are to be temporarily stored will be staged at an area designated by USMA-Environmental Management Office. Wastes will be contained, labeled, and handled or otherwise managed in the following manner:

- Soil cuttings will be spread out on the ground onsite adjacent to the soil boring.
- Development and purge fluids will be collected and temporarily contained in U.S. Department of Transportation-approved 55-gal drums. Development and purge fluids will be discharged to the sanitary sewer prior to the end of each work day.
- The decontamination fluids will be collected and contained in U.S. Department of Transportation-approved 55-gal drums. Decontamination fluids will be discharged to the sanitary sewer prior to the end of each work day.
- Used personal protective equipment will be double-bagged and disposed of onsite as general refuse.

3.6 QUALITY CONTROL

Quality assurance/quality control procedures will be followed during long-term monitoring sampling activities. A detailed description of quality control procedures is provided in Section 4 of this Field Sampling Plan.

4. ENGINEERING ACTIVITIES

The engineering activities for this project include inspecting: (1) landfill cap integrity, (2) integrity of the swales and drainage system of each landfill, (3) seeps, (4) the condition and integrity of each monitoring well and cap and lock, and (5) landfill condition. These engineering activities are discussed in the following subsections.

4.1 DRAINAGE STRUCTURES

The inspections will include visual checks of culverts, drainage swales, and berms/benches, if present, to ensure that erosion problems are not occurring. Any material defects and erosion occurrences discovered at the landfill will be repaired immediately and restored to meet the design standard. Eroded soil or cover material will be replaced as soon as possible. Exposed or unvegetated soil will be re-seeded, fertilized, and mulched.

4.2 COVER SYSTEM

Areas of concern within the final landfill cover system may include erosion, exposure, loss of vegetative cover, asphalt degradation, settlement, gravity sliding, or cracking on the top or side slopes of the landfill. Annually, the cover system, including topsoil layer and/or asphalt layer, will be inspected and records will be maintained.

4.3 VECTORS

The presence of any vectors (e.g., rodents, flies, etc.) on the site will be evaluated during the annual inspection. If present, extermination or treatment that will remove the vecting population(s) will be recommended.

4.4 OTHER FACILITIES AND STRUCTURES

Monitoring well casings, casing locks, concrete aprons, site fence, bollards, and gates will be inspected to ensure that they are undamaged and functional. Identified damage will be reported immediately.

4.5 ANNUAL INSPECTION REPORTS

After each annual inspection, an inspection report will be prepared as part of the data summary report. The inspection report will include, at a minimum, the date and time of the inspection; personnel conducting the inspection; visual observations of the inspectors; a list of items inspected; a brief description of any repair work required, including the nature of the damage; and any repairs or corrective measures made.

5. QUALITY ASSURANCE REPORTS AND PROCEDURES FOR FIELD CHANGES AND CORRECTIVE ACTIONS

5.1 QUALITY ASSURANCE/QUALITY CONTROL FIELD AUDIT

Periodically during the performance of the long-term monitoring and maintenance program, field personnel will be required to report the performance of measurement systems and status of the field sampling program to the Project Manager. The frequency of reporting will be daily or weekly as appropriate during the period of time that measurements and sampling are being performed in the field. Reporting will generally be written. However, if a problem requiring corrective action is encountered, a formal written report will be prepared.

5.2 FIELD CHANGES AND CORRECTIVE ACTIONS

The Project Manager is responsible for site activities. Modification to site programs may be required due to site-specific conditions, needs, or unforeseen events. When modifications to a program are necessary, the Field Team Leader will notify the Project Manager of the anticipated change. The client will also be notified before any changes are implemented. If these changes are subsequently determined to be unacceptable, the actions taken during a period of deviation from the program will be evaluated for their significance.

As a result of an out-of-control event that takes place in the field, the Project Manager will be notified by the Field Team Leader. If previously reported data are affected by the situation requiring correction, or if the corrective action will impact the project budget or schedule, the action should directly involve the Project Manager and the client. Changes or events that occur in the field and corrective actions will be documented on a Daily Quality Control Report (Figure 13).

Two kinds of corrective actions are:

1. **Immediate**—To correct or repair non-conforming equipment and systems. The need for such an action will most frequently be identified by the analyst as a result of calibration checks.

2. **Long-Term**—To eliminate causes of non-conformance. The need for such actions will be identified by audits. Examples of this type of action include:

    - Staff training in technical skills or in implementing the Quality Assurance/Quality Control Program

    - Reassessment of field operation procedures and/or personnel.

The essential steps in the corrective action system are as follows:

1. Assign responsibility for investigating the problem
2. Investigate and determine the cause of the problem
3. Assign and accept the responsibility for implementing the corrective action
4. Establish effectiveness of the corrective action and implement the correction
5. Verify that the corrective action has eliminated the problem.

Depending on the nature of the problem, the corrective action employed may be formal or informal. In either case, occurrence of the problem, corrective action employed, and verification that the problem has been eliminated are routinely documented and maintained in the project files.

5.3 QUALITY CONTROL SUMMARY REPORT

At the completion of the annual field program, the Site Manager will prepare a Quality Control Summary Report. The Quality Control Summary Report includes copies of the Daily Quality Control Reports (Figure 13), with a particular focus on the total numbers/location of samples taken; deviations from this Field Sampling Plan; Quality Assurance Project Plan; and Safety, Health, and Emergency Response Plan; and a summary of any problems/correction actions.

Figures

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

FIGURE 1
LANDFILL LOCATIONS MAP

PROJECT MGR	DESIGNED B	PROJECT No	FILE No
CEM		61558.01	

EA ENGINEERING, SCIENCE, AND TECHNOLOGY		UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE 2 ORGANIC COMPOST, POST SCHOOL, AND PX LANDFILLS	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR

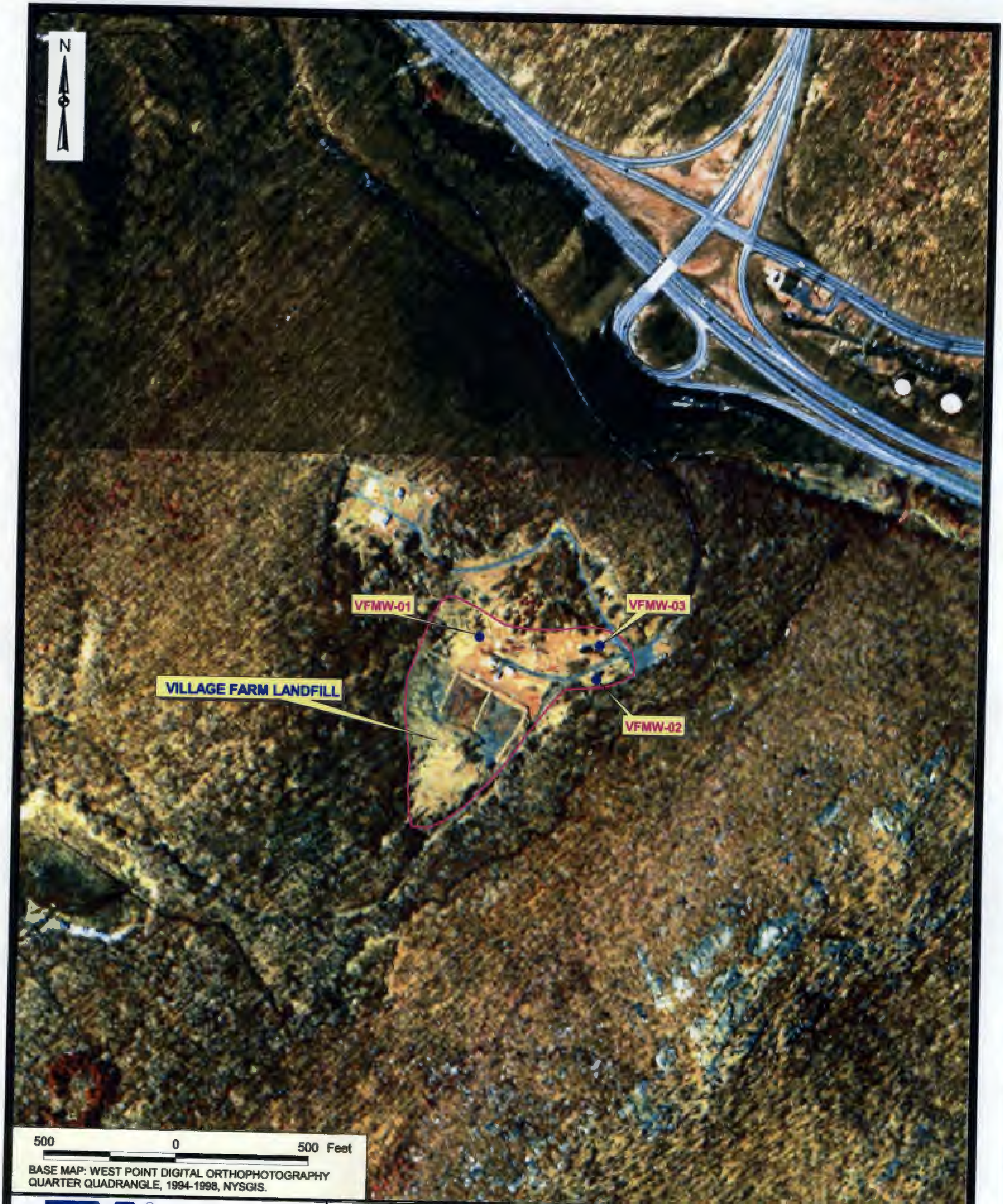
EA ENGINEERING, SCIENCE, AND TECHNOLOGY		UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE 3 HIGH SCHOOL LANDFILL	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR

EA ENGINEERING, SCIENCE, AND TECHNOLOGY		UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE 4 CAMP BUCKNER LANDFILL	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR

EA®	EA ENGINEERING, SCIENCE, AND TECHNOLOGY	UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 5 SKI LOT, MOTOR POOL, AND MOTOR POOL EAST LANDFILLS

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR

EA ENGINEERING, SCIENCE, AND TECHNOLOGY		UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK			FIGURE 6 BLDG. 706 PARKING LOT AND MICHIE STADIUM LOTS A-F LANDFILLS		
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR



EA ENGINEERING, SCIENCE, AND TECHNOLOGY		UNITED STATES MILITARY ACADEMY WEST POINT, NEW YORK				FIGURE 7 VILLAGE FARM LANDFILL	
PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT No	FILE No
CEM	BT	BT	CEM	AS SHOWN	30 OCT 2001	61558.01	I:\WESTPOINT\ MAP.APR

EA Engineering, Science, and Technology

LOG OF SOIL BORING

Job. No.	Client	Location
Drilling Method:		Boring No.
Sampling Method:		Sheet of

Coordinates:
Surface Elevation:
Casing Below Surface:
Reference Elevation:
Reference Description:

					Drilling	
Water Lev.					Start	Finish
Time						
Date						
Reference						

Sample Type	Inches Drvn/In. Recvrd	Dpth. Csg.	Samp. # /samp. depth	PID (ppm) HNu	Blows per 6 in.	Depth in Feet		USCS Log	Surface Conditions:
						0			
						1			
						2			
						3			
						4			
						5			
						6			
						7			
						8			
						9			
						10			
						11			
						12			
						13			
						14			
						15			
						16			
						17			
						18			
						19			
						20			SS = Split barrel sample.

Logged by: ______________ Date: ______________

Drilling Contractor: ______________ Driller: ______________

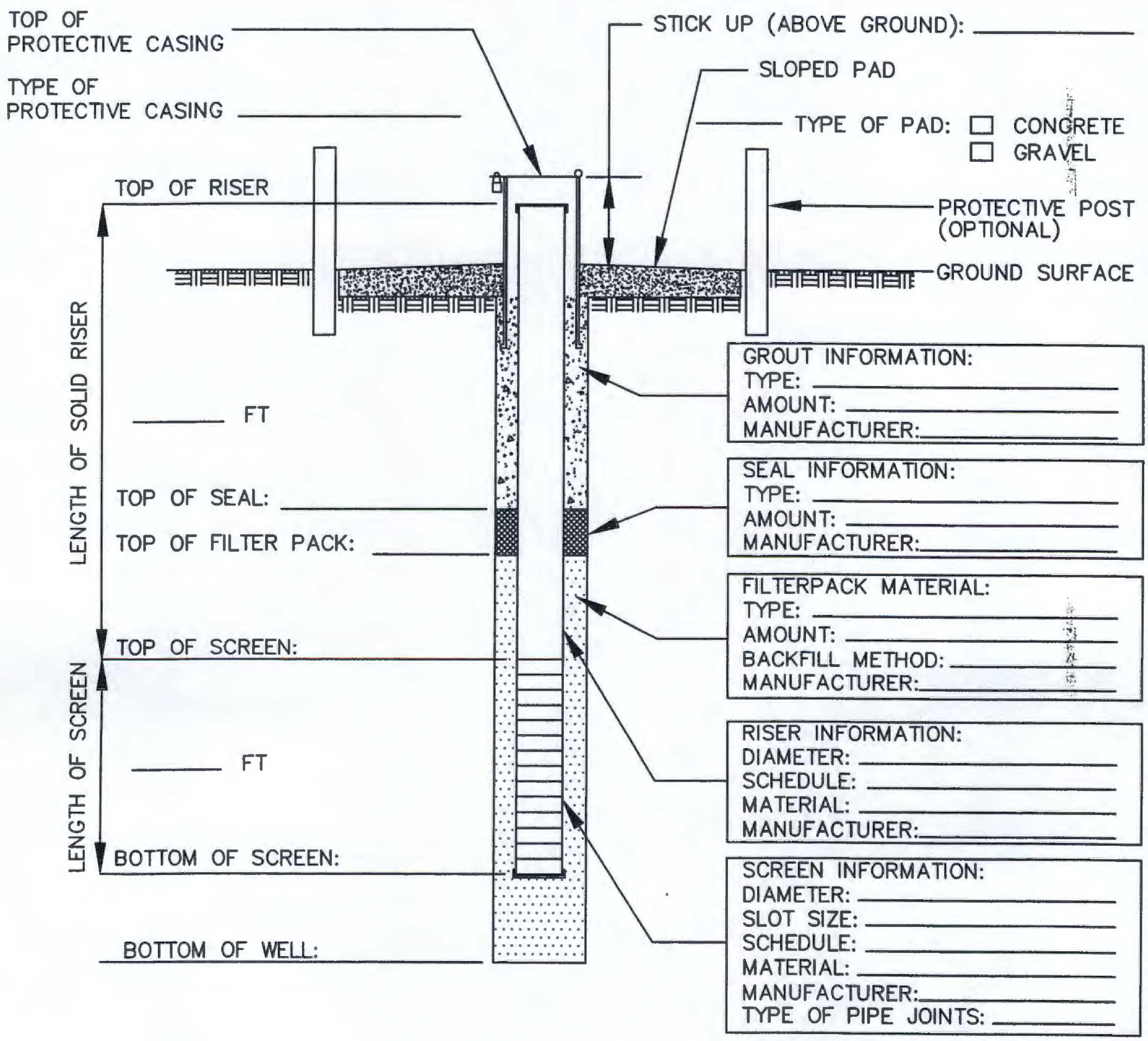
WELL SPECIFICATIONS:
Diam. of casing: ______ Screen Interval: ______ Sandpack: ______ Grout: ______
BOH: ______ Riser Interval: ______ Bentonite: ______ Cover: ______

Figure 8. Soil boring log.

FIELD RECORD OF MONITORING WELL CONSTRUCTION

(STICK UP)

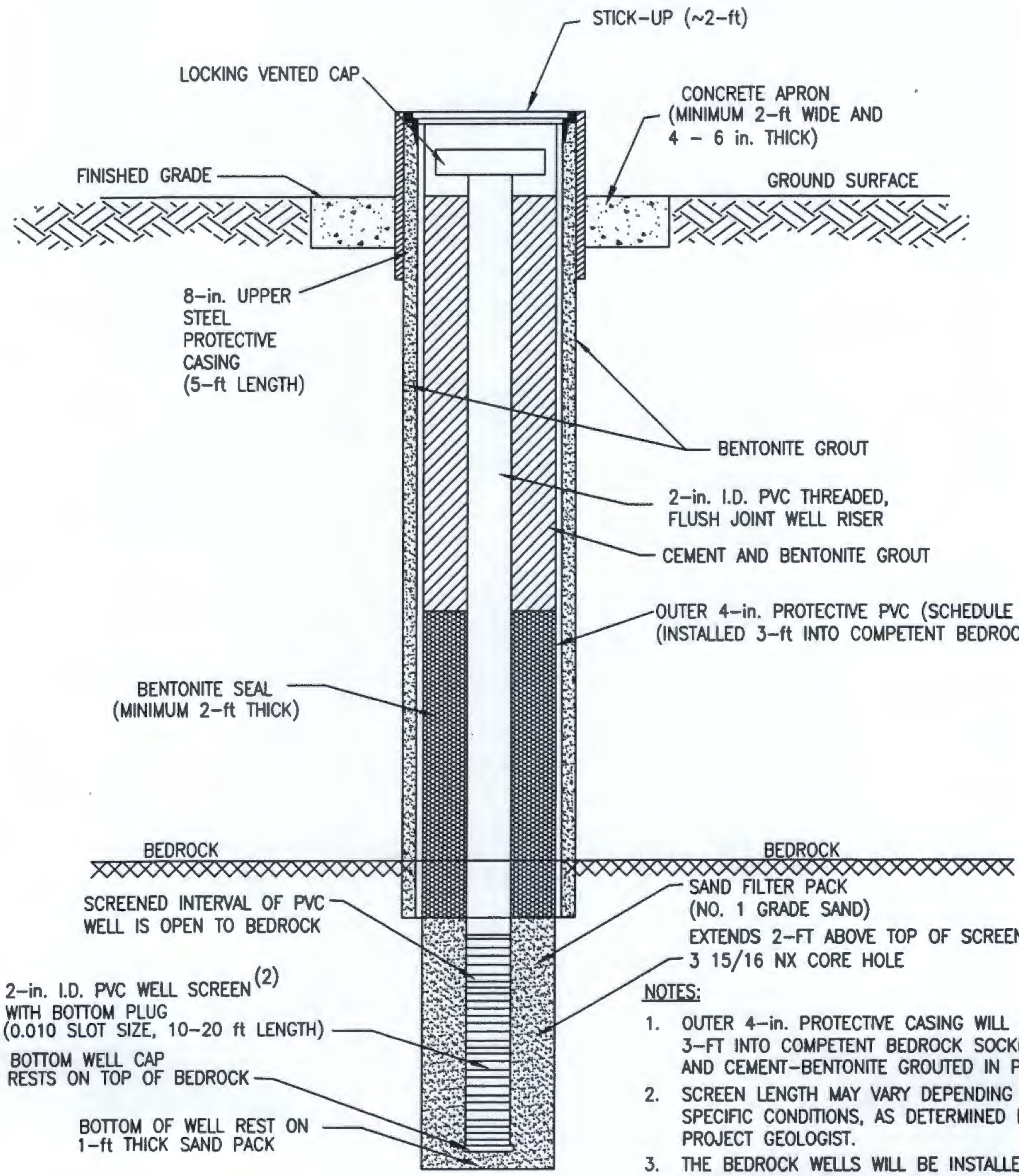
EA® EA ENGINEERING, SCIENCE, AND TECHNOLOGY	MONITORING WELL/SOIL BORING ID NO.:			SKETCH OF WELL LOCATION:
PROJECT TITLE/PROJECT NO.:	WELL INSTALLATION	START	FINISH	
	DATE:			
SITE NAME:	TIME:			
	DEPTH TO WATER (FT BGS):			
SITE GEOLOGIST:	DRILLING METHOD:			



NOTES: 1. ALL MEASUREMENTS ARE IN FEET BELOW GROUND SURFACE UNLESS OTHERWISE INDICATED.
2. ALL FEATURES NOT TO SCALE.

Figure 9. Field Record of Monitoring Well Construction form.

BEDROCK MONITORING WELL SCHEMATIC CONSTRUCTION DIAGRAM



MONITORING WELL SECTION

NOT TO SCALE

NOTES:

1. OUTER 4-in. PROTECTIVE CASING WILL BE INSTALLED 3-FT INTO COMPETENT BEDROCK SOCKET AND CEMENT-BENTONITE GROUTED IN PLACE.
2. SCREEN LENGTH MAY VARY DEPENDING ON SPECIFIC CONDITIONS, AS DETERMINED BY THE PROJECT GEOLOGIST.
3. THE BEDROCK WELLS WILL BE INSTALLED USING HOLLOW-STEM AUGER DRILLING METHODS AND DIRECT ROTARY DRILLING METHODS THROUGH TOP 3 ft OF BEDROCK.
4. THE TOP 20 ft OF BEDROCK WILL BE CORE SAMPLED USING NX CORE.
5. THE NEED FOR THE 2-in. PVC RISER AND WELL SCREEN WILL DEPEND ON THE DEGREE OF BEDROCK FRACTURES AS DETERMINED IN THE FIELD.

FILE: F:\FEDERAL\NON DOD\ARMY CORP OF ENGINEERS\61558010001\FSP\WELL_DIAGRAM.DWG

EA ENGINEERING, SCIENCE, AND TECHNOLOGY	US MILITARY ACADEMY WEST POINT, NEW YORK	FIGURE 10 BEDROCK MONITORING WELL SCHEMATIC CONSTRUCTION DIAGRAM

PROJECT MGR	DESIGNED BY	DRAWN BY	CHECKED BY	SCALE	DATE	PROJECT NO	FIGURE
DEM	RSW	BT	RSW	NONE	30 OCTOBER 2001	61558.01	10

EA Engineering, Science, and Technology

FIELD RECORD OF WELL DEVELOPMENT

Project Name:	Project No:	Date:
EA Personnel:	Development Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth To Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal)[C*D]:
C. Water Column Height (ft):	F. Five Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (min)						
Turbidity (nTu)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (μmhos/cm)						
eH (mV)						
Parameter	**6 Volumes**	**7 Volumes**	**8 Volumes**	**9 Volumes**	**10 Volumes**	**End**
Time (min)						
Turbidity (nTu)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°F)						
Conductivity (μmhos/cm)						
eV (mV)						

COMMENTS AND OBSERVATIONS:____

____

____

____

____

Figure 11. Field Record of Well Development form.

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FIELD RECORD OF WELL GAUGING, PURGING, AND SAMPLING

Project Name:	Project No.:	Date:
EA Personnel:	Purge Method:	
Weather/Temperature/Barometric Pressure:		Time:

Well No.:	Well Condition:
Well Diameter:	Measurement Reference:
Well Volume Calculations	
A. Depth to Water (ft):	D. Well Volume/ft:
B. Total Well Depth (ft):	E. Total Well Volume (gal) [C*D]:
C. Water Column Height (ft):	F. Three Well Volumes (gal):

Parameter	Beginning	1 Volume	2 Volumes	3 Volumes	4 Volumes	5 Volumes
Time (minutes)						
Depth to Water (ft)						
Purge Rate (gpm)						
Volume Purged (gal)						
pH						
Temperature (°C)						
Conductivity (μmhos/cm)						
Dissolved Oxygen (mg/L)						
Turbidity						

TOTAL QUANTITY OF WATER REMOVED (gal): ______

COMMENTS AND OBSERVATIONS: ______

EA 5120 0794-2

Figure 12. Field Record of Well Gauging, Purging, and Sampling.

EA Engineering, Science, and Technology

DAILY QUALITY CONTROL REPORT

Problems:

Corrective Actions:

Specific Sampling Problems/Alternate Methods:

Quality Control Activities:

Government Instructions:

Onsite Personnel	Affiliation	Job Title	Job Function

Figure 13. Daily Quality Control Report form.

Tables

TABLE 1 SUMMARY OF WELL DEPTHS, SCREENED INTERVALS, AND SUGGESTED PLACEMENT OF DEDICATED PUMP ASSEMBLIES

Landfill	Well ID	Total Well Depth (ft bgs)	Screen Interval (ft bgs)	Approximate Depth of Dedicated Pump Assembly (ft bgs)
PX Landfill	PXMW-01	11.5	3.5-10.5	7
Michie Stadium – Lot A	LAMW-03	21.0	10.5-20.5	15.5
Michie Stadium – Lot C	LCMW-03	31.5	21-31	36.5
Michie Stadium – Lot D	LDMW-04	94.20	---	90
Michie Stadium – Lot E	LEMW-04	21.5	14.5-19.5	17
Michie Stadium – Lot F	LF-01	12.41	4.27-12.27	8.27
Ski Lot Landfill	SL-5	17.6	7-17[a]	12
Post School Landfill[b]	PS-4			
Motor Pool Landfill	MP-4	20.2	5.2-20.05	12.85
Motor Pool East Landfill	MW 11-1	16	4.5-14.5	9.5
High School Landfill	HSMW-01	26.0	19-24	21.5
Organic Compost Landfill	OC-2	24.7	8.7-23.7	16.2
Camp Buckner Landfill	CBMW-03	14.0	3.5-13.5	8.5
Building 706 Parking Lot Landfill	MW48-01	7.5	4-7	5.5

(a) Approximate depths; well construction diagram incomplete.
(b) New well to be installed prior to beginning of long-term monitoring program; dedicated pumping assembly should be placed in the middle of the screened interval.

NOTE: Dashes (---) indicates no screened interval; bedrock well.

TABLE 2 SUMMARY OF GROUND-WATER SAMPLING AND ANALYSIS ACTIVITIES

Landfill ID	Landfill Name	No. of Ground-Water Samples	Monitoring Wells	Sample ID	Analysis
WSTPT-01	PX Landfill	1	PXMW-01	PX-yy-GW-01-F PX-yy-GW-01-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-02	Michie Stadium – Lot A	1	LAMW-03	LA-yy-GW-02-F LA-yy-GW-02-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-04	Michie Stadium – Lot C	1	LCMW-03	LC-yy-GW-03-F LC-yy-GW-03-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-05	Michie Stadium – Lot D	1	LDMW-04	LD-yy-GW-04-F LD-yy-GW-04-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-06	Michie Stadium – Lot E	1	LEMW-04	LE-yy-GW-04-F LE-yy-GW-04-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-7A	Michie Stadium – Lot F	1	LF-01	LF-yy-GW-01-F LF-yy-GW-01-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-09	Ski Lot Landfill	1	SL-5	SL-yy-GW-05-F SL-yy-GW-05-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-10	Post School Landfill	1	PS-4	PS-yy-GW-04-F PS-yy-GW-04-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-11	Motor Pool Landfill	1	MP-4	MP-yy-GW-04-F MP-yy-GW-04-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-11A	Motor Pool East Landfill	1	MW 11-1	ME-yy-GW-11-1-F ME-yy-GW-11-1-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-15B	High School Landfill	1	HSMW-01	HS-yy-GW-01-F HS-yy-GW-01-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-16	Organic Compost Landfill	1	OC-2	OC-yy-GW-02-UF OC-yy-GW-02-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-35A	Camp Buckner Landfill	1	CBMW-03	CB-yy-GW-03-F CB-yy-GW-03-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)
WSTPT-48	Building 706 Parking Lot Landfill	1	MW48-01	PL-yy-GW-01-F PL-yy-GW-01-UF	TAL Metals (Filtered) TAL Metals (Unfiltered)

NOTE: yy = Last two digits of sample year.
TAL = Target Analyte List.

TABLE 3 SUMMARY OF QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

Analysis	No. of Wells	Field Duplicate	Triplicate (Quality Control Split)	MS/MSD	Rinsate Blank	Field Blank	Total Samples per Event
TAL Metals by ICP-MS (Filtered)	14	1	1	1	1	1	19
TAL Metals by ICP-MS (Unfiltered)	14	1	1	1	1	1	19

NOTE: MS/MSD = Matrix spike/matrix spike duplicate.
TAL = Target Analyte List.
ICP-MS = Inductively coupled plasma mass spectrometry.

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Attachment A.1

Standard Operating Procedure – Ground-Water Sampling by Low-Flow Purge and Sampling Method Using Dedicated Pumps

ATTACHMENT A.1 – CONTENTS

ATTACHMENT A.1
STANDARD OPERATING PROCEDURE – GROUND-WATER SAMPLING BY LOW-FLOW PURGE AND SAMPLING METHOD USING DEDICATED PUMPS

A.1.1 SCOPE OF APPLICATION

The purpose of this Standard Operating Procedure is to establish the protocol for collecting ground-water samples using dedicated pump systems. The procedure is designed to permit the collection of ground-water samples with minimum turbidity, and is intended to be used in conjunction with the analyses for the types of ground-water contaminants (inorganic compounds). This Standard Operating Procedure was prepared based on guidance prepared by U.S. Environmental Protection Agency (U.S. EPA 1996[1]) Region 1 and conforms with the procedures described in the Sampling and Analysis Plan.

A.1.2 EQUIPMENT/MATERIALS

- Sampling and Analysis Plan.
- Well construction data, location map, field data from last sampling event.
- Field logbook and Field Record of Well Gauging, Purging, and Sampling forms (Figure 12 of the Field Sampling Plan).
- Electric water level measuring device, 0.01 ft accuracy for monitoring water level during pumping operations.
- Pumps: adjustable rate, submersible pumps constructed of stainless steel and Teflon®.
- Flow measurement supplies (e.g., graduated cylinder and stop watch).
- Power source (generator, etc.).
- Water quality indicator parameter monitoring instruments: pH, turbidity, specific conductances, and temperature. Optional indicators: Eh and dissolved oxygen. Water quality indicator parameters will be measured in the field consistent with U.S. Environmental Protection Agency EPA-600/4-79-020 (1983[2]) using the following methods: temperature (Method 170.1), pH (Method 150.1), turbidity (Method 180.1), specific conductance (Method 120.1), and dissolved oxygen (Method 360.1).

1. U.S. Environmental Protection Agency. 1996. Ground Water Issue-Low Flow Sampling (Minimal Drawdown) Ground-Water Sampling Procedures. April.
2. U.S. Environmental Protection Agency. 1983. Methods for Chemical Analysis of Water and Wastes (1979). EPA-600/4-79-020. U.S. EPA, Cincinnati, Ohio. Revised March.

- Flow-through cell (preferred) or clean container for water quality probes.
- Decontamination supplies (for monitoring instrumentation).
- Sample bottles and sample preservation supplies (as required by the analytical methods).
- Sample tags or labels.
- Cooler with bagged ice for sample bottles.
- Drum for purge water containment.

A.1.3 PRELIMINARY SITE ACTIVITIES

The following site activities are required prior to performing well purging and ground-water sampling. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate: site name, project number, field personnel, well identification, weather conditions, date and time, equipment used, and quality assurance/quality control data for field instrumentation.
- Check well for damage or evidence of tampering, record pertinent observations in field logbook and sampling form.
- Lay out sheet of polyethylene for monitoring and sampling equipment.
- Unlock well and remove well cap (if applicable).
- Measure and record the height of protective casing above the concrete pad or ground surface, as appropriate. This reading is compared to that recorded during well installation as an indication of possible well damage or settling that may have occurred.
- Dedicated sampling pumps should be positioned with the pump intake mid-point in the screened interval. If non-dedicated equipment is used, care will be taken to position pump or sampling hose intake at the screen mid-point.
- Measure and record the depth to water (to 0.01 ft) in the well to be sampled before purging begins. If the well casing does not have a reference point (usually a v-cut or indelible mark in the well casing), make one. If a reference point is made, it will be noted

in the field logbook. Care should be taken to minimize disturbance of any particulate attached to the sides or at the bottom of the well. The depth to well bottom will be measured following the completion of sampling.

- Prepare the pump by checking electrical connections, discharge tubing, and motor (Grundfos Redi-Flo2). Locate the generator (if applicable) downwind of the well; connect the power converter to the generator and to the pump.

A.1.4 WELL PURGING AND SAMPLING PROCEDURE

The following general procedure should be followed to obtain representative ground-water samples. Field logbooks and sampling forms should be filled out as the procedure is being performed, as noted:

- Enter the following information in the field logbook and sampling form, as appropriate, prior to purging: purge date and time, purge method, and depth to water. Total depth to well bottom will be measured following the completion of sampling.

- Connect the flow-through cell or clean container containing the instrumentation header to the pump discharge and begin purging the well at 0.2-0.5 L/min, unless a different purge rate has been previously established for that well. Fill the flow cell completely. Care should be taken not to cause entrapment of air in the system. Record the purge start time and purge rate.

- Establish that the water level has not dropped significantly such that the pump is dry (bubbles in discharge) or water is heard cascading down the inside of the well. Ideally, the pump rate should cause little or no water level drawdown in the well (>0.5 ft and the water level should stabilize). The water level should be monitored every 3-5 minutes (or as appropriate) during pumping. Record pumping rate adjustments and depths to water. Pumping rates should, if needed, be reduced to the minimum capabilities of the pump (e.g., 0.1-0.2 L/min) to avoid pumping the well dry and/or to ensure stabilization of indicator parameters. If water levels continue to drop with the pump on the lowest flow rate, the pump will be shut off and the well will be allowed to recharge to prevent the well from going dry. The well will not be purged to dryness prior to sampling to prevent erroneous field parameters and ground-water samples. Sampling will commence as soon as the well has recharged to a sufficient level to collected the appropriate volume of samples with the pump.

- During purging of the well, monitor the water quality indicator parameters (turbidity, temperature, specific conductance, pH, etc.) every 3-5 minutes (or as appropriate). Record purge rate, volume purged, depth to water, water quality indicator parameters values, and clock time at 3- to 5-minute intervals in field logbook and sampling record. Purging of the standing well water is considered complete when three consecutive readings of the water quality indicator parameters agree within approximately 10 percent. Turbidity readings consistently below 10 nephelometric turbidity units are considered to represent stabilization of discharge water for this parameter. If the parameters have stabilized, but the turbidity is not in the range of the 10 nephelometric turbidity units, the pump flow rate should be decreased and measurement of the parameters should continue every 3-5 minutes.

- Purge water at a well will be temporarily containerized prior to discharge to the U.S. Military Academy sanitary sewage system.

- Prior to sampling, disconnect the discharge tubing from the flow-through cell. If the water discharged by the pump is silty, wait for the water to clear before sampling. Ensure that bubbles are not observed in the discharge tubing. Record pertinent observations in field logbook and sampling records.

- Begin filling sample containers by allowing the pump discharge to flow gently down the inside of the container with as little agitation or aeration as possible.

- Label each sample as collected. Inorganic samples, after preservation, do not need to be cooled.

- Complete remaining portions of Field Record of Well Gauging, Purging, and Sampling form (Figure 9 of Field Sampling Plan) after each well is sampled, including sample date and time, total quantity of water removed, well sampling sequence, types of sample bottles used, sample identification numbers, preservatives used, parameters requested for analysis, and field observations of sampling event.

A.1.5 SAMPLE PRESERVATION

The following preservation procedures are examples of typical preservation protocols specific to the indicated analyses. Pre-preserved bottles will be used if possible. Minimum sample preservation requirements for each parameter group are summarized below:

- **Inorganics**—Fill the sample bottle, preserve the sample to pH<2 with nitric acid, seal container, and place sample on ice for shipment.

Disposable pipettes should be used to introduce chemicals into the samples if necessary. Chemicals used for preserving should be poured into a 150-ml beaker. They should not be drawn directly from the preservative bottles because the bottle may become contaminated.

Measurements for pH and temperature should not be taken from the sample containers. When preserving samples to a required pH, pH paper should be used to check the resultant pH. The sample should be poured across the pH paper. Never place pH paper directly into sample.

NOTE: Shipping regulations limit the amount of preservative which can be added. For a 1-L sample, this is generally 1.5 ml of acid preservative.

A.1.6 FIELD QUALITY CONTROL

Quality control samples are required to verify that the sample collection and handling process has not affected the quality of the ground-water samples. Field quality control samples must be prepared exactly as regular investigation samples with regard to sample volume, containers, and preservation. The following quality control samples will be collected for each sample delivery group (a sample delivery group may not exceed 20 samples) at the frequency noted:

- **Field Duplicate**—Required at a frequency of 10 percent per sample delivery group.
- **Matrix Spike/Matrix Spike Duplicate**—Required at a frequency of 5 percent.
- **Equipment Rinsate Blank**—Required at a frequency of once per sampling event.
- **Source Water Blank**—Required at a frequency of once per source per sampling event when equipment (rinsate) blank is required.

A.1.7 DECONTAMINATION

Non-dedicated sampling equipment and field monitoring equipment will be decontaminated prior to use and following sampling of each well. This equipment will be decontaminated by the procedure listed below. Alternative procedures must be approved by the Project Manager prior to sampling event. Decontamination fluids will be collected in a 5-gal bucket and treated at the ground-water treatment plant.

A.1.7.1 Procedure

The following decontamination procedure will be used:

- Flush the equipment with potable water
- Flush with non-phosphate detergent solution
- Flush with tap water to remove all of the detergent solution
- Flush with distilled/deionized water
- Flush with isopropyl alcohol
- Flush with distilled/deionized water.

It is recommended that the detergent and isopropyl alcohol used in the above sequence be used sparingly.

Section B

Quality Assurance Project Plan

Quality Assurance Project Plan for the Long-Term Monitoring and Maintenance Program at 15 Landfills at United States Military Academy West Point, New York

Contract No. DACW41-01-D-0030
Task Order No. 0001

Prepared for

Department of the Army
Kansas City District, Corps of Engineers
601 East 12th Street, 700 Federal Building
Kansas City, Missouri 64106-2896

Prepared by

EA Engineering, P.C. and its Affiliate
EA Engineering, Science, and Technology
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

December 2001
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EA Engineering, P.C. and its Affiliate
EA Engineering, Science, and Technology
3 Washington Center
Newburgh, New York 12550

David S. Santoro, P.E., L.S., President/Quality Control Officer EA Engineering, P.C.	12/3/01 Date
Michael S. Battle, P.G., Program Manager EA Engineering, Science, and Technology	12/3/01 Date
Charles E. McLeod, Jr., P.E., Project Manager EA Engineering, Science, and Technology	12/3/01 Date

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1. PROJECT DESCRIPTION

On 27 September 2001, the U.S. Army Corps of Engineers (USACE)–Kansas City District, issued Task Order No. 0001 under Contract No. DACW-41-01-D-0030 to EA Engineering, P.C. and its affiliate EA Engineering, Science, and Technology. Under this Task Order, EA is tasked to conduct the Long-Term Ground-Water Monitoring and Monitoring Well and Landfill Engineering inspections and Maintenance at multiple landfills (Organic Compost Landfill, Post School Landfill, High School Landfill, Camp Buckner Landfill, Ski Lot Landfill, Motor Pool Landfill, Motor Pool East Landfill, Building 706 Parking Lot Landfill, PX Landfill, Michie Stadium Lot A Landfill, Michie Stadium Lot B Landfill, Michie Stadium Lot C Landfill, Michie Stadium Lot D Landfill, Michie Stadium Lot E Landfill, and Michie Stadium Lot F Landfill) at the United States Military Academy (USMA), West Point, New York.

1.1 PURPOSE AND OBJECTIVES

This Quality Assurance Project Plan (QAPP) documents the analytical procedures and quality assurance/quality control procedures for laboratory analyses that will be used during the performance of long-term ground-water monitoring at USMA, West Point, New York. The scope of this QAPP follows guidance provided by the USACE Engineer Manual 200-1-3, *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001) and Engineer Manual 200-1-6, *Chemical Quality Assurance for HTRW Projects* (USACE 1997) to ensure that data generated are of sufficient quality and quantity to support the data quality objectives specified in the Field Sampling Plan.

The objective of the long-term monitoring program is to monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the landfill sites. This will provide a tiered approach to attaining the New York State Department of Environmental Conservation water quality standards based on results of ground-water samples. Additional tasks will assess the potential for adverse environmental impacts by monitoring for evidence of stressed vegetation, evaluate the integrity of the ground-water monitoring wells, and monitor the condition of ground water to determine whether applicable or relevant and appropriate requirements are met. The constituents of potential concern being monitored at this site are the U.S. Environmental Protection Agency (EPA) Target Analyte List inorganics (both filtered and unfiltered). Ground-water samples will be sent to Katahdin Analytical Services, in Westbrook, Maine, for analysis.

1.2 PROJECT AREA DESCRIPTION

USMA is located in Orange County, New York, on the west bank of the Hudson River approximately 45 mi north of New York City. The military reservation at West Pont consists of 15,974 acres, of which the main Post comprises 2,520 acres. It is bounded by New York State Route 218, the Hudson River, the Village of Highland Falls, and U.S. Route 9W. West Point is crossed by the Hudson Highlands, a belt of steep-walled knobbed ridges, irregular hills, and mountains. USMA is a registered National Historic Landmark. Figure 1 illustrates the location of USMA.

2. ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES

Organization and responsibilities of the analytical laboratory are discussed within the following sections.

2.1 ANALYTICAL LABORATORY ORGANIZATION

The laboratory organizational positions, management and technical staff, and their responsibilities are shown on Figure 2. The laboratory is a functional unit that has the responsibility for:

- Performance of specified analyses for projects at prescribed levels of quality
- Custody control and traceability from sample delivery to results reported to clients
- Implementation and maintenance of quality control procedures
- Documentation for those samples analyzed according to approved, written instructions and methods.

General Manager

- Provides resources and staffing to ensure data quality
- Provides resources and staffing to ensure laboratory safety
- Maintains an independent quality assurance officer.

Laboratory Operations Manager

- Responsible for all operational and support activities
- Ensures staff are qualified and trained
- Ensures all operations and support groups follow the Quality Assurance Program and works closely with the Quality Assurance Officer to maintain compliance
- Coordinates client services group activities to ensure quality of services provided to clients
- Establishes and maintains a documented communication mechanism between Client Services and the laboratory to ensure that contractual and operational reporting requirements are met.

Quality Assurance Officer

- Develops Analytical Laboratory's Quality Assurance Program
- Manages state and federal laboratory certifications
- Maintains a document control system
- Reviews Non-Conformance Reports and verifies corrective actions
- Exercises authority to shut down any process or procedure that impacts data quality
- Assesses effectiveness of the quality system through performance, systems, and data audits
- Ensures personnel qualifications and training are documented.

Laboratory Project Manager

- Serves as client liaison through project duration
- Identifies analytical requirements for each project
- Ensures coordination of production efforts, and on-time delivery of data packages that meet client specifications for parameters, methods, quality control, and report format.

Management Information Systems

- Responsible for the site preparation and onsite configuration of hardware and software for the Laboratory Information Management System
- Identifies custom programming needs, and prepares protocols for system operation
- Responsible for user training and routine system maintenance.

Laboratory Supervisors

- Responsible for the implementation of their respective analytical programs operating in the inorganics and organics laboratories
- Responsible for data review against project requirements and internal quality control criteria
- Initiates and coordinates quality control measures for the section

- Monitors and verifies the status and quality of analytical data within the section
- Responsible for coordinating and facilitating the section(s) interaction with the Quality Services and Client Services departments to ensure the clients' expectations and requirements are met and the section's performance meets and exceeds such criteria
- Reviews training documentation for section staff to ensure analysts have the qualifications and training to perform quality work and generate acceptable packages
- Ensures 100 percent technical review of data packages and preparation of the narrative
- Ensures section staff implementation of and compliance with all applicable Standard Operating Procedures (SOPs) and Method SOPs.

Sample Custodians

- Receives, logs, and assigns control numbers to incoming samples
- Inspects sample shipping containers for custody seals and container integrity
- Records condition of both shipping containers and sample containers
- Signs documents shipped with samples (i.e., air bills, chain-of-custody records, etc.)
- Verifies and records discrepancies in information on sample documents (i.e., sample tags, chain-of-custody records, traffic reports, air bills, etc.) in appropriate logbooks or on appropriate forms; notifies the Laboratory Project Manager for direction
- Controls samples in storage and assures that laboratory SOPs are followed when samples are removed from and returned to storage
- Monitors storage conditions for proper sample preservation such as refrigerator/freezer temperatures

Chemical Quality Control Coordinator

- Proper chain-of-custody, sample handling, and decontamination procedures followed.
- Quality control samples collected as required (e.g., blanks, duplicate).
- Review laboratory analytical quality control program and state the methods by which the laboratory analyzed the samples as well as analyses that may have deviated from those listed in the QAPP.

- Sample holding times will be reviewed to determine if there are potential impacts on the sample data results from holding time anomalies.

- The precision of the laboratory results will be assessed by comparing duplicate relative percent difference data against the control limits identified in the QAPP. These data will be used to determine if biases exist in the data.

- The accuracy of the data will be assessed by comparing the results of surrogate compounds used by the laboratory against the control limits listed in the QAPP. The matrix spike recoveries and laboratory control sample recoveries compared to the control limits to check for analytical accuracy and method bias will also be assessed.

- Analytical and field completeness are evaluated.

- Field quality control blanks are evaluated.

2.2 PROJECT CONTACTS

Name	Function	Affiliation	Phone	Fax	E-Mail
Chip McLeod	Project Manager	EA	(845) 565-8100	(845) 565-8203	cem@eaest.com
Robert Haras	Project Superintendent	EA	(845) 565-8100	(845) 565-8203	rjh@eaest.com
Deborah McGrath	General Manager	Katahdin	(207) 874-2400	(207) 775-4029	dmcgrath@katahdinlab.com
John Burton	Laboratory Operations Manager	Katahdin	(207) 874-2400	(207) 775-4029	jburton@katahdinlab.com
Deborah Nadeau	Quality Assurance Officer	Katahdin	(207) 874-2400	(207) 775-4029	dnadeau@katahdinlab.com
Andrea Colby	Laboratory Project Manager	Katahdin	(207) 874-2400	(207) 775-4029	acolby@katahdinlab.com
Chris Dodd	Management Information Systems	Katahdin	(207) 874-2400	(207) 775-4029	cdodd@katahdinlab.com
George Brewer	Metals Laboratory Supervisor	Katahdin	(207) 874-2400	(207) 775-4029	gbrewer@katahdinlab.com
Shelley Wilkinson	Sample Custodian	Katahdin	(207) 874-2400	(207) 775-4029	swilkinson@katahdinlab.com
Dan Hinckley	Quality Control Coordinator	EA	(410) 771-4950	(410) 771-1625	dhinckley@eaest.com
Laura Percifield	Laboratory Contact	USACE	(402) 444-4313	Not available	Not available

3. QUALITY ASSURANCE OBJECTIVES FOR DATA MEASUREMENT

3.1 DATA USES

The purpose of this QAPP is to provide a standard for control and review of measurement data to ensure they are scientifically sound, defensible, and of known quality. The data will be used to monitor changes in the chemistry of the ground water collected and will be evaluated as part of a 5-year review to determine the effectiveness of the remedial actions on restoring ground-water quality.

3.2 DATA QUALITY OBJECTIVES

Sampling is taking place to monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the landfill sites. Collect comparable ground-water samples for trend assessments. The constituents of potential concern being monitored at this site are the EPA Target Analyte List inorganics (both filtered and unfiltered). Filtered and unfiltered samples are being collected to assess the impacts from the surrounding formation on the ground-water quality.

3.2.1 Characteristics of Data Quality

The precision, accuracy, representativeness, completeness, and comparability parameters are the characteristics of data quality. Table 1 lists the formulas used to calculate precision, accuracy, and completeness.

- *Precision* is the mutual agreement among individual measurements of the same property and is a measure of the random error component of the data collection process. The overall precision of the data is the sum of that due to sampling and analysis. To determine the analytical precision of the method and/or laboratory analyst, a routine program of replicate analyses is performed. The results of the replicate analyses are used to calculate the relative percent difference, which is the governing quality control parameter for precision. For triplicate analyses, the relative standard deviation is reported (Attachment B.1).

- *Accuracy* is the agreement between a measurement and the true value. It is a measure of the bias or systematic error of the entire data collection process. Sampling accuracy is assessed by evaluating the results of field and trip blanks. To determine the accuracy of an analytical method, a periodic program of laboratory control sample spiking is conducted. The results of sample spiking are used to calculate the quality control parameter for accuracy evaluation, the percent recovery (Attachment B.1).

- *Representativeness* is the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a quantitative parameter that is most concerned with the proper design and implementation of the sampling program. The sampling program has been designed so that the samples collected are as representative as possible of the medium being sampled and that a sufficient number of samples will be collected. Representativeness is addressed by the description of the sampling techniques and the rationale used to select the sampling locations.

- *Completeness* is the adequacy in quantity of valid measurements to prevent misinterpretation and to answer important questions. For this project, the sampling completeness objective is 95 percent; acceptability completeness objective is 98 percent; and quality completeness objective is 80 percent.

- *Comparability* is the extent to which comparisons among different measurements of the same quantity or quality will yield valid conclusions. For this project, comparability among measurements will be achieved through the use of standard procedures and uniform concentration units. For this project, the split sample comparability objective is <25 percent relative percent difference.

- Sampling is taking place to monitor changes in the chemistry of the ground water that may result as a consequence of degradation or future releases of unknown buried waste remaining at the landfill sites. Collect comparable ground-water samples for trend assessments. The constituents of potential concern being monitored at this site are the EPA Target Analyte List inorganics (both filtered and unfiltered). Filtered and unfiltered samples are being collected to compare the surrounding formation with the ground water.

4. SAMPLE CUSTODY PROCEDURES

4.1 FIELD SAMPLING OPERATIONS

4.1.1 Sample Bottle Preparation

The chain-of-custody procedure begins with the preparation of the sample containers and preservatives to be used in sample collection. Unless superseded by specific project requirements, the laboratory purchases and distributes pre-cleaned sample containers. Vendors are required to provide documentation of analysis for each lot of containers, and the documentation will be kept on file in the Sample Management Office. Contaminant levels in each lot are also evaluated by the laboratory through analysis of randomly selected containers in each vendor lot.

Table 2 defines the type of container required for specific analysis and matrix, preservation techniques, and holding times for aqueous samples. Additional preservatives are supplied with the sample containers to be added in the field, if required.

Sample kits, which are coolers containing chain-of-custody forms (Figure 3), custody seals, sample containers, preservatives, and packing material, are prepared by the Sample Management Office and will be used for the bulk chemistry samples.

4.1.2 Sampling Activities

After the samples are placed into containers with preservatives appropriate to the parameters to be determined, each container will be provided with a sample label that will be filled out at the time of sampling. The collected samples are cooled, if necessary, and returned to the laboratory by the most expedient means to ensure that holding times will be met. The chain-of-custody form will be signed and dated as necessary as the samples pass from the collectors/compositers to those persons responsible for their transport.

4.1.3 Sample Labeling

The following information is **required** on each analytical sample label:

- Name of site
- Field station (sample identification) number
- Sample description
- Date and time of sample collection/compositing/homogenization
- Signature and printed name of the collector
- Sample preservation, if required
- Type of analysis being requested.

After the label has been prepared, it is affixed to the sample container.

4.2 LABORATORY OPERATIONS

The analytical laboratory has a designated Sample Management Officer who will be responsible for receiving samples in the laboratory, opening the coolers and checking the sample integrity and the custody seal, logging samples into the laboratory system, and controlling the handling and storage of samples while in the laboratory.

4.2.1 Sample Custody

Samples are physical evidence and should be handled according to certain procedural safeguards. For the purposes of some types of legal proceedings, a showing to the court that the laboratory is a secure area may be all that is required for the analyzed evidence to be admitted. However, it is anticipated that in some cases, the court may require a showing of the hand-to-hand custody of the samples while they were at the laboratory. In the event that the court requires such a comprehensive chain-of-custody demonstration, the laboratory must be prepared to produce documentation that traces the in-house custody of the samples from the time of receipt to the completion of the analysis.

The National Enforcement Investigations Center of EPA defines custody of evidence in the following ways:

- It is in your actual possession
- It is in your view, after being in your physical possession
- It was in your possession and then you locked or sealed it up to prevent tampering
- It is in a secure area.

4.2.2 Sample Receipt and Logging

After samples have been labeled and the chain-of-custody forms initiated, the Laboratory Project Manager completes the right side of the chain-of-custody form. This form provides sample-specific information and a listing of the parameters required on each sample, along with the required analytical sensitivity. The chain-of-custody and appropriate field data sheets are sealed in a water-tight plastic envelope and delivered with the samples to the laboratory.

The Sample Management Officer monitors custody of samples in the laboratory. Upon receipt at the laboratory, the Sample Management Officer or designated custodian inspects the samples for integrity and checks the shipment against the Chain-of-Custody/Analytical Task Order form. Cooler temperatures are checked and documented on the chain-of-custody. The pH of preserved samples (except volatile organics) will be measured and documented in the Sample pH Logsheet which will be maintained in the Sample Management Office.

Discrepancies are addressed at this point, and documented on the chain-of-custody form and must be resolved before samples are released to the laboratory for analysis. When the shipment and the chain-of-custody are in agreement, the custodian enters the samples into the Analytical Custody and Preservation Log and assigns each sample a unique laboratory number.

This number will be affixed to each sample bottle. The custodian then enters the sample and analysis information into the laboratory computer system, and samples are released for analysis by the Laboratory Project Manager after review and approval of all information. The original chain-of-custody form will be maintained in the analytical data report file and returned to the client with the final report.

4.2.3 Sample Storage and Security

While in the laboratory, the samples and aliquots that require storage at approximately 4°C ± 2°C are maintained in a locked refrigerator unless they are being used for analysis. Samples for purgeable organics determinations are stored in a separate locked refrigerator from other samples, sample extracts, and standards. The refrigerators in the laboratory used for storage of samples are locked, numbered, and dedicated to specific types of samples, e.g., organic extractables, volatiles, inorganics. Similarly, there are refrigerators designated for extracts and standards which are located in the appropriate laboratory areas. The sample storage areas are within the laboratory to which access is limited to laboratory chemists and controlled by assigned passkeys. Specific requirements for sample storage are the following:

- Samples are stored in a secure area.
- Access to the laboratory will be through a monitored area. Other outside-access doors to the laboratory are kept locked.
- Visitors sign a visitor's log and are escorted while in the laboratory.
- Refrigerators, freezers, and other sample storage areas are securely maintained or locked. Temperatures are monitored.
- Only the designated sample custodian and supervisory personnel have keys to locked sample storage area(s).
- Samples remain in secure sample storage until removed for sample preparation or analysis.
- Transfers of samples into and out of storage are documented on an internal chain-of-custody record, and the records are maintained in the Sample Management Office.

5. CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used in the analytical laboratory are controlled by a formal calibration program. The program verifies that equipment is of the proper type, range, accuracy, and precision to provide data compatible with specified requirements. Instruments and equipment that measure a quantity, or whose performance is expected at a stated level, are subject to calibration. Calibration will be performed by laboratory personnel using reference standards or externally by calibration agencies or equipment manufacturers.

Implementation and documentation of the laboratory calibration program will be the responsibility of the Laboratory Supervisors. The Quality Assurance Officer monitors the procedures through systems, performance, and data audits (Section 9). Two types of calibration are discussed in this section:

1. *Operational Calibration* is routinely performed as part of an analytical procedure or test method, such as the development of a standard curve for use with determinations where an analytical system response is related to analyte concentration, e.g., spectrometric and chromatographic systems.

2. *Periodic Calibration* is performed at prescribed intervals for measurement equipment, such as balances, automatic pipettes, and thermometers. In general, equipment that can be calibrated periodically is a distinct, singular purpose unit and is relatively stable in performance. Table 3 contains the requirements for equipment subject to periodic calibration.

5.1 CALIBRATION SYSTEM

The following sections contain a discussion of the elements comprising the calibration system.

5.1.1 Calibration Procedures

Written procedures are used by the analytical laboratory for analytical systems and equipment subject to calibration. Whenever possible, recognized procedures, such as those published by American Society for Testing and Materials or EPA, or procedures provided by manufacturers, are adopted. If established procedures are not available, a procedure will be developed considering the type of equipment, stability characteristics of the equipment, required accuracy, and the effect of operational error on the quantities measured. As a minimum, the procedures include:

- Equipment to be calibrated
- Reference standards used for calibration
- Calibration technique and sequential actions
- Acceptable performance tolerances

- Frequency of calibration
- Calibration documentation format.

5.1.2 Equipment Identification

Equipment that is subject to calibration will be identified by a unique number assigned by the laboratory, and calibration records reference the specific instrument identification.

5.1.3 Calibration Frequency

Instruments and equipment are calibrated at prescribed intervals and/or as part of the operational use of the equipment. Calibration frequency is based on the type of equipment, inherent stability, manufacturer's recommendations, values provided in recognized standards, intended data use, specified analytical methods, effect of error upon the measurement process, and prior experience.

5.1.4 Calibration Reference Standards

Two types of reference standards are used for calibration:

- *Physical standards,* such as weights for calibrating balances and certified thermometers for calibrating working thermometers, refrigerators and ovens, are generally used for periodic calibration. Whenever possible, physical reference standards have known relationships to nationally recognized standards (e.g., National Institute of Standards and Technology) or accepted values of natural physical constants. If national standards do not exist, the basis for the reference is documented. Physical reference standards are used only for calibration and are stored separately from equipment used in analyses. In general, physical reference standards are at least 4-10 times as accurate as the requirements for the equipment which they are used to calibrate. In general, physical standards are recalibrated annually by a certified external agency, and documentation will be maintained by the Quality Assurance staff.

- *Chemical standards,* such as Standard Reference Materials provided by National Institute of Standards and Technology or EPA. Whenever possible, chemical reference standards are directly traceable to National Institute of Standards and Technology Standard Reference Materials. If Standard Reference Materials are not available, compounds of vendor-certified high purity are used to prepare calibration standards. These are primarily used for operational calibration. Documentation, e.g., certificates of analysis or traceability, are required for chemical standards used for calibration and quality control. Chemical standards are verified prior to use.

5.1.5 Calibration Failure

Equipment or analytical systems that cannot be calibrated must be repaired and satisfactorily recalibrated before re-use. Analysis will not proceed until appropriate corrective action is taken and an acceptable calibration is achieved. This activity will be documented in a Non-Conformance Report which is discussed in Section 12 of this QAPP.

Scheduled calibration of equipment does not relieve the laboratory staff of the responsibility for using properly functioning equipment. If an equipment malfunction is suspected, the equipment will be tagged and removed from service and recalibrated. If it fails recalibration, the above process will apply. The Laboratory Supervisors are responsible for the development and implementation of a contingency plan for major equipment failure. The plan includes guidelines on waiting for repairs, use of other instrumentation, subcontracting analyses, and evaluating scheduled priorities.

5.1.6 Calibration Records

Records are prepared and maintained for each piece of equipment subject to calibration. Records demonstrating accuracy of preparation, stability, and proof of continuity of reference standards are also maintained.

Records for periodically calibrated equipment will include, as appropriate:

- Unique identification number of equipment and type of equipment
- Calibration frequency and acceptable tolerances
- Identification of calibration procedure used
- Date calibration was performed
- Identity of personnel and/or external agencies performing calibration
- Reference standards used for calibration
- Calibration data
- Certificates or statements of calibration provided by manufacturers and external agencies and traceability to national standards
- Information regarding calibration acceptance or failure and any repair of failed equipment.

Records for periodically calibrated equipment are maintained in the instrument log books, or in the equipment file maintained by the Quality Assurance Officer. Physical reference standards are maintained in a separate folder.

For instruments and equipment that are calibrated on an operational basis, calibration generally consists of determining instrumental response against compounds of known composition and concentration or the preparation of a standard response curve of the same compound at different concentrations. Records of these calibrations are maintained in the instrument logbook, which provides an ongoing record of the calibration undertaken for a specific instrument. Logbook entries are signed and dated by the chemist. Copies are placed in data packages as required, and checked in the data review process. Logbook entries are reviewed during internal audits by the Quality Services staff.

In addition to the instrument logbook, copies of the raw calibration data are kept with the analytical sample data. In this way, results can be readily processed and verified because the raw data package is complete as a unit. If samples from several projects are processed together, the calibration data are copied and included with each group of data.

5.2 OPERATIONAL CALIBRATION

Operational calibration will be generally performed as part of the analytical procedure and refers to those operations in which instrument response (in its broadest interpretation) is related to analyte concentration. Included is the preparation of a standard response (calibration) curve and often the analysis of blanks. Formulas used for calibration are listed in Table 4.

5.2.1 Preparation of Calibration Curve

Preparation of a standard calibration curve will be accomplished by using calibration standards. The process is summarized as:

- Preparation of a standard calibration curve is accomplished by the analysis of calibration standards that are prepared by adding the analyte(s) of interest to the solvent that is introduced into the instrument
- The concentrations of the calibration standards are chosen to cover the working range of the instrument or method
- Sample measurements are made within this working range
- The calibration curve is prepared by plotting or regressing the instrument responses versus the analyte concentrations, or by calculating a calibration/response factor for chromatographic methods
- The concentrations of the analyzed samples are calculated from system response using the calibration curve.

5.2.2 Instrument Calibration Procedures

Attachment B.2 contains the operational calibration procedures and criteria used by the various instrument groups to meet requirements for the analysis of ground-water samples for this project.

6. LABORATORY PROCEDURES

Analytical support will be provided by Katahdin Analytical Services, Westbrook, Maine.

6.1 ANALYTES AND ANALYTICAL METHODS

Constituents of concern for this project will be the specified EPA Target Analyte List inorganics (both filtered and unfiltered) designated in the Contract Laboratory Program Statements of Work for inorganic analyses.

Inorganic analytes for this project are determined using the methods listed in Table 5. The analytical protocols are provided in laboratory Methods SOPs which document the implementation specifics of the standard reference methods. Methods will be followed as written, with the following exceptions.

6.1.1 Target Analyte List Metals

Following appropriate digestion/preparation procedures, metal analytes, except mercury, will be determined utilizing inductively coupled plasma according to the methodology specified (SW-846 Method 6010B), including the use of TRACE inductively coupled plasma.

For inductively coupled plasma analyses, spectral interferences are corrected through the use of interelement correction factors or by setting background correction points. The application of either depends upon the configuration of the instrument. Although interelement correction factors are determined and reported for all inductively coupled plasma instruments, interelement correction factors are not applied for those instruments which allow the use of background correction.

6.2 QUALITY CONTROL SAMPLES

6.2.1 Equipment Rinsate Blanks

Rinsate blanks, consisting of reagent water collected from a final rinse of sampling equipment after the decontamination procedure, will be collected from each of the sets of sampling devices used for collection of samples. The results will be used to evaluate the completeness of the decontamination procedures during sampling.

6.2.2 Field Blanks

Field blanks will consist of reagent water from the laboratory and will be present on the site during sampling activities. The results will be used to confirm that the reagent water used for the equipment and process blanks was not contaminated prior to use.

6.2.3 Laboratory Quality Control Samples

For all methods, the laboratory quality control samples will be analyzed at the frequency consistent with EPA methods. Acceptance criteria are specified in the methods, and listed in Attachment B.2.

Quality Control Sample	Frequency
Method Blank	1 per analytical batch of 20 or fewer samples
Laboratory Control Sample	1 per analytical batch of 20 or fewer samples
Matrix Spike	1 per analytical batch of 20 or fewer samples
Matrix Spike Duplicate	1 per analytical batch of 20 or fewer samples

6.3 PROJECT REPORTING LIMITS

The method reporting limits were developed in accordance with Engineer Manual 200-1-3, and are based on one-half of the 6 NYCRR Part 360 Practical Quantitation Limits. The method reporting limits are the minimum concentrations to be reported by the laboratory. For this project, results will be reported to the limits as summarized in the following table:

Parameter	Method	Ground Water
Target Analyte List Metals	SW-846 6010B/7471A	Method Reporting Limit

Table 6 provides the method reporting limits for aqueous samples collected under the long-term monitoring program. The New York State Class GA ground-water quality standard for each analyte is also provided in Table 6.

6.4 STANDARD OPERATING PROCEDURES

An SOP will be a written step-by-step description of laboratory operating procedures exclusive of analytical methods. Katahdin documents all procedures in formal, approved SOPs, which are issued in a document-controlled manual. SOPs will be submitted in draft to the Quality Assurance Officer who is responsible for initiating the review and approval process and for distributing and controlling the final SOPs (QA-800). The Quality Assurance Officer maintains the original copies of the SOPs, as well as an historical file of all versions. The SOPs address the following areas:

- Storage containers and sample preservatives
- Sample receipt and logging
- Sample custody
- Sample handling procedures
- Sample transportation
- Glassware cleaning
- Laboratory security
- Quality control procedures and criteria
- Equipment calibration and maintenance

- Documentation
- Safety
- Data handling procedures
- Document control
- Personnel training and documentation
- Sample and extract storage
- Preventing sample contamination
- Traceability of standards
- Data reduction and validation
- Maintaining instrument records and logbooks
- Non-conformance
- Corrective actions
- Records management.

Analytical procedures are documented in the laboratory Method SOPs. A table identifying Katahdin's SOPs and Method SOPs is provided in Attachment B.3.

6.5 RECORDKEEPING

6.5.1 General Requirements

The laboratory maintains extensive records to ensure that all aspects of the analytical process are adequately documented because maintaining of laboratory records is a legal requirement. These records convey:

- What was done
- When it was done
- Who did it
- What was found.

Data entries are made in indelible, water-resistant ink. The date of the entry and the observer will be clear on each entry. The observer uses his/her full name or initials. An initial and signature log will be maintained so that the recorder of every entry can be identified. Information will be recorded in a notebook or on other records at the time the observations are made. Recording information on loose pieces of paper will not be allowed.

When a mistake is made, the wrong entry is crossed out with a single line, initialed and dated by the person making the entry, and the correct information recorded. Obliteration of an incorrect entry or writing over it is not allowed; neither is the use of correction tape or fluid on any laboratory records.

6.5.2 Laboratory Records

The following records are used to document analytical activities in the laboratory. These are in addition to those discussed elsewhere in this manual, such as chain-of-custody forms, log-in sheets, maintenance records (Section 10), and non-conformance forms (Section 12).

Reagent and Titrant Preparation Records—The procedure for each analysis includes the procedures for reagent/titrant preparation, including concentration, storage, and discard information. After a reagent/titrant is prepared, the following information will be entered on a label affixed to the storage bottle: (1) identity, (2) intended use, (3) titer/concentration, (4) preparation date, (5) storage requirement, (6) discard date, and (7) preparer. For titrimetric analyses, the procedure includes directions for standardizing the titrant; the laboratory data sheets include space for titrant standardization data.

Standards Preparation Logs—The preparation of stock, intermediate, and working standard solutions will be recorded in standards preparation logbooks which are specific to the requirements of each operational group. Each standard will be assigned a number that will be used to trace the preparation from stock to working standards and to reference the analysis of the standards. The logbooks are completed by the appropriate analysts as they prepare the standards and are reviewed by the supervisor.

Sample Preparation Logs—Sample preparation operations, such as digestions and extractions, are documented in sample preparation logs which are specific to the operations involved. The information in these logs can include: date, analyst, sample identification, weight or volume of sample used, reagents used, and final volume. It can also include the volume of spiking, surrogate, or internal standard solution.

Bench Data Sheets—Laboratory bench data sheets are used for those analyses in which instrument responses are manually transcribed from instrument readout or from recorder tracings. The data sheets are preprinted to reflect the requirements of the analysis and are used to ensure that the information is recorded in a complete and organized manner.

Instrument Run Logs—The run log is used for recording data generation, instrument malfunctions, repairs, and maintenance activities. Data generation from an instrument requires that the sequence of the introduction of standards, field samples, and quality control samples be recorded in the instrument run log. The following information will be recorded when applicable: instrument identification, date, time, analyst, sample identifications, dilutions, and filenames for disk storage.

Strip Chart Recordings/Chromatograms/Computer Output—Strip chart recordings, chromatograms, computer output, and other instrument-generated records are clearly labeled with the following information: instrument identification, date, analyst, and sample identifications. The operational conditions are also recorded, if applicable.

7. DATA REDUCTION, VERIFICATION, VALIDATION, AND REPORTING

7.1 DATA REDUCTION

7.1.1 Laboratory Data Collection and Reduction

For inorganic analyses where the instruments are not directly coupled to computerized data systems, the raw data are instrument responses in the form of meter, recorder, or printer output. The chemist performing the analysis enters the bench-generated data into a bound laboratory workbook specific for each parameter. All entries are made in ink. These data consist of instrumental responses (absorbencies, percent transmittances, etc.), standard and spike concentrations, sample numbers, and any other pertinent information. The workbooks will be under the control of the laboratory supervisor who will be responsible for their security. For computerized instruments, the output will be in the form of printer output and files on magnetic disks, which are filed by sample batch.

7.1.2 Data Reduction

Data reduction includes all processes that change either the values or numbers of data items. The data reduction processes used in the laboratory include establishment of calibration curves, calculation of sample concentrations from instrument responses, and computation of quality control parameters (Table 4). Calibration is discussed in Section 5 of this QAPP. Table 7 lists the formulas used to calculate sample concentrations.

7.1.3 Sample Calculations

The reduction of instrument responses to sample concentrations takes different forms for different types of methods. The discussion below details non-chromatographic and chromatographic methods and solid sample calculations.

For most spectrophotometric analyses, the sample concentrations are calculated from the measured instrument responses using a calibration curve. The sample concentrations can be back-calculated from a regression equation fitted to calibration data. For gravimetric and titrimetric analyses, the calculations are performed according to equations given in the method.

Reporting Conventions and Units—The number of conventions set forth in the figures for reported data will be consistent. Reporting units used are those commonly used for the analyses performed.

7.2 DATA VERIFICATION AND VALIDATION

The International Standard ISO 8402 defines the following terms:

- ***Verification***—Confirmation by examination and provision of objective evidence that specified requirements have been fulfilled.

- ***Validation***—Confirmation by examination and provision of objective evidence that the particular requirements for a specific intended use are fulfilled.

EPA has also adopted this terminology (U.S. EPA 1996). With regard to environmental testing, these definitions apply to two distinct processes involving evaluation of analytical data:

1. ***Data Verification*** is a process of evaluation used by the laboratory or an independent party to determine compliance with the specific quality control requirements identified in this QAPP. The data are reviewed by the laboratory staff during sample analysis and data generation. The following are the parameters reviewed for technical compliance:

    - Chain-of-custody
    - Preservation
    - Holding times
    - Initial and continuing calibration
    - Calibration and method blanks
    - Matrix spikes and duplicates.

    Data qualifiers are added to provide additional information to the data user (Table 8).

2. ***Data Validation*** is also a process of evaluation, performed exclusively by an independent third party on the same data set which the laboratory has reviewed and released. The purpose of this process is to determine the suitability of the data for its intended use. This is a different goal from that of verification, and the review must be performed by a validator who understands, not only the technical analytical requirements but, how the data will be used in the decision making process, which is stated in the project data quality objectives. The difference in the two processes is in the review criteria and in the resulting qualification of the data: Data evaluated as unusable will be flagged (R), and data judged usable but of a lesser quality than specified in the project data quality objectives will be flagged (J) as estimated.

7.2.1 Laboratory Data Verification Process and Responsible Personnel

Data verification will be performed by the laboratory prior to release of results, and to evaluate the data against acceptance criteria specified for quality control samples in this QAPP. The quality control data produced during analysis are reviewed by the analyst and an assigned Quality Control Chemist during the analytical process to evaluate data integrity during collection and reporting of analytical data.

Initial review of analytical and quality control data will be the responsibility of the analyst. Data are checked for errors in transcription, calculations, and dilution factors and for compliance with quality control requirements. Failure to meet method performance quality control criteria results in re-analysis of the sample or lot if data usability is affected. After the initial review is completed, the data are collected from summary sheets, workbooks, or computer files and assembled into a data package. The analyst prepares the narrative.

The second level of data review will be the prime responsibility of a Chemist, assigned by the Laboratory Supervisor, who verifies the data are compliant with method and project requirements, and reviews the narrative for completeness and accuracy. After technical review, the Laboratory Supervisor verifies that the data package is complete.

The third level of review will be performed by the Laboratory Project Manager who certifies the data by signing the Analytical Narrative in the final report. The Laboratory Project Manager checks to ensure that analyses were performed as requested and that the invoice is accurate.

Finally, the Quality Assurance Officer is responsible for a minimum 10 percent audit of final reports. The reports are chosen randomly for review.

7.2.2 Field Data Verification

Field data validation will consist of both quantitative measures (quality assurance/quality control samples) and qualitative evaluation. Qualitative evaluation will generally consist of reviewing documentation of field activities, how well collection procedures were followed, and field instrument performance. Project field data will also be compared to historical data, when available.

Validation will be the prime responsibility of the Project Manager who addresses the following areas:

- Proper chain-of-custody, sample handling, and decontamination procedures followed
- Samples collected according to specified methods
- Field instrumentation calibrated according to specified methods
- Quality control samples (e.g., blanks, replicates) collected as required
- Field data sheets and logbooks completed and in agreement with sample container labels and chain-of-custody forms

7.2.3 Data Validation

For this project, procedures in Engineer Manual 200-1-3 *Requirements for the Preparation of Sampling and Analysis Plans* (USACE 2001), CENWK-EP-ES *Data Quality Evaluation*

Guidance, and the current version of EPA Region 2 Inorganic Data Validation Guidelines will be used to validate data. The data generated from the 14 sampling points will be validated prior to incorporation into the annual report.

7.3 LABORATORY REPORTS

7.3.1 Hard Copy Reports

The Data Management staff receives the data package after the Laboratory Supervisor has released it. The Data Management staff assembles the draft report by collecting and incorporating:

- The data packages for each analysis associated with the reported samples
- Analytical narratives
- Other report-related information, such as copies of chain-of-custody, communication records, and non-conformance forms.

The laboratory's draft report contains the information specified in Attachment B.4. It will be prepared and reviewed by the Data Management staff, and released by the Data Management Supervisor. The draft data report will then be reviewed by the Laboratory Project Manager who will sign the report narrative to certify that the report meets the Data Quality Objectives for precision, accuracy, and completeness specified for this project. A copy of the report will be maintained in the laboratory files.

7.3.2 Electronic Data Deliverable

In addition to a hard copy data report, the laboratory will submit an electronic data deliverable for each data set. The standardized electronic data deliverable will be in a Microsoft Access format and contains the results of field samples and blanks for target analytes. Results of laboratory quality control samples will not be included. Table 9 lists the fields included in the electronic data deliverable.

7.4 PROJECT REPORTS

A reviewer designated by the Project Manager examines the final project report for compliance with the project requirements for field and laboratory work. Final validation will be the responsibility of the Project Manager or designated senior technical reviewers.

8. INTERNAL QUALITY CONTROL CHECKS

A quality control program is a systematic process that controls the validity of analytical results by measuring the accuracy and precision of method and matrix, developing expected control limits, using these to detect anomalous events, and requiring corrective action techniques to prevent or minimize the recurrence of these events. Quality control measurements for analytical protocols are designed to evaluate laboratory performance, and measurement biases resulting from the sample matrix and field performance.

- *Laboratory Method Performance*—Quality control criteria for method performance must be met for target analytes for data to be reported. These criteria generally apply to instrument tune, calibration, method blanks, laboratory control samples, and Standard Reference Materials. In some instances where method criteria fail, useable data can be obtained and are reported with client approval. The narrative will then include a thorough discussion of the impact on data quality.

- *Sample Performance*—The accuracy and precision of sample analyses are influenced by both internal and external factors. Internal factors are those associated with sample preparation and analysis. Internal factors are monitored by the use of internal quality control samples. Quality control field samples are analyzed to determine any measurement bias due to the sample matrix based on evaluation of matrix spike, matrix spike duplicate, and laboratory duplicates. If acceptance criteria are not met, matrix interferences are confirmed either by re-analysis or by inspection of the laboratory control sample results to verify that laboratory method performance is in control. Data are reported with appropriate qualifiers or discussion.

- *Field Performance*—Quality control samples are used to evaluate the effectiveness of the sampling and processing program to obtain representative samples, eliminating any cross-contamination.

8.1 LABORATORY QUALITY CONTROL SAMPLES

8.1.1 Method (Reagent) Blank

The method (reagent) blank will be used to monitor laboratory contamination. This is usually a sample of laboratory reagent water processed through the same analytical procedure as the sample (i.e., digested, extracted, distilled). One method blank will be prepared and analyzed every day that samples are prepared.

8.1.2 Fortified Method Blank Spike (Laboratory Control Sample)

Normally, fortified method blank samples are analyzed with each batch of 20 or fewer samples. These samples generally consist of laboratory tissue or solid matrix fortified with the analytes of interest for single-analyte methods and selected analytes for multi-analyte methods according to the appropriate analytical method. They are prepared and analyzed with the associated sample batch. The analyte recovery from each will be used to monitor analytical accuracy.

8.1.3 Fortified Sample (Matrix Spike)

A fortified sample (matrix spike) is an aliquot of a field sample which is fortified with the analyte(s) of interest and analyzed to monitor matrix effects associated with a particular sample. Samples to be spiked are chosen at random. The final spiked concentration of each analyte in the sample should be at least 10 times the calculated method detection limit. A duplicate fortified sample (matrix spike duplicate) will be performed for every batch of 20 or fewer samples for organic analyses.

8.2 FIELD QUALITY CONTROL SAMPLES

These samples are not included specifically as laboratory quality control samples but are analyzed when submitted. Data for these quality control samples are reported with associated samples. Equipment rinsate blank, field (source water) blank, and ground-water duplicate samples are discussed and will be collected as specified in Section 3.2.5 of the Field Sampling Plan.

8.2.1 Rinsate Blank

A rinsate blank will be generated by pouring reagent water over the sampling equipment after it has been decontaminated and collecting the rinse. A rinsate blank will be taken within each sampling episode.

8.2.2 Field Blank

A field blank will consist of reagent water from the laboratory that accompanies the samples during the collection process. A field blank will be taken within each sampling episode.

8.2.3 Field Duplicates

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identified recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned an identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection.

8.3 APPLICATION OF CONTROLS

Analytical quality control results are calculated using the formulas in Table 10, and are compared with the control limits in Attachment B.1 to determine if the data can be reported. If the limits are exceeded, appropriate corrective action must be taken, as specified in Attachment B.2.

9. PERFORMANCE AND SYSTEMS AUDITS

9.1 PERFORMANCE AUDITS

Audits are performed routinely to review and evaluate the adequacy and effectiveness of laboratory performance and quality assurance program, ascertain if the QAPP is being completely and uniformly implemented, assess the effectiveness of the laboratory quality assurance program, identify non-conformances, and verify that identified deficiencies are corrected. The individual Quality Assurance Officer will be responsible for such audits and will perform them according to a schedule planned to coincide with appropriate activities on the project schedule and sampling plans; however, no performance audits are planned due to the limited number of samples being taken.

10. PREVENTIVE MAINTENANCE

Periodic preventive maintenance will be required for sensitive field and laboratory equipment. Instrument manuals will be kept on file for reference if equipment needs repair. The troubleshooting section of factory manuals may be used in assisting personnel in performing maintenance tasks. The frequency of preventive maintenance for field equipment is indicated in each operating instruction manual. Field equipment will be checked by field personnel under the supervision of the field coordinators. It will be the responsibility of Field Operations Manager and Field Team Leader to conduct preventive maintenance (refer to the Field Sampling Plan).

Major instruments in the laboratory are covered by annual service contracts with manufacturers. Under these agreements, regular preventive maintenance visits are made by trained service personnel. Evidence of maintenance will be documented and maintained in permanent records by the individual responsible for each instrument.

The Laboratory Managers and Laboratory Supervisors are responsible for preparation and documentation of the program. Supervisors implement the program, and the Quality Assurance Officer reviews implementation to verify compliance. For each operational group, the preventive maintenance program includes the following:

- Listing of the instruments and equipment that are included in the program.
- Frequency of maintenance considering manufacturer's recommendations and/or previous experience with equipment.
- For each instrument in the program, a file will be maintained for the following information:
  - — List of spare parts maintained by the laboratory
  - — External service contracts
  - — Items to be checked and/or serviced during maintenance and directions for performing maintenance (if external service is not provided or if not stated in manufacturer's instrument manuals).

Specific preventive maintenance practices, their frequency of performance, and available spare parts for laboratory equipment are described in Table 11.

11. DATA QUALITY ASSESSMENT

11.1 FIELD DATA ASSESSMENT

Assessment of the field data will be the prime responsibility of the EA Project Manager and Field Team Leader who address the following areas:

- Proper chain-of-custody, sample handling, and decontamination procedures followed
- Samples collected according to specified methods
- Field instrumentation calibrated according to specified methods
- Quality control samples (e.g., blanks, replicates) collected as required
- Field data sheets and logbooks completed and in agreement with sample container labels and chain-of-custody forms.

Data quality assessment procedures for field data are discussed in detail in the Field Sampling Plan.

11.2 LABORATORY DATA ASSESSMENT

Data assessment will be a systematic process of reviewing data against a set of criteria to identify outliers or errors. Laboratory data assessment will be the ultimate responsibility of the Project Manager, who can designate a quality control person to perform a precision, accuracy, representativeness, completeness, and comparability-type analysis to assess method performance and determine if the data are of sufficient quality to be used for the project. Laboratory data review will be discussed in Section 7 of this QAPP. Each report narrative includes a discussion of the quality control samples and evaluates data usability based on the data.

12. CORRECTIVE ACTIONS

12.1 OBJECTIVES

The objectives of the corrective action procedures presented below are to ensure that recognized errors in performance of sample and data acquisition lead to effective remedial measures and that those steps required to correct an existing condition are documented to provide assurance that any data quality deficiencies are recognized in later interpretation and are not recurrent in the course of the project.

12.2 RATIONALE

Many times corrective measures are undertaken by project staff in a timely and effective fashion but go undocumented. Such incidents may be of a recurrent type that might not be recognized by other staff performing the same activity. In other cases, corrective actions are of a complex nature and may require scheduled interactions between departmental groups. In either case, documentation in a formal or informal sense can reinforce the effectiveness and duration of the corrective measures taken.

12.3 CORRECTIVE ACTION METHODS

12.3.1 Immediate Corrective Actions

Immediate corrective actions are of a minor or routine nature such as correcting malfunctioning equipment, correction of data transcription errors, and other such activities routinely made in the field, laboratory or office by technicians, analysts, and other project staff. These should be documented as prescribed in the project quality control procedures, as required. Specific documentation should be limited to notations in logbooks, notebook, or on data sheets or other such forms. Such notations should be initiated and dated by the person performing the corrective action.

12.3.2 Long-Term Corrective Actions

Long-term corrective action will be used to identify and eliminate causes of non-conformances which are of a complex nature and that are formally reported between management groups. A formal system for reporting and recording these corrective actions will use the following procedure.

12.3.3 Corrective Action Steps

For either immediate or long-term corrective actions, steps comprising a closed-loop corrective action system are as follows:

1. Define the problem
2. Assign responsibility for investigating the problem
3. Investigate and determine the cause of the problem
4. Determine a corrective action to eliminate the problem
5. Assign and accept responsibility for implementing the corrective action
6. Establish effectiveness of the corrective action and implement the correction
7. Verify that the corrective action has eliminated the problem.

Non-conformance events associated with analytical work are documented using Non-Conformance Reports which are reviewed and approved by the Quality Assurance Officer.

12.3.4 Audit Based Non-Conformances

Following audits, corrective action will be initiated by documenting the audit finding and recommended corrective action on an Audit Finding Report discussed in Section 9. The corrective action undertaken by the designated responsible party will be documented with an implementation schedule and management approval. The implementation will be verified by the auditor on the same form which will then be made part of the project audit report record. Other means of documenting long-term corrective action are equally acceptable if the seven elements listed above are addressed.

12.4 CORRECTIVE ACTION REPORT REVIEW AND FILING

Immediate and long-term corrective actions require review to assure that, during the time of non-conformance, erroneous data were not generated or that, if possible, correct data were acquired instead. Such confirmation and review will be the responsibility of the supervisor of the staff implementing the corrective action. Confirmation will be acknowledged by notation and dated signature on the affected data record or appropriate form or by memorandum to cognizant project management. Such corrective action forms and memorandum will be retained on file by responsible task leaders and filed centrally by the Project Manager.

12.5 CORRECTIVE ACTION REPORT TO MANAGEMENT

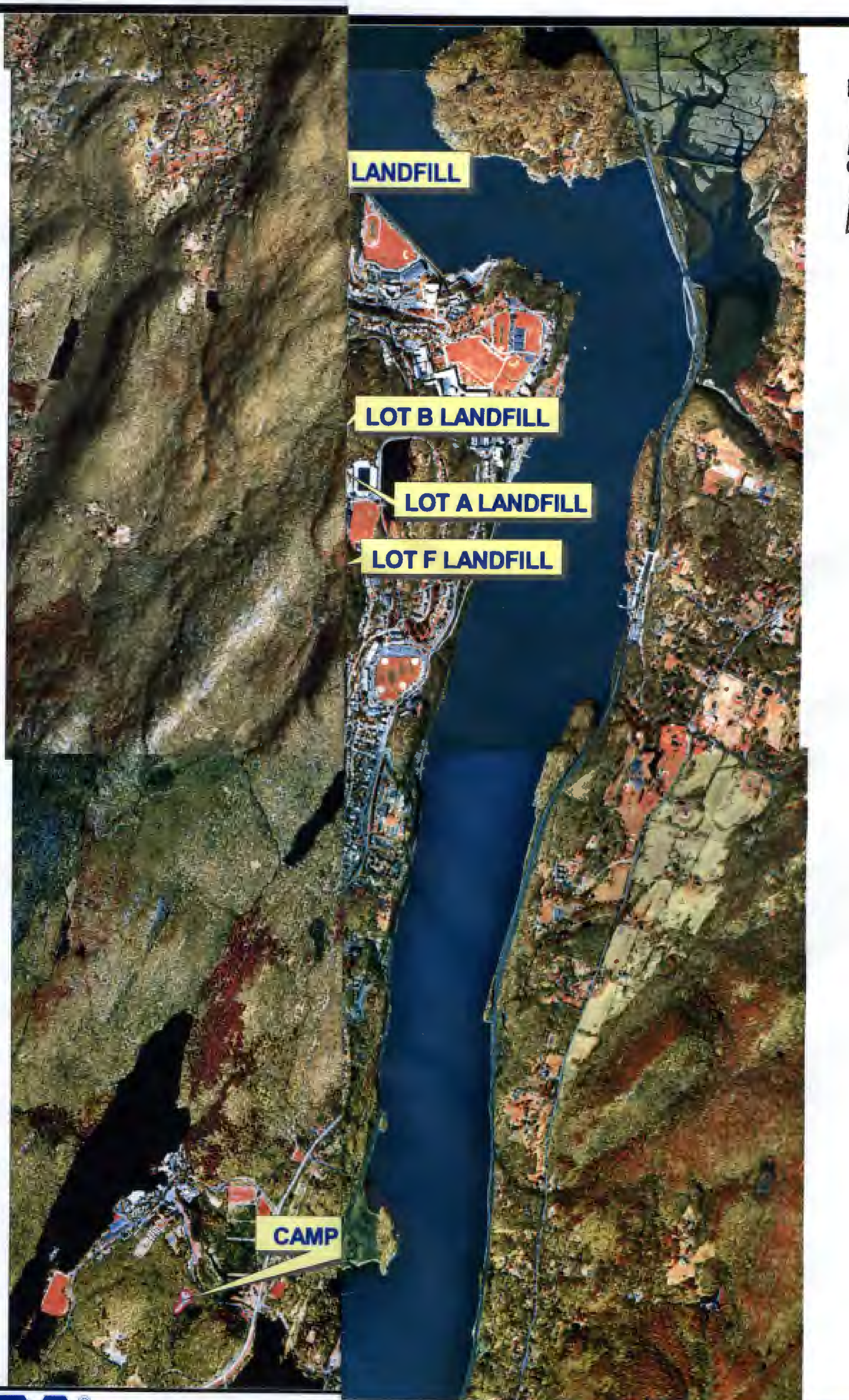
The Quality Assurance Officer will provide project management with corrective action reports. The Project Manager will be informed verbally of analytical non-conformance events as soon as possible and decisions made after evaluation are documented in the Non-Conformance Report. Copies of each Non-Conformance Report are maintained in the report file, and addressed in the final data report.

13. QUALITY ASSURANCE REPORTS

Fundamental to the success of this project will be the active participation of management through awareness of project activities, and during development, execution, and review of the project. Management will be informed of quality central activities through the receipt, review, and/or approval of the:

- QAPP
- Audit reports
- Corrective action reports
- Analytical report narratives.

Figures



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

FIGURE 1
LANDFILL LOCATIONS MAP

PROJECT MGR	DESIGNED B	PROJECT No	FILE No
CEM		61558.01	I:\WESTPOINT\MAP.APR

Katahdin
ANALYTICAL SERVICES

Organizational Chart - June 2001

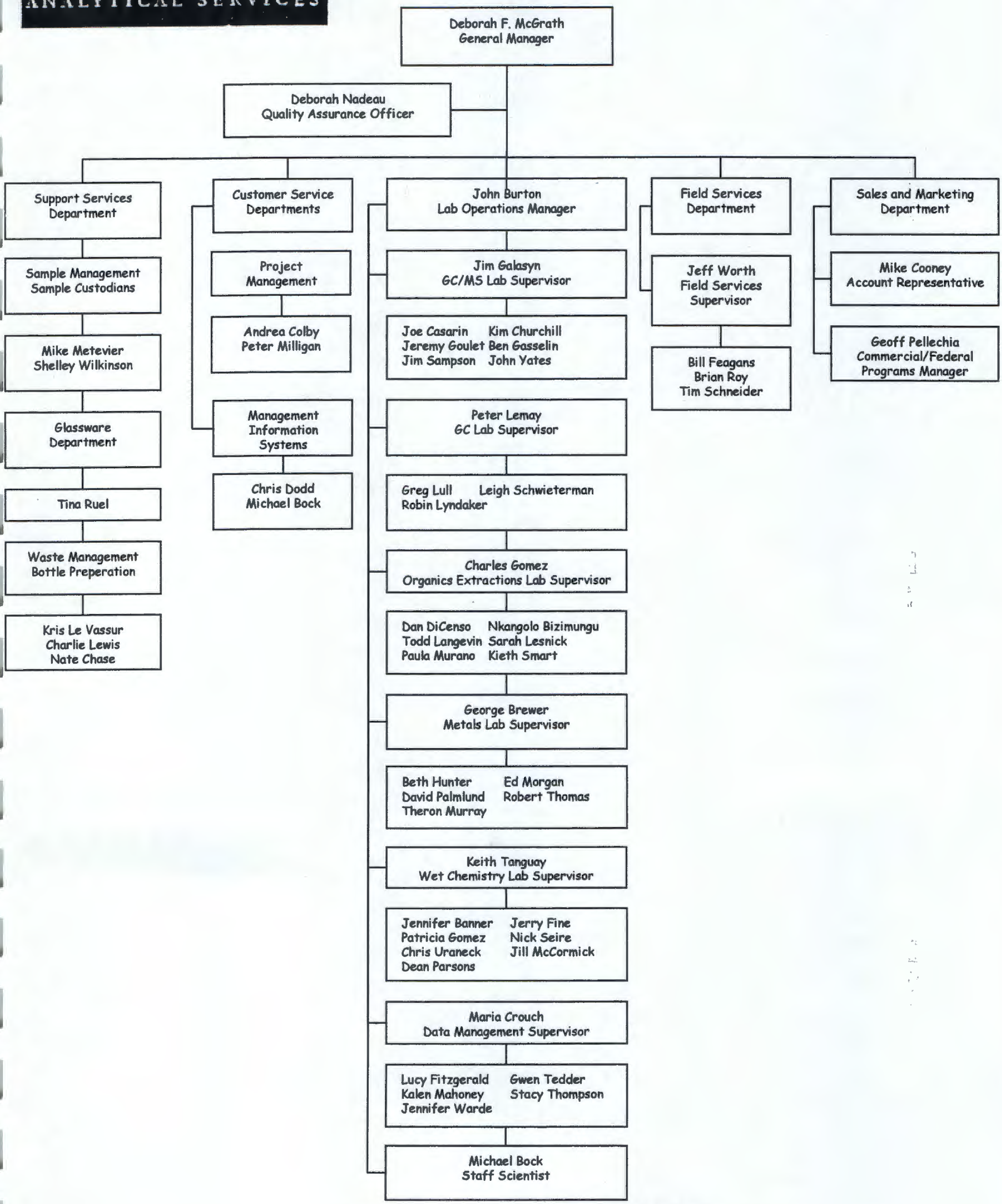


Figure 2. Organization chart for laboratory.

340 County Road No. 5
P.O. Box 720
Westbrook, ME 04092
Tel: (207) 874-2400
Fax: (207) 775-4029

Katahdin ANALYTICAL SERVICES

CHAIN of CUSTODY

PLEASE PRINT IN PEN   Page ___ of ___

Client	Contact	Phone # ( )	Fax # ( )
Address	City	State	Zip Code
Purchase Order #	Proj. Name / No.		Katahdin Quote #
Bill (if different than above)	Address		
Sampler (Print / Sign)		Copies To:	

LAB USE ONLY   WORK ORDER #: ______

KATAHDIN PROJECT MANAGER ______

REMARKS: ______

SHIPPING INFO: ☐ FED EX ☐ UPS ☐ CLIENT

AIRBILL NO: ______

TEMP°C ______ ☐ TEMP BLANK ☐ INTACT ☐ NOT INTACT

ANALYSIS AND CONTAINER TYPE
PRESERVATIVES

*	Sample Description	Date / Time coll'd	Matrix	No. of Cntrs.	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N	Filt. ☐Y☐N
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COMMENTS

Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)
Relinquished By: (Signature)	Date / Time	Received By: (Signature)	Relinquished By: (Signature)	Date / Time	Received By: (Signature)

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ORIGINAL

Figure 3. Chain-of-custody form.

Tables

TABLE 1 DATA QUALITY CHARACTERISTICS FORMULAS

Characteristic	Formula	Symbols
Precision (as relative percent difference)	$RPD = \frac{\lvert x_1 - x_2 \rvert}{(x_1 + x_2)/2} \times 100 = \frac{\lvert x_1 - x_2 \rvert}{(x_1 + x_2)} \times 200$	x1, x2 = Duplicate values.
Accuracy (as percent recovery for samples without a background level of the analyte, such as reference materials, laboratory control samples, and performance evaluation samples)	$\%R = \frac{X}{T} \times 100$	X = Found concentration T = True or assumed concentration
Accuracy (as percent recovery for measurements in which a known amount of analyte [a spike] is added to an environmental sample)	$\%R = \frac{X - B}{T} \times 100$	X = Found concentration B = Background concentration T = True or assumed concentration
Sampling Completeness	$C = (N/S) \times 100$	C = Completeness (%) N = Number of samples actually collected S = Number of samples planned in the Sampling and Analysis Plan
Acceptability Completeness	$C = (N/S) \times 100$	C = Completeness (%) N = Combination of data that met all quality control criteria or to which appropriate corrective actions were applied S = Total data generated by laboratory
Quality Completeness	$C = (N/S) \times 100$	C = Completeness (%) N = Data that met all quality control criteria S = Total data generated by laboratory

TABLE 2 REQUIRED CONTAINERS, PRESERVATION TECHNIQUE, AND HOLDING TIMES FOR FIELD BLANKS[(a)]

Parameter	Volume Required[(b)] (mL)	Container[(c)]	Preservative	Holding Time
METALS				
Filtered				
Mercury	100	P, G	HNO_3 to pH <2	28 days
Other Metals	500	P, G	HNO_3 to pH <2	6 months
Unfiltered				
Mercury	100	P, G	HNO_3 to pH <2	28 days
Other Metals	500	P, G	HNO_3 to pH <2	6 months

(a) From time of sample collection (40 CFR 261).
(b) If matrix spike/matrix spike duplicate analyses are required, the stated amount should be increased by a factor of three for the designated sample.
(c) P = polyethylene; G = glass. For metals in aqueous samples, polyethylene with a polypropylene cap (no lines) is preferred.

TABLE 3 SUMMARY OF PERIODIC CALIBRATION REQUIREMENTS

Instrument	Calibration Frequency		Acceptance Limits	Corrective Actions
Analytical Balances	Daily:	Sensitivity (with a Class P weight)	0.001 g	Adjust sensitivity
	Monthly:	Checked with Class S weights	Standard deviation <0.1 mg	Service balance
	Annually:	Calibrated by outside vendor against certified Class S weights		Service balance
Thermometers	Annually:	Calibrated against certified National Institute of Standards and Technology thermometers	$\pm$0.5 C	Tag and remove from service
Automatic Pipettors	Quarterly:	Gravimetric check	High volume (>100 mL): $\leq$1.0% relative error as relative standard deviation Low volume (<100 mL): $\leq$2.0% relative error as relative standard deviation	Service or replacement

TABLE 4 CALIBRATION FORMULAS

Application	Formula	Symbols
Linear regression calibration curves	$C=(R-a_0)/a_1$	C = Analytical concentration R = Instrument response a_0 = Intercept of regression curve (instrument response when concentration is zero) a_1 = Slope of regression curve (change in response per change in concentration)
Calibration factors[a]	$C=\frac{A_x V_f}{CF V_i}$	C = Concentration (µg/L) CF = Calibration factor A_x = Peak size of target compound in sample extract V_f = Final volume of extracted sample (mL) V_I = Initial volume of sample extracted (mL)
Response factors[b]	$C=\frac{C_{is} A_x V_f}{RF A_{is} V_i}$	C = Concentration (µg/L) RF = Internal standard response factor C_{is} = Concentration of the internal standard (µg/L) A_x = Area of the characteristic ion for the target compound V_f = Final volume of extracted sample (mL) A_{is} = Area of the characteristic ion for the internal standard V_I = Initial volume of sample extracted (mL)

(a) Used for quantitation by the internal standard technique.
(b) Used for quantitation by the external standard technique.

TABLE 5 ANALYTICAL METHODS

Parameter	Method	Reference Method	Method Standard Operating Procedure	Matrix	Reference
SAMPLE PREPARATION					
Mercury	Atomic Absorption – Cold Vapor	7470A	CA-615	A	U.S. EPA (1997)
Total Metals Digestion (GFAA)	Nitric Acid	3020A	CA-604	A	U.S. EPA (1997)
METALS					
Aluminum	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Antimony	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Arsenic	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Barium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Beryllium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Cadmium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Calcium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Chromium, Total	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Cobalt	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Copper	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Iron	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Lead	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Magnesium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Manganese	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Mercury	Atomic Absorption – Cold Vapor, Autoclave Digestion Procedure	7470A	CA-615	A	U.S. EPA (1997)
Mercury	Atomic Emission – Inductively Coupled Plasma	7471A	CA-608	A	U.S. EPA (1997)
Nickel	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Potassium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Selenium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Silver	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Sodium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Thallium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Vanadium	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)
Zinc	Atomic Emission – Inductively Coupled Plasma	6010B	CA-608	A	U.S. EPA (1997)

Matrix codes: A = Aqueous, inclusive of ground water and rinse blanks.

References:
U.S. EPA. 1997. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. U.S. EPA SW-846, 3rd Edition, including UPDATE III. U.S. EPA, Washington, D.C. June.

TABLE 6 METHOD REPORTING LIMITS FOR GROUND-WATER SAMPLES

Parameter	Method Reporting Limit[(a)]	6 NYCRR Part 360 Practical Quantitation Limits[(b)]	NYSDEC Class GA Ground-Water Standard[(c)]
TARGET ANALYTE LIST METALS BY U.S. ENVIRONMENTAL PROTECTION AGENCY METHOD 6010B/7471A (μg/L)			
Aluminum	5	10	---
Antimony	150	300	3
Arsenic	250	500	250
Barium	10	20	1,000
Beryllium	1.5	3	---
Cadmium	20	40	5
Calcium	20	40	---
Chromium	35	70	50
Cobalt	35	70	---
Copper	30	60	200
Iron	200	400	300
Lead	5	10	25
Magnesium	2	4	---
Manganese	20	40	300
Mercury	1	2	0.7
Nickel	75	150	100
Potassium	375	750	---
Selenium	35	70	10
Silver	50	100	50
Sodium	200	400	20,000
Thallium	5	10	---
Vanadium	40	80	---
Zinc	10	20	---

(a) Method Reporting Limit is determined according to U.S. Army Corps of Engineers Engineer Manual 200-1-3, Requirements for the Preparation of Sampling and Analysis Plans (USACE 2001).
(b) Title 6 NYCRR Part 360. 29 September 1997.
(c) New York State Department of Environmental Conservation (NYSDEC) Water Quality Regulations, Surface Water and Ground-Water Classifications and Standards. 6 NYCRR Chapter X, Parts 700-706. 4 August 1999.

NOTE: Dashes (---) indicate no established standard.

TABLE 7 SAMPLE CONCENTRATION FORMULAS

Application	Formula	Symbols		
Linear regression calibration curves	$C=(R=a_0)/a_1$	C	=	Analytical concentration
		R	=	Instrument response
		a_0	=	Intercept of regression curve (instrument response when concentration is zero)
		a_1	=	Slope of regression curve (change in response per change in concentration)
Calibration factors(a)	$C=\dfrac{A_x\ V_f}{CF\ V_i}$	C	=	Concentration (µg/L)
		CF	=	Calibration factor
		A_x	=	Peak size of target compound in sample extract
		V_f	=	Final volume of extracted sample (mL)
		v_i	=	Initial volume of sample extracted (mL)
Response factors(b)	$C=\dfrac{C_{is}\ A_x\ V_f}{RF\ A_{is}\ V_i}$	C	=	Concentration (µg/L)
		RF	=	Internal standard response factor
		C_{is}	=	Concentration of the internal standard (µg/L)
		A_x	=	Area of the characteristic ion for the target compound
		V_f	=	Final volume of extracted sample (mL)
		A_{is}	=	Area of the characteristic ion for the internal standard
		V_I	=	Initial volume of sample extracted (mL)
Residues(c)	$R=\dfrac{W-T\times 1{,}000{,}000}{V}$	R	=	Residue concentration (mg/L)(e)
		W	=	Weight of dried residue + container (g)
		T	=	Tare weight of container (g)
		V	=	Volume of sample used (mL)
Solid samples(f)	$K=\dfrac{C\ V\ D}{W\ (\%S/100)}$	K	=	Dry-weight concentration (mg/kg)
		C	=	Analytical concentration (mg/L)
		V	=	Final volume (mL) of processed sample solution
		D	=	Dilution factor
		W	=	Wet weight (g) of as-received sample taken for analysis
		%S	=	Percent solids of as-received sample

(a) Used for quantitation by the external standard technique.
(b) Used for quantitation by the internal standard technique.
(c) Conversion factor to convert g/mL to mg/L.
(d) Used to calculate the dry-weight concentration of a solid sample from the analytical concentration of the processed sample.

$$\frac{mg}{L}=\frac{g}{mL}\times\frac{10^3\,mL}{L}\times\frac{10^3\,mg}{g}$$

TABLE 8 LABORATORY INORGANIC ANALYSIS DATA QUALIFIERS[(a)]

C	***(Concentration) Qualifiers:***
B	Reported value is less than the project-specified Reporting Limit, but greater than the method-specified Instrument Detection Limit or Method Detection Limit.
U	Analyte analyzed for but not detected (concentration is less than the method-specified Instrument Detection Limit or Method Detection Limit).
Q	***(Quality Control) Qualifiers:***
E	Reported value is estimated because of presence of interference.
M	Duplicate injection precision not met.
N	Spiked sample recovery is not within control limits.
S	Reported value is determined by the method of standard additions.
W	Post-digestion spike for furnace Atomic Absorption Spectrophotometric analysis is out of control limits (85-115 percent) and sample absorbency is less than 50 percent of spike absorbency.
	* Duplicate analyses is not within control limits.
	+ Correlation coefficient for method of standard addition is less than 0.995.
M	***(Method) Qualifiers:***
P	Inductively Coupled Plasma
A	Flame Atomic Absorption Spectrophotometric
F	Furnace Atomic Absorption Spectrophotometric
CV	Cold Vapor Atomic Absorption Spectrophotometric
AV	Automated Cold Vapor Atomic Absorption Spectrophotometric
AS	Semi-Automated Spectrophotometric
C	Manual Spectrophotometric
T	Titrimetric
NR	Analyte is not required to be determined.
(a)	These Data Qualifiers are added by the laboratory to provide additional information for the reported results. ***They should not be confused with the qualifiers applied to the reported data as a result of a data validation process performed independently of the laboratory reporting procedure.***

TABLE 9 ELECTRONIC DATA DELIVERABLE FIELDS

*	Field	Data Type	Length	Description	Valid Values
1	Sys_Sample_Code	Text	20	Unique identifier. Concatenation of sys_loc code* sample type and matrix* sample date.	
2	Sample_Type_Code	Text	10	Code which distinguished between different type of sample.	"N" for normal sample, "FD" for field duplicate sample, "MB" for method blank, "TB" for trip blank, "RB" for rinsate blank, "AB" for ambient or field blank, "MS" for matrix spike, "MD" for matrix spike duplicate.
3	Lab_method	Text	35	Laboratory analytic method name or description.	
4	Sample_date	Date		Date sample was collected (in MM/DD/YY format for electronic data deliverable).	
5	Analysis_Date	Date		Date of sample analysis (in MM/DD/YY format for electronic data deliverable).	
6	Total_or_Dissolved	Text	1	Identifies whether water samples were submitted for total or dissolved (inorganic) analysis.	"T" for total concentration, "D" for dissolved or filtered concentration.
7	Test_Type	Text	10	Type of analytical test.	"Initial" for first run. "Reanalysis" for subsequent runs. "Re-extraction" for re-extracted samples.
8	Sample_Matrix_Code	Text	10	Code which distinguishes between different type of sample matrix.	"GW" for ground water, "SW" for surface water, "SO" for soil, "SD" for sediment, "W" for lab and field quality control blanks (method blanks, trip blanks, field blanks, rinsate blanks).
9	Basis	Text	10	"Wet" for wet-weight basis reporting, "Dry" for dry-weight basis reporting.	
10	Dilution_Factor	Single		Test dilution factor.	
11	Lab_Prep_Method_Name	Text	35	Laboratory sample preparation method name or description.	
12	Ext_date	Date		Extraction date.	
13	Percent_Moisture	Text	5	Percent moisture of the sample portion used in this test.	
14	Lab_Sample_Id	Text	20	Laboratory LIMS sample identifier.	
15	Batch_Id	Text	255	Sample batch id.	
16	Cas_Rn	Text	15	Chemical Abstract Registry number.	
17	Chemical_Name	Text	75	Analyte name.	
18	Organic_YN	Boolean		Indicates whether analyte is organic or inorganic.	-1 for organic, 0 for inorganic.
19	Result_Value	Text	20	Analytical result value.	
20	Result_Type_Code	Text	10	Type of analytical result.	"TRG" for target results, "TIC" for tentatively identified compounds, "SUR" for surrogates, "IS" for internal standards, "SC" for spiked compounds.

*	Field	Data Type	Length	Description	Valid Values
21	Detect_Flag	Text	2	Indicates whether or not an analyte was detected.	"Y" for detected result; "N" for non-detected results.
22	Lab_Qualifiers	Text	7	Qualifier flags assigned by the laboratory.	
23	Method_detection_Limit	Text	20	Method detection limit.	
24	Reporting_Detection_limit	Text	20	Detection limit used for reporting.	
25	Result_Unit	Text	15	Units of measurement for the result.	
26	Validator_qualifiers	Text	7	Validator qualifiers.	
27	Interpreted_Qualifiers	Text	7	Most appropriate qualifiers. Validator's qualifier if they exist, otherwise lab qualifier.	
28	Sys_loc_code	Text	20	Unique location name.	
29	Parent_sample_code	Text	20	Sys_sample code of parent sample of field duplicate.	
30	Site_Code	Text	20	Unique code for site or area.	
31	Sample_name	Text	30	Chain-of-custody field identification.	
32	Location_name	Text	30	Location name.	
33	Location_description	Text	70	Description of location.	
34	Start_Depth	Double		Top depth of sample.	
35	End_Depth	Double		Bottom depth of sample.	
36	Depth_unit	Text	15	Depth unit.	
37	Source	Text	50	Name of source file.	Electronic data deliverable file name.
38	Lab Name	Text	10	Lab Name.	
39	Task code	Text	10	Task Code.	

TABLE 10 ANALYTICAL QUALITY CONTROL FORMULAS

Sample	Formula	Symbols
Spikes (as %R from the concentrations of the analyte in the spiked and unspiked samples)	$\text{Percent recovery} = \frac{A - B}{C} \times 100$	A = Sample concentration of the spiked sample (ppm). B = Sample concentration of the unspiked sample (ppm). C = Concentration of the spike (ppm).
Duplicates (as the mean and relative percent difference of the duplicates)	$\text{Mean} = \frac{X_1 + X_2}{2}$ $\text{RPD} = \frac{\lvert X_1 - X_2 \rvert}{\text{Mean}} \times 100$	X_1 = Concentration of first replicate. X_2 = Concentration of second replicate.

TABLE 11 PREVENTIVE MAINTENANCE REQUIREMENTS FOR LABORATORY EQUIPMENT

Instrument	Item Checked/Serviced	Frequency
Gas Chromatograph	EC (Ni-63) wipe test	Semi-annually
	Clean detectors: Electron Capture Device	As needed
	Change column	As needed
	Change gas wool plug	As needed
	Clean insert	As needed
	Replace septum	As needed
	Change fuses	As needed
	Reactivate external carrier gas filler dryers	As needed
	Clean and silanize or replace glass liners or injectors	As needed
Gas Chromatograph/ Mass Spectrometry	Gas Chromatograph/Mass Spectrometry maintenance is the same as Gas Chromatograph with the following additions:	Quarterly
	Mechanical pump oil	Semi-annually
	Vacuum chaff filter	Annually
	Turbo pump oil	Semi-annually
	Computer air filter	Semi-annually
	Card cage air filter	As needed
	Source-clean ceramics, polish lenses	As needed
	Clean poles and ceramics	As needed
	Clean contacts on the component boards	As needed
	Vacuum the component boards	As needed
	Replace quartz injection port insert	As needed
	Replace septum	Daily
	Injection port liner checked	As needed
	Column maintenance	Semi-annually or as
	Disk drive	needed
	Printer	Quarterly
Inductively Coupled Plasma Spectrometer	Sample introduction system	Daily
	Check pumps	Daily
	Clean, realign torch	Monthly or as needed
	Replace nebulizer	Monthly or as needed
	Clean mixing chamber	Monthly or as needed
	Replace pump tubing	Daily, or as needed
Refrigerators/Freezers	Temperature checked and logged	Daily on each work day
	Compartment cleaned	Quarterly
Walk-In Coolers	Temperature checked and logged	Daily on each work day
	Unit cleaned	Quarterly
Balances	Service representative calibration	Annually
	Internal weight train, gears, electronics	Annual service
Thermometers	Calibrated	Annually
Class S Weights	Calibrated	Annually
Deionized/Organopure Water	Conductivity check	Weekly
	Ion-exchange bed changed	Weekly
	Replace filters	As needed
Vacuum Pumps and Air Compressor	Check performance	Weekly
	Lubrication, belts, etc.	As needed
Water Baths	Water Level	Added as needed
	Bath cleaned	6 Months

REFERENCES

American Society for Testing and Materials (ASTM). 1995. Annual Book of ASTM Standards, Volume 11.01. ASTM, Philadelphia, Pennsylvania.

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U.S. EPA. 1996. EPA Guidance for Quality Assurance Project Plans for Environmental Data Operations. External Working Draft. EPA QA/G-5. U.S. EPA, Quality Assurance Division, Washington, D.C.

U.S. EPA. 1997. Test Methods for Evaluating Solid Waste. Physical/Chemical Methods. EPA SW-846, 3rd Edition including UPDATE III. U.S. EPA, Washington, D.C.

Attachment B.1

Quality Control Criteria for Precision and Accuracy for Matrix Spikes, Surrogate Spikes, and Laboratory Control Samples

ATTACHMENT B.1

QUALITY CONTROL CRITERIA FOR PRECISION AND ACCURACY FOR MATRIX SPIKES, SURROGATE SPIKES, AND LABORATORY CONTROL SAMPLES[(a)]

Quality Control Parameter	Spiking Command	Accuracy (%R)	Precision[(b)]
		Water	Water
SW-3010A/3050A/6010B Metals by Inductively Coupled Plasma Atomic Emission Spectroscopy			
Matrix Spike	Aluminum	75-125	<20
	Antimony	75-125	<20
	Barium	75-125	<20
	Beryllium	75-125	<20
	Cadmium	75-125	<20
	Chromium	75-125	<20
	Cobalt	75-125	<20
	Copper	75-125	<20
	Iron	75-125	<20
	Manganese	75-125	<20
	Nickel	75-125	<20
	Silver	75-125	<20
	Vanadium	75-125	<20
	Zinc	75-125	<20
Laboratory Control Sample	Aluminum	80-120	≤20
	Antimony	80-120	≤20
	Barium	80-120	≤20
	Beryllium	80-120	≤20
	Cadmium	80-120	≤20
	Calcium	80-120	≤20
	Chromium	80-120	≤20
	Cobalt	80-120	≤20
	Copper	80-120	≤20
	Iron	80-120	≤20
	Magnesium	80-120	≤20
	Manganese	80-120	≤20
	Nickel	80-120	≤20
	Potassium	80-120	≤20
	Silver	80-120	≤20
	Sodium	80-120	≤20
	Vanadium	80-120	≤20
	Zinc	80-120	≤20

(a) LCS limits are based on historical performance data and are updated annually.
(b) Precision for LCS is calculated as the moving range for successive LCS recoveries; precision for matrix spikes is listed as relative percent difference.

NOTE: LCS = Laboratory control sample.

Attachment B.2

Summary of Laboratory Quality Control Requirements and Corrective Action Procedures

ATTACHMENT B.2

SUMMARY OF LABORATORY QUALITY CONTROL REQUIREMENTS AND CORRECTIVE ACTION PROCEDURES

Quality Control Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Metals by Inductively Coupled Plasma: SW-3010A/6010B in Water			
Holding time	6 months from sampling	Digestion/analysis and any re-analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration, minimum 1 point plus a calibration blank	Daily prior to sample analysis		
Initial Calibration Verification, prepared from a second source.	Before beginning a sample run	Recovery within ±10% of true value, and relative standard deviation <5%.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Initial Calibration Blank	Immediately after the initial calibration verification	Absolute value of initial calibration blank < PQL.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Continuing Calibration Verification	At beginning of run, after every 10 samples, and at end of run	Recovery within ±10% of true value, and relative standard deviation <5%.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Continuing Calibration Blank	After every 10 samples and at end of the run	Absolute value of continuing calibration blank <PQL.	1. Do not use results if ≥PQL and <10× continuing calibration blank level. 2. Investigate and correct problem.
PQL Solution	At beginning of run	Recovery within ±50% of true value.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Interference Check Solution A	Before beginning a sample run	For Al, Ca, Fe, and Mg, recovery within ±20% of true value. For analytes not spiked, ±PQL, or, if PQL ≤0.01 mg/L, ±2× PQL.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Interference Check Solution AB	Before beginning a sample run	Recovery of each analyte within ±20% of true value.	1. Do not use results for failing elements. 2. Investigate and correct problem.
Preparation Blank (W/S)	One per digestion batch of 20 or fewer samples	Less than PQL.	1. Investigate source of contamination. 2. Redigest and re-analyze all associated samples if sample concentration ≥PQL and <10× the blank concentration.
Laboratory Control Sample (W/S)	One per digestion batch of 20 or fewer samples	Recovery within ±20% of true value, unless vendor-supplied or statistical limits have been established.	1. Investigate source of problem. 2. Redigest and re-analyze all associated samples.
Matrix Spike Sample(s)	One per digestion batch of 20 or fewer samples	Recovery ±25% of true value, if sample <4× spike added.	Flag results.
Matrix Spike Duplicate Sample (P)	One per digestion batch of 20 or fewer samples	1. Recovery ±25% of true value, if sample <4× spike added. 2. Relative percent difference 20% for duplicate spikes.	Flag results.
Serial Dilution (L)	One per digestion batch	If original sample result is at least 50× IDL, 5-fold dilution must agree within ±10% of the original result.	Flag result or dilute and re-analyze sample to eliminate interference.

NOTE: IDL = Instrument detection limit.
PQL = Practical quantitation limit.

Quality Control Check	Frequency	Acceptance Criteria	Laboratory Corrective Action
Metals by Inductively Coupled Plasma: SW-3010A/6010B in Water (Continued)			
Linear Range Study	Every 6 months	Upper limit standard should be within ±10% of level extrapolated from lower standards.	Report to established upper limit until next linear range study.
IDL Study	Quarterly	IDL < PQL.	1. Repeat IDL study. 2. Raise PQL.
MDL Study	Annually	MDL < PQL	3. Repeat MDL study. 4. Raise PQL.
Metals by AA: SW-3020A/7470 in Water - Mercury/Cold Vapor Atomic Absorption			
Holding time	Mercury: 28 days from sampling	Digestion/analysis and any re-analysis performed within holding time.	Notify client, determine if laboratory to proceed or if client will resample.
Initial Calibration, 5 points plus a calibration blank.	Daily prior to sample analysis	Correlation coefficient ≥0.995.	Correct problem and repeat calibration.
Initial Calibration Verification, prepared from a second source.	Before beginning a sample run	Recovery within ±10% of true value.	Correct problem and repeat calibration.
Initial Calibration Blank	Before beginning a sample run	Less than PQL.	Correct problem and repeat calibration.
PQL Standard	Before beginning a sample run	Recovery within ±50% of true value.	No corrective action required at this time.
Continuing Calibration Verification	At beginning of run, after every 10 samples, and at end of the run	Recovery within ±20% of true value.	Repeat calibration and re-analyze all samples analyzed since the last successful continuing calibration verification.
Continuing Calibration Blank	At beginning of run, after every 10 samples, and at the end of the run	Less than PQL.	Repeat calibration and re-analyze all samples analyzed since the last successful continuing calibration blank.
Preparation Blank (W)	One per digestion batch of 20 or fewer samples	Less than PQL.	1. Investigate source of contamination. 2. Redigest and re-analyze all associated samples if sample concentration ≥PQL and <10× the blank concentration.
Laboratory Control Sample (W)	One per digestion batch of 20 or fewer samples	Recovery within ±20% of true value.	Redigest all affected samples.
Spike Sample (S)	One per digestion batch of 20 or fewer samples	Recovery ±25% of true value, if sample >4× spike value.	Flag results.
Matrix Spike Duplicate Sample (P)	One per digestion batch of 20 or fewer samples	1. Recovery ±25% of true value, if sample >4× spike value. 2. Relative percent difference 20% for duplicate spikes.	Flag results.
IDL Study	Quarterly	IDL < PQL	1. Repeat IDL study. 2. Raise PQL.
MDL Study	Annually	MDL < PQL	3. Repeat MDL study. 4. Raise PQL.
NOTE: MDL = Method detection limit.			

Attachment B.3

Summary of Laboratory Standard Operating Procedures

ATTACHMENT B.3

SUMMARY OF LABORATORY STANDARD OPERATING PROCEDURES

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
ADMINISTRATION AND SAFETY									
Respiratory Protection	---	---	---	---	AD-002	NA	NA	NA	Obsolete
Employee Safety Tour and Training	---	---	---	---	AD-003	NA	NA	NA	Obsolete
Laboratory Facility Security and Confidentiality	---	---	---	---	AD-004	1	03/98	12/00	12/00
CHEMICAL ANALYSIS – GENERAL									
Lab Ware Cleaning	---	---	---	---	CA-100	0	01/01	01/01	01/01
Equipment Maintenance	---	---	---	---	CA-101	1	08/96	12/00	12/00
Balance Calibration	---	---	---	---	CA-102	1	09/96	12/00	12/00
Calibration of Adjustable Pipettors	---	---	---	---	CA-103	1	04/96	12/00	12/00
Use of Laboratory Water Systems	---	---	---	---	CA-104	1	08/99	12/00	12/00
Reagent and Solvent Handling	---	---	---	---	CA-105	0	05/00	05/00	05/00
Standard Preparation, Documentation and Traceability	---	---	---	---	CA-106	1	02/99	12/00	12/00
CHEMICAL ANALYSIS – GC/MS									
Analysis of VOAs by Purge and Trap GS/MS (Method 524.2)	524.2	---	---	---	CA-200	1	01/98	07/00	07/00
Analysis of VOAs by Purge and Trap GC/MS (Method 8240)	NA	NA	NA	NA	CA-201	NA	NA	NA	Obsolete
Analysis of VOAs by Purge and Trap GC/MS (SW-846 Method 8260)	---	---	8260B	---	CA-202	4	10/96	05/01	05/01
Analysis of VOAs by Purge and Trap GC/MS (EPA CLP, Document No. OLM03.0 [including revision OLM03.1])	---	---	---	OLM03.1	CA-203	2	02/97	01/01	01/01
Analysis of SVOAs by Capillary Column GC/MS (SW-846 Method 8270)	---	---	8270C	---	CA-204	4	02/97	05/01	05/01

NOTE:
SOP = Standard operating procedure.
EPA = U.S. Environmental Protection Agency.
NA = Not applicable.
GC = Gas chromatograph.
MS = Mass Spectrometry.
VOA = Volatile organic analyte.
CLP = Contract Laboratory Procedure.
SVOA = Semivolatile organic analyte.

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – GC/MS (Continued)									
Analysis of SVOAs by Capillary Column GC/MS (EPA CLP, Document No. OLM03.0 [Including revision OLM03.1])	---	---	---	OLM03.1	CA-206	2	02/97	01/01	01/01
GS/MS Library Search Identification and Quantitation	---	---	---	---	CA-207	0	01/01	01/01	01/01
Zero Headspace Extraction of Volatile Samples for Toxicity Characteristic Leaching Procedure Method 1311	---	---	1311	---	CA-209	1	10/97	02/01	02/01
Analysis of Aqueous Samples for VOAs by Purge and Trap GC/MS (Mod. Method 624)	624	---	---	---	CA-210	1	01/97	01/01	01/01
Analysis of Aqueous Samples for VOAs by Purge and Trap GC/MS (SW-846 Method 8260 Low Level)	NA	NA	NA	NA	CA-211	0	10/96	10/96	Obsolete
Analysis of Semivolatile Organic Compounds by Capillary Column GC/MS (40 CFR Method 625)	625	---	---	---	CA-212	1	11/97	01/01	01/01
Analysis of Semivolatile Organic Compounds by (SW-846 Method 8270 – Modified for Selected Ion Monitoring)	---	---	8270C	---	CA-213	1	02/98	02/01	02/01
Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples Using SW-846 Method 5035	---	---	5035	---	CA-214	1	07/98	01/01	01/01
Analysis of VOAs by Purge and Trap GC/MS (EPA Contract Laboratory Program, Document No. OLC02.1)	---	---	---	OLC02.1	CA-215	0	01/00	01/00	01/00
Analysis of Semivolatile Organic compounds by Capillary Column GC/MS (EPA Contract Laboratory Program, Statement of Work, OLC02.1, February 1996)	---	---	---	OLC02.1	CA-216	0	01/00	01/00	01/00
1624	1624	---	---	---	CA-217	Draft			
Analysis of VOAs by Purge and Trap GC/MS (EPA Contract Laboratory Program, Document No. OLM04.2)	---	---	---	OLM04.2	CA-218	0	07/01	07/01	07/01
Analysis of VOAs by Purge and Trap GC/MS (SW-846 Method 8260 – Modified for Selected Ion Monitoring of Vinyl Chloride)	---	---	8260B	---	CA-220	0	07/01	07/01	07/01
CHEMICAL ANALYSIS – GC									
Analysis of Purgeable Halocarbon and Purgeable Aromatic Compounds in Water and Soil by GC (PID/ELCD) – Methods 601/602	601/602	---	---	---	CA-300	1	01/98	01/01	01/01
Analysis of Pesticides/PCBs by GC/ECD (EPA Method 608)	608	---	---	---	CA-301	0	01/01	01/01	01/01
Analysis of Pesticides by GC/ECD (SW-846 Method 8081)	---	---	8081A	---	CA-302	3	07/96	05/01	05/01
Analysis of Pesticides/PCBs by GC/ECD (Method 8080)	NA	NA	NA	NA	CA-303	NA	NA	NA	Obsolete

NOTE:
PID = Photoionization detector.
ELCD = Electrolytic conductivity detector.
PCB = Polychlorinated biphenyl.
ECD = Electron capture device.

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18^{th})	SW-846	Other					
CHEMICAL ANALYSIS – GC (Continued)									
Analysis of Pesticides and PCBs in Extracts of Soil and Water for the CLP (Under EPA SOW OLM03.1, 8/94)	---	---	---	OLM03.1	CA-304	2	03/97	02/01	02/01
Analysis of Chlorinated Herbicides by GC Using Methylation Derivatization (SW-846 Method 8151)	---	---	8151	---	CA-305	1	06/98	01/01	01/01
Analysis of Gasoline in Water and Soil by Purge and Trap GC/FID According to California Luft Methodologies	---	---	---	CALUFT	CA-307	0	02/97	02/97	02/97
Analytical Procedure for the Determination of Dimethylformamide by GC	---	---	---	Katahdin	CA-309	Draft			
Direct Injection Method for the Determination of 2-Methoxy-Ethanol Using GC/FID	---	---	---	Katahdin	CA-310	Draft			
Screening of SVOA Organic Extracts by GC/FID (EPA CLP, SOW OLM03.0)	NA	NA	NA	NA	CA-311	NA	NA	NA	Obsolete
Method for the Determination of VPH (MADEP – VPH)	---	---	---	MADEP	CA-312	1	04/98	02/01	02/01
Method 8010 – Analysis of Purgeable Halocarbon and Purgeable Aromatic Compounds in Water and Soil by GC (PID/ELCD)	NA	NA	NA	NA	CA-313	0	02/97	02/97	Obsolete
Summation of TPH Using the Maine HETL DRO Method 4.1.25 and GRO Method 4.2.17	---	---	---	MEDEP	CA-314	0	03/01	07/01	07/01
Determination of EPHs or DRO by Modified Methods 8015 and 8100	---	---	8015B	---	CA-315	2	06/97	05/01	05/01
Method for Determining VPH or GROs by Modified Method 8015	---	---	8015B	---	CA-316	2	06/97	05/01	05/01
Analysis of Petroleum Hydrocarbons in Extracts of Water and Soil	NA	NA	NA	NA	CA-317	NA	NA	NA	Obsolete
Determination of TPH as Diesel by GC/FID (California Luft Method)	---	---	---	CALUFT	CA-318	0	02/97	02/97	02/97
Extraction and Analysis of 1,2-Dibromoethane and 1,2-Dibromo-3-Chloropropane in Water by SW-846 Method 8011	---	---	8011	---	CA-319	1	02/97	01/01	01/01
Purge and Trap Extraction of Volatiles for GC Analysis – Method 5030	---	---	5030	---	CA-320	1	02/98	01/01	01/01
Analysis of Purgeable Aromatic Compounds in Water and Soil by GC (PID) – Method 8020	NA	NA	NA	NA	CA-321	0	02/97	02/97	Obsolete

NOTE:
SOW = Statement of Work.
FID = Flame ionization detector.
VPH = Volatile petroleum hydrocarbon.
MADEP = Massachusetts Department of Environmental Protection.
TPH = Total petroleum hydrocarbon.
DRO = Diesel range organic.
GRO = Gasoline range organic.
EPH = Extractable petroleum hydrocarbon.

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – GC (Continued)									
Method for the Analysis of EPHs (MADEP–EPH)	---	---	---	MADEP	CA-322	1	03/97	02/01	02/01
Method for Determining GROs by Maine HETL Method 4.2.17	---	---	---	MADEP	CA-323	1	09/97	11/00	11/00
Method for Determining DROs by Maine HETL Method 4.1.25	---	---	---	MEDEP	CA-324	1	09/97	01/01	01/01
Extraction and Analysis of 1,2-Dibromoethane, 1,2-Dibromo-3-Chloropropane, and 1,2,3-Trichloropropane in Water by EPA Method 504.1	504.1	---	---	---	CA-326	1	10/97	01/01	01/01
EPA Method 502.2T – Analysis of Trihalomethanes in Water by GC (ELCD)	502.2	---	---	---	CA-327	1	01/98	01/01	01/01
Method 8021 – Aromatic and Halogenated Volatiles by GC Using Photoionization and/or Electrolytic Conductivity Detectors	---	---	8021	---	CA-328	1	07/98	01/01	01/01
Analysis of PCBs as Total Aroclors by GC/ECD (SW-846 Method 8082)	---	---	8082	---	CA-329	2	04/98	05/01	05/01
Direct Injection Method for the Determination of Alcohols Using GC/FID	---	---	8015B	---	CA-330	Draft			
Sulfur Cleanup of Pesticide/PCB Extracts Using SW-846 Method 3660	---	---	3660	---	CA-331	1	07/98	01/01	01/01
Analysis of Pesticides and PCBs in Extracts of Soils and Water for the CLP (Under EPA SOW OLM04.2, 5/99)	---	---	---	OLM04.2	CA-332	0	03/01	07/01	07/01
Determination of Petroleum Range Organics by Florida Department of Environmental Protection Method No. FL-PRO	---	---	---	FL-PRO (11/95)	CA-333	0	07/01	07/01	07/01
CHEMICAL ANALYSIS – HPLC									
Analysis of Dinitrosopentamethylenetramine in Aqueous Samples	---	---	---	Katahdin	CA-400	NA	NA	NA	Obsolete
Analysis for Polynuclear Aromatic Hydrocarbons Using HPLC by EPA Method 8310	---	---	8310	---	CA-401	0	07/96	07/96	On Hold
Determination of Nitroaromatics and Nitramines by HPLC Method 8330	---	---	8330	---	CA-402	1	06/97	02/99	On Hold
CHEMICAL ANALYSIS – ORGANIC EXTRACTIONS									
Preparation of Sediment/Soil Samples by Sonication Using Method 3550 for Subsequent Pesticides/PCBs Analysis	---	---	3550B	---	CA-500	1	07/96	11/00	11/00
Preparation of Aqueous and Soil/Sediment Samples for Polynuclear Aromatic Hydrocarbon Analysis	NA	NA	NA	NA	CA-501	NA	NA	NA	Obsolete
Preparation of Aqueous Samples for Extractable Semivolatile Analysis	625	---	3510C 3520C	---	CA-502	1	08/96	07/00	07/00
Preparation of PCB Wipe Samples for Analysis by GC/ECD	---	---	3580A	---	CA-503	0	02/01	02/01	2/01
Preparation of Samples for Herbicide Analysis by Method 6640B	---	6640B	---	---	CA-504	1	03/98	01/01	01/01

NOTE: HPLC = High performance liquid chromatography.

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – ORGANIC EXTRACTIONS (Continued)									
Determination of TPH in Solid Matrices Using Soxhlet Extraction and Analysis by FT-IR- Method 418.1	NA	NA	NA	NA	CA-505	1	06/97	08/97	Obsolete
Determination of Total Recoverable Oil and Grease and TPH in Aqueous Samples by FT-IR-Method 418.1	NA	NA	NA	NA	CA-506	0	08/97	08/97	Obsolete
Gravimetric Determination of Total Recoverable Oil and Grease (413.1)	NA	NA	NA	NA	CA-507	0	03/98	03/98	Obsolete
Preparation of Aqueous Samples for CLP Extractable Pesticides/PCBs Analysis (EPA Contract Laboratory Program, Document Nos. OLM03.1 and OLM04.2)	---	---	---	OLM03.1 OLM04.2	CA-508	0	02/01	02/01	02/01
Preparation of Aqueous Samples for CLP Extractable Semivolatile Analysis (EPA Contract Laboratory Program, Document Nos. OLM03.1 and OLM04.2)	---	---	---	OLM03.1 OLM04.2	CA-509	0	02/01	02/01	02/01
Toxicity Characteristic Leaching Procedure for Inorganic and Non-VOAs	----	---	1311	---	CA-510	1	07/97	02/01	02/01
Extraction of Petroleum Hydrocarbons from Samples for Analysis by MADEP--EPH Methods	---	---	---	MADEP	CA-511	1	03/98	02/01	02/01
Preparation of Sediment/Soil Samples by Sonication Using Method 3550 For Subsequent Extractable Semivolatile Analysis	---	---	3550B	---	CA-512	1	08/96	11/00	11/00
Extract Cleanup Using Gel Permeation Chromatography	---	---	---	OLM03.1	CA-513	0	02/01	02/01	02/01
Field Prep and Analysis of Soil Samples for PCBs Using GC/ECD	NA	NA	NA	NA	CA-514	0	07/96	07/96	Obsolete
Preparation of Aqueous Samples for Pesticides/PCBs Analysis	608	---	3510C 3520C	---	CA-515	1	12/97	11/00	11/00
Preparation of Aqueous Samples for Herbicides by Method 8151	---	---	8151	---	CA-516	1	07/98	01/01	01/01
Preparation of Solid Samples for Herbicides Analysis by Method 8151	---	---	8151	---	CA-517	NA	NA	NA	Obsolete
Separatory Funnel Extraction of Aqueous Samples for PNA Analysis by HPLC	---	---	3510C 3520C	---	CA-518	Draft	NA	NA	On Hold
Extraction of Low Level Solids for Polynuclear Aromatic Analysis by HPLC	---	---	3550B	---	CA-519	Draft	NA	NA	On Hold
Preparation of Aqueous Samples for Analysis of EPHs or DROs	---	---	3510C 3520C	---	CA-520	1	06/97	01/01	01/01
Preparation of Water and Soil DRO Samples for Analysis by CA LUFT	---	---	---	CALUFT	CA-521	Draft			
Peroxide Test for Diethylether	NA	NA	NA	NA	CA-522	NA	NA	NA	Obsolete
Preparation of Non-Aqueous Waste Samples for Analysis of PCBs (Method 3580)	---	---	3580A	---	CA-523	1	12/97	02/01	02/01

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – ORGANIC EXTRACTIONS (Continued)									
Preparation of Sediment/Soil Samples by Soxhlet Extraction Using Method 3540 for Pesticide/PCB Analysis	---	---	3540C	---	CA-524	1	07/98	11/00	11/00
Extract Cleanup Using Sulfuric Acid	---	---	3660B	---	CA-525	1	02/98	11/00	11/00
Preparation of Sediment/Soil Samples by Soxhlet Extraction Using Method 3540 for Subsequent Extractable Semivolatile Analysis	---	---	3540C	---	CA-526	1	07/98	11/00	11/00
Preparation of Sediment/Soil Samples by Soxhlet Extraction Using Method 3540 for Subsequent Extractable TPH or DRO Analysis	---	---	3540C	---	CA-527	0	01/01	01/01	01/01
Method 1664 – N-Hexane Extractable Material and Silica Gel Treated N-Hexane Extractable Material by Extraction and Gravimetry (Oil and Grease and TPHs)	1664	---	---	---	CA-528	1	07/98	01/01	01/01
Method 9070 – N-Hexane Extractable Material by Extraction and Gravimetry (Oil and Grease)	---	---	9070	----	CA-529	1	07/98	01/01	01/01
Preparation of Chlorinated Phenolics in Wastewater by *In Situ* Acetylation	1653	---	---	---	CA-530	Draft			
Automated Soxtherm Extraction	---	---	3541	---	CA-531	Draft			
CHEMICAL ANALYSIS – METALS PREP AND ANALYSIS									
Elements Data Review	NA	NA	NA	NA	CA-600	NA	NA	NA	Obsolete
Glassware Preparation and Sample Preservation for Trace Element Analyses	NA	NA	NA	NA	CA-602	NA	NA	NA	Obsolete
Acid Digestion of Aqueous Samples by EPA Method 3020 for GFAA Analysis of Total or Dissolved Metals	---	---	3020A	---	CA-603	1	03/98	01/01	Obsolete
Acid Digestion of Aqueous Samples by EPA Method 3010 for ICP Analysis of Total or Dissolved Metals	---	---	3010A	---	CA-604	1	11/97	01/01	01/01
Acid Digestion of Solid Samples by EPA Method 3050 for Metals Analysis by ICP–AES and GFAA	---	---	3050B	---	CA-605	1	03/98	01/01	01/01
Hot Plate Acid Digestion of Solid Samples for Total Metals Analysis by GFAA	NA	NA	NA	NA	CA-606	NA	NA	NA	Obsolete
Trace Metals Analysis by ICP–AES Using EPA Method 6010	---	---	6010B	---	CA-608	1	07/98	01/01	01/01
Operation and Maintenance of the Thermo Jarrell Ash ICAP 61 ICP Spectrometer	---	---	---	---	CA-609	1	07/96	02/01	02/01
Operation and Maintenance of the Leeman Labs PS200 Automated Mercury Analyzer	---	---	---	---	CA610	3	07/96	01/01	01/01
Digestion and Analysis of Solid Samples for Mercury by EPA Method 7471	---	---	7471A	---	CA-611	2	12/97	01/01	01/01

NOTE: GFAA = Graphite Furnace Atomic Absorption.
ICP = Inductively Coupled Plasma.

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – METALS PREP AND ANALYSIS (Continued)									
Operation and Maintenance of the Thermo Jarrell Ash 61E Trace ICP Spectrometer	---	---	---	---	CA-612	1	11/97	02/01	02/01
Trace Metals Analysis by ICP–AES Using EPA Method 200.7	200.7	---	---	---	CA-613	1	03/98	01/01	01/01
Digestion and Analysis of Aqueous Samples for Mercury by EPA Method 245.1	245.1	---	---	---	CA-614	0	01/01	01/01	01/01
Digestion and Analysis of Aqueous Samples for Mercury by EPA Method 7470	---	---	7470A	---	CA-615	0	01/01	01/01	01/01
Operation and Maintenance of the Perkin-Elmer 5100PC Atomic Absorption Spectrophotmeter and HGA-600 Zeeman Graphite Furnace	---	---	---	---	CA-616	1	05/98	02/01	Obsolete
Trace Metals Analysis by Standard Method 3113 Using Graphic Furnace AA	3113	---	---	---	CA-617	NA	NA	NA	Obsolete
GFAA Metals Analysis by EPA 7000-Series Methods	---	---	7000 Series	---	CA-618	0	02/01	02/01	Obsolete
GFAA Metals Analysis by EPA CLP Methods	---	---	---	ILM04.0	CA-619	0	02/01	02/01	Obsolete
Synthetic Precipitation Leachate Procedure – Method 1312	---	---	1312	---	CA-620	Draft			
Extraction Procedure Toxicity Test for Organic and Inorganic Non-Volatile Analytes	---	---	1310	---	CA-621	Draft			
Acid Digestion of Aqueous Samples for ICP Metals Analysis in Accordance with EPA CLP Statement of Work, Document No. ILM04.0	---	---	---	ILM04.0	CA-622	0	01/00	01/00	01/00
Acid Digestion of Soil/Sediment Samples for ICP and GFAA Metals Analysis in Accordance with EPA CLP Statement of Work, Document No. ILM04.0	---	---	---	ILM04.0	CA-623	0	01/00	01/00	01/00
Trace Metal Analysis by ICP Spectroscopy Using Method 200.7 CLP-M	---	---	---	200.7 CLP-M	CA-624	0	05/00	05/00	05/00
Trace Metals Analysis By ICP-MS Using EPA Method 6020	---	---	6020	---	CA-627	0	04/01	04/01	04/01
Trace Metals Analysis by ICP – MS Using EPA Method 200.8	200.8	---	---	---	CA-628	0	04/01	04/01	04/01
CHEMICAL ANALYSIS – WET CHEMISTRY									
Alkalinity – Potentiometric, Titration pH 4.5	NA	NA	NA	NA	CA-700	NA	NA	NA	Obsolete
Biochemical Oxygen Demand in Aqueous Sample Matrices	405.1	5210B	---	---	CA-701	0	02/01	02/01	02/01
Analysis of Total Organic Carbon and Dissolved Organic Carbon in Aqueous Samples Using the Dohman Carbon Analyzer (EPA Method 415.1 and SM 5310C)	415.1	5310C	---	---	CA-702	1	10/97	02/01	02/01
Chemical Oxygen Demand, Low and High Range, by Closed Reflux Digestion and Manual Spectrophotometry	410.4	---	---	HACH 8000	CA-703	0	02/01	02/01	02/01

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – WET CHEMISTRY (Continued)									
Cyanide – Spectrophotometric Determination in Domestic and Industrial Wastewater, Drinking, Surface, and Saline Waters, and Sediment/Soil Samples	NA	NA	NA	NA	CA-704	0	05/98	05/98	Obsolete
Fluoride Determination by Ion-Selective Electrode Using Methods 340.2 and SM 4500-F-C	340.2	4500F C	---	---	CA-705	0	01/01	01/01	01/01
Total Organic Halides	---	---	9020B	---	CA-706	1	07/98	02/01	02/01
Titrimetric Determination of Total Hardness by Addition of EDTA Using EPA Method 130.2 and SM 2340C	130.2	2340C	---	---	CA-707	0	02/01	02/01	02/01
pH Concentration Measurements in Aqueous Samples	150.1	4500H-B	9040B	---	CA-708	2	02/97	05/01	05/01
PH Concentration Measurements in Soil Matrices – SW 846 Method 9045	---	---	9045C	---	CA-709	3	08/96	02/01	02/01
Distillation of Soil and Aqueous Samples for Ammonia Analysis	350.2	4500NH_3 B	---	---	CA-710	0	02/01	02/01	02/01
Analysis of Ammonia-Nitrogen by the Colorimetric Automated Phenate Method (EPA 350.1 and SM 4500NH3 H)	350.1	4500NH_3 H	---	---	CA-711	1	12/97	02/01	02/01
Analysis of Total Kjeldahl Nitrogen Using Block Digestion and Flow Injection Colorimetry (Lachat) (EPA Method 351.2)	351.2	---	---	---	CA-712	0	02/01	02/01	02/01
Spectrophotometric Determination of Total Recoverable Phenolics	420.1	---	9065	---	CA-714	1	04/98	02/01	02/01
Analysis of TPO4 (Total Phosphorus) Using Block Digestion and Flow Injection Colorimetry (Lachat) (EPA Method 365.4)	365.4	---	---	---	CA-715	0	02/01	02/01	02/01
Total Solids/Total Volatile Solids Determination in Solid Matrices	---	2540G	---	ILM03.0	CA-717	1	12/97	02/01	02/01
Total Solids/Total Volatile Solids in Aqueous Matrices	160.3 160.4	2540B 2540E	---	---	CA-718	0	02/01	02/01	02/01
Total Dissolved Solids (Filtered Residue)	160.1	2540C	---	---	CA-719	1	12/97	01/01	01/01
Total Suspended Solids (Non-Filtered Residue)	160.2	2540D	---	---	CA-720	1	12/97	01/01	01/01
Turbidmetric Determination of Sulfate	375.4	4500SO4 E	9038	426C (SM15th)	CA-721	1	01/98	02/01	02/01
Titrimetric Determination of Sulfide Using EPA Method 376.1; SW-846 9034	376.1	---	9034	---	CA-722	0	02/01	02/01	02/01
Wet Chemistry Data Review	NA	NA	NA	NA	CA-723	NA	NA	NA	Obsolete
Soil Preparation by Rotary Extraction	NA	NA	NA	NA	CA-724	NA	NA	NA	Obsolete
Automated LACHAT Colormetric Analysis of Chloride	325.2	4500CI E	9251	---	CA-726	1	04/98	02/01	02/01
Nitrite – Automated Colorimetric Analysis (LACHAT)	NA	NA	NA	NA	CA-727	NA	NA	NA	Obsolete
Total Nitrate/Nitrite, Nitrite and Nitrate with Cadmium Reduction by Automated Colorimetry	353.2	4500NO3 F	---	10-107-04-1-A (Lachat)	CA-728	1	05/98	02/01	02/01
Analysis for Lime Equivalency/Ash Alkalinity of Industrial Wastes (EPA Method 310.1 Mod)	310.1	---	---	---	CA-729	0	02/01	02/01	02/01

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18th)	SW-846	Other					
CHEMICAL ANALYSIS – WET CHEMISTRY (Continued)									
Reactive Cyanide SW-846 Chapter Seven 7.3.3.2	---	---	7.3.3.2	---	CA-733	1	08/96	02/01	02/01
Reactive Sulfide SW-846 Chapter Seven, 7.3.4.2	---	---	7.3.4.2	---	CA-734	2	08/96	02/01	02/01
Test Method for Flash Point by Pensky-Martens Closed-Cup Tester	---	---	1010	ASTM D93-80	CA-736	1	08/96	01/01	01/01
Cation Exchange Capacity	---	---	9081	---	CA-737	Draft			
Acid Volatile Sulfides	376.3	---	---	---	CA-738	Draft			
Titrimetric Determination of Total Alkalinity by EPA Method 310.1 and SM 2320 B Using the Mettler DI25 Autotitrator	310.1	2320B	---	---	CA-739	1	04/98	02/01	02/01
PH Concentration Measurements in Soil Matrices – CLP Method	---	---	---	OLM03.1	CA-740	1	02/97	02/01	02/01
Total Organic Carbon in Solids – Lloyds Kahn	NA	NA	NA	NA	CA-741	0	10/97	10/97	Obsolete
Anions by Ion Chromatography – Method 300.0	300.0	---	---	---	CA-742	1	10/97	05/00	05/00
Colorimetric Determination of Orthophosphate in Aqueous Samples Method (EPA 365.2 and SM 4500P E)	365.2	4500P E	---	---	CA-743	1	10/97	02/01	02/01
Specific Conductance	120.1	2510B	---	---	CA-744	0	02/01	02/01	02/01
Determination of Turbidity by Nephelometry	180.1	2130B	---	---	CA-745	0	02/01	02/01	02/01
Determination of Hexavalent Chromium in Aqueous Samples Using EPA SW-846 Method 7196 and SM 3500CR-D	---	3500Cr D	7196	---	CA-746	2	05/98	05/01	05/01
Titrimetric Determination of Bromide by Method 320.1	320.1	---	---	---	CA-747	1	05/98	02/01	02/01
Practical Salinity – Electrical Conductivity Method	---	2520B	---	---	CA-748	1	05/98	02/01	02/01
Ferrous Iron – Colorimetric Determination by Phenanthroline	---	3500Fe D	---	-	CA-749	1	06/98	02/01	02/01
Analysis of Total Organic Carbon and Dissolved Organic Carbon in Aqueous Samples Using the Dohrman Carbon Analyzer (SW-846 EPA Method 9060)	---	---	9060	---	CA-750	2	07/98	05/01	05/01
Preparation and Analysis of Samples for Cyanide Using Midi-Distillation Followed by Flow Injection Analysis	335.2/.3 335.4	4500CN C	9012A	335.2 CLP-M	CA-751	1	05/00	05/01	05/01
CHEMICAL ANALYSIS – BACTERIOLOGY									
Bacteriological Evaluation of Potable and Non-Potable Waters for the Presence of Fecal Coliform by the Membrane Filtration Method	NA	NA	NA	NA	CA-730	NA	NA	NA	Obsolete
Overview of the Bacteriological Evaluation of Potable and Non-Potable Waters	NA	NA	NA	NA	CA-731	NA	NA	NA	Obsolete
Bacteriological Evaluation of Potable and Non-Potable Waters for the Presence of Total Coliform by the Membrane Filtration Method	NA	NA	NA	NA	CA-732	NA	NA	NA	Obsolete
QUALITY ASSURANCE									
Preparation of Standard Operating Procedures	---	---	---	---	QA-800	2	03/98	11/00	11/00
Analytical Quality Control	NA	NA	NA	NA	QA-801	NA	NA	NA	Obsolete
Quality Control Charts for HAZWRAP Analysis	NA	NA	NA	NA	QA-802	NA	NA	NA	Obsolete
NOTE: ASTM = American Society for Testing and Materials.									

SOP Title	Methods Covered				SOP No.	Revision No.	Issue Date	Revision Date	Last Reviewed
	EPA	SM (18^{th})	SW-846	Other					
QUALITY ASSURANCE (Continued)									
Laboratory Quality Assurance (Self-Inspection System)	---	---	---	---	QA-803	1	08/99	12/00	12/00
Document Control Procedures	---	---	---	---	QA-804	1	09/96	12/00	12/00
Personnel Training and Documentation of Capability	---	---	---	---	QA-805	2	05/96	12/00	12/00
Method Detection Limit and Instrument Detection Limit Studies	---	---	---	---	QA-806	0	12/00	12/00	12/00
Method Performance/Precision and Accuracy Requirements	---	---	---	---	QA-807	1	01/99	12/00	12/00
Generation and Implementation of Statistical Quality Control Limits and/or Control Charts	---	---	---	---	QA-808	1	09/99	12/00	12/00
Working Thermometer Verification	---	---	---	---	QA-809	0	12/00	12/00	12/00
Communication of Client/Project Specific Information	---	---	---	---	QA-810	0	05/00	05/00	05/00
SAMPLE MANAGEMENT/DATA MANAGEMENT									
Subcontracting Analyses	---	---	---	---	SD-900	1	09/96	12/00	12/00
Sample Container Preparation and Shipment	---	---	---	---	SD-901	2	08/96	12/00	12/00
Sample Receipt and Internal Control	---	---	---	---	SD-902	3	06/96	05/00	05/00
Sample Disposal	---	---	---	---	SD-903	1	02/99	02/01	02/01
Data Reduction and Validation	---	---	---	---	SD-904	1	02/99	12/00	12/00
Data Report Assembly	NA	NA	NA	NA	SD-905	0	11/96	11/96	Obsolete
Software Quality Assurance	---	---	---	---	SD-906	1	04/99	12/00	12/00
Personal Computer Data Management	NA	NA	NA	NA	SD-907	NA	NA	NA	Obsolete
Proper Labeling and Shipment of Preserved Sample Bottles	---	---	---	---	SD-912	0	02/01	02/01	02/01
Data Back-up, Archival and Restoration	---	---	---	---	SD-913	1	04/99	12/00	12/00
Assembly of Level I and Level II Reports	---	---	---	---	SD-914	0	11/00	11/00	11/00
Assembly of Level III and Level IV Reports	---	---	---	---	SD-915	0	08/01	08/01	08/01
Records of Sample Preparation and Analysis for CLP	NA	NA	NA	NA	SD-908	NA	NA	NA	Obsolete
CLP Data Package Assembly and Review	NA	NA	NA	NA	SD-909	NA	NA	NA	Obsolete
CLP Sample Receipt, Identification and Storage	NA	NA	NA	NA	SD-910	NA	NA	NA	Obsolete
CLP SDG File Preparation and Organization	NA	NA	NA	NA	SD-911		NA	NA	Obsolete

Attachment B.4

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for Analytical Report

ATTACHMENT B.4

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Section C

Safety, Health, and Emergency Response Plan

Safety, Health, and Emergency Response Plan for Long-Term Monitoring and Maintenance Program at 15 Landfills at United States Military Academy West Point, New York

Contract No. DACW41-01-D-0030
Task Order No. 0001

Prepared for

Department of the Army
Kansas City District, Corps of Engineers
601 East 12th Street, 700 Federal Building
Kansas City, Missouri 64106-2896

Prepared by

EA Engineering, P.C. and its Affiliate
EA Engineering, Science, and Technology
3 Washington Center
Newburgh, New York 12550
(845) 565-8100

December 2001
FINAL
61558.01

Safety, Health, and Emergency Response Plan for Long-Term Monitoring and Maintenance Program at 15 Landfills at United States Military Academy West Point, New York

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3 Washington Center
Newburgh, New York 12550

David Santoro

David S. Santoro, P.E., L.S., President EA Engineering, P.C.	12/3/01 Date
Michael S. Battle, P.G., Program Manager EA Engineering, Science, and Technology	12/3/01 Date
Kris H. Hoiem, CIH, Program Safety and Health Officer EA Engineering, Science, and Technology	12/3/01 Date
Charles E. McLeod, Jr., P.E., Project Manager EA Engineering, Science, and Technology	12/3/01 Date

December 2001
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1. INTRODUCTION

On 27 September 2001, the U.S. Army Corps of Engineers (USACE)–Kansas City District, issued Delivery Order No. 0001 under Contract No. DACW-41-01-D-0030 to EA Engineering, P.C. and its affiliate EA Engineering, Science, and Technology. Under this Delivery Order, EA is tasked to conduct the Long-Term Ground-Water Monitoring and Monitoring Well and Landfill Engineering inspections and Maintenance at multiple landfills (Organic Compost Landfill, Post School Landfill, High School Landfill, Camp Buckner Landfill, Ski Lot Landfill, Motor Pool Landfill, Motor Pool East Landfill, Building 706 Parking Lot Landfill, PX Landfill, Michie Stadium Lot A Landfill, Michie Stadium Lot B Landfill, Michie Stadium Lot C Landfill, Michie Stadium Lot D Landfill, Michie Stadium Lot E Landfill, and Michie Stadium Lot F Landfill) at the United States Military Academy (USMA), West Point, New York.

1.1 PURPOSE

The purpose of this SHERP is to provide personnel with protection standards and mandatory safety practices, procedures, and contingencies to be followed while performing field activities at landfill sites at the USMA facility. This SHERP as developed defines actions to be taken in respect to personal safety during work activities associated with the field sampling effort defined in the Long-Term Monitoring Plan. Work activities include well installation, well development, well gauging, ground-water sampling, and engineering inspections of the landfill caps and monitoring. One copy of this SHERP will be maintained for use during the scheduled field sampling effort and made available for site use/employee review at all times. Persons who enter the site are required to read and understand this SHERP and sign the SHERP Review Record (Attachment C.1). This SHERP addresses the following regulations and guidance documents:

- Occupational Safety and Health Administration (OSHA) Standards for General Industry, 29 CFR 1910
- OSHA Standards for Construction Industry, 29 CFR 1926
- National Institute of Occupational Safety and Health, OSHA, U.S. Environmental Protection Agency, and U.S. Coast Guard *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities,* October 1985
- EM-385-1-1 Safety and Health Requirements Manual, USACE.

1.2 BACKGROUND

1.2.1 Site History

The USMA is mostly located in the Town of Highlands, in the southeast corner of Orange County, New York, approximately 45 mi north of New York City. USMA consists of West Point, the range areas outside of West Point, Stewart Army Subpost, and Galeville. The academy is adjacent to the west shore of the Hudson River at the base of several prominent hillsides (Figure 1). Much of the original topography has been altered by construction of buildings and roads.

The USMA was established in 1802 as a training facility for officers in the military service and continues to serve this purpose today. It currently consists of facilities and infrastructure which support the academy's primary training mission. USMA has residents living permanently onsite and additional workers who commute to the academy.

The sites included in the long-term monitoring program consist of 15 former landfills within the academy boundary, including the PX Landfill, Michie Stadium Lot A, Michie Stadium Lot B, Michie Stadium Lot C, Michie Stadium Lot D, Michie Stadium Lot E, Michie Stadium Lot F, Ski Lot Landfill, Post School Landfill, Motor Pool Landfill, Motor Pool East Landfill, High School Landfill, Organic Compost Landfill, Camp Buckner Landfill, and Building 706 Parking Lot Landfill (Figure 1).

Several investigations have been completed at the 15 landfills. Environmental sampling conducted at the landfills to date includes collection of ground-water, surface water, and leachate seep samples for chemical analysis. Results of these previous investigations identified the presence of several constituents of concern at concentrations exceeding applicable regulatory standards that may pose a risk to site workers. A brief summary of the potential constituents of concern that may be encountered during activities associated with this long-term monitoring program are described below:

- **Volatile Organic Compounds**—Phenol and benzene were detected at a concentration in excess of regulatory standards in a ground-water sample collected from the Post School Landfill and the Ski Lot landfill, respectively. All other detections of volatile organic compounds, with the exception of bis(2-ethylhexyl)phthalate, which is a common laboratory contaminant, were below regulatory criteria.

- **Semivolatile Organic Compounds**—No semivolatile organic compounds were detected in excess of regulatory criteria in ground-water, surface water, or leachate seep samples during previous investigations. Polycyclic aromatic hydrocarbons were detected in excess of regulatory criteria in stream sediments at the Motor Pool East Landfill. Elevated concentrations of these analytes are considered to be the result of surface runoff.

- **Pesticides**—Endrin, endosulfan, endosulfan II, heptachlor, 4,4'-dichlorodiphenyldichloroethylene, and/or 2,4,5-T, were detected at concentrations above regulatory criteria in ground-water or leachate samples at the Organic Compost Landfill, Post School Landfill, Ski Lot Landfill, Motor Pool Landfill, Building 706 Landfill, and Michie Stadium Lots A and F Landfills.

- **Polychlorinated Biphenyls**—Two PCBs, Aroclors 1254 and 1260, were detected at concentrations in excess of regulatory criteria in stream sediment samples collected at the Motor Pool East Landfill.

- **Target Analyte List Metals**—Target Analyte List metals were detected in excess of regulatory criteria in ground-water, surface water, and/or leachate seep samples at all of the landfills. The most common exceedances were iron, manganese, and sodium.

A detailed description of each of the landfills and results of previous investigations are included in Section 1 of the Field Sampling Plan.

1.2.2 Long-Term Monitoring Plan Scope

The Long-Term Monitoring Program consists of well gauging and ground-water sampling.

The scope of work covered by this SHERP is presented in the Field Sampling Plan. The scope of this SHERP includes, but is not limited to, safety and health hazards anticipated for field activities including:

- Ground-water well installation/development/sampling

- Engineering site inspections associated with monitoring wells and landfill caps maintenance activities

- Surveying.

1.2.3 Potential Constituents of Concern

The Field Sampling Plan for the USMA 15 Landfills indicates organic and inorganic constituents of concern could be present in site monitoring wells. Previous investigations at the site have confirmed the presence of metals, volatile organic compounds, semivolatile organic compounds, and pesticides. Specific concentrations of constituents of concern were not available at the time this SHERP was prepared (Table 1).

1.3 SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN ORGANIZATION

This SHERP presents the overall approach to safety during execution of the project activities conducted at USMA 15 Landfills. This section presents an introduction and outlines the report organization. Section 2 summarizes the project management team. Section 3 outlines the hazard communications and environmental monitoring during field operations. Section 4 presents the required employee training. Section 5 details personnel protective equipment. Section 6 summarizes emergency response reactions to site contingencies. Section 7 outlines site controls and work zones. Attachment C.1 contains a copy of the SHERP Review Record. Attachment C.2 provides the Site Entry and Exit Log. An Accident/Loss and Incident Report form is provided in Attachment C.3.

2. PROJECT MANAGEMENT

2.1 KEY PERSONNEL

The following table contains information on key project personnel:

Position	Name	Work Phone	Home Phone
Project Manager	Charles McLeod	(845) 565-8100	(845) 226-4365
Project Manager (Alternate)	Douglas McClure	(845) 565-8100	(845) 361-5919
Program Manager	Michael Battle	(845) 565-8100	(845) 223-7952
Program Safety and Health Officer	Kris Hoiem	(410) 771-4950	(410) 357-5485
Project Superintendent	Robert Haras	(845) 565-8100	(845) 564-2612
Project Superintendent (Alternate)	Kim Shutty	(845) 565-8100	(845) 883-5611
Site Safety and Health Officer/ Emergency Coordinator	Robert Haras	(845) 565-8100	(845) 564-2612
Site Safety and Health Officer/ Emergency Coordinator (Alternate)	Kim Shutty	(845) 565-8100	(845) 883-5611

2.2 RESPONSIBILITIES

Clear lines of authority will be established for enforcing compliance with the safety, health, and contingency procedures consistent with industry policies and procedures.

Designated EA personnel are responsible for implementation of the SHERP during field sampling. This includes field supervision; implementing and directing emergency operations; coordinating with onsite and offsite emergency responders; enforcing safe work practices and decontamination procedures (if needed); ensuring proper use of personal protective equipment (PPE); communicating site safety program modifications and requirements to site personnel; proper reporting of injuries, illnesses, and incidents to the appropriate internal and external organizations; and containing and controlling the loss of potentially hazardous materials to soil, air, and surface/ground water during all phases of construction operations.

In the event of an onsite injury, occupational illness, near miss, or environmental contamination incident, the following organizations/individuals will be notified as appropriate:

- Project Superintendent
- Site Safety and Health Officer/Emergency Coordinator
- Project Manager
- Program Safety and Health Officer
- Program Manager
- Corporate Safety and Health Officer
- Other organizations or persons as appropriate as defined by USMA.

2.2.1 Project Manager

The ***Project Manager*** has overall responsibility for site activities and will be the primary contact during work activities.

2.2.2 Program Safety and Health Officer (or Designee)

The ***Program Safety and Health Officer*** has overall project responsibility for the development and implementation of this SHERP and conformance with project requirements.

2.2.3 Site Safety and Health Officer/Emergency Coordinator

The ***Site Safety and Health Officer/Emergency Coordinator*** is responsible for coordination of onsite contingency operations, as well as the Site Safety and Health Program. The Site Safety and Health Officer/Emergency Coordinator will be onsite throughout the project and will be responsible for daily compliance with site safety and health requirements.

During an emergency, the Project Superintendent and Site Safety and Health Officer/Emergency Coordinator will be responsible for initiating and coordinating emergency responses/contingency operations.

The Program Safety and Health Officer, Project Superintendent, and Site Safety and Health Officer/Emergency Coordinator will have the authority to make on-the-spot corrections concerning safety, health, and environmental pollution infractions.

2.2.4 Project Superintendent

The ***Project Superintendent's*** responsibilities include, but are not limited to, providing technical support to the Site Safety and Health Officer/Emergency Coordinator, evaluating onsite environmental monitoring results and report to the Project Manager and Program Safety and Health Officer, initiating evacuation of the work site when needed, communicating with offsite emergency responders, and coordinating activities of onsite and offsite emergency responders.

2.2.5 Employee Responsibilities

Employees are responsible for reading, understanding, and meeting the safety and health requirements contained in this SHERP. A SHERP Review Record sign-off sheet is provided in Attachment C.1. Employees are required to implement these procedures when conducting daily operations. This will also include receiving appropriate training and medical monitoring and utilization of EA provided safety and health equipment (to include all forms of PPE) to safely conduct site operations. This will also include maintaining appropriate grooming standards (removal or proper trimming of beards, mustaches, and sideburns) to ensure the proper fit of respiratory protection. Employees will review each task prior to commencement to consider the potential safety and health hazards, and the measures to be taken in the event of an emergency. Employees should know where material safety data sheets, first aid supplies, and emergency equipment are maintained. The Project Superintendent and Site Safety and Health Officer/Emergency Coordinator should be notified of potential safety and health hazards, near-miss conditions, or incidents present on the job site or unusual effects believed to be related to hazardous chemical exposures. Failure to follow established safety and health procedures could result in immediate dismissal from the site and, if repeated, a potential loss of employment.

2.2.6 Subcontractors

Responsibilities of subcontractor personnel include: following the SHERP and applicable safety and health rules, regulations, and procedures; using required controls, procedures, and safety devices, including PPE; notifying his/her supervisor of identified or suspected emergencies, safety, or health hazards; and complying with training and medical requirements. Subcontractor personnel are responsible for reading, understanding, and meeting the safety and health requirements contained in this SHERP. A SHERP Review Record sign-off sheet is provided in Attachment C.1.

3. HAZARD COMMUNICATION AND ENVIRONMENTAL MONITORING DURING FIELD OPERATIONS

3.1 HAZARD COMMUNICATION

The Site Safety and Health Officer/Emergency Coordinator will keep onsite a material safety data sheet for each chemical brought onsite during field activities. Subcontractors must inform the Project Superintendent and Site Safety and Health Officer/Emergency Coordinator of hazardous substances brought onsite and provide appropriate material safety data sheets to the Project Superintendent and Site Safety and Health Officer/Emergency Coordinator. Chemicals brought onsite must be labeled in accordance with OSHA Hazard Communication Requirements, 29 CFR 1926.59.

3.2 CHEMICAL HAZARDS

3.2.1 Area of Concern Chemical Hazards

Assumptions regarding potential chemical constituents were made by reviewing information from past investigation activities conducted at the USMA 15 landfills. Materials identified suggest that the primary potential constituents of concern were metals. Table 1 provides a list of potential site chemical hazards and symptoms of overexposure.

3.2.2 Chemicals for Equipment Calibrations and Operations

The following chemicals are typically supplied by the primary field program team:

- Alconox®
- Isopropyl alcohol
- Hydrochloric acid sample preservative
- pH calibration standard solution
- Conductivity calibration standard solution
- Isobutylene calibration gas
- Methane calibration gas.

The following chemicals are typically supplied by the driller:

- Portland cement
- No. 2 silica sand
- Sodium bentonite.

These chemicals will be used for equipment calibrations/operations and well construction. Alconox® and isopropyl alcohol are typically used for cleaning and decontamination. The quantities to be used will not exceed 1-oz quantities, and will be used under contained calibrated environments. The decontamination wastewater will be containerized as part of the investigation-derived waste. Portland cement, No. 2 silica sand, and sodium bentonite are typically used for well construction. Chemicals used during the field activities will be properly contained and labeled. Occupational exposures will be negligible.

3.3 PHYSICAL AND BIOLOGICAL HAZARDS

Physical hazards can potentially be present during field activities. These physical hazards may include, but not be limited to:

- Fire/explosion
- Heat/cold stress
- Heavy equipment
- Noise
- Electrical
- Utilities
- Weather
- Biological.

The USMA 15 landfill facilities will be visually inspected for the presence of general safety hazards (e.g., trip/slip hazards, unstable surfaces or steep grades, vehicle and pedestrian traffic, sharp objects) prior to beginning work. If hazards are present, these hazards will be recorded and precautionary measures taken to prevent injury.

3.3.1 Fire/Explosion

The potential for fire and/or explosion emergencies is present. Workers must continuously monitor the work area for combustible or explosive gases when operations have the potential to generate sparks. Employees should always be alert for unexpected events, such as ignition of chemicals or sudden release of materials under pressure, and be prepared to act in these emergencies.

Field vehicles will be equipped with a fire extinguisher. Employees must be trained in the proper use of fire suppression equipment. However, professionals should handle large fires that cannot be controlled with a fire extinguisher. The proper authorities (West Point Fire Department) should be notified in these instances.

3.3.2 Heat Stress and Heat-Related Illness

Effects of heat stress and illness are possible during the performance of field activities at the USMA 15 landfill facilities. Injury from heat exposure may occur to persons working outdoors during a period of high temperature conditions. This is a major concern when personnel are working in PPE clothing. The body's principal means of cooling is through the evaporation of sweat. When personnel are working in PPE, sweat is trapped inside the clothing and cannot evaporate, thus raising the body's core temperature and resulting in a heat-related illness. Monitoring will commence at temperatures of 70°F and above when employees are wearing impervious full-body clothing.

Personnel should be familiar with the signs and symptoms of heat stress. These include:

- **Heat Cramps**—Painful contraction of voluntary muscles.
- **Heat Exhaustion**—Dizziness, lightheadedness, slurred speech, rapid pulse, confusion, fainting, fatigue, copious perspiration, cool skin that is sometimes pale and clammy, and nausea.
- **Heat Stroke**—Hot, dry, flushed skin; delirium; and coma (in some cases).

Resting frequently in a shaded area and consuming large quantities of fresh, potable water and electrolyte replenishing fluids (i.e., Gatorade) can prevent heat stress. If heat exhaustion symptoms are observed, the person will be required to rest in a shaded area and consume liquids. If symptoms are widespread or observed frequently, an appropriate work/rest regimen will be instituted. This may involve limiting the work period so that after 1 minute of rest, a person's heart rate does not exceed 110 beats per minute.

If the heart rate is higher than 110 beats per minute, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the heart rate is 110 beats per minute at the beginning of the next rest period, then the next cycle should be shortened by another 33 percent. Resting heart rate should be determined prior to starting onsite activities.

A healthy individual's resting heart rate is usually 60-72 beats per minute. If symptoms of heat stroke are observed, the victim will be cooled immediately and transported to the nearest hospital. Workers should not hesitate to seek medical attention if heat stroke is suspected.

3.3.3 Effects of Cold Exposure

Effects of cold exposure are possible during the performance of field activities at the USMA 15 landfill facilities; however, the work specified in the Long-Term Monitoring Plan is primarily expected to be performed during periods when inclement weather is less frequent.

Cold stress can be caused by exposure to temperatures at or below freezing or to excessive wind at higher temperatures. When an individual's body temperature falls below 98.6°F, cold stress injuries may occur. The body's cells are composed primarily of water that can freeze when exposed to low temperatures, resulting in cell damage or death. Primary effects of cold exposure include frostnip, frostbite, and hypothermia:

- **Frostnip** commonly occurs as a result of surface tissue freezing at the tips of the ears, nose, cheeks, chin, fingertips, and toes. Symptoms of frostnip include the appearance of white shiny skin. If frostnip occurs, gradually warm the affected areas with a warm hand or warm breath. Do not rub.

- **Frostbite** occurs as the result of surface and subsurface tissues freezing. Symptoms include erythema, blistering, throbbing pain, numbness, and swelling. If frostbite is suspected, move to a warm location and provide slow and steady re-warming.

- **Hypothermia** is the result of prolonged exposure to cold temperatures and body heat loss. Symptoms of hypothermia include body shivers, slow reaction time, mental confusion, glassy eyes, low body temperature, low pulse rate, and difficult respiration. Death can occur within 2 hours if not treated. If hypothermia is suspected, move to a warm location, remove wet and/or cold clothing, and provide re-warming as rapidly as possible. Provide both external heat (fire, electric blanket, body heat) and internal heat (hot liquids for conscious victims). Seek medical attention immediately.

In order to avoid potential cold stress, field personnel should take precautions against the cold and maintain body temperatures. This is most easily done by wearing the proper protective clothing, including insulated head and ear covering, gloves, insulated socks and/or boots, and insulated clothing in layers. If the potential exists for clothing to become wet, then the outer layer of clothing should be water repellent. Clothing that becomes wet with either water or sweat should be replaced immediately. In addition, the work area can be protected by the placement of vehicles or tarps to reduce wind chill.

3.3.4 Heavy Equipment

The use of heavy equipment (e.g., drill rigs, generators, compressors, etc.) may pose safety hazards to site workers. Only trained, experienced personnel will conduct heavy equipment work. If possible, personnel must remain outside the turning radius of large, moving equipment. At a minimum, personnel must maintain visual contact with the equipment operator. No guards, safety appliances, or other devices may be removed or made ineffective unless repairs or maintenance are required, and then only after power has been shut off and locked out. Safety devices must be replaced once repair or maintenance is complete. Exhaust from equipment must be directed so that it does not endanger workers or obstruct the view of the operator. When not operational, equipment must be set and locked so that it cannot be activated, released, dropped, etc.

3.3.5 Noise

Work around large equipment often creates excessive noise. Noise can cause workers to be startled, annoyed, or distracted; can cause physical damage to the ear, pain, and temporary and/or permanent hearing loss; and can interfere with communication. If workers are subjected to noise exceeding an 8-hour time-weighted average sound level of 85 dBA (decibels on the A-weighted scale), hearing protection will be selected with an appropriate noise reduction rating to comply with 29 CFR 1910.95 and to reduce noise levels to or below the permissible values. Therefore, during the field activities where workers are using heavy equipment, such as drill rigs and backhoes, etc., hearing protection must be utilized.

3.3.6 Electrical

Overhead power lines, electrical wiring, electrical equipment, and buried cables pose risks to workers of electric shock, burns, muscle twitches, heart fibrillation, and other physical injuries, as well as fire and explosion hazards. Workers will take appropriate protective measures when working near live electrical parts, including inspection of the work area, to identify potential spark sources, maintenance of a safe distance, proper illumination of the work areas, provision of barriers to prevent inadvertent contact, and use of nonconductive equipment. If overhead lines cannot be de-energized prior to the start of work, a 10-ft distance must be maintained between overhead energized power lines with a voltage of 50 kV and elevated equipment parts. This distance will be increased 4 in. for every 10 kV greater than 50 kV. For example, workers must maintain a distance of 11.7 ft from energized power lines with a voltage of 100 kV.

3.3.7 Utilities

Underground utilities pose hazards to workers involved in drilling and other invasive operations. These hazards include electrical hazards, explosion, and asphyxiation, as well as costly and annoying hazards associated with damaging communication, sewer, and water lines. Prior to commencement of invasive operations, Underground Facilities Protection Organization will be contacted to inspect and flag the area of investigation. The Underground Facilities Protection Organization's telephone number in New York is 1-800-962-7962 and requires 2 days' notice prior to digging on the site.

Personnel should be aware that although an area may be cleared, it does not mean that unanticipated hazards will not appear. Workers should always be alert for unanticipated events such as snapping cables, drilling into unmarked underground utilities, and drilling into a heavily contaminated zone, etc. Such occurrences should prompt involved individuals to halt work immediately and take appropriate corrective measures to gain control of the situation.

3.3.8 Weather

Weather conditions should always be taken into consideration. Heavy rains or snowfall, electrical storms, high winds, and extreme temperatures, for example, may create extremely dangerous situations for employees. Equipment performance may also be impaired because of inclement weather. Whenever unfavorable conditions arise, the Site Safety and Health Officer/Emergency Coordinator will evaluate both the safety hazards and ability of the employees to effectively perform given tasks under such conditions. Activities will be halted at their discretion.

Wind direction should be accounted for when positioning equipment at sampling locations. If exposure to organic vapors is anticipated, workers should locate upwind of sampling points. Wind direction often changes abruptly and without warning, so personnel should always be prepared to reposition, if necessary.

3.3.9 Biological

Although the site is not located in an area indigenous to many types of biological hazards, a discussion of the biological hazards potentially occurring is warranted. Any grassy area at the site may be territory for deer ticks or other insects, which may carry Lyme disease. Precautions that will be taken to reduce these hazards are clearing high vegetation within the work zones, minimizing movement through uncleared areas, wearing long pants while onsite, applying insect repellant to clothing, and checking employees' clothing and bodies for ticks periodically.

Due to the location of the site, the known animal species that may potentially be encountered include squirrels, skunks, rats, deer, mice, raccoon, opossum, fox, and chipmunks. These animals are typically afraid of human beings and will stay away from workers. However, any animal that acts aggressively should be considered dangerous due to the possibility of rabies or potential infections from bites or punctures.

Poisonous plants (poison ivy, poison oak, poison sumac, etc.) may potentially be encountered at USMA. Precautions should be taken to minimize exposure to plants by clearing vegetation, when necessary, within the work zone and wearing longsleeve shirts, pants, and gloves.

3.3.9.1 Bloodborne Pathogens

During the site operations, EA employees may be exposed to blood and body secretions in support of emergency response operations where site personnel have been injured, and require first aid and/or cardiopulmonary resuscitation (CPR). Due to the potential that blood and body secretions may contain disease-causing organisms such as the Hepatitis B Virus, and Human Immunodeficiency Virus, employees electing to provide first aid and CPR support (until the arrival of a competent onsite medical responder) should take appropriate measures to reduce or eliminate their potential for contact and exposure. The concept of "Universal Precautions" will be followed, assuming a potential hazard is present. Employees providing first aid support should wear the appropriate PPE to prevent or reduce their potential for contact and exposure.

This will typically be accomplished through the use of nitrile gloves, splash-proof eye protection, and the use of mouth-to-mouth guards and proper cleanup (good sanitation and hygiene) following the incident. The hands and face should be thoroughly washed with water and antiseptic soap or cleanser following an incident, or antiseptic containing disposable towelettes used in the absence of appropriate field washing facilities. The Program Safety and Health Officer should be notified of potential employee exposure to blood and body fluids while conducting work in support of this project.

3.4 SAFE WORK PRACTICES

3.4.1 Site-Specific Work Practices

Safe work practices that must be followed by site workers, include:

- Eat, drink, and smoke only in those areas designated by the Site Safety and Health Officer/Emergency Coordinator. These activities will not take place within work zones.
- In the event the potential for chemical contamination exists onsite, employees will wash and conduct appropriate decontamination activities.
- Defective PPE must be repaired or replaced immediately.
- Each employee required to take prescription drugs will notify the Project Superintendent and/or Site Safety and Health Officer/Emergency Coordinator prior to the start of work. Controlled or unauthorized drugs will **not** be permitted onsite at any time.

3.5 ENVIRONMENTAL MONITORING

For the intrusive work (e.g., drilling) and well sampling conducted onsite, the environmental monitoring for toxic, flammable/combustible gases, and oxygen will be performed as needed using a combustible gas indicator and a flame ionization detector or photoionization detector. Employees who have been trained in the proper operation, use limitations, and calibration of the monitoring equipment will only use instruments. Monitoring will be conducted at intervals not greater than once every 30 minutes using either the photoionization or flame ionization detector and the combustible gas indicator. Instrument calibration and measurements taken will be logged in the field notebook.

Environmental monitoring will include sufficient monitoring of air quality in work zones during intrusive field operations to assess levels of employee exposure and to verify that the level of PPE being worn by personnel is adequate. Monitoring will be conducted to ensure that contaminants are not migrating offsite to minimize the exposure to nearby populations and/or workers (Table 3).

3.5.1 Calibration and Maintenance

Direct-reading instruments will be calibrated prior to use on a daily basis with a known concentration of calibration gas (typically isobutylene or methane, depending on the instrument) following the instrument manufacturer's guidance. Instructions in the manufacturer's operations manual regarding storage, cleaning, and maintenance of the instruments will be followed. Calibration will be properly recorded in the field logbook to show the date, calibration material type and concentration, and the actual reading obtained. Equipment failing to meet the manufacturer's standards for accuracy and repeatability will be considered suspect and replaced with an alternate, properly functioning piece of equipment.

4. EMPLOYEE TRAINING

4.1 SITE WORKERS

Personnel who will be performing construction-related non-hazardous onsite tasks are not required to have been trained according to U.S. Department of Labor OSHA Standard, 29 CFR 1926.65, *Hazardous Waste Operations and Emergency Response*. These workers will have equivalent safety and health training based upon their specific job tasks and activities.

The Site Safety and Health Officer/Emergency Coordinator and personnel conducting the field sampling and monitoring for site gases and vapors during intrusive operations (e.g., drilling) will be trained as required to meet the U.S. Department of Labor OSHA Standard, 29 CFR 1926.65, *Hazardous Waste Operations and Emergency Response*, to qualify as hazardous waste site workers and supervisor. Training will include:

- A minimum of 40 hours of initial offsite instruction
- A minimum of 3 days of actual field experience under the direct supervision of a trained, experienced supervisor
- An 8-hour "refresher" training period annually
- Additional training that addresses unique or special hazards/operational requirements
- First aid and cardiopulmonary resuscitation.

Onsite management and supervisors who are directly responsible for or who supervise employees will receive at least 8 additional hours of specialized management training. Copies of training certificates and dates of attendance will be available through the Site Safety and Health Officer/Emergency Coordinator upon request.

4.1.1 Subcontractor Training

Prior to start of work operations, the Project Manager will obtain a written list of subcontractor personnel to be onsite and written certification from subcontractor management that these workers meet the training requirements for their assigned tasks.

4.1.2 Pre-Entry Orientation Session

Prior to entering the site, personnel will attend a pre-entry orientation session presented by the Site Safety and Health Officer/Emergency Coordinator. Personnel will verify attendance of this meeting by signing the SHERP Review Record provided in Attachment C.1. Visitors entering designated work areas will be subject to applicable safety and health regulations during field operations at the site. The Project Superintendent and/or Site Safety and Health Officer/Emergency Coordinator is responsible for briefing the personnel onsite of potential hazards that may be encountered on the site, the presence and location of the site SHERP, and emergency response procedures. Visitors will be under the direct supervision of the Project Superintendent and/or Site Safety and Health Officer/Emergency Coordinator or his/her representative.

At a minimum, the pre-entry orientation session will discuss the contents of this SHERP, potential health effects of hazards associated with onsite activities, and the potential hazards presented by unearthing unidentified hazardous materials. Personnel will be instructed in the emergency procedures to include onsite communications and implementation of the site-specific contingency plans.

4.2 MEDICAL SURVEILLANCE

Non-hazardous waste site workers will be medically examined to meet OSHA requirements specific to their job. Hazardous waste site workers must have satisfactorily completed a comprehensive medical examination by a licensed physician within 12 months (or 24 months pending physician's approval) prior to the start of site operations. Subcontractors will provide this information in writing to the Project Manager for their workers prior to mobilization onsite. This information will be posted onsite in the project field office. A licensed physician who is certified in Occupational Medicine by the American Board of Preventative Medicine will review medical surveillance protocol and examination results. Medical surveillance protocols will comply with 29 CFR 1926.65. The content of medical examinations will be determined by the attending physician and will be based upon the guidelines in the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*. Medical examinations and consultations will be provided for employees covered by this program on the following schedule:

- Prior to field work assignment
- At least annually for employees covered by the program (or biennial with the approval of the occupational physician)
- At termination of employment or reassignment to an area where the employee would not be covered if the employee has not been examined within the past 6 months
- As soon as possible upon the development of signs or symptoms that may indicate an overexposure to hazardous substances or other health hazards, or that an unprotected person has been exposed in an emergency situation
- More frequently if the physician deems such examination necessary to maintain employee health.

An accurate record of the medical surveillance will be maintained for each employee for a period of no less than 30 years after the termination of employment. Records will be managed and maintained per recordkeeping provisions of EA's Safety and Health Program Manual (SHP-001). Records must include at least the following information about the employee:

- Name and social security number
- Physician's written opinions, recommendations, limitations, and test results
- Employee medical complaints related to hazardous waste operations
- Information provided to the physician by the employee concerning possible exposures, accidents, etc.

4.3 HAZARD COMMUNICATION PROGRAM

4.3.1 Hazard Communication

The Site Safety and Health Officer/Emergency Coordinator will conduct regularly scheduled safety meetings with site workers to discuss the planned activities, since these activities and workers may change over the duration of the project. The objective of instituting a Hazard Communication Program is to ensure that hazards associated with the site and with chemicals brought onsite by EA or subcontractors are evaluated, and that information concerning these hazards is transmitted to site employees. Site personnel include EA and subcontractor employees, manufacturer's representatives, or local agency employees, and other workers who observe or perform services onsite. Employee awareness of chemical identities, health and physical hazards, properties, and characteristics is essential to safely handle chemicals and to minimize potential hazards. The Hazard Communication Program must follow OSHA requirements listed in 29 CFR 1926.59.

4.3.2 Hazard Communication Labeling

The Site Safety and Health Officer/Emergency Coordinator will ensure that containers are properly labeled and that workers know the contents of containers. Container labels will contain, at a minimum, information on name of product on container, chemical(s) in product, manufacturer's name and address, protective equipment required for the safe handling of the product, and first aid procedures in case of overexposure to product contents.

4.3.3 Material Safety Data Sheets

The Site Safety and Health Officer/Emergency Coordinator will maintain a current alphabetical file of complete material safety data sheets for each hazardous substance stored or used at the work site. The file must be easily accessible to employees. Subcontractors and visitors to the work place will be informed of the existence and location of this file. Workers and visitors will be instructed on how to read and understand the information shown on the material safety data sheets. Subcontractors must inform the Site Safety and Health Officer/Emergency Coordinator about hazardous substances that they bring onsite and provide material safety data sheets.

4.3.4 Hazard Communication Training

Site workers and visitors will be informed of the Hazard Communication Program, their legal rights under the program, the location of the chemical inventory, and the location of the material safety data sheets file. Prior to site work or potential exposure to hazardous substances, the Site Safety and Health Officer/Emergency Coordinator will describe hazardous substances routinely used and provide information about:

- Nature of potential chemical hazards
- Appropriate work practices
- Appropriate control programs
- Appropriate protective measures
- Methods to detect presence or release of hazardous substances
- Emergency procedures.

5. PERSONAL PROTECTIVE EQUIPMENT

5.1 PERSONAL PROTECTIVE EQUIPMENT REQUIREMENTS

Based upon currently available information, the site is considered non-hazardous and will require Level D protection for anticipated conditions and activities. In the event that potential chemical hazards are identified, the level of protection may be upgraded appropriately to the potential hazard conditions. Only those personnel identified and qualified for hazardous waste work as defined in 29 CFR 1926.65 will be allowed to upgrade beyond Level D or provide support of hazardous material/substance contingency operations. Only the Site Safety and Health Officer/Emergency Coordinator, in conjunction with the Program Safety and Health Officer, will be allowed to approve PPE upgrade beyond Level D and site re-entry for the purpose of hazardous conditions assessment.

The following is a list of the Level D PPE components for the minimum level of protection authorized for use during this project.

- Coveralls or appropriate work clothes
- Steel-toe, steel-shank safety boots/shoes
- Hard hats (if overhead hazards are present)
- Chemical resistant gloves (neoprene or nitrile) as appropriate to prevent contact during sample collection activities
- Leather work gloves (as needed)
- Safety glasses with side shields and face shield (as needed) or impact-resistant chemical goggles; safety glasses, goggles, and face shields will meet American National Standards Institute requirements for impact resistance and safety
- Hearing protectors (as needed)
- Flotation devices (as needed when working near lakes or rivers).

The following is a list of the Level C PPE components for the maximum levels of protection authorized for use during this project:

- Full facepiece, air purifying respirator equipped with combination organic vapor and high efficiency particulate cartridges

- Poly-coated Tyvek coveralls
- Steel-toe, steel-shank safety boots/shoes
- Chemical-resistant boot covers
- Hard hat
- Hearing protectors
- Chemical resistant gloves (neoprene or nitrile) as appropriate to prevent contact during sample collection activities.

6. EMERGENCY RESPONSE AND REACTION TO SITE CONTINGENCIES

6.1 EMERGENCY RECOGNITION

Prior to work startup, personnel must be familiar with emergency condition identification, notification, and response procedures. The emergency telephone numbers for local emergency response and reporting organizations and directions to the nearest hospital are provided in Table 2. Figure 2 shows maps with directions from each landfill to the hospital. The Project Superintendent, along with the Site Safety and Health Officer/Emergency Coordinator, will rehearse/review emergency procedures and/or applicable site contingencies initially during site orientation and as part of the ongoing site safety program with EA and subcontractor personnel. Offsite emergency personnel will ultimately handle onsite emergencies. Initial response and first aid treatment, however, will be provided onsite.

Person(s) identifying an accident, injury, emergency condition, or a scenario requiring implementation of a response in support of this SHERP will immediately take actions to report the situation to the Project Superintendent and Site Safety and Health Officer/Emergency Coordinator. Notification may take place by runner, hand-held radio, or telephone. The Project Superintendent and Site Safety and Health Officer/Emergency Coordinator will initiate the required response based upon the type of incident, following the procedures contained in this SHERP. Chain-of-command and sign-in sheets for personnel on the site will be established at the beginning of each work day to ensure personnel are accounted for and who will take control should the Project Superintendent and/or Site Safety and Health Officer/Emergency Coordinator become injured. The following items constitute those site conditions requiring an emergency response or contingency action in accordance with this SHERP:

- Fire/explosion
- Heavy equipment accident
- Natural disaster
- Medical emergency
- Discovery of unanticipated hazards (e.g., unmarked utility lines, heavily contaminated material).

Follow-on operations to evaluate and control the source of fire, explosion, and hazardous material incidents will occur only after discussion with the Project Manager, Project Superintendent, and/or Site Safety and Health Officer/Emergency Coordinator. The Project Superintendent and/or Site Safety and Health Officer/Emergency Coordinator will act as the emergency coordinator at the site to coordinate onsite activities and contingencies with outside response organizations. If the Project Superintendent is unable to act as the Emergency Coordinator, then the authority to take action will be transferred to the Site Safety and Health Officer/Emergency Coordinator, or other designee, as indicated in the daily updated chain-of-command.

6.2 PRE-EMERGENCY PLANNING

The Site Safety and Health Officer/Emergency Coordinator will contact the applicable local emergency response organizations contained in Table 2 prior to work start to identify the emergency response requirements and commitments required to support this project. The Project Manager, or designee, will contact those local authorities potentially required to respond in the event of an onsite emergency incident or contingency. This notification will inform each applicable agency of the starting date, anticipated scope of work, and existence of the SHERP. A copy of the SHERP will be made available to each emergency response agency upon request to the Project Manager. Emergency activities will be coordinated (as applicable) with the local emergency planning committee, as required in accordance with Superfund Amendments and Reauthorization Act Title III requirements.

6.3 OPERATIONS SHUTDOWN

The USMA facility Site Safety and Health Officer/Emergency Coordinator or the Project Manager may mandate operations shutdown. Conditions warranting work stoppage will include (but are not limited to):

- Uncontrolled fire
- Explosion
- Uncovering potentially dangerous buried hazardous materials
- Conditions immediately dangerous to life and health or the environment
- Potential for electrical storms
- Treacherous weather-related conditions
- Limited visibility
- Air contaminant concentrations in excess of the action levels contained in Table 3
- Upgrading of site security threat conditions.

6.4 PROCEDURES FOR HANDLING EMERGENCY INCIDENTS

In the event of an emergency, the information available at that time must be properly evaluated and the appropriate steps taken to implement the emergency response plan. The Site Safety and Health Officer/Emergency Coordinator will assume command of the situation. He/she will alert the emergency management system per Table 2, and evacuate personnel to the pre-designated evacuation location. The Site Safety and Health Officer/Emergency Coordinator will make required notifications to include, but not be limited to, the EA Project Manager, EA Program Safety and Health Officer, and USMA Point-of-Contact as defined in this SHERP and Table 2, and the appropriate federal and state agencies.

Site personnel will have the capability of notifying emergency responders directly from the site using the phone in the company vehicle or in the site support office.

The Project Manager will complete and submit to a USMA-appointed representative an Accident/Loss and Incident Report, within 24 hours, using the format contained in Attachment C.3. The following information will be provided when reporting an emergency:

- Name and location of person reporting
- Location of accident/incident
- Name and affiliation of injured party
- Description of injuries, fire, spill, or explosion
- Status of medical aid and/or other emergency control efforts
- Details of chemicals involved
- Summary of accident, including suspected cause and time it occurred
- Temporary control measures taken to minimize further risk.

This information is not to be released under any circumstances to parties other than those listed in this section and emergency response team members. Once emergency response agencies have been notified, the Project Manager and USMA Point-of-Contact will be immediately notified.

6.5 MEDICAL EMERGENCIES

Personnel should always be alert for signs and symptoms of illnesses related to chemical, physical, and onsite health hazards. Severe injuries resulting from accidents must be recognized as emergencies and treated as such. At least one person currently trained in first aid/ cardiopulmonary resuscitation must be present onsite. This will normally be the Site Safety and Health Officer/Emergency Coordinator.

In a medical emergency, the Site Safety and Health Officer/Emergency Coordinator must sound the emergency alarm, upon which work must stop and personnel must move to the predesignated evacuation location. **If the emergency situation cannot be conveyed by word of mouth, a whistle or other horn will be sounded. Three short blasts, separated by a 2-second silence, will be used as the emergency signal.** Personnel currently trained in first aid will evaluate the nature of the injury, decontaminate the victim (if necessary), and initiate first aid assistance immediately and transport if appropriate. First aid will be administered only to limit further injury and stabilize the victim. The local Emergency Medical Services must be notified immediately if needed. The route to the nearest hospital is shown on Figure 2 for each landfill. This figure also provides a large-scale view and the distance from the hospital to the USMA facility.

Although not anticipated, victims who are heavily contaminated with toxic or dangerous materials must be decontaminated before being transported from the site. Since no hazardous materials are anticipated, a formal decontamination station will not be available, however, there is an emergency eyewash station in each of the EA vehicles. Decontamination will consist of removal of contaminated coveralls/clothing, and wrapping the victim in a sheet or other clothlike material. No persons will re-enter the site of injury/illness until the cause of the injury or symptoms has been determined and controlled. At no time will personnel transport victims to emergency medical facilities unless the injury does not pose an immediate threat to life and transport to the emergency medical facility can be accomplished without the risk of further injury. Emergency Medical Services will be used to transport serious injuries offsite unless deemed otherwise by the Site Safety and Health Officer/Emergency Coordinator.

The Site Safety and Health Officer/Emergency Coordinator must complete an Accident/Loss and Incident Report (Attachment C.3) and submit it to the Project Manager within 24 hours of the following types of incidents:

- Job-related injuries and illnesses
- Accidents resulting in loss or damage to property
- Accidents involving vehicles and/or vessels, whether or not they result in damage to property or personnel
- Accidents in which there may have been no injury or property damage, but which have a high probability of recurring with at least a moderate risk to personnel or property
- Near-miss incidents that could have resulted in any of the conditions defined above.

An accident that results in a fatality or the hospitalization of three or more employees must be reported within 8 hours to the U.S. Department of Labor through the Project Manager. Subcontractors are responsible for their reporting to the U.S. Department of Labor.

In order to support onsite medical emergencies, first aid/emergency medical equipment will be available at the following locations:

• First-aid kit	Company vehicle
• Eyewash	Company vehicle
• Emergency alarm	Horn on the company vehicle
• Copy of the SHERP	Company vehicle
• Telephone	Company vehicle.

The eyewash kit must be portable and capable of supplying at least a 15-minute supply of potable water to the eyes.

6.6 FIRE/EXPLOSION EMERGENCIES

Fire and explosion must be immediately recognized as an emergency. The Site Safety and Health Officer/Emergency Coordinator must sound an emergency signal, and personnel must be decontaminated (if necessary) and evacuated to the pre-designated evacuation location. Only persons properly trained in fire suppression and other emergency response procedures will support control activities. Control activities will consist of the use of onsite portable fire extinguishers for limited fire suppression and employee evacuation. Upon sounding the emergency alarm, personnel will evacuate the hazard location and assemble at the designated site meeting area. Only the Site Safety and Health Officer/Emergency Coordinator, or those site personnel trained in the use of portable fire extinguishers, will attempt to suppress a site fire. Small, multi-purpose dry chemical extinguishers will be maintained in each EA vehicle onsite. Fires not able to be extinguished using onsite extinguishers will require the support of the local Fire Department. The Site Safety and Health Officer/Emergency Coordinator should take measures to reduce injury and illness by evacuating personnel from the hazard location as quickly as possible. The Site Safety and Health Officer/Emergency Coordinator must then notify the local Fire Department. The Site Safety and Health Officer/Emergency Coordinator will determine proper followup actions. Site personnel will not resume work during or after a fire/explosion incident until the Site Safety and Health Officer/Emergency Coordinator has directed that the incident is over and work may resume. During the incident, site personnel will remain outside the incident area and obey the instructions of the Site Safety and Health Officer/Emergency Coordinator.

6.7 EMERGENCY TELEPHONE NUMBERS

Communications will be by telephones located in the EA vehicle onsite and the field personnel will have access to this telephone to directly contact offsite emergency response organizations. Refer to Table 2 for a listing of emergency telephone numbers.

6.8 CONTROL OF SITE PRODUCED AMBIENT NOISE LEVELS

In order to maintain ambient noise levels within acceptable standards, site activities will take place between 0700 and 1900 hours each workday. Equipment used onsite containing internal combustion engines will be required to have mufflers attenuating sound output 80 dBA at a distance of 50 ft from the operating equipment. Complaints by local inhabitants received by the Site Safety and Health Officer/Emergency Coordinator will prompt sound level monitoring operations to ensure compliance with the standard.

7. SITE CONTROL AND WORK ZONES

7.1 WORK ZONES

The following work zones will be established during implementation of the USMA facility Long-Term Monitoring Program as a means of site control. Work zones will be established in accordance with the following:

- **Exclusion Zone (EZ)**—This area has either known or potential contamination and has the highest potential for exposure to chemicals onsite. The EZ will be delineated with stakes and hazard tape. The outer boundary of the EZ is called the hotline. The hotline separates the area of known or potential contamination from the rest of the site. The hotline should initially be established by visually surveying the site for signs of contamination, providing sufficient space to protect personnel outside the zone, allowing an adequate area in which to conduct site operations, and for reducing the potential for contaminant migration.

  The hotline will be physically secured or clearly marked. During subsequent site operations, the boundary may be adjusted as more information becomes available.

  Persons who enter the EZ must wear the appropriate level of PPE for the degree and types of hazards present at the site. If the EZ is subdivided, different levels of PPE may be appropriate. Each sub-area of the EZ should be clearly marked to identify hazards and required level of PPE.

- **Contamination Reduction Zone (CRZ)**—One access point to the EZ designated by the Site Safety and Health Officer/Emergency Coordinator.

  The purpose of the CRZ is to reduce the possibility that the Support Zone (SZ) will become contaminated or affected by the site hazards. Because of both distance and decontamination procedures, the degree of contamination in the CRZ generally will decrease as one moves from the hotline to the SZ.

  The CRZ will be established outside the areas of known or potential contamination. Contamination Reduction Corridors, which are access control points between the EZ and CRZ, should be established for both personnel and heavy equipment. These corridors should consist of an appropriate number of decontamination stations necessary to address the contaminants of the particular site (see National Institute of Occupational Safety and Health/OSHA/U.S. Coast Guard/U.S. Environmental Protection Agency *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October 1985 for information on decontamination procedures and work zones).

- **Support Zone**—Uncontaminated area and may include site vehicles.

  The SZ is the uncontaminated area where workers are unlikely to be exposed to hazardous substances or dangerous conditions. The SZ is the appropriate location for the command post, equipment and supply center, field laboratory, and other administrative or support functions that are necessary to keep site operations running efficiently.

  Potentially contaminated clothing, equipment, and samples must remain outside the SZ until decontaminated. However, personnel located in the SZ must receive instruction in proper evacuation procedures in case of a hazardous substance emergency. The SZ should be upwind and as far from the EZ as practicable.

The level of PPE will depend upon the type of work performed and site monitoring data. Level D will be the minimum protection in the EZ. The CRZ will require a minimum Level D.

No specific PPE requirements are needed in the SZ, as contaminated materials are prohibited from being stored in this area.

Only authorized personnel will be permitted in the EZ and CRZ. Entering these zones will require donning the required PPE prior to entry. These zones will be established prior to beginning the field activities.

Exiting the EZ will require going through decontamination in the CRZ.

Safe work practices to be followed by site workers include:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in the EZ and CRZ.
- Hands and face must be thoroughly washed upon leaving the work area.
- Personnel must not take prescription drugs unless specifically approved by a licensed physician who is familiar with the issues of worker exposure to hazardous materials.
- When respirators are required, facial hair that interferes with the face-to-facepiece fit of the respirator will not be permitted.
- Work is allowed during daylight hours only.
- If dust is being visually generated in the EZ, the Site Safety and Health Officer/ Emergency Coordinator will advise on procedures for misting or wetting the soil to prevent possible exposure from inhalation of soil contaminants.

- Possessing, using, purchasing, distributing, selling, or having controlled substances in your system during the workday, including meal or break periods onsite, is strictly prohibited.

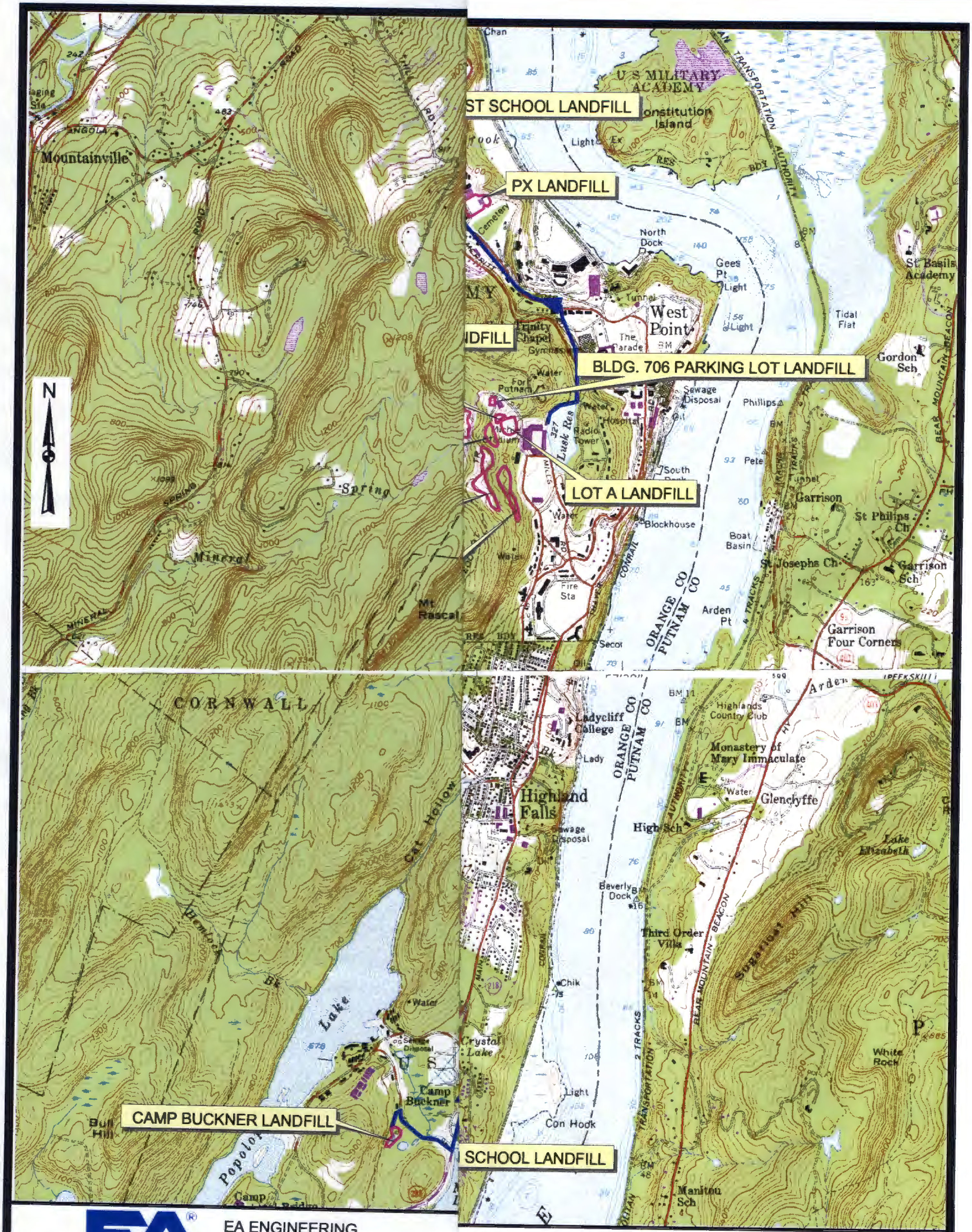
- The use or possession of alcoholic beverages onsite is prohibited. Similarly, reporting to work or performing one's job assignments with excessive levels of alcohol in one's system will not be permitted.

Figures

EA ENGINEERING, SCIENCE, AND TECHNOLOGY

FIGURE 1
LANDFILL LOCATIONS MAP

PROJECT MGR	DESIGNED	PROJECT No	FILE No
CEM		61558.01	I:\WESTPOINT\MAP.APR



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

FIGURE 2
ROUTE TO HOSPITAL MAP

PROJECT MGR	DESIGNED BY	PROJECT No	FILE No
CEM	BT	61558.01	I:\WESTPOINT\MAP.APR

Tables

TABLE 1 POTENTIAL SITE CHEMICAL HAZARDS AND SYMPTOMS OF OVEREXPOSURE

Compound	PEL or TLV/STEL	IDLH	Route of Exposure	Symptoms
Arsenic (As)	0.01 mg/m^3	Ca 100 mg/m^3	Inhalation and ingestion via particulates	Ulceration of nasal septum, dermatitis, gastrointestinal bleeding
Barium (Ba)	0.5 mg/m^3	1100 mg/m^3	Inhalation and ingestion via particulates	Upper respiratory irritation, muscle spasm, slow pulse, irritated eyes, skin
Beryllium (Be)	0.002 mg/m^3	Ca 10 mg/m^3	Inhalation and ingestion via particulates	Respiratory irritation, weakness, weight loss, carcinogen
Chromium (Cr), total	0.5 mg/m^3	---	Inhalation and ingestion via particulates	Histologic fibrosis of lungs
Copper (Cu)	1.0 mg/m^3	---	Inhalation and ingestion via particulates	Irritation of nasal membranes, pharynx, nasal perforation, eye irritation
Cobalt (Co)	0.02 mg/m^3	Ca 20 mg/m^3	Inhalation and ingestion via particulates; skin/eye contact	Cough, dermatitis, respiratory hypersensitivity
Lead (Pb)	0.05 mg/m^3	700 mg/m^3	Inhalation and ingestion via particulates	Lassitude, insomnia, pallor, anoxia, weight loss, constipation, abdominal pain, colic, anemia, wrist paralysis
Nickel (Ni) (insoluble/soluble)	1 mg/m^3/0.1 mg/m^3	Ca	Inhalation and ingestion via particulates	Sensitive skin, asthma, nasal cavity irritation, pneumonitis, carcinogen
Mercury (Hg) *Skin*	0.01-0.03 mg/m^3	10 mg/m^3	Inhalation and ingestion via particulates	Dizziness, nausea, vomiting, diarrhea, constipation, skin burns, emotional distance
Selenium (Se)	0.2 mg/m^3	---	Inhalation and ingestion via particulates	Irritation eyes, nose, and throat, headache, chills, dyspnea, bronchitis, metallic taste, garlic breath
Thallium (Tl) *Skin*	0.1 mg/m^3	20 mg/m^3	Inhalation and ingestion via particulates	Nausea, diarrhea, abdominal pain, vomiting, tremor, chest pain, pulmonary edema
Tin (Sn)	2 mg/m^3	400 mg/m^3	Inhalation via particulates, skin/eye contact	Irritated eyes, skin, respiratory dysfunction

NOTE:
PEL = Permissible Exposure Limit.
TLV = Threshold Limit Value.
STEL = Short-Term Exposure Limit (15 minutes).
IDLH = Immediately Dangerous to Life and Health.
Ca = Carcinogen.
Skin = The cutaneous route of exposure can significantly contribute to the overall exposure.

TABLE 2 EMERGENCY TELEPHONE NUMBERS

ONSITE EMERGENCY NUMBERS		
Police	USMA Police/Security	(845) 938-3333 or (845) 938-3312
Fire	USMA Fire Department	(845) 938-3151 or (845) 938-4646
Ambulance	USMA Ambulance	(845) 938-4004 or (845) 938-4005
Hospital	Keller Army Community Hospital 900 Washington Road, Building 900 West Point, NY 10996	(845) 938-3305
Directions to Keller Hospital:		
PX Landfill	Take Buckner Loop west to Washington Road west.	
Michie Stadium Lot A Landfill	Take Delafield Road northwest to Merritt Road west to Washington Road west.	
Michie Stadium Lot B Landfill	Take Delafield Road northwest to Merritt Road west to Washington Road west.	
Michie Stadium Lot C Landfill	Take Stony Lonesome Road north to Delafield Road northwest to Merritt Road west to Washington Road west.	
Michie Stadium Lot D Landfill	Take Stony Lonesome Road south to Delafield Road northwest to Merritt Road west to Washington Road west.	
Michie Stadium Lot E Landfill	Take Delafield Road northwest to Merritt Road west to Washington Road west.	
Michie Stadium Lot F Landfill	Take Fenton Road northeast to Stony Lonesome Road north to Delafield Road northwest to Merritt Road west to Washington Road west.	
Ski Lot Landfill	Take Storm King Road north to Washington Road east.	
Post School Landfill	Take Barry Road to Washington Road west.	
Motor Pool Landfill	Take Reynolds Road west to Washington Road east.	
Motor Pool East Landfill	Take Reynolds Road west to Washington Road east.	
High School Landfill	Take Route 9W north to Route 218 north to USMA Washington Gate to Washington Road south.	
Organic Compost Landfill	Take Garrard Road south to Washington Road south.	
Camp Buckner Landfill	Take Route 9W north to Route 218 north to USMA Washington Gate to Washington Road south.	
No. 706 Parking Lot Landfill	Take Stony Lonesome Road south to Delafield Road northwest to Merritt Road west to Washington Road west.	
PROJECT TEAM EMERGENCY NUMBERS		
EA Project Manager	Chip McLeod	(845) 565-8100 (845) 226-4365
EA Program Safety and Health Officer	Kris Hoiem	(410) 771-4950 (410) 357-5485
EA Project Superintendent	Robert Haras	(845) 565-8100
EA Site Safety and Health Officer/Emergency Coordinator	Robert Haras	(845) 565-8100
USMA Point-of-Contact	Bill Busko	(845) 938-4459
ENVIRONMENTAL EMERGENCY NUMBERS		
New York State Department of Environmental Conservation, Albany, New York		(518) 474-2121
Chemical Emergency Center (significant chemical leak or spill)		(800) 424-9300

TABLE 3 SITE CONTAMINANT MONITORING REQUIREMENTS

Task	Instrument	Frequency and Location	Action Levels[a]	Required Response
Monitoring Well Installation	FID/PID	Initially and every 30 minutes in the breathing zone	Background	Continue work.
			>Background to 5 ppm	Evacuate to a safe upwind location and wait for levels to dissipate. Retest the area after 15 minutes. If levels have not dissipated, upgrade to Level C. Continue work in Level C personal protective equipment or retest in another 15 minutes.
			>5 ppm	Evacuate to a safe upwind location immediately. Retest area after 15 minutes wearing Level C personal protective equipment. If sampling results defined by the flame ionization detector have not dissipated in 30 minutes, contact the Program Safety and Health Officer and Project Manager for further guidance.
	CGI	Initially and every 30 minutes at the well opening or borehole	0-5%	Continue.
			5-10%	Continue monitoring. Prepare to shut down.
			>10%	Shut down. Contact Project Superintendent/Site Safety and Health Officer and Project Manager.
Monitoring Well Sampling	FID/PID	Initially and every 30 minutes in the breathing zone	Background	Continue work.
			>Background to 5 ppm	Evacuate to a safe upwind location and wait for levels to dissipate. Retest the area after 15 minutes. If levels have not dissipated, upgrade to Level C. Continue work in Level C personal protective equipment or retest in another 15 minutes.
			>5 ppm	Evacuate to a safe upwind location immediately. Retest area after 15 minutes wearing Level C personal protective equipment. If sampling results defined by the flame ionization detector have not dissipated in 30 minutes, contact the Program Safety and Health Officer and Project Manager for further guidance.
	CGI	Initially and every 30 minutes at the well opening	0-5%	Continue.
			5-10%	Continue monitoring. Prepare to shut down.
			>10%	Shut down. Contact Project Superintendent/Site Safety and Health Officer and Project Manager.

(a) Action levels for PID or FID are based on measurements taken above background concentrations when background concentration is less than 1 ppm. When background concentrations exceed 1 ppm total volatile hydrocarbons, PID, or FID action levels will be inclusive of background concentrations and so noted on the environmental monitoring record.

NOTE: FID = Flame ionization detector.
PID = Photoionization detector.
CGI = Combustible gas indicator.

Attachment C.1

Safety, Health, and Emergency Response Plan Review Record

ATTACHMENT C.1

SAFETY, HEALTH, AND EMERGENCY RESPONSE PLAN REVIEW RECORD

I have read the Safety, Health, and Emergency Response Plan for this site and have been briefed on the nature, level, and degree of exposure likely as a result of participation in this project. I agree to conform to all the requirements of this Plan.

SITE: 15 Landfills, United States Military Academy, West Point, New York
PROJECT NO.: 61558.01

Name	Signature	Affiliation	Date

Attachment C.2

Site Entry and Exit Log

ATTACHMENT C.2

SITE ENTRY AND EXIT LOG

SITE: 15 Landfills, United States Military Academy, West Point, New York
PROJECT NO.: 61558.01

Name	Date	Time of Entry	Time of Exit	Initials

Attachment C.3

Accident/Loss and Incident Report

ACCIDENT/LOSS REPORT

THIS REPORT MUST BE COMPLETED BY THE INJURED EMPLOYEE'S SUPERVISOR AND FAXED TO EA CORPORATE HUMAN RESOURCES WITHIN 24 HOURS OF ANY ACCIDENT. THE FAX NUMBER IS (410) 771-1780.

NOTE: WHENEVER AN EMPLOYEE IS SENT FOR MEDICAL TREATMENT FOR A WORK RELATED INJURY OR ILLNESS, PAGE 4 OF THIS REPORT MUST ACCOMPANY THAT INDIVIDUAL TO ENSURE THAT ALL INVOICES/BILLS/CORRESPONDENCE ARE SENT TO CORPORATE CENTER FOR TIMELY RESPONSE.

DATE OF ACCIDENT: ______________________ TIME OF ACCIDENT: ________

EXACT LOCATION WHERE ACCIDENT OCCURRED (including street, city, and state): ____

____

____

NAME OF INJURED EMPLOYEE: ______________________________

HOME ADDRESS: ______________________________________

HOME PHONE: ____________________ DATE OF BIRTH: ____________

AGE: ____________ SEX: ☐ MALE ☐ FEMALE MARITAL STATUS: __________

SOCIAL SECURITY NUMBER: ______________ DATE OF HIRE: ____________

NUMBER OF DEPENDENTS: ______________________________

EMPLOYEE JOB TITLE: ________________________________

DEPARTMENT IN WHICH REGULARLY EMPLOYED: ______________

EXPLAIN WHAT HAPPENED (include what the employee was doing at the time of the accident and how the accident occurred): ______________________________

____

____

____

____

____

____

DESCRIBE THE INJURY AND THE SPECIFIC PART OF THE BODY AFFECTED (i.e., laceration, right hand, third finger, second joint): ______________________

____

____

OBJECT OR SUBSTANCE THAT DIRECTLY INJURED EMPLOYEE: ______________

____

NAME AND ADDRESS OF THE PHYSICIAN (if medical attention was administered): ______

____

____

* PLEASE ATTACH THE PHYSICIAN'S WRITTEN RETURN TO WORK SLIP *

NOTE: A PHYSICIAN'S RETURN TO WORK SLIP IS REQUIRED PRIOR TO ALLOWING THE WORKER TO RETURN TO WORK.

IS THE EMPLOYEE EXPECTED TO LOSE AT LEAST ONE FULL DAY OF WORK? _____
WAS THE EMPLOYEE ASSIGNED TO RESTRICTED DUTY? ______________
NUMBER OF DAYS AND HOURS EMPLOYEE USUALLY WORKS PER WEEK: ______

LIST ALL PPE EMPLOYEE WAS WEARING AND ALL SAFETY DEVICES IN USE AT THE TIME OF THE ACCIDENT: ______________________________

____

____

DESCRIBE THE PREVENTIVE MEASURES TAKEN TO AVERT A RECURRENCE OF THIS TYPE OF INCIDENT: ______________________________

____

____

____

____

DATE WHEN MEASURES WERE IMPLEMENTED AND BY WHOM: ______________

____

AUTOMOBILE ACCIDENT INFORMATION

AUTHORITY CONTACTED AND REPORT NO.: ______________
EA EMPLOYEE VEHICLE YEAR, MAKE, AND MODEL: ______________
V.I.N.: ______________ PLATE/TAG NO: ______________
OWNER'S NAME AND ADDRESS: ______________

____

DRIVER'S NAME AND ADDRESS: ______________

____

RELATION TO INSURED: ______________ DRIVER'S LICENSE NO.: ______________
DESCRIBE DAMAGE TO YOUR PROPERTY: ______________

____

____

DESCRIBE DAMAGE TO OTHER VEHICLE OR PROPERTY: ______________

____

____

____

____

____

OTHER DRIVER'S NAME AND ADDRESS: ______________________________

____

OTHER DRIVER'S PHONE: ______________________________

OTHER DRIVER'S INSURANCE COMPANY AND PHONE: ______________________________

____

LOCATION OF OTHER VEHICLE: ______________________________

NAME, ADDRESS, AND PHONE OF OTHER INJURED PARTIES: ______________________________

____

____

WITNESS

NAME: ______________________ PHONE: ______________________

ADDRESS: ______________________________

STATEMENT: ______________________________

____

____

____

____

____

SIGNATURE: ______________________________

NAME: ______________________ PHONE: ______________________

ADDRESS: ______________________________

STATEMENT: ______________________________

____

____

____

____

____

SIGNATURE: ______________________________

NAME OF SUPERVISOR: ______________________________

DATE OF THIS REPORT: ____________ REPORT PREPARED BY: ______________________

I have read this report and the contents as to how the accident/loss occurred are accurate to the best of my knowledge.

Signature: ______________________________ Date: ______________________

Injured Employee

Revised 04\26\94

I am seeking medical treatment for a work related injury/illness.

Please forward all bills/invoices/correspondence to:

EA ENGINEERING, SCIENCE, AND TECHNOLOGY, INC.

15 LOVETON CIRCLE

SPARKS MD 21031

ATTENTION: KRIS HOIEM

(410) 771-4950

Revised 04\26\94

INCIDENT REPORT

THIS REPORT IS TO BE COMPLETED WHEN A NEAR MISS OCCURS THAT COULD HAVE POTENTIALLY RESULTED IN SERIOUS PHYSICAL HARM. PLEASE FAX THIS FORM TO EA CORPORATE SAFETY AND HEALTH DEPARTMENT AT (410) 771-4950, ATTN: KRIS HOIEM.

EXPLAIN WHAT HAPPENED (include what the employee was doing at the time of the near miss and how it occurred): ______________________________

REPORT PREPARED BY: ______________________ DATE: ______________

Revised 04\26\94