# 2007 Annual Report
# Shepley's Hill Landfill

## Devens, Massachusetts

**August 2008**

*Prepared for:*

## Army Contracting Agency

**for**

## Department of the Army
## BRAC ENVIRONMENTAL

**30 Quebec Street, Box 100**

**Devens, Massachusetts**

**Contract Number W91ZLK-05-D-0009 Task Order - 0006**

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# 2007 Annual Report

# Shepley's Hill Landfill and Treatment Plant
# Long-Term Monitoring and O&M Services
# Former Fort Devens, Massachusetts

## August 2008

*I hereby certify that the enclosed Annual Report, shown and marked in this submittal, is that proposed to be incorporated with Contract Number W91ZLK-05-D-0009 Task Order -0006. This Annual Report complies with the Performance Work Statement and is being submitted for Government approval.*

Reviewed and Approved by:

Program Manager Date

Project Manager Date

Accepted by:

Contracting Officer's Representative Date

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# ACRONYMS AND ABBREVIATIONS

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|---|---|
| **AMEC** | AMEC Earth & Environmental Inc. |
| **AOC** | Area of Concern |
| **AR** | Annual Report |
| **ATP** | Arsenic Treatment Plant |
| **BEC** | Base Environmental Coordinator |
| **BCT** | BRAC Cleanup Team |
| **bgs** | Below Ground Surface |
| **BRAC** | Base Re-alignment and Closure |
| **CERCLA** | Comprehensive Environmental Response, Compensation, and Liability Act |
| **cfd** | Cubic Feet per Day |
| **CFR** | Code of Federal Regulations |
| **CIP** | Clean-in-place |
| **CMR** | Code of Massachusetts Regulations |
| **COC** | Contaminant of Concern |
| **COR** | Contracting Officer's Representative |
| **cy** | cubic yard |
| **ECC** | Environmental Chemical Corporation |
| **EPA** | U.S. Environmental Protection Agency |
| **FBRO** | Filtered bottom roll-off |
| **FS** | Feasibility Study |
| **FYR** | Five Year Review |
| **gpm** | gallons per minute |
| **GWTP** | Groundwater Treatment Plant |
| **LEL** | Lower explosive limit |
| **LGP** | Landfill gas probes |
| **LTM** | Long-Term Monitoring |
| **LTMMP** | Long Term Monitoring and Maintenance Plan |
| **MassDEP** | Massachusetts Department of Environmental Protection |
| **MCL** | Maximum concentration limit |

| | |
|---|---|
| **msl** | Mean sea level |
| **O&M** | Operations and Maintenance |
| **ORP** | Oxidation reduction potential |
| **ORD** | U. S. Environmental Protection Agency, Office of Research and Development |
| **PID** | Photoionization detector |
| **POTW** | Publicly-Owned Treatment Works |
| **PMP** | Project Management Plan |
| **ppb** | parts per billion |
| **ppm** | parts per million |
| **PVC** | Polyvinyl chloride |
| **RI** | Remedial Investigation |
| **ROD** | Record of Decision |
| **SHL** | Shepley's Hill Landfill |
| **SPC** | Specific conductivity |
| **SWET** | Stone & Webster Environmental Technology & Services |
| **USACE-NAE** | U. S. Army Corps of Engineers, New England District |
| **USEPA** | U. S. Environmental Protection Agency |
| **µg/L** | Micrograms per liter |
| **VOC** | Volatile Organic Compound |

## EXECUTIVE SUMMARY

The Annual Report (AR) documents the long-term monitoring, inspection, and operations and maintenance activities conducted in 2007 at Shepley's Hill Landfill (SHL) at Former Fort Devens, Massachusetts. The Army has prepared this report in accordance with the final approved Revised Long Term Monitoring and Maintenance Plan (LTMMP) (CH2MHill, 2007b). The LTMMP provides the basis for monitoring of groundwater, landfill gas sampling, and landfill inspections that have been conducted since the mid 1990's, and now includes monitoring of the arsenic groundwater extraction, treatment, and POTW discharge system (Contingency Remedy) that has been in full time operation since March, 2006.

In addition, this 2007 AR includes the initial performance assessment for the Contingency Remedy that was deferred in the 2006 AR (CH2M HILL, 2007a). As described in the Record of Decision for Shepley's Hill landfill (USAEC, 1995), the remedial response objectives are to:

- Protect potential residential receptors from exposure to contaminated groundwater migrating from the landfill having chemicals in excess of MCLs, and
- Prevent contaminated groundwater from contributing to the contamination of Plow Shop Pond sediments in excess of human health and ecological risk-based concentrations.

A full evaluation of off-site risks is presently being performed as part of the *Supplemental Groundwater Investigation and Landfill Cap Assessment* (AMEC, in progress). Therefore, the performance assessment included in this report is focused on extraction system hydraulics and demonstration of containment, while the determination that the overall remedy is achieving the objectives above will necessarily be made in the future.

The overall condition of the landfill appears satisfactory with the exception of several settled areas where pooling of water is frequently observed, damaged or non-existent fencing, and missing/damaged monitoring well padlocks. Elevated levels of methane and percent lower explosive limit (LEL) were observed in three landfill gas probes (LGPs) (LGP-05-10X, LGP-05-11X, and LGP-05-13X) on the southern end of the landfill that were inconsistent with prior sampling results. All LGPs were re-sampled in March 2008 and the results were consistent with historic data. Landfill gas vent results were generally consistent with historical results and indicate proper landfill gas venting.

The Contingency Remedy groundwater extraction and treatment system was operated for the majority of 2007 at 25 gpm. The extraction rate was increased to 50 gpm in July 2007 and has operated at that rate since. The system was on-line approximately 73% of the available time during the year. However, a significant part of the downtime was the period the plant was off-line during the change of Operation & Maintenance (O&M) contractors. Since ECC began O&M on 6 March 2007 the plant has operated approximately 82% of the available time. By far the largest contributor of downtime is the frequent need for filtered bottom roll-off (FBRO) pumpouts and clean-in-place maintenance on the microfiltration system.

The arsenic treatment plant (ATP) was extremely effective at removing arsenic from the groundwater. Average influent arsenic concentrations remain high at greater than 3,000 micrograms per liter (µg/L) based on periodic sampling. Effluent arsenic concentrations have been consistently low, averaging 1.34 µg/L during the year, well below the target goal of 10 µg/L. Through 31 December 2007, approximately 581 pounds of arsenic have been removed from groundwater.

In general, arsenic concentrations in the LTMMP wells remain relatively stable or are decreasing, compared to historic levels. Only the following wells in 2007 were reported to have concentrations greater than historical averages: SHL-11, SHL-19, SHL-20, SHM-93-22C, and SHM-96-22B. It should be noted that SHL-19 has consistently exhibited very high turbidity and therefore the total arsenic values reported may not accurately reflect dissolved concentrations. The majority of geochemical data collected to date do not indicate significant changes in redox conditions and arsenic concentrations. However, it should be noted that arsenic concentrations have been trending downward in near-field monitoring wells SHM-93-22B and SHM-96-5B since system start-up in Spring 2006 with the most significant declines to date in the latest sampling round.

Consistent with EPA guidance including *A Systematic Approach for Evaluating of Capture Zones at Pump and Treat Systems* (USEPA, 2008), a multiple lines of evidence approach was taken with respect to the performance assessment. Four individual assessment components were identified as part of a hydraulic capture zone analysis: gradient vector analysis, capture zone width calculation, comparison to model results, and a drawdown assessment. Two assessment components were identified as part of geochemical monitoring: an advective travel

time analysis and a qualitative trend analysis. With respect to the hydraulic capture zone analysis, while no single component conclusively demonstrates capture effectiveness, all four indicate some degree of correspondence to the expected aquifer response to pumping. With respect to the geochemical monitoring, the data are presently inconclusive, yet this too is consistent with expectations in that, based on estimated groundwater velocities, it will take several years to 'flush' currently impacted groundwater from areas outside the capture zone and then additional time for new equilibrium redox conditions (presumably oxidizing) to be established, which in turn are expected to result in declines in arsenic concentration. Based on the cumulative weight of these lines of evidence, the extraction, treatment, and discharge system is interpreted to be operating as designed.

It is recommended that settled areas where pooling and minor rutting damage has been observed should be repaired (filled, graded & seeded). Small trees near the margin of the landfill should be removed and the gas vents painted. The security fence gates should be repaired and secured with chains and locks to minimize vehicle traffic on the landfill. All gates, monitoring wells and piezometers should be equipped with "keyed alike" padlocks and keys be issued to all parties requiring access.

An assessment of the landfill perimeter gas monitoring network should be completed followed by installation of additional gas wells in both the southern and northern boundary areas. The frequency of the perimeter landfill gas monitoring should be increased to quarterly in 2008. Finally, alternative filtration methods should be evaluated for potential bench and/or pilot testing at the Shepley's Hill ATP to reduce plant downtime.

As part of the 2008 AR, observed water levels, gradients and flow direction vectors should be compared to the revised groundwater model being developed by AMEC as part of the *Supplemental Groundwater Investigation and Landfill Cap Assessment* (in progress). Future groundwater monitoring should be conducted consistent with the revised LTMMP; however, optimization of the monitoring program should be evaluated in the 2008 AR. Finally, observed trends in arsenic concentrations and other geochemical indicator parameters should be projected into the future to establish the expected time to reach target maximum concentration limits (MCLs). This analysis should be initiated in the 2008 AR and used to predict geochemical response in the downgradient area.

# 1.0 INTRODUCTION

This Annual Report (AR) was prepared by ECC for the U. S. Army to meet the required reporting for the Shepley's Hill Landfill, located at the Former Fort Devens, Massachusetts (Figure 1-1). This AR discusses the operation and maintenance (O&M) of the existing groundwater extraction, treatment and discharge system, groundwater monitoring, and landfill monitoring and maintenance for 2007. These activities were conducted as part of the first year of monitoring under the *Revised Long Term Maintenance and Monitoring Plan* (LTMMP) (CH2M HILL, 2007).

## 1.1 Background

Shepley's Hill Landfill encompasses approximately 84 acres in the northeast corner of the main post of the former Fort Devens (Figure 1-1). The landfill is bordered to the northeast by Plow Shop Pond, to the north by Nonacoicus Brook (which drains the pond), to the west by Shepley's Hill, to the south by recent commercial development, and to the east by land formerly containing a railroad roundhouse.

The landfill was reportedly operating by the early 1940s, and evidence from test pits within the landfill suggests earlier usage, possibly as early as the mid-nineteenth century. The landfill contains a variety of waste materials, including incinerator ash, demolition debris, asbestos, sanitary wastes, spent shell casings, glass, and other wastes. Based on boring logs, the maximum depth of the refuse occurs in the central portion of the landfill and is estimated to be about 40 feet below ground surface (bgs). The volume of the landfill has been estimated at over $1.3 \times 10^6$ cubic yards (cy) (USAEC, 1995).

The landfill was closed in five phases between 1987 and 1992-93 in accordance with Massachusetts regulations 310 CMR 19.000. The Massachusetts Department of Environmental Protection (MassDEP) approved the closure plan in 1985. The closure consisted of installing a 30-mil and 40-mil polyvinyl chloride (PVC) membrane cap, covered with soil and vegetation and incorporating gas vents. The closure also included installation of wells to monitor groundwater quality around the landfill, and construction of drainage swales to control surface water runoff. MassDEP issued a Landfill Capping Compliance Letter approving the closure in February 1996.

Subsequent to closure, remedial investigations (RIs) under CERCLA evaluated soil, sediment, surface water, and groundwater conditions at and in the immediate vicinity of the landfill. The results confirmed the presence of various contaminants, particularly certain inorganics and volatile organic compounds (VOCs), in groundwater, sediments and surface water at or adjacent to Shepley's Hill Landfill. A Feasibility Study (FS) and Record of Decision (ROD), for Shepley's Hill Landfill Operable Unit, Area of Contamination 4, 5 and 18 (USAEC, 1995) resulted in a remedy that required long term monitoring and maintenance of the existing landfill cap and groundwater monitoring. Table 1-1 lists the relevant COCs and their target cleanup levels. The ROD included a contingency provision, which required that a pump and treat system be installed if groundwater contaminant concentrations (primarily arsenic) did not meet risk-based performance standards over time. Due to continued elevated contaminant concentrations, the Army installed and started operating a groundwater extraction and treatment system (the Contingency Remedy) in 2006 to address groundwater contamination emanating from the northern portion of the landfill.

## 1.2 5-Year Review Status

Stone & Webster Environmental Technology & Services (SWET) conducted the first two years of landfill post-closure monitoring in 1996 and 1997. These first two years of monitoring were included in the first Five Year Review (FYR), Shepley's Hill Landfill, Long Term Monitoring (SWET, 1998) after the final capping of the landfill in 1993. The USACE, New England District conducted the monitoring between 1998 and 2005. In 2000, a comprehensive review for all Devens sites was performed and included in the *Five Year Review Report for Devens Reserve Forces Training Area, Devens, MA* (HLA, 2000) which included monitoring conducted for Shepley's Hill Landfill Operable Unit in 1996 through 1999. A second comprehensive FYR was completed in 2005 (Nobis, 2005) and included monitoring conducted from 1999 through 2004. In this review the Army and EPA deferred the protectiveness statement for the Shepley's Hill Landfill Operable Unit pending completion of Landfill Cap Maintenance and the CSA\CAAA (now referred to as the Supplemental Groundwater and Landfill Cap Assessment for Long-Term Monitoring and Maintenance). The Landfill Cap Maintenance will be completed in the fall of 2008. The Supplemental Groundwater and Landfill Cap Assessment for Long-Term Monitoring and Maintenance report is expected to be submitted before the end of 2008. The next FYR will be completed in 2010.

### 1.3 Regulatory Context

In accordance with CERCLA Section 120(h)(3), federal agencies are required to demonstrate that remedies are "operating properly and successfully" (OPS) prior to deed transfer of federally-owned property (USEPA, 1996a). CERCLA Section 120(h)(3) provides for transfer of property upon which remedial actions have taken place through the issuance of the CERCLA covenant to the property deed that warrants that *(I) all remedial action necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of such transfer and (II) any additional remedial action found to be necessary after the date of such transfer shall be conducted by the United States (CERCLA 120(h)(3)(A)(ii)).*

Section 120(h)(3)(B), Covenant Requirements, of CERCLA goes on to state:
*for the purposes of subparagraph (A)(ii)(I) and (C)(iii), all remedial action described in such subparagraph has been taken if the construction and installation of an approved remedial design has been completed, and the remedy has been demonstrated to the Administrator to be operating properly and successfully. The carrying out of long-term pumping and treating, or operation and maintenance, after the remedy has been demonstrated to the Administrator to be operating properly and successfully does not preclude the transfer of the property.*

A remedial action or system is considered to be operating "properly" if it is operating as designed. A remedial system is operating successfully if "its operation will achieve the cleanup levels or performance goals delineated in the decision document (USEPA, 1996a)." As described in the Record of Decision for Shepley's Hill landfill (USAEC, 1995), the remedial response objectives are to:

- Protect potential residential receptors from exposure to contaminated groundwater migrating from the landfill having chemicals in excess of MCLs, and
- Prevent contaminated groundwater from contributing to the contamination of Plow Shop Pond sediments in excess of human health and ecological risk-based concentrations.

Ultimately, these objectives will be evaluated through the Supplemental Groundwater Investigation and Landfill Cap Assessment (AMEC, in progress) initiated by the Army in 2005 to assess the adequacy of the landfill cap and the overall remedy at mitigating risks. The initial

phase of this effort will focus on the area north of the landfill beyond the capture zone of the groundwater treatment system and the potential impacts associated with elevated arsenic concentrations in groundwater. Subsequently, the Red Cove area of Plow Shop Pond is to be addressed as Area of Contamination (AOC) 72. In addition, USEPA's Office of Research and Development (ORD), is conducting an independent detailed investigation of the physical and geochemical processes related to arsenic accumulation in Red Cove.

The working hypothesis in these assessments is that the distribution of arsenic in groundwater is closely related to reducing conditions, which persist to the north of the landfill footprint to beyond W. Main St. and in groundwaters converging on Red Cove. With implementation of the Contingency Remedy, the source of reduced groundwater emanating from the landfill is presumably being contained, however, groundwater geochemistry and specifically redox conditions downgradient are expected to take some time (potentially years, as will be shown below) to adjust to new equilibrium conditions. Therefore, the performance assessment included as Section 5 is focused on extraction system hydraulics and demonstration of containment, while the determination that the overall remedy is "operating properly and successfully" will be necessarily addressed in the future, after completion of the *Supplemental Groundwater Investigation and Landfill Cap Assessment* (AMEC, in progress) and the subsequent AOC 72 reporting.

### 1.4 Objectives

2007 was the first complete year of operation of the Contingency Remedy and the first year of monitoring under the revised LTMMP (CH2M HILL, 2007b). The objectives of this Annual Report are as follows:

- Summarize landfill maintenance activities.
- Document landfill cap inspection to identify areas requiring future maintenance.
- Present landfill gas measurements at 18 gas vents and 13 permanent landfill perimeter gas monitoring wells to establish long-term trends with regard to gas production and venting.

- Summarize operations, maintenance, sampling, and reporting associated with the arsenic treatment plant (ATP) and provide recommendations for any modifications.

- Present results from LTMMP wells for groundwater elevations, laboratory geochemical analyses including COC concentrations, and field parameters to compare to cleanup levels established in the ROD.

- Assess system hydraulic performance to include the results of a planned system shutdown to quantify observed drawdowns.

In addition, during 2007 agreement was reached to increase the extraction rate from 25 gpm to the target design rate of 50 gpm, which was carried out in July. As a result, this AR is the first to document the full operation of the Contingency Remedy, albeit only for a portion of the year, and, therefore, includes an initial assessment of the performance of the treatment system with regard to hydraulic capture and chemical monitoring.

### 1.5 Report Organization

Section 2 of this report documents the routine landfill maintenance and inspection activities, and also includes the results of gas monitoring in both gas vents and perimeter soil gas wells. Section 3 of this report presents the ATP operations, maintenance, and monitoring, notably including the transition from operation at 25 gallons per minute (gpm) to 50 gpm in July 2007. Section 4 summarizes the LTMMP groundwater monitoring resulting including synoptic water levels, arsenic concentrations and other water quality data. Section 5 presents the initial system performance assessment focused on the period of operation after July when the extraction system operation was increased to the full design rate of 50 gpm. Finally, Section 6 presents conclusions and recommendations for future system operations, monitoring, and assessments.

# 2.0 LANDFILL MAINTENANCE AND MONITORING

In October 2007, ECC performed a walk-over inspection of the Shepley's Hill Landfill in Devens, Massachusetts, and also conducted cap vent and soil gas probe sampling and analysis. This annual inspection and sampling is conducted to detect and correct problems such as erosion, settlement, or movement of soil on the cap, and to evaluate the effectiveness of the cap vent system. A summary of landfill cap maintenance, findings of the inspection and sampling are presented in the following sections. The landfill inspection checklist and supporting figures are presented in Appendix A.

## 2.1 Maintenance

In September and October of 2007 the landfill cap was mowed to an approximate height of 6". The mowing event lasted approximately three weeks and included all areas within the landfill boundary with the exception of the south eastern portion of the landfill. This area is primarily covered with loess, sandy soil that doesn't support vegetative growth. A significant portion of this area is also being used for the staging of soil from nearby construction activities (to be used later for re-grading). In addition to the mowing, several areas within the northern drainage swales (around the Shepley's Hill Arsenic Treatment Plant) were cleared of minor vegetation/shrub growth.

In May 2007, the northern end of the access road (leading in the ATP) had been severely damaged from erosion and runoff of rain water and melting snow. Severe ruts had developed that made the road nearly impassable. ECC subcontracted to a vendor (Hickory Ridge Landscaping) to make repairs to the road. The ruts were filled with riprap and compacted. The repairs have been unaffected by subsequent rain or snow melt runoff. Photographs of the repairs are included in Appendix A.

## 2.2 Inspection

The Shepley's Hill Landfill was inspected on 9 October 2007. Features of the landfill that were inspected included the cap, drainage system, gas vent system, access roads, monitoring wells, piezometers, and security fence. Observations were made regarding the vegetative cover, vegetation types, erosion, settlement, and general conditions. The overall condition of the landfill appears satisfactory with the exception of several settled areas where pooling is

frequently observed, damaged or non-existent fencing, and missing/damaged monitoring well padlocks. A summary of the findings are presented in the following text, inspection findings are presented in the Landfill Inspection Report in Appendix A.

*Monitoring Wells*: Inspection of the condition of wells revealed no damage to the protective casings or caps, however several monitoring wells are not equipped with locks or the locks were observed to be damaged (intentionally cut).

*Piezometers*: Inspection of the condition of piezometers revealed no damage to the protective casings or caps, however several piezometers are not equipped with locks or the locks were observed to be damaged (intentionally cut).

*Cover Surface*: No large (greater than 100 square feet) bare spots were observed, and there was no evidence of surface disruption caused by frost heaves. One gopher hole was observed near the northern end of the landfill.

*Vegetative Growth*: Overall, the vegetative cover appears to be in good condition (the inspection was conducted immediately following a mowing event). In a few locations, small trees have begun to grow near the margins of the landfill and should be removed.

*Landfill Gas Vents*: No damage to gas vents was observed, and no gas being vented could be visually detected. The non-galvanized vents are exhibiting rust and should be re-painted.

*Drainage Swales*: All drainage swales appeared to be in good condition. Several swales were without rip rap protection but did not exhibit any erosion.

*Culverts*: Culverts all appeared to be in good operating condition without the need for repair or clean-out.

*Catch Basins*: Catch basins were all in good operating condition without the need for clean-out, and there appears to be proper grading around the rims.

*Settlement*: There are many areas across the landfill where settlement has caused depressions to exist. Some of these areas have sustained minor rutting damage from either mowing or trespassing vehicles. These depressions have been observed after rainfall to hold water which

indicates that the integrity of the cap is sound. However, these depressions should be filled and graded to conform to the slope of the surrounding landfill surface.

*Erosion*: No erosion was noted anywhere over the landfill surface.

*Access Roads*: At the time of the inspection all access roads were in good condition. Repairs to the ATP access road completed in May 2007 remain in good condition.

*Security Fencing*: The fencing surrounding the site is in places non-existent, and along the western boundary where the fence runs over Shepley's Hill several tree falls have destroyed the fence. Along the eastern boundary there is a new railroad spur line that breaches the fence, and the fence is non-existent along much of the southern boundary. In general, there is open public access to the landfill from the western and southern portions of the site.

*Wetlands Encroachment*: There was no observed encroachment of wetlands species around the landfill perimeter.

Photographs taken during the landfill inspection are included in Appendix A.

### 2.2.1 Recommendations

The settled areas where pooling and minor rutting damage has been observed should be repaired (filled, graded & seeded). In addition, the small trees near the margin of the landfill should be removed and the gas vents painted.

Due to the multiple organizations that require frequent access to monitoring wells and piezometers several of the security locks are missing or have been intentionally cut to gain access. The security fence gates should be repaired and secured with chains and locks to minimize vehicle traffic on the landfill. All monitoring wells and piezometers should be equipped with "keyed alike" padlocks and keys be issued to all parties requiring access.

## 2.3 Landfill Gas Monitoring

On 22 and 23 October 2007, the sampling of all the cap vents and land gas probes (LGP) (adjacent to the cap) was completed (See Figure A-1 for locations). Sampling included purging of the vents and LGPs with an air pump and using field instruments to sample for the following parameters:

- Total Volatile Organic Compounds
- Percent oxygen
- Hydrogen sulfide concentration (ppm)
- Percent lower explosive limit (LEL)
- Carbon monoxide concentration (ppm)
- Percent carbon dioxide
- Percent methane

Results of the Landfill Gas Monitoring are discussed in the following sections. Results of the monitoring are presented in Appendix B.

### 2.3.1 Perimeter Gas Monitoring

Results from the LGP sampling indicated the presence of elevated levels of methane and percent lower explosive limit (LEL) in three LGPs (LGP-05-10X, LGP-05-11X, and LGP-05-13X) on the southern end of the landfill that were inconsistent with historical data from previous sampling events. The results of this sampling event are considered anomalous, possibly resulting from low pressure weather conditions or excessive purging of the LGPs prior to sampling. On 18 March 2008, all LGPs were re-sampled. The results of this sampling event showed virtually no methane or percent LEL present in any of the LGPs consistent with historical data.

The data from March 2008 indicate that landfill gas is not migrating out of the landfill boundary. However, due to the sampling anomalies, LGP sampling and data evaluation should be conducted more frequently. In addition, construction details indicate that existing LGPs are shallow and do not monitor the full thickness of the unsaturated zone. Therefore, an assessment of the perimeter monitoring network should be completed followed by installation of additional gas wells in both the southern and northern boundary areas. It is recommended that the frequency of the perimeter landfill gas monitoring be increased to quarterly for 2008. Future sampling frequencies will be re-assessed based on the 2008 results.

### 2.3.2 Landfill Gas Vent Results

Several vents in the southern section of the landfill exhibited high levels of methane (>20%), carbon monoxide (>15 ppm), carbon dioxide (>25%) and LEL (>100%). However, no vents

showed presence of any VOCs and only one vent sampled indicated the presence of hydrogen sulfide (V-16 at 1 ppm H2S). Oxygen levels ranged from 0.1% (V-16, 17 & 18) to 19.8% (V-10), with the lowest O2 levels principally observed in vents exhibiting higher levels of methane and LEL. Landfill gas vent results were fairly consistent with historical results and indicate proper landfill gas venting.

# 3.0 ARSENIC TREATMENT PLANT OPERATIONS, MAINTENANCE AND MONITORING

The Shepley's Hill Arsenic Treatment Plant (ATP) treated and discharged approximately 13.2 million gallons of groundwater from 1 January through 31 December, 2007, bringing the cumulative discharge total to approximately 19.9 million gallons since system startup.

The treatment plant was off-line from 31 January to 6 March 2007 as a result of a change in the Operations & Maintenance (O&M) provider from CH2M Hill to ECC. All operations at the plant up to 31 January 2007 were conducted by CH2M Hill. All subsequent operations were conducted by ECC. The plant was on-line approximately 73% of the available time during the year. However, a significant part of the downtime was the period the plant was off-line during the change of O&M providers. Since ECC began O&M on 6 March 2007 the plant has operated approximately 82% of the available time. A summary of on-line hours, flow totals, and operating status for each month is shown in Table 3-1.

The operations, maintenance and monitoring history for the ATP for the period from 1 January 2007 through 31 December 2007 is presented in the following sections.

## 3.1 Operations

The following sections describe the ATP operations and system efficiency for the reporting period.

### 3.1.1 System Description

The ATP consists of the following major components:

- Two extraction wells
- Chlorine dioxide generator and dosing system
- Ferric chloride dosing system (currently not in use)
- Microfiltration skid
- Solids removal and dewatering system

Groundwater is pumped into the ATP via two extraction wells, each with the capacity to pump up to 50 gpm. The extraction wells are located at the northern border of the landfill cap and can be operated independently or in tandem to a maximum total influent flow of 50 gpm.

Groundwater from the extraction wells enters the ATP through a manifold where the flow is combined into a single influent waste stream. ATP influent is dosed with chlorine dioxide to oxidize inorganics (primarily iron, arsenic, and manganese). The oxidized inorganics quickly form precipitates which can be filtered out of the waste stream by the microfiltration system. Filtrate from the microfiltration system is pumped into an effluent sump which then pumps the treated water into the Devens Publicly Owned Treatment Works (POTW) collection system.

It is noted that the ATP also has a ferric chloride dosing system. The original design requires that in the ATP influent contain approximately 40 parts per million (ppm) of iron to effectively precipitate and coagulate arsenic. However, current influent characteristics show iron concentrations well above the necessary level, therefore the ferric chloride system is not currently in use. Influent iron concentrations are monitored quarterly to ensure sufficient iron is present in the influent. If necessary the ferric chloride system can be activated.

The microfiltration system is periodically backwashed to clear the filtered precipitates from the filter membranes. Backwash solution is pumped into the solids removal system where the precipitates are allowed to settle in an inclined plate clarifier (IPC), the settled solids (sludge) is then conditioned with polymer and pumped into a filtered bottom roll-off (FBRO) for further dewatering. Supernatant from the IPC and leachate from the FBRO are periodically pumped back into the influent manifold.

The ATP operated at an average flow of 25 gpm through 23 July 2007. On 24 July 2007 the plant influent flow was increased to approximately 50 gpm. Historical monthly treatment totals are shown in Table 3-2.

### 3.1.2 System Efficiency

During 2007 the treatment plant was operational approximately 73% of the available time. This includes approximately 34 days that the plant was shutdown (1 February through 6 March 2007) while O&M responsibilities were transitioned from CH2M Hill to ECC. ECC started plant operations on 6 March 2007, for the remainder of the year the plant was operational

approximately 83% of the available time. By far the largest contributor of downtime is the frequent need for FBRO pumpouts and clean-in-place maintenance on the microfiltration system.

The ATP system continues to generate a significant amount of sludge, requiring the FBRO to be emptied after treating approximately 900,000 gallons of groundwater, which is roughly every 15 days of continuous operations. The FBRO pumpout process requires the ATP be shutdown the day previous to the pumpout to allow excess leachate to drain from the FBRO. A subcontracted vendor (Global Remediation) uses a vactor truck to vacuum the dewatered sludge from the roll-off. The sludge is transported to a secure landfill for off-site disposal. Once the FBRO pumpout is completed, the ATP is restarted. The typical downtime from an FBRO pumpout is approximately 24-36 hours.

The primary cause of the high sludge generation is the high concentrations of inorganics (primarily iron) in the influent. Influent concentrations have decreased slightly since startup of the ATP, however the combined inorganic concentrations (iron, arsenic, and manganese) remains high at approximately 67 parts per million (ppm). The FBRO pumpout history is shown in Table 3-3.

The ATP microfiltration system continues to require frequent clean-in-place (CIP) maintenance. CIPs are necessary when the microfiltration membranes become fouled and require increase pressure to pump the waste water through the system. CIPs are required approximately every 2 weeks and are typically scheduled in conjunction with the FBRO pumpouts in order to minimize downtime. However, several factors influence how effective the CIP procedures are and how often they are necessary.

Since startup, several different CIP process have been tested and refined to determine the most effective. Current CIPs consist of closed-loop flow through the membrane modules with a solution of sulfuric and citric acid, combined with periodic air sparging of the filter modules. The solution is recirculated for approximately 8 hours, and then allowed to soak overnight. The microfiltration system is then drained and rinsed, and the process is repeated with a solution of caustic soda and sodium hypochlorite, this solution is recirculated for approximately 4 hours (no over night soak). The process is greatly influenced by how fouled the membranes were prior to

the CIP, the amount of time the solutions are allowed to soak and by the temperature of the solution.

Effective CIPs typically result in the system being able to run approximately 15 days before another CIP is required. Approximately every other month an extended (prolonged soak) or double CIP (acid solution recirculation/soak repeated after caustic solution recirculation) is required to regain full recovery.

The CIP process continues to be evaluated and refined to improve the process and minimize downtime.

## 3.2 Maintenance

This section details several system maintenance highlights encountered or implemented during the year.

### 3.2.1 Microfilter Air Line Upgrade

On 25 January 2007 CH2M Hill completed improvements to the microfiltration system air lines. Individual valves were installed on the stainless steel air lines to the microfiltration modules. These valves enable the operator to direct air sparges to individual modules during CIP cycles. During previous CIPs it was observed that individual modules may have become clogged, resulting in restricted air flow to the affected module and ineffective cleaning. The installed valves allowed the operator to isolate and air sparge each module independently, improving cleaning effectiveness for each module.

### 3.2.2 Microfilter Piping Upgrade

In August 2006, the microfiltration system vendor (Pall) conducted a site visit to evaluate the CIP process. During the site visit it was determined that due to the excessive solids loading to the system a "flow-through" CIP was required. This process requires the microfiltration skid to be close-looped and allow the CIP solution to re-circulate through the membranes. The original skid design and CIP procedure had allowed for only a "feed side" CIP, during which the CIP solution was recirculated on the feed side of the membranes only. At that time the skid was temporarily altered to allow minimal flow of the CIP solution through the membranes through a

½" bypass line. This temporary bypass line allowed CIP flow through the membranes of approximately 15 gpm with a back pressure of approximately 15 psi.

On 20 March 2007 the temporary bypass was replaced with a permanent 2" bypass line and isolating valve. This modification increased CIP flow through the membranes to 55 gpm with less than 2 psi back pressure, resulting in improved CIP effectiveness. In addition, this modification eliminated the need to remove/replace modules to achieve effective cleaning.

### 3.2.3 Backwash Tank Replacement

On 20 August 2007 the microfiltration system backwash tank (T-2) was replaced. The tank seams had failed in multiple places resulting in several leaks. The failures had resulted from the repeated filling/draining of the tank, which caused repeated bowing of the sidewalls. The original construction was of ½" thick polypropylene walls which bowed out significantly when the tank was full. The replacement tank was constructed with ¾" walls and included an internal re-enforcement bar which prevented the tank from bowing when full.

### 3.2.4 Backwash Tank Transducer Replacement

On 18 September 2007 the level transducer for the microfilter backwash tank was replaced. The original transducer had failed due to corrosion caused by excessive chlorine exposure. The replacement transducer was manufactured with wetted parts constructed of hastelloy stainless steel, which is more suitable for chlorinated solutions.

### 3.2.5 Wellfield Maintenance

During the period of performance for this report no well field maintenance was performed or required. Both extraction wells continue to operate at designed flow with no problems observed.

## 3.3 Monitoring

The following sections detail the ATP sampling for arsenic and other contaminants of concern.

### 3.3.1 Arsenic Monitoring

In accordance with the GWTP's discharge permit, weekly effluent arsenic samples were collected on January 5, 16, 23 and 30, 2007. Weekly sampling was necessary due to elevated effluent arsenic results from the quarterly sampling conducted in December 2006. The January

2007 weekly sampling results were below the requirement for continued weekly sampling. Monthly sampling resumed in March 2007 (the plant did not operate in February) and continued throughout the year. Monthly sampling results indicate no exceedances of any arsenic permit limits. Monthly sampling results are shown in Table 3-4.

Overall the plant has been extremely effective at removing arsenic from the groundwater. Average influent arsenic concentrations remain high at greater than 3,000 parts per billion (ppb) (see table below).

**Treatment System Influent Concentrations**

| | EW-01 | | | EW-04 | | |
|---|---|---|---|---|---|---|
| **Date** | **As** | **Fe** | **Mn** | **As** | **Fe** | **Mn** |
| 08/07/2007 | 2.40 | 88 | 2.46 | 4.09 | 67 | 1.71 |
| 09/11/2007 | 2.58 | 80 | 2.32 | 4.04 | 54 | 1.52 |
| 12/27/2007 | 2.45 | 77 | 2.29 | 3.88 | 56 | 1.66 |

Note: All values in mg/L.

Effluent arsenic concentrations have been consistently low, averaging 1.34 ppb during the year, well below the target goal of 10 ppb. Through 31 December 2007 the ATP has removed approximately 581 pounds of arsenic from the treated groundwater.

On 3 December 2007 representatives from the Devens POTW conducted unannounced arsenic compliance sampling on the ATP effluent. The system effluent was found to be within discharge parameters.

### 3.3.2 Other Contaminants of Concern

The permit required quarterly sampling was conducted on 22 March 2007, 13 June 2007, 11 September 2007, and 27 December 2007. The 11 September 2007 sampling also included the required annual sampling. All sampled parameters were within discharge limits. Quarterly and Annual sampling results are shown in Tables 3-5 and 3-6, respectively. Table 3-7 presents the results of volatile organic compounds (VOCs) samples collected from the plant influent. Low levels of VOCs were detected in influent samples consistent with past monitoring results.

### 3.3.3 Discharge Permit Modification

On 28 June 2007, MassDevelopment re-issued the Landfill Discharge Permit, the current permit expires on 28 June 2010. The re-issued permit eliminated several monitoring parameters that were required by the previous permit. Historical data had showed that the eliminated parameters had consistently been at or near non-detect levels and are not COCs associated with the landfill. The correspondence and Landfill Discharge Permit are included in Appendix C. Eliminated parameters are illustrated in Tables 3.4, 3.5 and 3.6.

## 3.4 Recommendations

As a result of evaluating the ATP effectiveness and efficiency during the period of performance for this report, ECC recommends the following improvements be considered for the plant.

### 3.4.1 Water Heater Replacement

The current potable water heater for the ATP has an 8 gallon capacity, which is sufficient for potable (sanitary) uses within the plant. The water heater also supplies heated water for the microfiltration CIP solution. The CIP process recommended by the microfiltration vendor (Pall) requires the use of heater water; however the current water heater is unable to provide the sufficient heated water volume for this process. The recommend CIP process requires approximately 120 gallons of 90 degree F water, currently the solution is typically around 60-65 degrees. Pall recommends compensating for the lower solution temperature by increasing the recirculation and soaking times for the CIP solutions. However, Pall strongly suggests that the extended soak times are not as optimal as having the CIP solution at the recommended temperature.

Replacing the current water heater with a larger heater that can provide sufficient volume and temperature could increase CIP effectiveness. In addition, reducing or eliminating the necessary CIP recirculation and soak time would reduce plant downtime. However, the microfiltration vendor Pall just introduced a new CIP solution and method of recirculation that will increase the CIP effectiveness without replacing the water heater. Therefore, further evaluation is required prior to determining if the water heater replacement is necessary.

### 3.4.2 Evaluate Alternative Filtration Options

In response to the MCL for arsenic being lowered to 10 ppb for drinking water, several vendors have recently developed technologies for achieving this level in drinking water supplies. In general, removal of arsenic, manganese and iron are all accomplished using the same process. Most of the new processes involve filtration, and one of the vendors (Filtronics) offers a filtration system (Electromedia® I) that is claimed to remove arsenic, manganese and iron to below detection limits at 2 ppb. Preceding the filter vessel are two small reaction vessels where oxidizing chemicals are introduced to the flow.

The primary difference between these technologies and the current Pall Aria Microfiltration system is the proprietary filtration media used after oxidation. The Filtronics media allows adsorption of partially oxidized manganese. Typical adsorption processes require a regeneration process to eventually desorb contaminants and remove them from the filter media. However in the Filtronics process, the adsorbed manganese is exposed to the oxidation process longer and eventually allowed to completely oxidize, at which point the completely oxidized manganese can be removed from the media with conventional backwashing (as opposed to regeneration). These alternative systems could operate with less backwashing and less "off-line" maintenance (such as the CIP process), which would result in more consistent plant influent flow and less plant downtime. In addition, these systems may be as effective at meeting discharge requirements while requiring less chlorine dioxide. Reducing chlorine dioxide dosing could lower the levels of chlorine and chlorine byproducts in the ATP effluent, making on-site discharge more feasible.

ECC recommends these alternative methods be evaluated for potential bench and/or pilot testing for feasibility of use at the Shepley's Hill ATP.

# 4.0 GROUNDWATER MONITORING

Groundwater monitoring activities were conducted in accordance with the LTMMP (CH2M Hill, 2007b) for the period of 1 January 2007 through 31 December 2007. The details and results of these sampling events are presented in the following sections. Field forms for water levels and groundwater sampling are provided in Appendix D and analytical data validation reports are provided in Appendix E. It is noted that supplemental data, beyond that required under the LTMMP is also being collected as part of the *Supplemental Groundwater Investigation and Landfill Cap Assessment* (in progress) and ORD studies in Red Cove. These data will be required in order to make an OPS determination for the overall remedy.

## 4.1 Groundwater Elevations

Groundwater level measurements at Shepley's Hill Landfill wells were collected as part of site-wide monitoring events on 8 April and 15 October 2007. Table 4-1 provides the relevant characteristics of the LTMMP monitoring well network including geological unit(s) screened and screen depths or elevations and Figure 4-1 displays the locations of these wells, color coded by sampling frequency. Groundwater elevations for both sampling rounds are listed in Table 4-2. Groundwater elevations measured in April were generally a few feet higher than those in October. Contour maps of watertable elevation on 8 April and 15 October are presented in Figures 4-2 and 4-3 and reflect operation of the Contingency Remedy at 25 gpm and 50 gpm, respectively. While precipitation was generally below average for much of 2007, as reflected in the declining water levels (in 48 of 70 wells), the geometry of the watertable surface in both spring and fall is similar to that observed in previous years. As has been the case in previous watertable mapping, some individual water levels are inconsistent with both previous measurements and nearby wells, notably N-5,P-2 and SHP-95-27X in April, and SHP-05-43 and SHP-05-44 in October. These apparently anomalous values likely reflect data recording errors and were disregarded in the contouring effort.

## 4.2 Geochemical Results

LTMMP monitoring wells were purged and sampled in accordance with EPA's guidance for low stress purging and sampling (U.S. EPA, 1996b & 2002). Samples were analyzed for volatile organic compounds, inorganics, and general water quality parameters.

### 4.2.1 Laboratory

Table 4-3 provides a summary of laboratory analytical and field parameter data collected from the April and October 2007 sampling events. The laboratory analytes include arsenic, iron, manganese, and a suite of cations including calcium, magnesium, potassium, and sodium. In addition, other general chemistry parameters include turbidity, alkalinity, chloride, nitrogen (as nitrate), and sulfate. Values that exceed the cleanup levels established in the ROD are highlighted in Table 4-3.

In-situ geochemical water quality measurements collected in conjunction with the "quarterly snapshot" sampling are presented in Table 4-4. Quarterly snapshots supplement in-situ field parameters collected as part of semi-annual sampling events to provide additional data to assess trends in the nearfield area. Parameters include pH, specific conductivity (SPC), dissolved oxygen, temperature, and oxidation reduction potential (ORP). A summary of historical arsenic results at selected LTMMP wells is presented in Table 4-5. Arsenic (the primary COC) trends are discussed in Section 4.2.1.1, while ORP results (the primary indicator of redox conditions controlling arsenic mobility) are summarized in Section 4.2.2.

These data are being used to evaluate geochemical conditions, as they change with operation of the Contingency Remedy, primarily downgradient of the wellfield; however, data were collected in other areas to provide a baseline of upgradient conditions. A notable observation during initial operation of the system is the general stability of the parameters. Since the Contingency Remedy pumping rate had just been increased to the full 50 gpm design rate at the time of the Fall sampling event, significant changes in redox conditions and arsenic downgradient of the extraction wellfield are not expected, however, these will be important parameters for future monitoring of both system performance and arsenic clean-up.

#### 4.2.1.1 Arsenic Results

Arsenic was detected above its cleanup level in 31 of 38 monitoring wells sampled at the site during the 2007 sampling events. This has been the case for a number of years. Figure 4-4 presents arsenic results for the 2006 and 2007 semi-annual sampling events. Historic arsenic data through 2007 for selected monitoring wells are provided in Table 4-5 and also plotted in chart form in Appendix F. In general, arsenic concentrations in these wells have been relatively stable or decreasing, compared to historic levels. Only the following wells in 2007 were

reported to have concentrations greater than historical averages: SHL-11, SHL-19, SHL-20, SHM-93-22C, and SHM-96-22B. The 2006 AR (CH2M HILL, 2007a) suggested the high arsenic concentration (1,790 µg/L) at SHL-19 observed June 2006 was anomalous. However, during the most recent sampling round in October 2007, an elevated arsenic concentration (885.1 µg/L) was again reported for this well. Further, it should be noted that this well consistently exhibits elevated turbidity and therefore the reported total arsenic values may not accurately reflect dissolved concentrations. Therefore, further assessment through collection of both filtered and unfiltered samples is recommended for 2008.

The arsenic concentration at SHM-96-22B has slightly decreased in the past year compared to 2006 sampling rounds and SHL-96-5B has significantly decreased from April 2007 to October 2007 since its historical maximum of 5,110 µg/L in May, 2000. This general pattern may be related to the operation of the extraction wells nearby; however, observations over a longer period will be necessary to better define trends.

During the 2007 spring sampling event, SHM-96-22B and SHM-96-5B had the highest concentrations of arsenic at the site (2,800 and 2,030 µg/L in April 2007, respectively). For SHM-96-5B, the lowest historical concentration of arsenic occurred in October 2007. Wells SHM-96-5B and SHM-96-22B are located relatively close to each other and are screened at similar depths in mostly sand/till; however, SHM-96-5B is partially completed into bedrock (a few feet) near the eastern edge of a trough interpreted in the bedrock surface, through which the bulk of horizontal groundwater flow to the north presumably occurs. As such this well likely reflects transition zone conditions along the eastern edge of the plume. During the 2007 fall sampling event, well N-5, P-1 had the highest concentration of arsenic, 4,856 µg/L. It is also noteworthy that SHL-8S and SHL-8D both had first time detections in excess of 10 µg/L and therefore should be monitored in the future to determine if this trend persists or is anomalous.

#### 4.2.1.2 Other COCs Results

The other COCs detected at concentrations above cleanup levels were iron, manganese, and sodium (Table 4-3). Wells that had concentrations of manganese above the cleanup level of 1,715 µg/L were: N-5 P-1, SHL-11, SHL-19, SHL-20, and SHL-22, SHM-05-39B, SHM-05-41B, SHM-05-41C, SHM-96-5B, SHM-96-5C, SHM-96-22B, SHM-99-31C, SHM-99-32X. The maximum value detected for manganese was 11,400 µg/L at SHM-96-5B in October 2007. Sodium was detected at levels above its cleanup level of 20,000 µg/L at 21 wells during 2007.

The maximum value detected for sodium was 47,000 µg/L at SHM-05-39B. Concentrations of iron above the cleanup level of 9,100 µg/L were detected at 20 wells with a maximum value of 100,000 µg/L at SHM-05-41B in October 2007.

### 4.2.2 Field Parameters

In-situ geochemical water quality measurements collected in 2007 are presented in Tables 4-3 and 4-4. While this sampling is conducted quarterly, the fourth round for 2007 was actually collected in January 2008 and will be included in the 2008 Annual Report. ORP is a particularly significant field parameter at Shepley's Hill Landfill. Since arsenic and iron are mobilized by reducing conditions, higher concentrations are expected in locations where ORP values are negative. Arsenic concentrations and field ORP measurements from 2007 are listed in Table 4-3. As previously noted, the majority of samples with arsenic above 10 ug/L also have negative ORP values. The few exceptions to this trend may reflect transition areas or seasonal influences.

Downgradient area wells that have negative ORP values include SHM-99-32X, SHM-99-31B, SHM-05-39B, SHM-05-41A, and SHM-05-41C. Nearfield area wells with negative ORP values include SHL-9, SHL-22, SHM-96-22B, SHM-93-22C, SHM-96-5B, and SHM-96-5C. Pond area wells with observed negative ORP values include SHP-01-38A, SHP-01-36X, and SHP-01-37X. Six upgradient area wells had negative ORP values: SHL-15, N-5 P-1, N-5 P-2, SHL-11, SHL-19, and SHL-20.

# 5.0 SYSTEM PERFORMANCE METRICS AND ASSESSMENT

In the 2006 AR (CH2M HILL, 2007a), a hydraulic performance assessment of the groundwater extraction system was deferred based on the fact that the system had not been operating at the target design rate of 50 gpm. In addition, it was concluded "the Group 1 and 2 well designations are no longer relevant for the combined capped landfill and Contingency Remedy" and, therefore, recommended that new more appropriate system performance assessment metrics for the Contingency Remedy be established. The following section presents an assessment of system performance, utilizing data from the end of the year (and early 2008) after the extraction rate was increased 50 gpm. This assessment is the initial step in a comprehensive assessment of Contingency Remedy performance that will be completed in the coming years as additional monitoring data is collected under full implementation.

With full implementation of the Contingency Remedy, the source of reduced groundwater emanating from the landfill is presumably being contained, however, groundwater geochemistry and specifically redox conditions downgradient are expected to take some time (potentially years, as will be shown below) to adjust to new equilibrium conditions. Therefore, this performance assessment of the extraction system is currently focused on system hydraulics and demonstration of containment. The OPS determination for the overall remedy will be addressed in the future after completion of the *Supplemental Groundwater Investigation and Landfill Cap Assessment* (AMEC, in progress) and the subsequent AOC 72 reporting.

## 5.1 Revised System Performance Metrics

The 2006 AR recommended "the operational wellfield flow rate should be increased from 25 gpm to 50 gpm to evaluate long-term wellfield and plant operation at the model-predicted hydraulic containment rate." As discussed in Section 1.3, this increase was initiated in July 2007 and, therefore, only the final sampling round of 2007 was conducted under the full design operational flow rate.

Consistent with EPA guidance including *A Systematic Approach for Evaluating of Capture Zones at Pump and Treat Systems* (USEPA, 2008), a multiple lines of evidence approach was taken with respect to the capture assessment. The assessment components include the following:

- Hydraulic Capture Zone Analysis
    - Gradient Vector Analysis
    - Capture Zone Width Calculation
    - Drawdown Assessment
    - Comparison to Numerical Model Results
- Geochemical Monitoring
    - Advective Travel Time Analysis
    - Qualitative Concentrations Trend Analysis

This assessment approach was discussed with USEPA and MassDEP at the 20 December 2007 BRAC Cleanup Team (BCT) meeting. Table 5-1 provides a description of each assessment component, its data requirements, and a brief summary of the results. Additional details are provided in the following sections.

## 5.2 Hydraulic Capture Assessment

The hydraulic capture assessment is comprised of four lines of evidence to support the evaluation. These components are presented in the following sections.

### 5.2.1 Gradient Vector Analysis

Horizontal hydraulic gradient vectors were computed for selected well triplets (3 adjacent wells with similar screened intervals) using data from three separate synoptic water level surveys conducted on 15 October 2007, 25 February 2008, and 4 March 2008. As discussed in Section 4, the 15 October 2007 event was the first conducted under 50 gpm pumping conditions. The February and March events were conducted after system shutdown and restart, respectively, as part of the Drawdown Assessment discussed below in Section 5.3.3. Figure 5-1 plots all three sets of vectors, where data was available, for comparison.

In general, all three sets of vectors are very similar, indicating directions of flow are relatively stable in many areas. Since both reflect 50 gpm operating conditions, differences between the October 2007 and March 2008 surveys should only reflect natural seasonal variations (October water levels being generally below average, March being slightly above). In contrast,

differences between the February 2008 and March 2008 surveys should primarily reflect influence of the pumping stress on flow directions within the aquifer.

As expected, gradient vectors under pumping conditions (blue arrows) in the nearfield area are redirected toward the extraction wells relative to ambient (non-pumping) conditions (green arrows). In contrast, gradient vectors distant from the nearfield area exhibit an equal or greater apparent variation due to seasonal changes in watertable elevation. Lastly, vectors along the western edge of plow Shop Pond confirm (as previously interpreted) that there is hydraulic gradient toward the pond in the Red Cove area and away from the pond closer to the dam, and this condition is largely uninfluenced by pumping stresses or seasonal changes. As will be shown in Sections 5.2.4 and 5.3.1 below, calculated gradient vectors are also consistent with model predicted patterns of flow both inside and outside the capture zone.

### 5.2.2 Capture Zone Width Calculation

Calculation of capture zone width was performed based on the basic water balance equation for an idealized aquifer:

$$Q = W B K i$$

where: Q = flow rate (vol/time)
W = capture zone width (length)
B = saturated thickness (length)
K = hydraulic conductivity (length/time)
i = hydraulic gradient (dimensionless)

assuming: 1) homogenous, isotropic aquifer
2) constant saturated thickness
3) no recharge

Input parameter values are as follows:

1. Cumulative extraction rate of EW-01 and EW-04 is 50 gpm (9625 cubic feet per day).
2. Saturated thickness at the extraction well area is a maximum of 94 feet with an average of 90 feet. The impacted portion in which the wells are screened is approximately 50 feet.
3. Hydraulic conductivity of the overburden/waste deposits is estimated at 45 ft/day at the extraction wells and 35 ft/day upgradient within the landfill (Harding ESE, 2002; CH2M HILL, 2006).

4. Hydraulic gradient across the extraction well area (based on 2007 water levels from N5, P1 to SHM-93-22C) ranges from 0.0054 to 0.0072 ft/ft with an average of 0.0063 ft/ft.

Using the average hydraulic conductivity (40 ft/day) and gradient (0.0063 ft/ft), the calculated capture zone width is 763 feet based on the estimated saturated thickness of 50 feet. This saturated thickness value is considered representative of the impacted portion of the aquifer, across which the extraction wells are screened, as well as the full saturated thickness within the landfill proper just upgradient. For the full saturated thickness at the extraction wells (90 feet), the calculated capture zone width is 424 feet. Further upgradient, the overburden aquifer continues to thin as the bedrock surface rises and calculated capture zone width would increase proportionally.

Given the simplicity of this analytical solution approach, results are inversely proportional to both the hydraulic conductivity and saturated thickness parameters. Therefore, it is acknowledged that uncertainty in these values directly corresponds to uncertainty in the predicted capture zone width. Despite this limitation, based on an interpreted width of the impacted portion of the aquifer at the extraction wells of less than 444 feet (approximate distance from SHM-96-5B to SHL-23) the calculated capture zone width is considered sufficient to achieve full containment.

### 5.2.3 Drawdown Assessment

Consistent with the work plan (ECC, 2008) provided 18 January 2008, an extraction system hydraulic drawdown assessment was performed beginning in late February. The primary objective of this assessment was to calculate drawdown in the aquifer based on a comparison of synoptic water level surveys under ambient (non-pumping) and stressed (pumping) conditions. Because the last synoptic water level survey under ambient conditions was conducted in August 2005 and water levels are highly sensitive to seasonal and even barometric changes, it would be inappropriate to compare against 2007 water level data (under 50 gpm pumping conditions) for this purpose. Therefore, a controlled shutdown test was conducted, during which a new pair of synoptic water level surveys under ambient and stressed conditions were collected.

On 20 February 2008 the extraction system was shutdown for a period of 6 days in order to collect water levels under ambient and stressed conditions that could be compared to quantify the induced aquifer drawdown. Details of the test timeline and data collection were as follows:

- Continuously monitoring transducers installed in 13 monitoring wells: SHL-8S, SHL-9, SHL-20, SHL-22, SHM-96-5B, SHM-96-5C, SHM-96-22B, SHM-93-22C, SHP-99-29X, SHP-05-45A, SHP-05-45B, N5-P1, N5-P2
- Pre-test synoptic water levels collected 20 February 2008 under 50 gpm operating conditions over the entire LTMMP network
- Extraction system shutdown on 20 February 2008 at 1200 hours (noon)
- Synoptic water levels collected 25 February 2008 under ambient conditions over the entire LTMMP network
- Extraction system restarted 26 February 2008 at 0700 hours
- Hourly water levels collected in selected nearfield wells (EW-01pilot, EW-04pilot, SHL-5, SHL-21, SHL-23, SHP-05-41A, SHP-05-41B, SHP-05-46A, SHP-05-46B) for 8 hours after restart
- Post-test synoptic water levels collected 3 March 2008 under 50 gpm operating conditions over the entire LTMMP network

Relative to the wells originally listed in the workplan, some adjustments to those targeted for transducers and hourly manual measurements were made based on USEPA transducers being relocated in mid-January (e.g. SHP-05-46A relocated to SHL-8S). In addition, data could not be collected from some wells due to frozen, dry, or flooded conditions (e.g. SHP-05-42A,B). Figure 5-2 displays the barometric pressure and temperature during the test period as recorded at Fitchburg Airport. From these data it is evident that 1) barometric pressures oscillated significantly, particularly after the restart on 25 February 2008 and 2) temperatures exceeded freezing and significant melting of snowpack likely occurred over the period of 25-27 February 2008. Figure 5-3 displays the water level changes collected by the continuous recording pressure transducers installed in selected wells (and also barometric pressure). It should be noted that the transducers installed by ECC were a vented design and therefore automatically compensate for barometric pressure changes, whereas the existing transducers maintained by USEPA appear to be the unvented type. Figure 5-4 displays the increase in drawdown with time as determined from hourly manual water levels collected for 8 hours after system restart. From these plots the following conclusions are drawn:

- nearfield water levels are influenced primarily by pumping stress while shallow or more distant wells are primarily influenced by barometric pressure changes,

- water levels stabilized rapidly (within a day) in the nearfield area to both shutdown and restart events,
- water levels appear to rise slightly during the shutdown period consistent with a steady barometric pressure decline and then rose steeply shortly after the restart, potentially in response to a combination of declining barometric pressure and the melting\recharge event, and
- water levels oscillated with barometric pressure significantly for the six days after restart when the final synoptic event was conducted, yet on average recover to near their 25 February 2008 levels for the final synoptic event on 3 March 2008.

Based on these observations it was determined that stabilization with regard to pumping stresses is quickly reached however the system is constantly adjusting to 'ambient' stresses such as recharge and barometric pressure changes. Further, potentially due to the presence of the cap, the response to these stresses in wells outside the influence of pumping is not spatially uniform, with some water levels rising while others are falling. This condition limits the potential to "correct" water level differences observed for the component of change due to ambient conditions. As a consequence, water level differences between the 25 February 2008 and 3 March 2008 (post-test) synoptic events are interpreted to be reasonably representative of drawdown due to pumping.

Data from the three synoptic surveys and the calculated drawdown values are compiled in Table 5-2. Figure 5-5 plots these observed drawdowns in comparison to contours of predicted drawdown developed using the existing groundwater model (see also section 5.2.4 below). This map suggests that the distribution of drawdowns is in general agreement. However, it is evident that the model overpredicts the magnitude in the nearfield area. This is expected due to the following: 1) some wells have shallow screens while the extraction wells are screened only in the deep portion of the aquifer, and 2) the model does not presently account for vertical anisotropy in hydraulic conductivity of the aquifer which likely limits propagation of pumping stresses vertically in the field.

In conclusion, based on 1) the systematic increase in observed drawdown with proximity to the extraction wells and 2) the general agreement between observed and predicted drawdowns, pumping stress from the extraction well pair is interpreted to influence the aquifer as expected.

### 5.2.4 Comparison to Numerical Model Results

As discussed above, the existing groundwater flow model of operating conditions (referred to as 'run412' in various CH2M HILL reports) was utilized to calculate predicted drawdown for comparison to that observed. As discussed in the *Supplemental Groundwater Investigation* (Harding ESE, 2002), the ambient conditions variant of the model (known as 'run200') was originally calibrated to February 1999 water levels, several years prior to construction of the Contingency Remedy. To evaluate calibration to a more recent and comprehensive dataset, Figure 5-6 compares water levels observed under 50 gpm operating conditions from the 20 February 2008 synoptic survey to those predicted by the 'run412' model. This correlation plot indicates that the model matches the majority of observed waters levels throughout the site and downgradient area within 1-2 feet, though most are under-predicted, particularly in the upgradient area. Despite this under-prediction the plot also indicates the model generally represents the change in groundwater elevations (horizontal hydraulic gradients) across the site. Consequently, the model is considered reasonably well calibrated and, therefore, suitable for use in predictive simulations.

Figure 5-7 shows the model predicted watertable elevation contours and capture zone as defined by backward particle tracking from the extraction well pair. This map indicates the 50 gpm capture zone encompasses the entire landfill footprint and was used as the primary basis for defining the optimum extraction well locations. Notably, flow patterns in the nearfield area generally agree with the horizontal gradients vector plotted in Figure 5-1.

Collectively, the correspondence to observed water levels, gradients and flow direction vectors suggest the model is a reasonable representation of the groundwater flow system under pumping conditions and, therefore, supports the interpretation that the extraction system is operating as designed. It is noted that the 'run412' flow model is currently being revised and recalibrated as part of the Supplemental Groundwater Investigation and Landfill Cap Assessment (AMEC, in progress). Model revisions are to include: 1) discretization of a deep overburden layer corresponding to the portion of the aquifer in which the extraction wells are completed and 2) introduction of vertical anisotropy within the overburden ranging from 3:1 in the shallow portion to 10:1 in the deep portion. Because these changes will likely affect model predictions, it is recommended that similar comparisons with the revised model be performed as part of the 2008 AR.

## 5.3 Geochemical Monitoring Assessment

Recent and historical trends in aquifer geochemistry and specifically arsenic are discussed in Section 4.2. While there have been some declines in arsenic concentrations in selected nearfield wells (the two most notable being SHM-96-5B and SHM-93-22B) since the Contingency Remedy has been in operation, no convincing trends are evident.

As stated above, through October 2007 the extraction system was operated at 25 gpm, or half the design rate considered to be effective at fully containing impacted groundwater migrating from the landfill. Therefore, it is possible that only partial containment has been achieved through this period and, thus, significant changes in downgradient geochemical conditions are not yet expected. As a consequence, analytical data is not expected to provide much insight on system performance at this time.

### 5.3.1 Advective Travel Time Analysis

The existing groundwater flow model may be used to calculate travel time relationships throughout the flowfield. Figure 5-8 illustrates model-predicted travel times using time markers (arrows spaced at 2 year intervals) along backward particle paths initiated from the south side of Nonacoicus Brook. This map shows that groundwater in the downgradient area travels horizontally at an average velocity of roughly 0.5 ft/day. For example, groundwater presently in the vicinity of SHP-37X near Red Cove will require approximately 5 years to travel 900 feet and reach SHL-9 just downgradient of the extraction wells. As a consequence of this relatively slow advective transport velocity and the fact that redox conditions will likely take some time to fully equilibrate to flow system changes, rapid changes in ORP values and arsenic concentrations in downgradient wells are not expected.

### 5.3.2 Qualitative Concentrations Trend Analysis

Based on the circumstances discussed above, geochemical data collected in 2007 provides relatively little insight into system performance. Despite this, notable declines in arsenic concentration were observed during the October 2007 sampling at SHM-96-5B and SHM-93-22B, the two impacted monitoring locations nearest the extraction wells. While these data may reflect the beginning of mitigation of arsenic impacts in the downgradient aquifer, additional sampling rounds are required before such a conclusion can be drawn with confidence.

## 5.4 Performance Assessment Summary

Consistent with EPA guidance including *A Systematic Approach for Evaluating of Capture Zones at Pump and Treat Systems* (USEPA, 2008), a multiple lines of evidence approach was taken with respect to the performance assessment. The individual assessment components, their data requirements, and a brief summary of the results are provided in Table 5-1. With respect to the hydraulic capture zone analysis, while no single component conclusively demonstrates capture effectiveness, all four indicate some degree of correspondence to the expected aquifer response to pumping. With respect to the geochemical monitoring, the data are presently inconclusive, yet this too is consistent with expectations in that, based on estimated groundwater velocities, it will take several years to 'flush' currently impacted groundwater from areas outside the capture zone and then additional time for new equilibrium redox conditions (presumably oxidizing) to be established, which in turn are expected to result in declines in arsenic concentration.

Based on the cumulative weight of these lines of evidence, the extraction, treatment, and discharge system is interpreted to be operating as designed.

## 5.5 Recommendations for Future System Performance Metrics

In future annual assessments, as more geochemical data are accumulated under continued operation of the Contingency Remedy at its full design rate, it is recommended that observed trends in arsenic concentrations, and key geochemical indicator parameters such as ORP, be projected into the future to establish the expected time to reach target MCLs. Such an analysis could then be used to predict geochemical changes in the downgradient area, which could be used as future system performance metrics.

# 6.0 CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations resulting from the long-term monitoring and O&M services conducted at Shepley's Hill Landfill during 2007 are summarized in the following sections.

## 6.1 Conclusions

- The landfill cap was mowed to an approximate height of 6" in the fall of 2007 and areas within northern drainage swales were cleared of vegetation.
- Repairs were made to the northern portion of the access road to the ATP in May 2007 to address erosion and ruts.
- The overall condition of the landfill appears satisfactory with the exception of several settled areas where pooling of water is frequently observed, damaged or non-existent fencing, and missing/damaged monitoring well padlocks.
- Elevated levels of methane and percent lower explosive limit (LEL) were observed in three LGPs (LGP-05-10X, LGP-05-11X, and LGP-05-13X) on the southern end of the landfill that were inconsistent with prior sampling results. All LGPs were re-sampled in March 2008 and the results were consistent with historic data.
- Landfill gas vent results were fairly consistent with historical results and indicate proper landfill gas venting.
- The Contingency Remedy groundwater extraction and treatment system was operated for the majority of the 2007 at 25 gpm. The extraction rate was increased to 50 gpm in July 2007 and has operated at that rate since.
- The ATP was on-line approximately 73% of the available time during the year. However, a significant part of the downtime was the period the plant was off-line during the change of O&M providers. Since ECC began O&M on 6 March 2007 the plant has operated approximately 82% of the available time. By far the largest contributor of downtime is the frequent need for FBRO pumpouts and clean-in-place maintenance on the microfiltration system.
- Several maintenance activities were completed, including microfilter air line and piping upgrade and backwash tank and transducer replacement to maintain the ATP in good working condition.
- The ATP was extremely effective at removing arsenic from the groundwater. Average influent arsenic concentrations remain high at greater than 3,000 µg/L. Effluent arsenic

concentrations have been consistently low, averaging 1.34 µg/L during the year, well below the target goal of 10 µg/L. Through 31 December 2007 the ATP has removed approximately 581 pounds of arsenic from the treated groundwater.

- While precipitation was generally below average for much of 2007, as reflected in the declining water levels, the geometry of the watertable surface in both spring and fall is similar to that observed in previous years.
- In general, arsenic concentrations in the LTMMP wells remain relatively stable or decreasing, compared to historic levels. Only the following wells in 2007 were reported to have concentrations greater than historical averages: SHL-11, SHL-19, SHL-20, SHM-93-22C, and SHM-96-22B.
- Nearly all groundwater samples which have arsenic concentrations exceeding 10 µg/L, with the exception of ten (SHL-5, SHL-8D, SHL-8S, SHM-05-39A, SHM-05-40X, SHM-05-41B, SHM-05-42B, SHM-96-5B, SHM-99-31A, and SHM-99-31C), also have a corresponding negative ORP value. All of these exceptions occur in October, which suggests seasonal influence on ORP values.
- Geochemical data collected to date have not displayed significant changes in chemistry related to the operation of the system, however based on the last sampling round only, reductions in arsenic concentrations may be beginning in two wells immediately downgradient of the capture zone.
- The hydraulic capture zone assessment indicates that the extraction wellfield is operating as designed. Observed hydraulic gradients, drawdowns, and calculated capture zone width under 50 gpm operations indicate that the groundwater pumping system zone of influence is consistent with modeled predictions.

## 6.2 Recommendations

- The settled areas where pooling and minor rutting damage has been observed should be repaired (filled, graded & seeded). In addition, the small trees near the margin of the landfill should be removed and the gas vents painted.
- The security fence gates should be repaired and secured with chains and locks to minimize vehicle traffic on the landfill. All gates, monitoring wells, and piezometers should be equipped with "keyed alike" padlocks and keys be issued to all parties requiring access.

- An assessment of the landfill perimeter gas monitoring network should be completed followed by installation of additional gas wells in both the southern and northern boundary areas.
- The frequency of the perimeter landfill gas monitoring should be increased to quarterly in 2008.
- Alternative filtration methods should be evaluated for potential bench and/or pilot testing at the Shepley's Hill ATP to reduce plant downtime. (Note: ECC is currently reviewing a pilot study proposal from Filtronics, Inc and will have a recommendation by September 2008.)
- Observed water levels, gradients and flow direction vectors should be compared to the revised groundwater model as part of the 2008 AR to further assess system performance.
- In order to address the potential bias of Arsenic concentrations due to turbidity, both filtered and unfiltered samples should be collected from SHL-19.
- The groundwater monitoring program should be conducted consistent with the revised LTMMP in 2008. Optimization of the monitoring program should be re-evaluated in the 2008 AR.
- Observed trends in arsenic concentrations and other geochemical indicator parameters should be projected to establish the expected time to reach target MCLs. This analysis should be initiated in the 2008 AR and used to predict geochemical response in the downgradient area.

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Table 1-1
Contaminants of Concern (COC) Cleanup Level
Shepley's Hill Landfill
Devens, Massachusetts

| COC | Cleanup Level (µg/L) | Selection Basis |
|---|---|---|
| Arsenic | 10 | MCL |
| Chromium | 100 | MCL |
| 1,2-Dichlorobenzene | 600 | MCL |
| 1,4-Dichlorobenzene | 5 | MCL |
| 1,2-Dichloroethane | 5 | MCL |
| Lead | 15 | Action Level |
| Manganese | 1715 | Background [(1)] |
| Nickel | 100 | MCL |
| Sodium | 20000 | Health Advisory |
| Aluminum | 6870 | Background |
| Iron | 9100 | Background |

**Notes:**

**1) Revised ROD clean-up level based on background evaluation**

**MCL = Maximum Contaminant Level**

# Table 3-1
# Operations Summary - January 2007
# Shepley's Hill Landfill
# Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharge | Status |
|---|---|---|---|
| 1/1/2007 | 20 | 25,200 | System shutdown at 2000, high MF pressure |
| 1/2/2007 | 1 | 1,600 | Operated in manual only, started CIP |
| 1/3/2007 | 10 | 13,800 | System started at 1100, shutdown at 2100 |
| 1/4/2007 | 12 | 17,000 | System restarted at 1200 |
| 1/5/2007 | 14 | 17,600 | Completed effluent sampling, shutdown at 1400 |
| 1/6/2007 | 0 | 0 | Off-line |
| 1/7/2007 | 1 | 1,000 | Operated in manual only |
| 1/8/2007 | 2 | 2,600 | Operated in manual only, started CIP |
| 1/9/2007 | 0 | 0 | Off-line |
| 1/10/2007 | 0 | 0 | Off-line |
| 1/11/2007 | 0 | 0 | Off-line |
| 1/12/2007 | 13 | 25,500 | System restarted at 1100 |
| 1/13/2007 | 24 | 45,800 | Operating |
| 1/14/2007 | 24 | 46,500 | Operating |
| 1/15/2007 | 24 | 50,500 | Operating |
| 1/16/2007 | 24 | 44,200 | Operating, weekly sampling completed |
| 1/17/2007 | 24 | 38,900 | Operating |
| 1/18/2007 | 24 | 38,900 | Operating |
| 1/19/2007 | 24 | 38,900 | Operating |
| 1/20/2007 | 24 | 38,900 | Operating |
| 1/21/2007 | 13 | 20,100 | System shutdown at 1300 for FBRO pumpout |
| 1/22/2007 | 10 | 16,200 | System restarted at 1400 |
| 1/23/2007 | 24 | 37,800 | Operating, weekly sampling completed |
| 1/24/2007 | 24 | 37,500 | Operating |
| 1/25/2007 | 20 | 3,400 | Operating, shutdown 4 hours of piping upgrade |
| 1/26/2007 | 24 | 38,000 | Operating |
| 1/27/2007 | 24 | 37,700 | Operating |
| 1/28/2007 | 24 | 37,500 | Operating |
| 1/29/2007 | 24 | 37,100 | Operating |
| 1/30/2007 | 11 | 14,600 | Weekly sampling completed, shutdown at 1100 for CIP |
| 1/31/2007 | 8 | 12,800 | System restarted at 1200, shutdown at 2000 |
| **Total** | **471** | **739,600** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **63** | | |

# Table 3-1
# Operations Summary - March 2007
# Shepley's Hill Landfill
# Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharge | Status |
|---|---|---|---|
| 3/1/2007 | 0 | 0 | Off-line |
| 3/2/2007 | 0 | 0 | Off-line |
| 3/3/2007 | 0 | 0 | Off-line |
| 3/4/2007 | 0 | 0 | Off-line |
| 3/5/2007 | 0 | 0 | Off-line |
| 3/6/2007 | 13 | 18,100 | System started at 1100 |
| 3/7/2007 | 24 | 34,800 | Operating |
| 3/8/2007 | 24 | 34,000 | Operating |
| 3/9/2007 | 24 | 33,400 | Operating |
| 3/10/2007 | 24 | 35,200 | Operating |
| 3/11/2007 | 24 | 33,400 | Operating |
| 3/12/2007 | 13 | 18,300 | Shutdown at 1300 for CIP |
| 3/13/2007 | 9 | 12,400 | System started at 1500 |
| 3/14/2007 | 24 | 34,000 | Operating |
| 3/15/2007 | 24 | 35,500 | Operating |
| 3/16/2007 | 24 | 35,300 | Operating |
| 3/17/2007 | 24 | 35,600 | Operating |
| 3/18/2007 | 24 | 34,200 | Operating |
| 3/19/2007 | 24 | 31,100 | Operating |
| 3/20/2007 | 8 | 10,400 | Shutdown at 0800 for CIP |
| 3/21/2007 | 8 | 12,400 | System started at 1600 |
| 3/22/2007 | 24 | 36,600 | Operating, quarterly sampling completed |
| 3/23/2007 | 15 | 23,300 | System shutdown at 1500, chlorine empty |
| 3/24/2007 | 0 | 0 | Off-line |
| 3/25/2007 | 0 | 0 | Off-line |
| 3/26/2007 | 1 | 1,000 | System run for B/W only |
| 3/27/2007 | 10 | 15,900 | System started at 1400 |
| 3/28/2007 | 24 | 36,800 | Operating |
| 3/29/2007 | 24 | 36,600 | Operating |
| 3/30/2007 | 24 | 37,700 | Operating |
| 3/31/2007 | 24 | 36,400 | Operating |
| **Total** | **461** | **672,400** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **62** | | |

# Table 3-1
# Operations Summary - April 2007
# Shepley's Hill Landfill
# Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 4/1/2007 | 20 | 29,200 | System shutdown at 2000, FBRO full |
| 4/2/2007 | 0 | 0 | System shutdown |
| 4/3/2007 | 0 | 0 | System Shutdown |
| 4/4/2007 | 0 | 0 | System shutdown, started CIP |
| 4/5/2007 | 0 | 0 | System shutdown, CIP completed |
| 4/6/2007 | 18 | 23,500 | FBRO emptied, system on at 0900 |
| 4/7/2007 | 24 | 36,800 | Operating |
| 4/8/2007 | 24 | 37,000 | Operating |
| 4/9/2007 | 24 | 36,200 | Operating |
| 4/10/2007 | 24 | 37,200 | Operating |
| 4/11/2007 | 24 | 36,100 | **Monthly effluent sampling, As was non-detect** |
| 4/12/2007 | 24 | 36,100 | Operating |
| 4/13/2007 | 24 | 37,200 | Operating |
| 4/14/2007 | 24 | 36,200 | Operating |
| 4/15/2007 | 24 | 36,200 | Operating |
| 4/16/2007 | 24 | 36,600 | Operating |
| 4/17/2007 | 24 | 36,600 | Operating |
| 4/18/2007 | 24 | 35,900 | Operating |
| 4/19/2007 | 24 | 36,400 | Operating |
| 4/20/2007 | 24 | 36,100 | Operating |
| 4/21/2007 | 24 | 34,400 | Operating |
| 4/22/2007 | 24 | 34,700 | Operating |
| 4/23/2007 | 24 | 34,800 | Operating |
| 4/24/2007 | 17 | 27,000 | System shutdown from 0830 to 1530 for CIP |
| 4/25/2007 | 24 | 35,700 | Operating |
| 4/26/2007 | 24 | 34,800 | Operating |
| 4/27/2007 | 24 | 36,500 | Operating |
| 4/28/2007 | 21 | 31,500 | System remotely shutdown at 2100, high TMP |
| 4/29/2007 | 0 | 0 | System shutdown |
| 4/30/2007 | 16 | 21,300 | System restarted at 0800, running at lowered flow |
| **Total** | **572** | **854,000** | |
| **Total Available Hours** | **720** | | |
| **Percent On-Line** | **79** | | |

## Table 3-1
## Operations Summary - May 2007
## Shepley's Hill Landfill
## Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 5/1/2007 | 24 | 31,000 | System operating, running at lowered flow. |
| 5/2/2007 | 24 | 28,200 | System operating, running at lowered flow. |
| 5/3/2007 | 8 | 10,000 | System shutdown at 0800 for CIP & FBRO. |
| 5/4/2007 | 13 | 21,100 | System restarted at 1100, CIP completed & FBRO emptied. |
| 5/5/2007 | 24 | 36,200 | Operating. |
| 5/6/2007 | 24 | 36,200 | Operating. |
| 5/7/2007 | 9 | 14,600 | System shutdown at 0900 for CIP. |
| 5/8/2007 | 13 | 19,900 | System restarted at 1100, CIP completed. |
| 5/9/2007 | 24 | 36,700 | Operating. |
| 5/10/2007 | 24 | 37,000 | Operating. |
| 5/11/2007 | 24 | 37,000 | Operating. |
| 5/12/2007 | 24 | 37,000 | Operating. |
| 5/13/2007 | 24 | 36,500 | Operating. |
| 5/14/2007 | 24 | 37,600 | Operating. |
| 5/15/2007 | 20 | 30,400 | System shutdown at 0900 for sludge pump repair, restarted at 1300. |
| 5/16/2007 | 24 | 36,900 | **Monthly effluent sampling, As was 1.2 ug/L.** |
| 5/17/2007 | 24 | 35,700 | Operating. |
| 5/18/2007 | 24 | 34,800 | Operating. |
| 5/19/2007 | 24 | 35,700 | Operating. |
| 5/20/2007 | 24 | 35,100 | Operating. |
| 5/21/2007 | 8 | 12,100 | System shutdown at 0800 for CIP. |
| 5/22/2007 | 14.5 | 21,400 | System restarted at 0930, CIP completed. |
| 5/23/2007 | 24 | 36,200 | Operating. |
| 5/24/2007 | 24 | 34,800 | Operating. |
| 5/25/2007 | 24 | 36,100 | Operating. |
| 5/26/2007 | 24 | 35,300 | Operating. |
| 5/27/2007 | 24 | 35,800 | Operating. |
| 5/28/2007 | 24 | 35,600 | Operating. |
| 5/29/2007 | 24 | 34,900 | Operating. |
| 5/30/2007 | 24 | 35,000 | Operating. |
| 5/31/2007 | 20 | 29,900 | System shutdown at 2000 to allow FBRO to drain. |
| **Total** | **657.5** | **974,700** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **88** | | |

**Table 3-1**
**Operations Summary - June 2007**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 6/1/2007 | 14 | 19,600 | System shutdown to allow FBRO to drain. |
| 6/2/2007 | 15.5 | 22,400 | System shutdown to allow FBRO to drain. |
| 6/3/2007 | 24 | 35,100 | Operating. |
| 6/4/2007 | 6 | 9,000 | System shutdown for CIP and FBRO pump out. |
| 6/5/2007 | 15 | 23,400 | System restarted at 0900. |
| 6/6/2007 | 24 | 36,400 | Operating. |
| 6/7/2007 | 24 | 37,600 | Operating. |
| 6/8/2007 | 24 | 36,200 | Operating. |
| 6/9/2007 | 24 | 35,400 | Operating. |
| 6/10/2007 | 24 | 35,700 | Operating. |
| 6/11/2007 | 24 | 35,700 | Operating. |
| 6/12/2007 | 23.5 | 34,700 | System shutdown for 0.5 hours for chlorine cylinder change out. |
| 6/13/2007 | 24 | 35,800 | **Completed quarterly sampling, effluent As at 1.3 ppb.** |
| 6/14/2007 | 24 | 34,900 | Operating. |
| 6/15/2007 | 24 | 35,100 | Operating. |
| 6/16/2007 | 24 | 36,100 | Operating. |
| 6/17/2007 | 24 | 36,600 | Operating. |
| 6/18/2007 | 21.25 | 32,400 | System shutdown at 0915, low air alarm, restarted at 1200. |
| 6/19/2007 | 24 | 36,000 | Received 1000 gallons sodium chlorite delivery. |
| 6/20/2007 | 11.5 | 18,300 | System shutdown at 1130 to start CIP, |
| 6/21/2007 | 8.5 | 12,600 | CIP completed, system on at 0915. System shutdown at 1015, low air alarm, system restarted at 1630. |
| 6/22/2007 | 24 | 36,100 | Operating. |
| 6/23/2007 | 24 | 36,200 | Operating. |
| 6/24/2007 | 24 | 36,600 | Operating. |
| 6/25/2007 | 24 | 36,600 | Operating. |
| 6/26/2007 | 24 | 36,400 | Operating. |
| 6/27/2007 | 24 | 36,000 | Operating. |
| 6/28/2007 | 24 | 36,300 | Operating. |
| 6/29/2007 | 17 | 26,100 | System shutdown due to tank level alarm. |
| 6/30/2007 | 15 | 22,900 | System shutdwon for faulty pressure transducer. |
| **Total** | **627.25** | **942,200** | |
| **Total Available Hours** | **720** | | |
| **Percent On-Line** | **87** | | |

## Table 3-1
## Operations Summary - July 2007
## Shepley's Hill Landfill
## Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 7/1/2007 | 0 | 0 | System shutdown pending FBRO pump out and CIP. |
| 7/2/2007 | 8 | 12,500 | FBRO pump out and CIP completed, system restarted at 1600. Repaired faulty level transducer in T-2. |
| 7/3/2007 | 24 | 34,700 | Operating. |
| 7/4/2007 | 24 | 34,500 | Operating. |
| 7/5/2007 | 24 | 34,100 | Operating. |
| 7/6/2007 | 24 | 33,000 | Operating. |
| 7/7/2007 | 24 | 31,500 | Operating. |
| 7/8/2007 | 14 | 17,800 | Plant shutdown remotely, low air alarm. System restarted, air compressor setpoint adjusted. |
| 7/9/2007 | 15.5 | 12,200 | System shutdown for CIP. |
| 7/10/2007 | 14 | 19,600 | CIP completed, system restarted at 1000. |
| 7/11/2007 | 24 | 33,600 | Operating. |
| 7/12/2007 | 24 | 35,700 | **Completed monthly effluent sampling, As at 1.4 ppb** |
| 7/13/2007 | 24 | 36,100 | Operating. |
| 7/14/2007 | 24 | 35,800 | Operating. |
| 7/15/2007 | 24 | 35,800 | Operating. |
| 7/16/2007 | 24 | 36,100 | Operating. |
| 7/17/2007 | 20.5 | 32,000 | System shutdown remotely at 2030, faulty T-2 transducer. |
| 7/18/2007 | 15 | 21,700 | System restarted at 0630, transducer cleaned. System remotely shutdown at 2130, transducer not functioning. |
| 7/19/2007 | 0 | 0 | System down pending transducer replacement. |
| 7/20/2007 | 0 | 0 | " |
| 7/21/2007 | 0 | 0 | " |
| 7/22/2007 | 0 | 0 | " |
| 7/23/2007 | 15.5 | 34,400 | Transducer replaced, system restarted at 0830. Flow increase to 40 gpm. |
| 7/24/2007 | 24 | 61,700 | Flow increased to 44 gpm. |
| 7/25/2007 | 22 | 60,600 | System shutdown at 0830 to troubleshoot T2 transducer, system back on at 1030. |
| 7/26/2007 | 23.5 | 64,400 | Received chlorine cylinder delivery. |
| 7/27/2007 | 24 | 62,700 | Operating. |
| 7/28/2007 | 24 | 62,100 | Operating. |
| 7/29/2007 | 18 | 46,100 | Room oxygen sensor failure. |
| 7/30/2007 | 24 | 61,300 | Operating. |
| 7/31/2007 | 7.5 | 20,500 | Shutdown for CIP and FBRO pump out. |
| **Total** | **533.5** | **970,500** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **72** | | |

**Table 3-1**
**Operations Summary - August 2007**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 8/1/2007 | 0 | 0 | System shutdown pending CLO2 valve replacement. |
| 8/2/2007 | 0 | 0 | " |
| 8/3/2007 | 15.5 | 40,000 | System restarted at 0830. |
| 8/4/2007 | 2 | 5,200 | System shutdown at 0200, low air alarm. |
| 8/5/2007 | 0 | 0 | " |
| 8/6/2007 | 16 | 40,200 | System restarted at 0800. Increased flow to approx. 45 gpm. |
| 8/7/2007 | 24 | 62,400 | **Monthly sampling completed, effluent As at 1.5 ppb.** |
| 8/8/2007 | 24 | 63,900 | Operating. |
| 8/9/2007 | 22.75 | 59,200 | Annual air compressor maintenance completed. |
| 8/10/2007 | 24 | 63,600 | Operating. Discovered leak in T-2 tank. |
| 8/11/2007 | 24 | 63,600 | Operating. |
| 8/12/2007 | 24 | 63,700 | Operating. |
| 8/13/2007 | 23.25 | 60,600 | Changed chlorine cylinder. Completed microfilter IT. |
| 8/14/2007 | 24 | 62,200 | Operating. |
| 8/15/2007 | 24 | 62,200 | Replaced room O2 sensor. |
| 8/16/2007 | 24 | 61,800 | Operating. |
| 8/17/2007 | 24 | 62,200 | Operating. |
| 8/18/2007 | 24 | 61,700 | Operating. |
| 8/19/2007 | 24 | 61,900 | Operating. |
| 8/20/2007 | 13.5 | 36,300 | System shutdown at 0515 for FBRO pump out and CIP. Replaced T-2 tank. System restarted at 1545. |
| 8/21/2007 | 24 | 61,700 | Operating. |
| 8/22/2007 | 24 | 61,700 | Operating. |
| 8/23/2007 | 23.75 | 61,900 | Changed chlorine cylinder. |
| 8/24/2007 | 24 | 62,000 | Operating. |
| 8/25/2007 | 24 | 62,300 | Operating. |
| 8/26/2007 | 24 | 61,600 | Operating. |
| 8/27/2007 | 24 | 62,700 | Operating. |
| 8/28/2007 | 13.25 | 29,100 | Chlorine Dioxide generator maintenance started. Started CIP on microfilter. |
| 8/29/2007 | 14 | 37,800 | Chlorine Dioxide generator maintenance completed. Microfilter CIP completed. Changed chlorine cylinder. Increased flow to approx. 50 gpm. |
| 8/30/2007 | 23.5 | 65,100 | Replaced T-2 level transducer, replacement not scaled properly, re-installed original. |
| 8/31/2007 | 24 | 66,800 | Operating. |
| **Total** | **599.5** | **1,563,400** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **81** | | |

## Table 3-1
## Operations Summary - September 2007
## Shepley's Hill Landfill
## Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 9/1/2007 | 24 | 66,100 | Operating. |
| 9/2/2007 | 24 | 67,500 | Operating. |
| 9/3/2007 | 24 | 68,500 | Operating. |
| 9/4/2007 | 24 | 67,300 | Operating. |
| 9/5/2007 | 24 | 65,400 | Operating. |
| 9/6/2007 | 9.5 | 25,800 | Received 2,200 gallons of sodium chlorite. System shutdown at 0930 for FBRO pump out and microfilter CIP. |
| 9/7/2007 | 9.75 | 28,700 | Completed CIP and FBRO pumpout. Changed chlorine cylinder. System restarted at 1315. |
| 9/8/2007 | 24 | 63,100 | Operating. |
| 9/9/2007 | 24 | 63,600 | Operating. |
| 9/10/2007 | 24 | 65,400 | Operating. |
| 9/11/2007 | 24 | 66,800 | **Completed annual sampling, effluent As at 1.3 ppb.** |
| 9/12/2007 | 24 | 66,700 | Operating. |
| 9/13/2007 | 20.5 | 57,800 | System shutdown at 0445, low air pressure. System restarted at 0815. |
| 9/14/2007 | 24 | 66,800 | Operating. |
| 9/15/2007 | 22.25 | 61,600 | System shutdown at 0655, low air pressure. System restarted at 0840. |
| 9/16/2007 | 24 | 66,800 | Operating. |
| 9/17/2007 | 24 | 66,200 | Operating. |
| 9/18/2007 | 23.5 | 66,100 | Changed chlorine cylinder. Installed replacement T-2 level transducer. |
| 9/19/2007 | 24 | 66,700 | Operating. |
| 9/20/2007 | 24 | 69,400 | Operating. |
| 9/21/2007 | 7.25 | 21,300 | System shutdown at 0715 for FBRO pumpout and CIP. Changed chlorine cylinder. |
| 9/22/2007 | 15 | 42,100 | Completed CIP, system restarted at 0900. |
| 9/23/2007 | 24 | 63,600 | Operating. |
| 9/24/2007 | 24 | 63,700 | Operating. |
| 9/25/2007 | 24 | 63,900 | Operating. |
| 9/26/2007 | 24 | 63,600 | Operating. |
| 9/27/2007 | 24 | 63,600 | Performed integrity test on microfilter, passed. |
| 9/28/2007 | 24 | 64,400 | Operating. |
| 9/29/2007 | 24 | 63,300 | Operating. |
| 9/30/2007 | 24 | 63,300 | Operating. |
| **Total** | **659.75** | **1,809,100** | |
| **Total Available Hours** | **720** | | |
| **Percent On-Line** | **92** | | |

## Table 3-1
## Operations Summary - October 2007
## Shepley's Hill Landfill
## Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 10/1/2007 | 24 | 64,100 | Operating. |
| 10/2/2007 | 23.75 | 62,800 | Changed chlorine cylinder. |
| 10/3/2007 | 23 | 59,800 | System shutdown at 0550, high sump level. System restarted at 0650. |
| 10/4/2007 | 24 | 63,000 | Operating. |
| 10/5/2007 | 24 | 63,400 | Operating. |
| 10/6/2007 | 17.5 | 48,400 | System SCADA call at 1546, system remotely shutdown at 1730. |
| 10/7/2007 | 0 | 0 | System down for CIP and FBRO pumpout. |
| 10/8/2007 | 0.5 | 2,000 | CIP completed, recovery poor, CIP repeated. |
| 10/9/2007 | 14.25 | 38,600 | CIP completed, recovery good, system restarted at 0945. |
| 10/10/2007 | 24 | 65,200 | **Completed monthly effluent sampling, As at 1.2 ppb.** |
| 10/11/2007 | 24 | 66,600 | Operating. |
| 10/12/2007 | 24 | 66,300 | Operating. |
| 10/13/2007 | 24 | 65,600 | Operating. |
| 10/14/2007 | 23.67 | 64,300 | System shutdown at 1152, water leak on CLO2 generator. Leaked repaired, system restarted at 1212. |
| 10/15/2007 | 24 | 64,200 | Operating. |
| 10/16/2007 | 24 | 58,300 | Reduced microfilter flow to 45 gpm pending CIP. |
| 10/17/2007 | 24 | 52,900 | Operating. |
| 10/18/2007 | 10 | 23,900 | Shutdown at 1000 for CIP. |
| 10/19/2007 | 10.5 | 23,400 | CIP completed, system restarted at 1330. Operating at reduced flow, MF flow meter fluctuating. Changed chlorine cylinder. |
| 10/20/2007 | 24 | 52,000 | Operating. |
| 10/21/2007 | 24 | 53,800 | Operating. |
| 10/22/2007 | 24 | 52,500 | Operating. |
| 10/23/2007 | 24 | 55,800 | Flow meter fluctuation issue correct, increased MF flow to 45 gpm. |
| 10/24/2007 | 24 | 62,500 | Increased MF flow to 50 gpm. |
| 10/25/2007 | 13 | 36,600 | Shutdown at 1300 for CIP and FBRO pumpout. |
| 10/26/2007 | 14 | 36,200 | FBRO pumpout and CIP completed, system restarted at 1000. |
| 10/27/2007 | 24 | 62,600 | Operating. |
| 10/28/2007 | 24 | 65,400 | Operating. |
| 10/29/2007 | 24 | 63,000 | Operating. |
| 10/30/2007 | 23.75 | 59,600 | Changed chlorine cylinder. Completed Integrity Test on microfilter skid. |
| 10/31/2007 | 24 | 63,200 | Operating. |
| **Total** | **629.92** | **1,616,000** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **85** | | |

## Table 3-1
## Operations Summary - November 2007
## Shepley's Hill Landfill
## Devens, Massachusetts

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 11/1/2007 | 24 | 62,800 | Operating. |
| 11/2/2007 | 24 | 63,300 | Operating. |
| 11/3/2007 | 24 | 63,100 | Operating. |
| 11/4/2007 | 24 | 63,300 | Operating. |
| 11/5/2007 | 24 | 65,800 | Operating. |
| 11/6/2007 | 23.5 | 61,300 | Changed chlorine cylinder. Completed monthly sampling, effluent As at 1.3 ppb. |
| 11/7/2007 | 24 | 63,000 | Operating. |
| 11/8/2007 | 24 | 63,000 | Operating. |
| 11/9/2007 | 24 | 63,000 | Operating. |
| 11/10/2007 | 24 | 63,200 | Operating. |
| 11/11/2007 | 9 | 24,900 | System shutdown at 0900 for FBRO pumpout and CIP. |
| 11/12/2007 | 14.25 | 37,000 | FBRO pumpout and CIP completed, system restarted at 0945. |
| 11/13/2007 | 24 | 62,400 | Operating. |
| 11/14/2007 | 24 | 62,700 | Operating. |
| 11/15/2007 | 24 | 62,400 | Operating. |
| 11/16/2007 | 24 | 62,700 | Operating. |
| 11/17/2007 | 24 | 62,700 | Operating. |
| 11/18/2007 | 24 | 62,700 | Operating. |
| 11/19/2007 | 23.75 | 60,900 | Changed chlorine cylinder. |
| 11/20/2007 | 9 | 25,200 | System shutdown at 0900 for CIP. |
| 11/21/2007 | 12 | 30,900 | CIP completed, system restarted at 1200. Replaced CV-1 valve on MF skid. |
| 11/22/2007 | 24 | 61,800 | Operating. |
| 11/23/2007 | 7 | 20,100 | System shutdown at 0700, air compressor failure. |
| 11/24/2007 | 0 | 0 | System shutdown pending air compressor maintenance. |
| 11/25/2007 | 0 | 0 | System shutdown pending air compressor maintenance. |
| 11/26/2007 | 0 | 1,600 | Air compressor repaired, system remained shutdown pending MF PLC repair. |
| 11/27/2007 | 0 | 0 | System shutdown pending MF PLC repair. |
| 11/28/2007 | 14 | 37,100 | MF PLC repaired, system restarted at 1000. |
| 11/29/2007 | 24 | 65,400 | Operating. |
| 11/30/2007 | 24 | 63,900 | Operating. |
| **Total** | **544.5** | **1,436,200** | |
| **Total Available Hours** | **720** | | |
| **Percent On-Line** | **76** | | |

**Table 3-1**
**Operations Summary - December 2007**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Date | Hours On-Line | Gallons Discharged | Status |
|---|---|---|---|
| 12/1/2007 | 24 | 64,600 | Operating. |
| 12/2/2007 | 24 | 64,100 | Operating. |
| 12/3/2007 | 14 | 38,700 | Devens POTW on-site, set up auto-sampler. Plant shutdown at 0930 to clean chlorite feed, plant restarted at 1000. Plant shutdown at 1300, low air, restarted at 1730. Plant shutdown at 1900, low air, plant left off for FBRO and CIP. |
| 12/4/2007 | 0 | 1,300 | Started CIP. |
| 12/5/2007 | 11 | 28,100 | Completed CIP and FBRO pumpout. |
| 12/6/2007 | 24 | 61,700 | Operating. |
| 12/7/2007 | 24 | 61,500 | Operating. |
| 12/8/2007 | 24 | 61,100 | Operating. |
| 12/9/2007 | 24 | 61,100 | Operating. |
| 12/10/2007 | 24 | 61,600 | Operating. |
| 12/11/2007 | 24 | 61,600 | Operating. |
| 12/12/2007 | 24 | 61,600 | Operating. |
| 12/13/2007 | 24 | 61,600 | Operating. |
| 12/14/2007 | 24 | 61,600 | Operating. |
| 12/15/2007 | 24 | 61,400 | Operating. |
| 12/16/2007 | 24 | 60,900 | Operating. |
| 12/17/2007 | 8 | 21,800 | System shutdown at 0800 for CIP. |
| 12/18/2007 | 14 | 35,700 | CIP completed, system restarted at 1000. Changed chlorine cylinder. |
| 12/19/2007 | 18 | 45,300 | System shutdown at 0300, SCADA alarm for sludge pump, system restarted at 0900. |
| 12/20/2007 | 24 | 60,300 | Operating. |
| 12/21/2007 | 6.25 | 17,300 | Shutdown at 0615 for FBRO pumpout and CIP. |
| 12/22/2007 | 13.25 | 33,700 | FBRO pumpout and CIP completed, system restarted at 1045. |
| 12/23/2007 | 24 | 61,300 | Operating. |
| 12/24/2007 | 24 | 61,300 | Operating. |
| 12/25/2007 | 24 | 61,300 | Operating. |
| 12/26/2007 | 23.75 | 61,300 | Changed chlorine cylinder. |
| 12/27/2007 | 24 | 62,600 | Completed quarterly sampling. |
| 12/28/2007 | 24 | 62,100 | Operating. |
| 12/29/2007 | 24 | 62,400 | Operating. |
| 12/30/2007 | 17.75 | 47,400 | System shutdown at 1200 to allow FBRO to decant, system restarted at 1815. |
| 12/31/2007 | 24 | 62,900 | Operating. |
| **Total** | **630** | **1,629,200** | |
| **Total Available Hours** | **744** | | |
| **Percent On-Line** | **85** | | |

**Table 3-2**
**Monthly Discharge Totals**
**Arsenic Treatment Plant**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Month | Discharge Flow (gallons) |
|---|---|
| startup 8&9/2005 | 213,900 |
| Mar-06 | 555,800 |
| Apr-06 | 833,600 |
| May-06 | 941,700 |
| Jun-06 | 979,000 |
| Jul-06 | 646,600 |
| Aug-06 | 327,200 |
| Sep-06 | 453,500 |
| Oct-06 | 597,500 |
| Nov-06 | 562,500 |
| Dec-06 | 606,800 |
| Jan-07 | 739,600 |
| Feb-07 | 0 |
| Mar-07 | 672,400 |
| Apr-07 | 854,000 |
| May-07 | 974,700 |
| Jun-07 | 942,200 |
| Jul-07 | 970,500 |
| Aug-07 | 1,563,400 |
| Sep-07 | 1,809,100 |
| Oct-07 | 1,616,000 |
| Nov-07 | 1,436,200 |
| Dec-07 | 1,629,200 |
| **Cumulative Total** | **19,925,400** |

# Table 3-3
# Filter Bottom Rolloff Pumpout History
# Arsenic Treatment Plant
# Shepley's Hill Landfill
# Devens, Massachusetts

| FBRO Number | Total Volume Treated | Volume Treated per FBRO | Date Emptied |
|---|---|---|---|
| 1 | 850,000 | 850,000 | 3/29/06 |
| 2 | 1,817,000 | 967,000 | 5/5/06 |
| 3 | 2,860,400 | 1,043,400 | 6/8/06 |
| 4 | 3,987,800 | 1,127,400 | 7/21/06 |
| 5 | 5,326,400 | 1,338,600 | 10/23/06 |
| 6 | 6,321,500 | 995,100 | 12/5/06 |
| 7 | 7,295,600 | 974,100 | 1/22/07 |
| 8 | 8,327,100 | 1,031,500 | 4/6/07 |
| 9 | 9,243,800 | 916,700 | 5/4/07 |
| **Changed to using Effluent Totalizer** | | | |
| 10 | 10,110,500 | 994,400 | 6/4/07 |
| 11 | 10,957,600 | 847,100 | 7/2/07 |
| 12 | 11,937,100 | 979,500 | 8/1/07 |
| 13 | 12,845,700 | 908,600 | 8/20/07 |
| 14 | 13,861,100 | 1,015,400 | 9/7/07 |
| 15 | 14,758,100 | 897,000 | 9/21/07 |
| 16 | 15,671,100 | 913,000 | 10/8/07 |
| 17 | 16,575,600 | 904,500 | 10/26/07 |
| 18 | 17,582,300 | 1,006,700 | 11/12/07 |
| 19 | 18,530,500 | 948,200 | 12/5/07 |
| 20 | 19,413,700 | 883,200 | 12/21/07 |

FBRO = Filter bottom Rolloff

**Table 3-4**
**Monthly Effluent Sampling Results**
**Arsenic Treatment Plant**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Date | Effluent Arsenic Concentration (ug/L) |
|---|---|
| 8/29/2005 | 1.5 |
| 8/30/2005 | 1.2 |
| 8/31/2005 | 17.1 |
| 9/1/2005 | 1 |
| 9/2/2005 | 1 |
| 9/6/2005 | 1 |
| 9/8/2005 | 0.9 |
| 9/9/2005 | 3 |
| 3/10/2006 | 0.9 |
| 3/15/2006 | 2 |
| 3/23/2006 | 1 |
| 4/7/2006 | 2 |
| 4/14/2006 | 1.3 |
| 4/20/2006 | 9 |
| 4/27/2006 | 2 |
| 5/22/2006 | 2 |
| 6/27/2006 | ND |
| 7/12/2006 | 2 |
| 8/31/2006 | 13 |
| 9/28/2006 | 28 |
| 10/16/2006 | 4 |
| 11/14/2006 | 2 |
| 12/26/2006 | 34 |
| 1/5/2007 | 19 |
| 1/16/2007 | 2 |
| 1/23/2007 | 4 |
| 1/30/2007 | 1 |
| 3/22/2007 | 2 |
| 4/11/2007 | ND |
| 5/16/2007 | 1.2 |
| 6/13/2007 | 1.3 |
| 7/12/2007 | 1.4 |
| 8/7/2007 | 1.5 |
| 9/11/2007 | 1.3 |
| 10/10/2007 | 1.2 |
| 11/6/2007 | 1.3 |
| 12/27/2007 | 1.2 |

Notes:
Table includes all daily/weekly (when required) Arsenic sampling results
ND - Non-detect

# Table 3-5
# Quarterly Effluent Sampling Results
# Arsenic Treatment Plant
# Shepley's Hill Landfill
# Devens, Massachusetts

| Sample Date | 9/2/2006 | 3/15/2006 | 6/27/2006 | 9/2/2006 | 12/26/2006 | 3/22/2007 | 6/13/2007 | 9/11/2007 | 12/27/2007 |
|---|---|---|---|---|---|---|---|---|---|
| **Analyte** | | | | | | | | | |
| BOD | NA | ND | ND | | | | | | |
| Solids, Total Suspended | ND | ND | ND | | | | | | |
| Cyanide, Total | ND | ND | **0.007** | ND | ND | ND | ND | | |
| Chloride | **54** | **44** | **50** | **100** | **50** | **68** | **56** | **60** | **67** |
| pH | **6.7** | **5.8** | **6.5** | | | | | | |
| Nitrogen, Nitrate | ND | ND | ND | ND | ND | ND | **0.18** | **0.32** | **0.21** |
| Sulfate | ND | ND | ND | **2.6** | **160** | **70** | **2.2** | **2.7** | **3.3** |
| Oil & Grease, Hem-Grav | ND | ND | ND | | | | | | |
| **Metals** | | | | | | | | | |
| Aluminum, Total | ND | ND | ND | ND | ND | ND | ND | | |
| Antimony, Total | ND | ND | ND | ND | ND | ND | ND | | |
| Arsenic, Total | **0.001** | **0.002** | ND | **0.028** | **0.034** | **0.002** | **0.0013** | **0.0013** | **0.0012** |
| Barium, Total | ND | **0.02** | **0.03** | **0.02** | **0.015** | **0.029** | **0.023** | **0.023** | **0.023** |
| Beryllium, Total | ND | ND | ND | ND | ND | ND | ND | | |
| Cadmium, Total | ND | ND | ND | ND | ND | ND | ND | | |
| Chromium, Total | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Copper, Total | ND | ND | ND | ND | **0.026** | **0.017** | **0.015** | **0.0049** | **0.0076 J** |
| Lead, Total | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Magnesium, Total | ND | **8.5** | **8.8** | **9.1** | **8.4** | **8.1** | **7.5** | **7.1** | **7.6** |
| Manganese, Total | ND | **0.87** | **2.1** | **0.26** | **0.876** | **0.709** | **0.001** | **0.0026** | **0.0011 J** |
| Mercury, Total | ND | ND | ND | ND | ND | ND | ND | ND | **0.00002 J** |
| Nickel, Total | ND | ND | ND | ND | ND | **0.010** | **0.005** | | |
| Selenium, Total | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Silver, Total | ND | ND | ND | ND | ND | ND | ND | ND | **0.0009 J** |
| Thallium, Total | ND | ND | ND | ND | ND | ND | ND | | |
| Zinc, Total | ND | ND | ND | ND | ND | **0.007** | **0.005** | | |
| **VOCs** | | | | | | | | | |
| Bis(2-ethylhexyl)phthalate | ND | ND | ND | ND | ND | ND | ND | | |

Notes:
All units in mg/l, except pH (standard pH units).
NA = Not analyzed
ND = Non-detect at laboratory detection limit.
Shaded areas indicate sampling parameter no longer required.
All detection limits are below discharge limits.
J = Value is greater than RDL but less than MDL.

**Table 3-6**
**Annual Effluent Sampling Results - September 11, 2007**
**Arsenic Treatment Plant**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Analyte VOCs | Conc. | Analyte Semi-Volatiles | Conc. | Analyte Pest. & PCBs | Conc. |
|---|---|---|---|---|---|
| Methylene chloride | ND | Acenaphthene | ND | 4,4'-DDD | ND |
| 1,1-Dichloroethane | 0.51J | 1,2,4-Trichlorobenzene | ND | 4,4'-DDE | ND |
| Chloroform | ND | Hexachlorobenzene | ND | 4,4'-DDT | ND |
| Carbon tetrachloride | 0.22J | Bis(2-chloroethyl)ether | ND | Aldrin | ND |
| 1,2-Dichloropropane | ND | 2-Chloronaphthalene | ND | Alpha-BHC | ND |
| Dibromochloromethane | ND | 1,2-Dichlorobenzene | ND | Aroclor 1221 | ND |
| 1,1,2-Trichloroethane | ND | 1,3-Dichlorobenzene | ND | Aroclor 1232 | ND |
| Tetrachloroethene | ND | 1,4-Dichlorobenzene | ND | Aroclor 1242/1016 | ND |
| Chlorobenzene | 0.72 | 3,3'-Dichlorobenzidine | ND | Aroclor 1248 | ND |
| Trichlorofluoromethane | ND | 2,4-Dinitrotoluene | ND | Aroclor 1254 | ND |
| 1,2-Dichloroethane | ND | 2,6-Dinitrotoluene | ND | Aroclor 1260 | ND |
| 1,1,1-Trichloroethane | ND | Azobenzene | ND | Beta-BHC | ND |
| Bromodichloromethane | ND | Fluoranthene | ND | Chlordane | ND |
| trans-1,3-Dichloropropene | ND | 4-Bromophenyl phenyl ether | ND | Delta-BHC | ND |
| cis-1,3-Dichloropropene | ND | Bis(2-chloroisopropyl)ether | ND | Dieldrin | ND |
| 1,1-Dichloropropene | ND | Bis(2-chloroethoxy)methane | ND | Endosulfan I | ND |
| Bromoform | ND | Hexachlorobutadiene | ND | Endosulfan II | ND |
| 1,1,2,2-Tetrachloroethane | ND | Hexachloroethane | ND | Endosulfan sulfate | ND |
| Benzene | 1.1 | Isophorone | ND | Endrin | ND |
| Toluene | ND | Naphthalene | ND | Endrin aldehyde | ND |
| Ethylbenzene | ND | Nitrobenzene | ND | Endrin ketone | ND |
| Chloromethane | ND | Bis(2-Ethylhexyl)phthalate | ND | Heptachlor | ND |
| Bromomethane | ND | Butyl benzyl phthalate | ND | Heptachlor epoxide | ND |
| Vinyl chloride | 0.32J | Di-n-butylphthalate | ND | Lindane | ND |
| Chloroethane | 1.2 | Di-n-octylphthalate | ND | Methoxychlor | ND |
| 1,1-Dichloroethene | ND | Diethyl phthalate | ND | Toxaphene | ND |
| trans-1,2-Dichloroethene | ND | Dimethyl phthalate | ND | cis-Chlordane | ND |
| Trichloroethene | ND | Benzo(a)anthracene | ND | trans-Chlordane | ND |
| 1,2-Dichlorobenzene | ND | Benzo(a)pyrene | ND | | |
| 1,3-Dichlorobenzene | ND | Benzo(b)fluoranthene | ND | **TPHs (total)** | ND |
| 1,4-Dichlorobenzene | 0.88J | Benzo(k)fluoranthene | ND | | |
| Methyl tert butyl ether | ND | Chrysene | ND | | |
| p/m-Xylene | ND | Acenaphthylene | ND | | |
| o-Xylene | ND | Anthracene | ND | | |
| cis-1,2-Dichloroethene | 1.2 | Benzo(ghi)perylene | ND | | |
| Dibromomethane | ND | Fluorene | ND | | |
| 1,2,3-Trichloropropane | ND | Phenanthrene | ND | | |
| Styrene | ND | Dibenzo(a,h)anthracene | ND | | |
| Dichlorodifluoromethane | ND | Indeno(1,2,3-cd)Pyrene | ND | | |
| Acetone | ND | Pyrene | ND | | |
| Carbon disulfide | ND | Aniline | ND | | |
| 2-Butanone | ND | 4-Chloroaniline | ND | | |
| 4-Methyl-2-pentanone | ND | Dibenzofuran | ND | | |
| 2-Hexanone | ND | 2-Methylnaphthalene | ND | | |
| Bromochloromethane | ND | Acetophenone | ND | | |
| Tetrahydrofuran | 2.3J | 2,4,6-Trichlorophenol | ND | | |
| 2,2-Dichloropropane | ND | 2-Chlorophenol | ND | | |
| 1,2-Dibromoethane | ND | 2,4-Dichlorophenol | ND | | |
| 1,3-Dichloropropane | ND | 2,4-Dimethylphenol | ND | | |
| 1,1,1,2-Tetrachloroethane | ND | 2-Nitrophenol | ND | | |
| Bromobenzene | ND | 4-Nitrophenol | ND | | |
| n-Butylbenzene | ND | 2,4-Dinitrophenol | ND | | |
| sec-Butylbenzene | 0.13J | Pentachlorophenol | ND | | |
| tert-Butylbenzene | ND | Phenol | ND | | |
| o-Chlorotoluene | ND | 2-Methylphenol | ND | | |
| p-Chlorotoluene | ND | 3-Methylphenol/4-Methylphenol | ND | | |
| 1,2-Dibromo-3-chloropropane | ND | 2,4,5-Trichlorophenol | ND | | |
| Hexachlorobutadiene | ND | | | | |
| Isopropylbenzene | 0.26J | | | | |
| p-Isopropyltoluene | ND | | | | |
| Naphthalene | ND | | | | |
| n-Propylbenzene | ND | | | | |
| 1,2,3-Trichlorobenzene | ND | | | | |
| 1,2,4-Trichlorobenzene | ND | | | | |
| 1,3,5-Trimethylbenzene | ND | | | | |
| 1,2,4-Trimethylbenzene | ND | | | | |
| Ethyl ether | 15 | | | | |
| Isopropyl Ether | ND | | | | |
| Ethyl-Tert-Butyl-Ether | ND | | | | |
| Tertiary-Amyl Methyl Ether | ND | | | | |
| 1,4-Dioxane | ND | | | | |

Notes:
J = Value is below the reported detection limit but greater than the method detection limit, the value is estimated.
ND = Non-detect at laboratory detection limit. All detection limits are below discharge limits.
All units in ug/l

# Table 3-7
## Annual Influent VOC Sampling Results
## Arsenic Treatment Plant
## Shepley's Hill Landfill Devens, Massachusetts

| Analyte | EW-01 Conc. | | EW-04 Conc. | |
|---|---|---|---|---|
| 1,1,1,2-TETRACHLORROETHANE | ND | | ND | |
| 1,1,1-TRICHLOROETHANE | ND | | ND | |
| 1,1,2,2-TETRACHLOROETHANE | ND | | ND | |
| 1,1,2-TRICHLOROETHANE | ND | | ND | |
| 1,1-DICHLOROETHANE | 0.93 | | ND | |
| 1,1-DICHLOROETHYLENE | ND | | ND | |
| 1,1-DICHLOROPROPENE | ND | | ND | |
| 1,2,3-TRICHLOROBENZENE | ND | | ND | |
| 1,2,3-TRICHLOROPROPANE | ND | | ND | |
| 1,2,4-TRICHLOROBENZENE | ND | | ND | |
| 1,2,4-TRIMETHYLBENZENE | ND | | ND | |
| 1,2-DIBROMO-3-CHLOROPROPANE (DBCP) | ND | | ND | |
| 1,2-DIBROMOETHANE (ETHYLENE DIBROMIDE) | ND | | ND | |
| 1,2-DICHLOROBENZENE | ND | | ND | |
| 1,2-DICHLOROETHANE | ND | | ND | |
| 1,2-DICHLOROPROPANE | ND | | ND | |
| 1,3,5-TRIMETHYLBENZENE | ND | | ND | |
| 1,3-DICHLOROPROPANE | ND | | ND | |
| 1,4-DICHLOROBENZENE | 1.4 | J | 0.62 | J |
| 2,2-DICHLOROPROPANE | ND | | ND | |
| 2-BUTANONE | ND | | ND | |
| 2-CHLOROTOLUENE | ND | | ND | |
| 2-PHENYLBUTANE | ND | | ND | |
| 4-CHLOROTOLUENE | ND | | ND | |
| 4-METHYL-2-PENTANONE | ND | | ND | |
| ACETONE | ND | | ND | |
| BENZENE | 1.4 | | ND | |
| BROMOBENZENE | ND | | ND | |
| BROMODICHLOROMETHANE | ND | | ND | |
| BROMOMETHANE | ND | | ND | |
| CARBON DISULFIDE | ND | | ND | |
| CARBON TETRACHLORIDE | ND | | ND | |
| CFC-11 | ND | | ND | |
| CFC-12 | ND | | ND | |
| CHLOROBENZENE | 0.77 | | 0.70 | |
| CHLOROBROMOMETHANE | ND | | ND | |
| CHLORODIBROMOMETHANE | ND | | ND | |
| CHLOROETHANE | 0.76 | J | ND | |
| CHLOROFORM | ND | | ND | |
| CHLOROMETHANE | ND | | ND | |
| cis-1,2-Dichloroethene | 1.9 | | ND | |
| CIS-1,3-DICHLOROPROPENE | ND | | ND | |
| CYMENE | ND | | ND | |
| DIBROMOMETHANE | ND | | ND | |
| DICHLOROMETHANE | ND | | ND | |
| DIISOPROPYL ETHER | ND | | ND | |
| Ethyl ether | 20 | | 8.9 | |
| ETHYLBENZENE | ND | | ND | |
| ETHYL-TERT-BUTYL ETHER | ND | | ND | |
| HEXACHLORO-1,3-BUTADIENE | ND | | ND | |
| ISOPROPYLBENZENE | 0.36 | J | ND | |
| M-DICHLOROBENZENE | ND | | ND | |
| METHYL N-BUTYL KETONE | ND | | ND | |
| Methyl tert butyl ether | 0.37 | J | ND | |
| METHYLBENZENE | ND | | ND | |
| NAPHTHALENE | 2.2 | J | 2.1 | J |
| N-BUTYLBENZENE | ND | | ND | |
| N-PROPYLBENZENE | ND | | ND | |
| O-XYLENE | ND | | ND | |
| P/M-XYLENE | ND | | ND | |
| P-DIOXANE | 78 | J | ND | |
| STYRENE (MONOMER) | ND | | ND | |
| TERT-AMYL METHYL ETHER (TAME) | ND | | ND | |
| TERT-BUTYLBENZENE | ND | | ND | |
| TETRACHLOROETHENE | ND | | ND | |
| TETRAHYDROFURAN | 2.2 | J | ND | |
| TRANS-1,2-DICHLOROETHENE | ND | | ND | |
| TRANS-1,3-DICHLOROPROPENE | ND | | ND | |
| TRIBOMOMETHANE | ND | | ND | |
| TRICHLOROETHYLENE | ND | | ND | |
| VINYL CHLORIDE | 0.52 | J | ND | |

Notes:

Samples collected 17 October 2007

J = Value is below the reported detection limit but greater than the method detection limit, the value is estimated.

ND = Non-detect at laboratory detection limit. All detection limits are below discharge limits.

All units in ug/l

**Table 4-1**
**Long Term Monitoring Network**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Well ID | Surface (ft msl) | Screen Interval (ft bgs) | Screen Elevation (ft msl) | Interval Description | Chemistry | | | Hydraulics |
|---|---|---|---|---|---|---|---|---|
| | | | | | Qtrly Field Parameters | Fall | Spring | Fall/Spring |
| **DOWNGRADIENT - MOLUMCO ROAD** | | | | | | | | |
| SHM-05-40X | 224.6 | 32.0 - 34.0 | 192.6 - 190.6 | Mid-Depth Overburden/Till | - | X | - | X |
| SHM-05-39A | 222.9 | 37.0 - 39.0 | 185.9 - 183.9 | Mid-Depth Overburden | - | X | - | X |
| SHM-05-39B | 222.9 | 66.0 - 68.0 | 156.9 - 154.9 | Deep Overburden | - | X | - | X |
| SHP-99-31A | 213.8 | 4.0 - 14.0 | 209.8 - 199.8 | Shallow Overburden/WT | - | X | - | X |
| SHP-99-31B | 213.5 | 50.0 - 60.0 | 163.5 - 153.5 | Mid-Depth Overburden | - | X | - | X |
| SHP-99-31C | 213.5 | 68.0 - 78.0 | 145.5 - 135.5 | Deep Overburden | - | X | - | X |
| SHX-99-32X | 220.1 | 72.0 - 82.0 | 148.1 - 138.1 | Deep Overburden | - | X | - | X |
| SHP-05-48A,B | – | – | – | Water Table | - | - | - | X |
| SHP-05-49A,B | – | – | – | Water Table | - | - | - | X |
| SHP-99-34 A | 223.6 | 12.5 - 17.5 | 211.1 - 206.1 | Shallow Overburden/WT | - | - | - | X |
| SHP-99-34 B | 223.6 | 74.5 - 79.5 | 149.1 - 144.1 | Deep Overburden | - | - | - | X |
| **DOWNGRADIENT - WOODS** | | | | | | | | |
| SHM-05-41A | 223.8 | 42.0 - 44.0 | 181.8 - 179.8 | Shallow Overburden | - | X | X | X |
| SHM-05-41B | 223.6 | 62.0 - 64.0 | 161.6 - 159.6 | Mid-Depth Overburden | - | X | X | X |
| SHM-05-41C | 224 | 88.0 - 93.0 | 136.0 - 131.0 | Deep Overburden/Till | - | X | X | X |
| SHM-05-42A | 214.5 | 40.0 - 42.0 | 174.5 - 172.5 | Shallow Overburden | - | X | X | X |
| SHM-05-42B | 214.5 | 70.0 - 72.0 | 144.5 - 142.5 | Mid-Depth Overburden | - | X | X | X |
| **NEARFIELD AREA** | | | | | | | | |
| SHL-23 | 240.4 | 23.0 - 33.0 | 217.4 - 207.4 | Shallow Overburden/WT | X | X | X | X |
| SHL-9 | 222.9 | 15.0 - 25.0 | 207.9 - 197.9 | Shallow Overburden/WT | X | X | X | X |
| SHL-22 | 219.6 | 105.0 - 115.0 | 114.6 - 104.6 | Deep Overburden | X | X | X | X |
| SHM-93-22B | 219.9 | 82.3 - 92.3 | 137.6 - 127.6 | Mid-Depth Overburden | X | X | X | X |
| SHM-93-22C | 217.9 | 124.3 - 134.3 | 93.6 - 83.6 | Bedrock | X | X | X | X |
| SHL-5 | 216.4 | 3.0 - 13.0 | 213.4 - 203.4 | Shallow Overburden/WT | X | X | X | X |
| SHM-96-5B | 218.5 | 80.0 - 90.0 | 138.5 - 128.5 | Base of Sand/Till | X | X | X | X |
| SHM-96-5C | 218.7 | 50.0 - 60.0 | 168.7 - 158.7 | Mid-Depth Overburden | X | X | X | X |
| SHL-8S | 220.1 | 52.0 - 54.0 | 168.1 - 166.1 | Mid-Depth Overburden | X | X | X | X |
| SHL-8D* | 220.1 | 68.0 - 70.0 | 152.1 - 150.1 | Deep Overburden | X | X | X | X |
| SHL-21 | 257.9 | 42.0 - 52.0 | 215.9 - 205.9 | Shallow Overburden/WT | X | X | X | X |
| SHP-05-45A | 227.3 | 20.0 - 25.0 | 207.3 - 202.3 | Shallow Overburden | - | - | - | X |
| SHP-05-45B | 227.7 | 65.0 - 75.0 | 162.7 - 152.7 | Mid-Depth Overburden | - | - | - | X |
| SHP-05-46A | 227.3 | 20.0 - 25.0 | 207.3 - 202.3 | Shallow Overburden | - | - | - | X |
| SHP-05-46B | 227.1 | 65.0 - 75.0 | 162.1 - 152.1 | Mid-Depth Overburden | - | - | - | X |
| SHP-05-43 | 259.4 | 50.5 - 60.5 | 208.9 - 198.9 | Shallow Overburden | - | - | - | X |
| SHP-05-44 | 256.4 | 51.0 - 61.0 | 205.4 - 195.4 | Mid-Depth Overburden | - | - | - | X |
| **POND AREA** | | | | | | | | |
| SHL-13 | 220.1 | 5.0 - 20.0 | 215.1 - 200.1 | Shallow Overburden/WT | - | X | - | X |
| SHP-01-36X | 221.1 | 3.0 - 8.0 | 218.1 - 213.1 | Shallow Overburden/WT | - | X | - | X |
| SHP-01-37X | 219.5 | 1.0 - 6.0 | 218.5 - 213.5 | Shallow Overburden/WT | - | X | - | X |
| SHP-01-38A | 219.8 | 1.5 - 6.5 | 218.3 - 213.3 | Shallow Overburden/WT | - | X | - | X |
| PSP-01 | – | – | – | Pond Stage | - | - | - | X |
| SHP-05-47A,B | – | – | – | Water Table | - | - | - | X |
| N1-P1 | 228.8 | | | Deep Overburden | - | - | - | X |
| N1-P2 | 228.8 | | | Mid-Depth Overburden | - | - | - | X |
| N1-P3 | 228.8 | | | Shallow Overburden/WT | - | - | - | X |
| N2-P1 | 221.6 | | | Deep Overburden | - | - | - | X |
| N2-P2 | 221.6 | | | Mid-Depth Overburden | - | - | - | X |
| SHP-01-38B | 219.9 | 18.0 - 23.0 | 201.9 - 196.9 | Deep Overburden | - | - | - | X |
| N3-P1* | 219.8 | 33.0 - 35.0 | 186.8 - 184.8 | Bedrock | - | - | - | X |
| N3-P2* | 219.8 | 4.0 - 9.0 | 215.8 - 210.8 | Water Table | - | - | - | X |
| **UPGRADIENT AREA** | | | | | | | | |
| SHL-15 | 260.1 | | | Shallow Overburden/WT | - | X | - | X |
| N5-P1* | 241.7 | 144.0 - 149.0 | 97.7 - 92.7 | Bedrock | - | X | - | X |
| N5-P2* | 241.7 | 20.0 - 25.0 | 221.7 - 216.7 | Shallow Overburden/WT | - | X | - | X |
| SHP-99-29X | 242.5 | 19.0 - 29.0 | 223.5 - 213.5 | Shallow Overburden/WT | - | X | - | X |
| SHL-20 | 235.4 | 39.0 - 49.0 | 196.4 - 186.4 | Deep Overburden/Till | - | X | - | X |
| SHL-11 | 235 | 12.0 - 27.0 | 223.0 - 208.0 | Shallow Overburden/WT | - | X | - | X |
| SHL-4 | 226.4 | 3.0 - 13.0 | 223.4 - 213.4 | Shallow Overburden/WT | - | X | - | X |
| SHL-19 | 239.5 | 20.0 - 30.0 | 219.5 - 209.5 | Shallow Overburden/WT | - | X | - | X |
| SHL-10 | 249.1 | 24.0 - 39.0 | 225.1 - 210.1 | Shallow Overburden/WT | - | X | - | X |
| SHM-93-10C | 247.1 | 44.0 - 54.0 | 202.7 - 192.7 | Bedrock | - | X | - | X |
| SHM-93-10D | 246.5 | | | Bedrock | - | X | - | X |
| SHL-3 | 247.4 | 24.0 - 34.0 | 223.4 - 213.4 | Shallow Overburden/WT | - | - | - | X |
| SHP-99-35X | 257.5 | 30.2 - 40.2 | 227.3 - 217.3 | Shallow Overburden/WT | - | - | - | X |
| SHL-18 | 236.8 | | | Shallow Overburden/WT | - | - | - | X |
| SHM-93-18B | 236.2 | 78.5 - 88.5 | 157.7 - 147.7 | Deep Overburden/Till | - | - | - | X |
| SHP-95-27X | 236.3 | | | Shallow Overburden/WT | - | - | - | X |
| N6-P1* | 257.1 | 84.0 - 88.0 | 173.1 - 169.1 | Bedrock | - | - | - | X |
| N7-P1* | 254.4 | 65.0 - 69.0 | 189.4 - 185.4 | Bedrock | - | - | - | X |
| N7-P2* | 254.4 | 29.0 - 35.0 | 225.4 - 219.4 | Shallow Overburden/WT | - | - | - | X |
| SHL-24* | 237.8 | 110.0 - 120.0 | 127.8 - 117.8 | Deep Overburden | - | - | - | X |
| EW-01 pilot | | | | Overburden | - | - | - | X |
| EW-04 pilot | | | | Overburden | - | - | - | X |

**Notes:**
ft bgl = feet below ground level
ft msl = feet mean sea level
* Includes estimated values derived from Supplemental Groundwater Investigation (Harding ESE, 2003).
Adapted from Final Revised Long Term Monitoring and Maintenance Plan (CH2MHill, 2007).

# Table 4-2
## Site-Wide Groundwater Elevation Surveys
## Shepley's Hill Landfill
## Devens, Massachusetts

| Well ID | Reference Elevation[1,2] (ft msl) | 4/8/2007 | | 10/15/2007 | |
|---|---|---|---|---|---|
| | | DTW (TOC) (ft) | Elevation (ft msl) | DTW (TOC) (ft) | Elevation (ft msl) |
| N-1, P-1 | 231 | 14.73 | 216.27 | 14.15 | 216.85 |
| N-1, P-2 | 231 | 14.57 | 216.43 | 13.74 | 217.26 |
| N-1, P-3 | 231.2 | 15.41 | 215.79 | 13.12 | 218.08 |
| N-2, P-1 | 223.1 | 5.9 | 217.2 | 4.7 | 218.4 |
| N-2, P-2 | 223 | 6.14 | 216.86 | 4.86 | 218.14 |
| N-3, P-1 | 221.8 | 5.14 | 216.66 | 4.22 | 217.58 |
| N-3, P-2 | 221.5 | 8.21 | 213.29 | 3.54 | 217.96 |
| N-5, P-1 | 243.7 | 23.68 | 220.02 | 24.22 | 219.48 |
| N-5, P-2 | 243.7 | 20.04 | 223.66 | 24.41 | 219.29 |
| N-6, P-1 | 259.9 | 36.92 | 222.98 | 37.64 | 222.26 |
| N-7, P-1 | 256.6 | 30.62 | 225.98 | 31.49 | 225.11 |
| N-7, P-2 | 257.1 | 30.75 | 226.35 | 31.66 | 225.44 |
| PSP-01 | 216.1 | 1.28 | 214.82 | 2.3 | 213.8 |
| SHL-10 | 248.8 | 30.8 | 218 | 30.49 | 218.31 |
| SHL-11 | 236.5 | 18.57 | 217.93 | 18.22 | 218.28 |
| SHL-13 | 221.8 | 6.64 | 215.16 | 6.76 | 215.04 |
| SHL-15 | 260.9 | 16.94 | 243.96 | 20.62 | 240.28 |
| SHL-18 | 238.6 | 18.85 | 219.75 | 19.12 | 219.48 |
| SHL-19 | 241.5 | 22.49 | 219.01 | 22.82 | 218.68 |
| SHL-20 | 237 | 18.92 | 218.08 | 18.68 | 218.32 |
| SHL-21 | 260 | 45.11 | 214.89 | 49.12 | 210.88 |
| SHL-22 | 220.6 | 5.99 | 214.61 | 8.26 | 212.34 |
| SHL-23 | 242.3 | 26.41 | 215.89 | 29.72 | 212.58 |
| SHL-24 | 239.8 | 15.49 | 224.31 | 16.12 | 223.68 |
| SHL-3 | 248.6 | 29.44 | 219.16 | 29.18 | 219.42 |
| SHL-4 | 228.1 | 10.22 | 217.88 | 10.01 | 218.09 |
| SHL-5 | 218.6 | 2.17 | 216.43 | 5.8 | 212.8 |
| SHL-8D | 221.8 | 7.19 | 214.61 | 8 | 213.8 |
| SHL-8S | 222 | 7.51 | 214.49 | 8.14 | 213.86 |
| SHL-9 | 223 | 8.03 | 214.97 | 10.79 | 212.21 |
| SHM-05-39A | 222.6 | 10.5 | 212.1 | 12.01 | 210.59 |
| SHM-05-39B | 222.6 | 11.38 | 211.22 | 12.66 | 209.94 |
| SHM-05-40X | 224.4 | 13.2 | 211.2 | 14.75 | 209.65 |
| SHM-05-41A | 223.5 | 9.21 | 214.29 | 11.55 | 211.95 |
| SHM-05-41B | 223.3 | 9.04 | 214.26 | 11.36 | 211.94 |
| SHM-05-41C | 223.6 | 9.27 | 214.33 | 11.61 | 211.99 |
| SHM-05-42A | 217.8 | 3.47 | 214.33 | 5.57 | 212.23 |
| SHM-05-42B | 217.8 | 3.41 | 214.39 | 5.64 | 212.16 |
| SHM-93-10C | 248.6 | 29.2 | 219.4 | 29.35 | 219.25 |
| SHM-93-10D | 248.9 | 30.17 | 218.73 | 30.1 | 218.8 |
| SHM-93-18B | 238.3 | 18.53 | 219.77 | 18.81 | 219.49 |
| SHM-93-22C | 221.7 | 7.01 | 214.69 | 9.37 | 212.33 |
| SHM-96-22B | 220.4 | 5.87 | 214.53 | 8.05 | 212.35 |
| SHM-96-5B | 220 | 5.1 | 214.9 | 7.12 | 212.88 |
| SHM-96-5C | 219.4 | 4.55 | 214.85 | 6.61 | 212.79 |
| SHM-99-31A | 215.4 | 1.8 | 213.6 | 3.9 | 211.5 |
| SHM-99-31B | 215.4 | 2.96 | 212.44 | 4.39 | 211.01 |
| SHM-99-31C | 215.8 | 3.24 | 212.56 | 4.66 | 211.14 |
| SHM-99-32X | 222.3 | 8.82 | 213.48 | 10.26 | 212.04 |
| SHP-01-36X | 225.1 | 8.14 | 216.96 | 6.12 | 218.98 |
| SHP-01-37X | 223.7 | 6.83 | 216.87 | 8.6 | 215.1 |
| SHP-01-38A | 221.8 | 4.4 | 217.4 | 3.46 | 218.34 |
| SHP-01-38B | 222 | 4.45 | 217.55 | 3.59 | 218.41 |
| SHP-05-43 | 261.7 | 52.32 | 209.38 | 45.02 | 216.68 |
| SHP-05-44 | 259.1 | 52.57 | 206.53 | 41.07 | 218.03 |
| SHP-05-45A | 229.5 | 14.85 | 214.65 | 17.19 | 212.31 |
| SHP-05-45B | 230.1 | 15.47 | 214.63 | 17.88 | 212.22 |
| SHP-05-46A | 229.3 | 14.41 | 214.89 | 15.92 | 213.38 |
| SHP-05-46B | 228.7 | 13.78 | 214.92 | 16.6 | 212.1 |
| SHP-05-47A | 218.5 | 5.57 | 212.93 | 5.46 | 213.04 |
| SHP-05-47B | 216.3 | 2.6 | 213.7 | 3.09 | 213.21 |
| SHP-05-48A | 217 | 3.45 | 213.55 | Dry | -- |
| SHP-05-48B | 218.4 | 4.92 | 213.48 | Dry | -- |
| SHP-05-49A | 217.8 | Dry | -- | 4.52 | 213.28 |
| SHP-05-49B | 216.2 | Dry | -- | Dry | -- |
| SHP-95-27X | 238.5 | 33.03 | 205.47 | 16.7 | 221.8 |
| SHP-99-29X | 244.41 | Dry | -- | 24.56 | 219.85 |
| SHP-99-34A | 225.7 | 12.72 | 212.98 | 13.31 | 212.39 |
| SHP-99-34B | 225.6 | 12.37 | 213.23 | 13.84 | 211.76 |
| SHP-99-35X | 259.2 | 36.78 | 222.42 | 37.19 | 222.01 |

Notes: 1. All ground surface and reference elevations based on field survey performed by Meridan Associates, Inc. between July and August 2005 except SHL-10, which is based on groundwater monitoring well completion log by ConTest, Inc.

2. Elevations based upon project system, reported to be National Geodetic Vertical Datum of 1929 (NGVD29).

MSL = Mean Sea Level

DTW = Depth to Water

TOC = Top of Casing

**Table 4-3**
**Groundwater Analytical Results**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Analaytical Parameter | Units | MCL or ROD Standard | Sample ID | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | N-5, P-1 Oct-2007 | N-5, P-2 Oct-2007 | SHL-4 Oct-2007 | SHL-5 May-2007 | SHL-5 Oct-2007 | SHL-8D Apr-2007 | SHL-8D Oct-2007 | SHL-8S Apr-2007 | SHL-8S Oct-2007 | SHL-9 Apr-2007 | SHL-9 Oct-2007 | SHL-10 Oct-2007 | SHL-11 Oct-2007 | SHL-13 Oct-2007 | SHL-15 Oct-2007 |
| ALKALINITY, TOTAL (AS CACO3) | ug/l | n/a | 280000 | 600000 | 130000 | 28000 | 39000 | 42000 | 55000 | 17000 | 17000 | 63000 | 84000 | 20000 | 230000 | 18000 | 60000 |
| CHLORIDE | ug/l | n/a | 17000 | 18000 | 19000 | 2600 | 1000 U | 5100 | 11000 | 5600 | 6900 | 1000 U | 3800 | 1000 U | 21000 | 41000 | 9900 |
| NITRATE (AS N) | ug/l | n/a | 310 | 250 | 79 J | 100 U | 110 | 590 | 230 | 100 U | 80 J | 690 | 91 J | 280 | 220 | 100 U | 520 |
| SULFATE | ug/l | n/a | 7700 | 1000 U | 3000 | 1900 | 1600 | 6600 | 6900 | 800 J | 1000 U | 11000 | 5800 | 2300 | 4500 | 5600 | 19000 |
| TURBIDITY | NTU | n/a | 110 | 320 | 2.2 | 1.9 | 3.2 | 0.2 U | 0.2 U | 0.2 U | 1.2 | 14 | 1 | 0.2 U | 31 | 0.2 U | 1.2 |
| | | | Total Metals by SW6010/SW6020 | | | | | | | | | | | | | | |
| ARSENIC | ug/l | 10.00 | 4856 | 28.1 | 7.5 | 6.2 | 16.2 | 3 U | 11.8 | 3 U | 22.6 | 26 | 34.1 | 0.59 J | 686.5 | 1.6 | 42 |
| CALCIUM METAL | ug/l | n/a | 69000 | 140000 | 35000 | 8100 | 9400 | 13000 | 18000 | 3600 | 3600 | 22000 | 26000 | 5800 | 34000 | 6900 | 21000 |
| IRON | ug/l | 9100.00 | 33000 | 68000 | 1800 | 2400 | 6300 | 29 J | 22 J | 22 J | 80 | 7300 | 11000 | 45 J | 48000 | 110 | 3400 |
| MAGNESIUM | ug/l | n/a | 9800 | 15000 | 7000 | 1500 | 1700 | 1900 | 2600 | 640 | 660 | 1500 | 1700 | 790 | 5200 | 1500 | 2800 |
| MANGANESE | ug/l | 1715.00 | 6330 | 374 | 631 | 349 | 362 | 53 | 80 | 29 | 56 | 469 | 515 | 14 | 2320 | 503 | 570 |
| POTASSIUM | ug/l | n/a | 5900 | 20000 | 4900 | 1600 J | 1900 J | 870 J | 970 J | 1300 J | 1300 J | 1900 J | 2500 | 830 J | 9500 | 980 J | 4900 |
| SODIUM | ug/l | 20000.00 | 20000 | 23000 | 13000 | 1400 J | 1400 J | 5600 | 9100 | 5600 | 5900 | 2800 | 4100 | 1200 J | 23000 | 24000 | 7600 |
| **Field Readings** | **Units** | **MCL or ROD Standard** | **N-5, P-1 Oct-2007** | **N-5, P-2 Oct-2007** | **SHL-4 Oct-2007** | **SHL-5 May-2007** | **SHL-5 Oct-2007** | **SHL-8D Apr-2007** | **SHL-8D Oct-2007** | **SHL-8S Apr-2007** | **SHL-8S Oct-2007** | **SHL-9 Apr-2007** | **SHL-9 Oct-2007** | **SHL-10 Oct-2007** | **SHL-11 Oct-2007** | **SHL-13 Oct-2007** | **SHL-15 Oct-2007** |
| pH | pH Units | n/a | 5.98 | 5.75 | 5.88 | 5.35 | 6.01 | 5.88 | 5.98 | 6.06 | 6.06 | 6.47 | 6.21 | 6.60 | 6.76 | 6.1 | 5.63 |
| SPC | ms/cm | n/a | 0.638 | 1.271 | 0.24 | 0.07 | 0.11 | 0.171 | 0.133 | 0.09 | 0.059 | 0.26 | 0.16 | 0.07 | 0.39 | 0.175 | 0.158 |
| DO | mg/l | n/a | 0.13 | 0.15 | 0.15 | 1.36 | 0.10 | 1.9 | 1.65 | 2.13 | 0.69 | 0.36 | 0.08 | 10.30 | 0.21 | 0.6 | 0.24 |
| ORP | Millivolts | n/a | -60 | -41 | 16.40 | 411.00 | 8.00 | 169 | 138 | 158 | 130 | -52.00 | -62.00 | 37.00 | -91.00 | 148.3 | -2 |
| Temp | DEG C | n/a | 11.86 | 12.03 | 11.26 | 10.18 | 12.84 | 8.2 | 10.44 | 8.18 | 10.32 | 6.37 | 10.14 | 14.39 | 11.87 | 17.18 | 11.39 |

Notes: J = Estimated Detect
U = Not detected at indicated reporting limit
NS = Not Sampled
Highlighted values exceed MCL or ROD standard

**Table 4-3**
**Groundwater Analytical Results**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Analaytical Parameter | Units | MCL or ROD Standard | Sample ID | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SHL-19 Oct-2007 | SHL-20 Oct-2007 | SHL-21 Apr-2007 | SHL-21 Oct-2007 | SHL-22 Apr-2007 | SHL-22 Oct-2007 | SHL-23 Apr-2007 | SHL-23 Oct-2007 | SHM-05-39A Oct-2007 | SHM-05-39B Oct-2007 | SHM-05-40X Oct-2007 | SHM-05-41A Apr-2007 | SHM-05-41A Oct-2007 | SHM-05-41B Apr-2007 |
| ALKALINITY, TOTAL (AS CACO3) | ug/l | n/a | 88000 | 250000 | 20000 | 14000 | 380000 | 370000 | 3600 | 2000 U | 180000 | 370000 | 240000 | 28000 | 30000 | 250000 |
| CHLORIDE | ug/l | n/a | 1000 U | 21000 | 1000 U | 1000 U | 23000 | 24000 | 1000 U | 1000 U | 16000 | 57000 | 14000 | 4600 | 1000 U | 8100 |
| NITRATE (AS N) | ug/l | n/a | 140 | 110 | 100 U | 92 J | 100 U | 200 | 410 | 210 | 140 | 210 | 1100 | 100 U | 100 U | 100 U |
| SULFATE | ug/l | n/a | 13000 | 14000 | 10000 | 6600 | 5500 | 5700 | 5900 | 5900 | 3300 | 1900 | 1800 | 18000 | 13000 | 3300 |
| TURBIDITY | NTU | n/a | 470 | 14 | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 0.2 U | 1.1 | 190 | 110 | 260 | 0.77 | 2.7 | 100 |
| | | | Total Metals by SW6010/SW6020 | | | | | | | | | | | | | |
| ARSENIC | ug/l | 10.00 | 885.1 | 336.2 | 3 U | 0.81 J | 98 | 55.1 | 3 U | 0.73 J | 241.5 | 309.4 | 4445 | 30 | 24.9 | 1990 |
| CALCIUM METAL | ug/l | n/a | 24000 | 66000 | 7700 | 5100 | 97000 | 100000 | 2200 | 2800 | 29000 | 99000 | 50000 | 8600 | 8200 | 42000 |
| IRON | ug/l | 9100.00 | 50000 | 7200 | 27 J | 40 J | 460 | 370 | 23 J | 210 | 52000 | 10000 | 58000 | 4000 | 3400 | 74000 |
| MAGNESIUM | ug/l | n/a | 3800 | 9300 | 740 | 580 | 13000 | 13000 | 200 | 250 | 3800 | 14000 | 7500 | 1700 | 1700 | 5100 |
| MANGANESE | ug/l | 1715.00 | 2700 | 6540 | 1.3 J | 4.6 J | 3420 | 4320 | 13 | 14 | 1250 | 5920 | 1330 | 487 | 356 | 1440 |
| POTASSIUM | ug/l | n/a | 3600 | 6100 | 1300 J | 1000 J | 5900 | 5400 | 900 J | 990 J | 8200 | 9300 | 7300 | 2200 J | 1800 J | 12000 |
| SODIUM | ug/l | 20000.00 | 4200 | 28000 | 2800 | 2600 | 34000 | 34000 | 1300 J | 1000 J | 10000 | 47000 | 19000 | 4400 | 3400 | 12000 |
| **Field Readings** | **Units** | **MCL or ROD Standard** | **SHL-19 Oct-2007** | **SHL-20 Oct-2007** | **SHL-21 Apr-2007** | **SHL-21 Oct-2007** | **SHL-22 Apr-2007** | **SHL-22 Oct-2007** | **SHL-23 Apr-2007** | **SHL-23 Oct-2007** | **SHM-05-39A Oct-2007** | **SHM-05-39B Oct-2007** | **SHM-05-40X Oct-2007** | **SHM-05-41A Apr-2007** | **SHM-05-41A Oct-2007** | **SHM-05-41B Apr-2007** |
| pH | pH Units | n/a | 6.00 | 6.20 | 5.72 | 5.66 | 6.70 | 6.40 | 5.35 | 5.54 | 6.58 | 6.85 | 6.41 | NS | 7.2 | NS |
| SPC | ms/cm | n/a | 0.19 | 0.42 | 0.104 | 0.061 | 1.11 | 0.54 | 0.058 | 0.044 | 0.342 | 0.892 | 0.473 | NS | 0.079 | NS |
| DO | mg/l | n/a | 0.29 | 0.12 | 9.2 | 9.86 | 0.19 | 0.11 | 11.11 | 11.03 | 0.1 | 0.12 | 0.12 | NS | 0.12 | NS |
| ORP | Millivolts | n/a | -43.90 | -60.80 | 179 | 46 | -51.00 | -65.00 | 234 | 182 | 5.2 | -90 | 70.4 | NS | -12.6 | NS |
| Temp | DEG C | n/a | 11.39 | 11.75 | 11.76 | 14.1 | 7.73 | 10.75 | 11.33 | 11.79 | 10.88 | 12.66 | 11.72 | NS | 10.22 | NS |

Notes: J = Estimated Detect
U = Not detected at indicated reporting limit
NS = Not Sampled
Highlighted values exceed MCL or ROD standard

**Table 4-3**
**Groundwater Analytical Results**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Analaytical Parameter | Units | MCL or ROD Standard | Sample ID | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SHM-05-41B Oct-2007 | SHM-05-41C Apr-2007 | SHM-05-41C Oct-2007 | SHM-05-42A Apr-2007 | SHM-05-42A Oct-2007 | SHM-05-42B Apr-2007 | SHM-05-42B Oct-2007 | SHM-93-10C Oct-2007 | SHM-93-10D Oct-2007 | SHM-93-22C Apr-2007 | SHM-93-22C Oct-2007 | SHM-96-5B Apr-2007 | SHM-96-5B Oct-2007 |
| ALKALINITY, TOTAL (AS CACO3) | ug/l | n/a | 340000 | 340000 | 340000 | 14000 | 16000 | 350000 | 460000 | 180000 | 84000 | 310000 | 280000 | 330000 | 320000 |
| CHLORIDE | ug/l | n/a | 11000 | 34000 | 37000 | 1000 U | 1000 U | 30000 | 44000 | 23000 | 26000 | 42000 | 45000 | 18000 | 21000 |
| NITRATE (AS N) | ug/l | n/a | 120 | 100 U | 100 U | 100 U | 100 U | 100 U | 100 U | 250 | 70 J | 100 U | 38 J | 100 U | 280 |
| SULFATE | ug/l | n/a | 1000 U | 3600 | 1000 U | 7600 | 6600 | 3400 | 130 J | 20000 | 19000 | 21000 | 13000 | 4300 | 4500 |
| TURBIDITY | NTU | n/a | 170 | 100 | 140 | 1 | 0.91 | 110 | 230 | 0.91 | 65 | 38 | 21 | 30 | 9 |
| | | | Total Metals by SW6010/SW6020 | | | | | | | | | | | | |
| ARSENIC | ug/l | 10.00 | 2591 | 627 | 684.5 | 3 U | 1.01 J | 249 | 304.4 | 9.8 | 10.3 | 76 | 72.5 | 2030 | 750 |
| CALCIUM METAL | ug/l | n/a | 48000 | 90000 | 97000 | 5000 | 5600 | 59000 | 77000 | 72000 | 44000 | 97000 | 89000 | 70000 | 81000 |
| IRON | ug/l | 9100.00 | 100000 | 18000 | 18000 | 120 | 180 | 75000 | 94000 | 140 | 1900 | 2500 | 1700 | 22000 | 5000 |
| MAGNESIUM | ug/l | n/a | 6000 | 12000 | 13000 | 1000 | 1200 | 9600 | 12000 | 4000 | 1200 | 15000 | 15000 | 11000 | 12000 |
| MANGANESE | ug/l | 1715.00 | 1770 | 2960 | 3260 | 24 | 8.1 J | 1330 | 1700 | 67 | 24 | 604 | 494 | 9060 | 11400 |
| POTASSIUM | ug/l | n/a | 12000 | 4500 | 4200 | 1700 J | 1900 J | 20000 | 20000 | 5200 | 5900 | 5100 | 4800 | 10000 | 9200 |
| SODIUM | ug/l | 20000.00 | 14000 | 35000 | 36000 | 990 J | 1000 J | 32000 | 39000 | 9200 | 8600 | 23000 | 25000 | 26000 | 28000 |
| **Field Readings** | **Units** | **MCL or ROD Standard** | **SHM-05-41B Oct-2007** | **SHM-05-41C Apr-2007** | **SHM-05-41C Oct-2007** | **SHM-05-42A Apr-2007** | **SHM-05-42A Oct-2007** | **SHM-05-42B Apr-2007** | **SHM-05-42B Oct-2007** | **SHM-93-10C Oct-2007** | **SHM-93-10D Oct-2007** | **SHM-93-22C Apr-2007** | **SHM-93-22C Oct-2007** | **SHM-96-5B Apr-2007** | **SHM-96-5B Oct-2007** |
| pH | pH Units | n/a | 6.47 | NS | 7.46 | NS | 5.08 | NS | 6.09 | 7.46 | NS | 7.40 | 6.72 | 6.47 | 5.75 |
| SPC | ms/cm | n/a | 0.527 | NS | 0.563 | NS | 0.046 | NS | 0.737 | 0.45 | NS | 1.05 | 0.67 | 0.94 | 0.69 |
| DO | mg/l | n/a | 0.1 | NS | 0.14 | NS | 0.09 | NS | 0.09 | 0.35 | NS | 0.20 | 0.20 | 0.24 | 0.13 |
| ORP | Millivolts | n/a | 3.5 | NS | -28.9 | NS | 78.6 | NS | 17.9 | 19.00 | NS | -188.00 | -41.00 | -82.00 | 22.00 |
| Temp | DEG C | n/a | 10.21 | NS | 10.17 | NS | 10.02 | NS | 10.34 | 12.47 | NS | 8.06 | 12.11 | 7.52 | 11.04 |

Notes: J = Estimated Detect
U = Not detected at indicated reporting limit
NS = Not Sampled
Highlighted values exceed MCL or ROD standard

**Table 4-3**
**Groundwater Analytical Results**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Analaytical Parameter | Units | MCL or ROD Standard | Sample ID | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | SHM-96-5C Apr-2007 | SHM-96-5C Oct-2007 | SHM-96-22B Apr-2007 | SHM-96-22B Oct-2007 | SHM-99-31A Oct-2007 | SHM-99-31B Oct-2007 | SHM-99-31C Oct-2007 | SHM-99-32X Oct-2007 | SHP-01-36X Oct-2007 | SHP-01-37X Oct-2007 | SHP-01-38A Oct-2007 | SHP-99-29X Oct-2007 |
| ALKALINITY, TOTAL (AS CACO3) | ug/l | n/a | 350000 | 360000 | 310000 | 320000 | 46000 | 200000 | 390000 | 300000 | 29000 | 41000 | 190000 | 120000 |
| CHLORIDE | ug/l | n/a | 37000 | 32000 | 26000 | 20000 | 19000 | 16000 | 34000 | 35000 | 44000 | 49000 | 32000 | 1000 U |
| NITRATE (AS N) | ug/l | n/a | 130 | 130 | 100 U | 180 | 130 | 190 | 120 | 130 | 110 | 120 | 270 | 240 |
| SULFATE | ug/l | n/a | 4400 | 2800 | 5400 | 3200 | 6900 | 2200 | 1200 | 3400 | 7600 | 1100 | 12000 | 4900 |
| TURBIDITY | NTU | n/a | 96 | 180 | 240 | 390 | 2.1 | 7.6 | 130 | 180 | 0.2 U | 0.2 U | 35 | 7 |
| | | | Total Metals by SW6010/SW6020 | | | | | | | | | | | |
| ARSENIC | ug/l | 10.00 | 47 | 61.1 | 2800 | 1978 | 22.7 | 85.5 | 292.1 | 206.2 | 16.7 | 26.6 | 781.4 | 2953 |
| CALCIUM METAL | ug/l | n/a | 69000 | 69000 | 61000 | 61000 | 12000 | 44000 | 86000 | 78000 | 8900 | 10000 | 32000 | 11000 |
| IRON | ug/l | 9100.00 | 56000 | 60000 | 78000 | 55000 | 12000 | 28000 | 44000 | 60000 | 6900 | 8200 | 37000 | 44000 |
| MAGNESIUM | ug/l | n/a | 8600 | 11000 | 11000 | 10000 | 800 | 5100 | 13000 | 11000 | 1700 | 1600 | 5400 | 990 |
| MANGANESE | ug/l | 1715.00 | 3270 | 3980 | 1410 | 3200 | 798 | 1210 | 4050 | 3480 | 309 | 588 | 848 | 10400 |
| POTASSIUM | ug/l | n/a | 16000 | 13000 | 17000 | 12000 | 680 J | 6800 | 16000 | 12000 | 1500 J | 2200 J | 12000 | 530 J |
| SODIUM | ug/l | 20000.00 | 29000 | 30000 | 28000 | 27000 | 13000 | 16000 | 38000 | 34000 | 25000 | 28000 | 24000 | 2600 |
| **Field Readings** | **Units** | **MCL or ROD Standard** | **SHM-96-5C Apr-2007** | **SHM-96-5C Oct-2007** | **SHM-96-22B Apr-2007** | **SHM-96-22B Oct-2007** | **SHM-99-31A Oct-2007** | **SHM-99-31B Oct-2007** | **SHM-99-31C Oct-2007** | **SHM-99-32X Oct-2007** | **SHP-01-36X Oct-2007** | **SHP-01-37X Oct-2007** | **SHP-01-38A Oct-2007** | **SHP-99-29X Oct-2007** |
| pH | pH Units | n/a | 6.39 | 5.85 | 6.63 | 6.35 | 5.75 | 6.15 | 6.12 | 6.41 | 5.85 | 6.12 | 6.19 | 4.82 |
| SPC | ms/cm | n/a | 1.16 | 0.85 | 1.24 | 0.51 | 0.148 | 0.492 | 0.626 | 0.874 | 0.196 | 0.218 | 0.386 | 0.21 |
| DO | mg/l | n/a | 0.13 | 0.10 | 0.15 | 0.11 | 0.2 | 0.13 | 0.1 | 0.14 | 0.17 | 0.12 | 0.12 | 0.21 |
| ORP | Millivolts | n/a | -102.00 | -54.00 | -141.00 | -113.00 | 59.5 | -44 | 30.2 | -89 | -13 | -41.3 | -82.9 | 155.20 |
| Temp | DEG C | n/a | 7.63 | 10.39 | 7.10 | 9.84 | 13.21 | 10.1 | 10.53 | 10.18 | 17.24 | 16.73 | 12.46 | 12.44 |

Notes: J = Estimated Detect
U = Not detected at indicated reporting limit
NS = Not Sampled
Highlighted values exceed MCL or ROD standard

# Table 4-4
## In-Situ Water Quality Monitoring Results
## Shepley's Hill Landfill
## Devens, Massachusetts

### DOWNGRADIENT (MOLUMCO ROAD)

**SHM-05-40X**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 6.41 | 0.473 | 0.12 | 11.72 | 70.4 |

**SHM-05-39A**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.58 | 0.342 | 0.1 | 10.88 | 5.2 |

**SHM-05-39B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.85 | 0.892 | 0.12 | 12.66 | -90 |

**SHM-99-31A**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 5.75 | 0.148 | 0.2 | 13.21 | 59.5 |

**SHM-99-31B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.15 | 0.492 | 0.13 | 10.1 | -44 |

**SHM-99-31C**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.12 | 0.626 | 0.1 | 10.53 | 30.2 |

**SHM-99-32X**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.41 | 0.874 | 0.14 | 10.18 | -89 |

### DOWNGRADIENT (WOODS)

**SHM-05-41A**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 7.2 | 0.079 | 0.12 | 10.22 | -12.6 |

**SHM-05-41B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.47 | 0.527 | 0.1 | 10.21 | 3.5 |

**SHM-05-41C**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 7.46 | 0.563 | 0.14 | 10.17 | -28.9 |

**SHM-05-42A**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 5.08 | 0.046 | 0.09 | 10.02 | 78.6 |

**SHM-05-42B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/17/2007** | 6.09 | 0.737 | 0.09 | 10.34 | 17.9 |

### NEARFIELD AREA

**SHL-23**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/10/2007** | 5.35 | 0.058 | 11.11 | 11.33 | 234 |
| **7/12/2007** | 6.16 | 0.03 | 11.2 | 11.9 | 112 |
| **10/17/2007** | 5.54 | 0.044 | 11.03 | 11.79 | 182 |

**SHL-9**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/10/2007** | 6.47 | 0.262 | 0.36 | 6.37 | -52 |
| **7/12/2007** | 6.48 | 0.119 | 0.19 | 9.37 | -6 |
| **10/16/2007** | 6.21 | 0.158 | 0.08 | 10.14 | -62 |

**SHL-22**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/10/2007** | 6.7 | 1.109 | 0.19 | 7.73 | -51 |
| **7/11/2007** | 6.79 | 0.756 | 0.19 | 11.65 | 114 |
| **10/16/2007** | 6.4 | 0.536 | 0.11 | 10.75 | -65 |

**SHM-96-22B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/10/2007** | 6.63 | 1.235 | 0.15 | 7.1 | -141 |
| **7/12/2007** | 6.29 | 0.83 | 0.12 | 10.03 | -78 |
| **10/16/2007** | 6.35 | 0.506 | 0.11 | 9.84 | -113 |

**SHM-96-5B**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/11/2007** | 6.47 | 0.936 | 0.24 | 7.52 | -82 |
| **7/11/2007** | 6.31 | 0.689 | 0.25 | 12.97 | 97.4 |
| **10/17/2007** | 5.75 | 0.692 | 0.13 | 11.04 | 22 |

**SHM-96-5C**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/11/2007** | 6.39 | 1.161 | 0.13 | 7.63 | -102 |
| **7/11/2007** | 6.52 | 0.864 | 0.23 | 11.95 | 56 |
| **10/17/2007** | 5.85 | 0.854 | 0.1 | 10.39 | -54 |

**SHL-8S**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/11/2007** | 6.06 | 0.09 | 2.13 | 8.18 | 158 |
| **7/11/2007** | 5.89 | 0.07 | 0.89 | 10.6 | 118 |
| **10/18/2007** | 6.06 | 0.059 | 0.69 | 10.32 | 130 |

**SHL-8D**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/11/2007** | 5.88 | 0.171 | 1.9 | 8.2 | 169 |
| **7/11/2007** | 5.94 | 0.165 | 0.99 | 10.8 | 86 |
| **10/18/2007** | 5.98 | 0.133 | 1.65 | 10.44 | 138 |

**SHL-21**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/11/2007** | 5.72 | 0.104 | 9.2 | 11.76 | 179 |
| **7/11/2007** | 5.81 | 0.084 | 7.45 | 13.49 | 118 |
| **10/16/2007** | 5.66 | 0.061 | 9.86 | 14.1 | 46 |

**SHL-5**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **5/29/2007** | 5.35 | 0.072 | 1.36 | 10.18 | 411 |
| **7/11/2007** | 5.85 | 0.098 | 0.2 | 13.03 | 94.4 |
| **10/18/2007** | 6.01 | 0.11 | 0.1 | 12.84 | 8 |

**SHM-93-22C**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **4/10/2007** | 7.4 | 1.051 | 0.2 | 8.06 | -188 |
| **7/13/2007** | 7.42 | 0.708 | 0.21 | 11.86 | -112 |
| **10/16/2007** | 6.72 | 0.667 | 0.2 | 12.11 | -41 |

### POND AREA

**SHL-13**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 6.1 | 0.175 | 0.6 | 17.18 | 148.3 |

**SHP-01-36X**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 5.85 | 0.196 | 0.17 | 17.24 | -13 |

**SHP-01-37X**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6.12 | 0.218 | 0.12 | 16.73 | -41.3 |

**SHP-01-38A**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6.19 | 0.386 | 0.12 | 12.46 | -82.9 |

### UPGRADIENT AREA

**SHL-15**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 5.63 | 0.158 | 0.24 | 11.39 | -2 |

**N-5, P-1**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 5.98 | 0.638 | 0.13 | 11.86 | -60 |

**N-5, P-2**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 5.75 | 1.271 | 0.15 | 12.03 | -41 |

**SHP-93-10D**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 11.44 | 0.513 | 0.71 | 13.48 | 73 |

**SHP-99-29X**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/18/2007** | 4.82 | 0.211 | 0.21 | 12.44 | 155.2 |

**SHL-10**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6.6 | 0.067 | 10.3 | 14.39 | 37 |

**SHL-11**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6.76 | 0.394 | 0.21 | 11.87 | -91 |

**SHL-19**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6 | 0.187 | 0.29 | 11.39 | -43.9 |

**SHL-20**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 6.2 | 0.422 | 0.12 | 11.75 | -60.8 |

**SHL-4**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 5.88 | 0.238 | 0.15 | 11.26 | 16.4 |

**SHM-93-10C**

| | pH | Cond | DO | Temp | Eh/ORP |
|---|---|---|---|---|---|
| **10/16/2007** | 7.46 | 0.451 | 0.35 | 12.47 | 19 |

Note:
pH = pH (pH Units)
Cond = Conductivity (ms/cm)
DO = Dissolved Oxygen (mg/l)
Temp = Temperature (Deg C)
Eh/ORP = Oxidation Reduction Potential (Millivolts)

**Table 4-5**
**Summary of Historic Arsenic Concentrations**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Sample Date | Monitoring Well ID | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | SHL-10 | SHL-11 | SHL-19 | SHL-20 | SHL-22 | SHL-4 | SHL-5 | SHL-9 | SHM-93-10C | SHM-93-22C | SHM-96-22B | SHM-96-5B | SHM-96-5C |
| Aug-91 | **67** | **320** | **340** | **98** | **27** | **260** | **23** | **37** | NS | NS | NS | NS | NS |
| Dec-91 | **120** | **320** | **710** | **89** | **25** | **140** | **38** | **67** | NS | NS | NS | NS | NS |
| Mar-93 | **280** | **340** | **390** | **330** | **32.9** | 2.54 | **11.4** | **42.4** | **21.3** | **68.9** | NS | NS | NS |
| Jun-93 | NS | NS | NS | NS | NS | NS | NS | NS | **18.1** | **49.8** | NS | NS | NS |
| Nov-96 | 3.40 B | **332** | **138** | **244** | **24.8** | **48.8** | **12** | **46.9** | **12.4** | **44.6** | **324** | **1,440** | **71** |
| May-97 | 10 U | **252** J | 10 U | 10 U | 10 U | **73.6** J | 10 U | **16.1** J | 10 U | **40.4** | **318** J | **3,300** J | **43.2** |
| Oct-97 | **209** | **366** | **298** | **227** | **34.8** | **180** | 10 U | **25.2** | **10.5** | 10.0 U | **352** | **2,040** | **43.1** |
| May-98 | 5.00 U | **346** | **77.5** | **238** | **10.6** | **37.4** | 5 U | **15** | 7.5 | **31.6** | **365** | **4,300** | **49.5** |
| Nov-98 | 5.40 U | **376** | **145** | **218** | 5.40 U | **89.1** | **11.5** | **27.2** | **10.2** | **51.1** | **406** | **3,080** | **46.8** |
| May-99 | 2.70 B | **431** | **156** | **216** | **12.2** B | **78.2** | 5 B | **71.3** | **10.8** B | **42.8** | **707** | **3,490** | **57** |
| Nov-99 | 1.90 U | **492** | **176** | **215** | 7.30 | **61.3** | 6.5 | **28.5** | 8.7 | **33.2** | **1,440** | **2,700** | **44.8** |
| May-00 | 2.50 U | **404** | **41.4** | **216** | **14.6** | **116** | 2.5 U | **15** | 5.9 J | **34.4** | **1,360** | **5,110** | **52.2** |
| Nov-00 | 4.20 U | **523** | **154** | **172** | **45** | **91.5** | **13.8** | **31.4** | 8.8 | **47.8** | **1,180** | **2,500** | **40.3** |
| May-01 | 4.10 U | **487** | **129** | **186** | **47.6** | **50.8** | **13.8** | **15.1** | 6.9 | **19.7** | **1,540** | **3,800** | **80.5** |
| Oct-01 | 1.50 U | **573** | **183** | **165** | **44.2** | **66** | **14.8** | **28.1** | **10.1** | **31.6** | **1,670** | **1,850** | **41.1** |
| May-02 | 4.00 B | **469** | **66.9** | **154** | **55.9** B | **47.8** B | **11.9** B | **144** | **11** B | **30.5** B | **2,040** | **3,800** | **50.4** B |
| Oct-02 | 3.20 U | **648** | **164** | **175** | **77.1** | **66.1** | 3.2 U | **29** | 7.1 | **30.1** | **159** | **1,970** | **41.3** |
| May-03 | 4.70 U | **498** | **36.1** | **197** | **101** | **26.6** | 7.3 | **13.4** | 9.8 | **21** | **2,070** | **3,920** | **55.1** |
| Nov-03 | 4.10 U | **639** | **83.6** | **194** | **76.4** | **13.4** | 4.7 B | **30.6** | 5.2 U | **29.8** | **2,500** | **3,380** | **48.3** |
| May-04 | 2.60 U | **502** | **75** | **136** | **88.1** | **27.2** | 7.4 B | **19.8** | 7.2 B | **27.8** | **1,690** | **3,950** | **47.1** |
| Nov-04 | 5.80 U | **617** | **121** | **156** | **65.4** | **19.5** | 6.8 B | **32.2** | **10.6** B | **34.9** | **2,360** | **2,110** | **49.5** |
| Jun-05 | 4.50 U | **524** | **26.3** | **159** | NS | **10.1** | 7 B | NS | 8.1 B | **15.8** | NS | NS | NS |
| Jan-06 | 5.00 U | **567** | **156** | **189** | **154** | 5 U | 5 U | **18** | **11** | **23** | **3,320** | **4,130** | **43** |
| Apr-06 | NS | NS | NS | NS | **171** | NS | NS | **21** | NS | NS | **3,690** | **2,110** | **47** |
| Jun-06 | 5.00 U | **700** | **1,790** | **346** | **167** | 5 U | 6 | **21** | **12** | **17** | **3,440** | **2,760** | **51** |
| Sep-06 | NS | NS | NS | NS | **109** | NS | NS | **46** | NS | NS | **3,110** | **1,570** | **37** |
| Dec-06 | 5.00 U | **668** | **142** | **361** | **115** | 5 U | 8 | **51** | 10 | **73** | **3,100** | **2,980** | **24** |
| Apr-07 | NS | NS | NS | NS | **98** | NS | 6.2 | **26** | NS | **76** | **2,800** | **2,030** | **47** |
| Oct-07 | 0.59 J | **686.50** | **885.10** | **336.20** | **55.1** | 7.5 | **16.2** | **34.1** | 9.8 | **72.5** | **1,978** | **750** | **61.1** |

Notes: Bold Number indicates cleanup level exceedances (MCL cleanup level is 10 ug/L)
B = Value within five times of the greater amount detected in the equipment or preparation blank
LTMP = Long term monitoring plan (sampled semi-annual only)
NS = Not Sampled
U = Not detected at indicated reporting limit

**Table 5-1**
**Summary of Revised System Performance Assessment Metrics and Results**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Performance Assessment Component | Method | Description | Data Utilized | Results | Interpretation | Conclusion |
|---|---|---|---|---|---|---|
| Hydraulic Capture Zone Analysis | Gradient Vector Analysis | Compute horizontal hydraulic gradient vectors between groups of wells in nearfield hydraulic monitoring network under 50 gpm pumping conditions for comparison to non-pumping baseline conditions. | Water level data from Fall 2007 synoptic round as well as February 2008 System Shutdown. | Map comparing computed vectors under pumping and non-pumping conditions from the 10/15/07, 2/20/08 and 2/25/08 synoptic events. | Horizontal flow patterns are influenced by pumping primarily in the nearfield area. | operating as designed |
| | Capture Zone Width Calculation | Compute theoretical capture zone width using basic flow budget and conservative assumptions regarding hydraulic conductivity and saturated thickness. | Observed hydraulic gradients for 2007, aquifer properties as specified in existing model, saturated thickness from SGI cross-sections and extraction well boring logs. | Calculated capture zone width is 763 feet at the extraction wells, based on the saturated thickness of 50 feet. | Calculated capture zone width is adequate to contain the estimated 444 foot width of impacted aquifer. | operating as designed |
| | Comparison to Numerical Model Results | Compare results of above analyses to particle track simulations using the current 3-d numerical model of the aquifer flowfield. | Numerical simulation results for 50 gpm design pumping rate (CH2M Hill's "run412" model). | Comparison maps series with predicted flow patterns and/or water levels, drawdowns etc. | Existing model reasonably matches observed flow directions, water levels, drawdowns etc. | operating as designed |
| | 50 gpm Drawdown Assessment | Compare nearfield water levels under 50 gpm pumping and non-pumping conditions at next system shutdown to determine observed drawdown. | Two synoptic rounds just prior to and after a system restart at 50 gpm. (Completed 3/3/08) | Comparison map with observed vs. predicted drawdowns based on the February 2008 System Shutdown. | Distribution and magnitude of observed drawdown generally consistent with predicted. | operating as designed |
| Geochemical Monitoring | Advective Travel Time Analysis | Develop particle track-based travel times to predict when unimpacted groundwater from plume flanks should arrive at downgradient impacted wells | Numerical simulation results for 50 gpm design pumping rate. | Map plotting predicted 2 year travel time markers | Advective velocities in downgradient groundwater generally 1 ft/day and therefore changes in geochemical conditions are expected to take several years to be fully realized. | currently inconclusive |
| | Qualitative Trend Analysis | Evaluate Fall 2007 As concentrations and ORP data for changes relative to historical conditions | Geochemical data from Fall 2007 synoptic round and database of historic As values etc. | Map of Historical As concentrations for the last 2 years. Longer term historical values tabulated and plotted as bar charts. | Some declines in nearfield arsenic evident in October round, no clear trends yet identified. | currently inconclusive |

**Table 5-2**
**Synoptic Water Levels Used in the Drawdown Asssessment**
**Shepley's Hill Landfill**
**Devens, Massachusetts**

| Well ID | Northing | Easting | Reference Elevation | Interval | DTW 022008 | Elevation 022008 | DTW 022508 | Elevation 022508 | DTW 030408 | Elevation 030408 | Calculated Drawdown[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (ft) | (ft) | (ft msl) | | (ft) | (ft msl) | (ft) | (ft msl) | (ft) | (ft msl) | (ft) |
| EW-01 pilot | 3027960 | 629943 | 228.0 | Overburden | 12.98 | 215.0 | 11.86 | 216.1 | 13.41 | 214.6 | -1.55 |
| EW-04 pilot | 3027991 | 629895 | 228.1 | Overburden | 12.52 | 215.6 | 12.04 | 216.1 | 13.15 | 215.0 | -1.11 |
| N-1, P-1 | 3027868 | 630723 | 231.0 | Deep Overburden | 13.4 | 217.6 | 13.9 | 217.1 | 13.7 | 217.3 | 0.21 |
| N-1, P-2 | 3027868 | 630723 | 231.0 | Mid-Depth Overburden | 13.3 | 217.7 | 13.6 | 217.4 | 13.7 | 217.3 | -0.13 |
| N-1, P-3 | 3027868 | 630723 | 231.2 | Shallow Overburden/WT | 13.0 | 218.2 | 13.4 | 217.8 | 13.4 | 217.8 | -0.07 |
| N-2, P-1 | 3027311 | 630659 | 223.1 | Deep Overburden | 4.7 | 218.4 | 5.1 | 218.0 | 5.0 | 218.1 | 0.11 |
| N-2, P-2 | 3027311 | 630659 | 223.0 | Shallow Overburden/WT | 4.9 | 218.1 | 5.3 | 217.7 | 5.2 | 217.8 | 0.08 |
| N-3, P-1 | 3027130 | 630778 | 221.8 | Bedrock | 3.5 | 218.3 | 4.2 | 217.6 | 3.9 | 217.9 | 0.31 |
| N-3, P-2 | 3027130 | 630778 | 221.5 | Water Table | 3.5 | 218.0 | 4.0 | 217.6 | 3.9 | 217.6 | 0.06 |
| N-5, P-1 | 3027173 | 629806 | 243.7 | Bedrock | 23.3 | 220.4 | 23.2 | 220.6 | 23.1 | 220.6 | 0.07 |
| N-5, P-2 | 3027173 | 629806 | 243.7 | Shallow Overburden/WT | 24.2 | 219.5 | 23.9 | 219.8 | 23.8 | 220.0 | 0.16 |
| N-6, P-1 | 3026339 | 630017 | 259.9 | Bedrock | 37.2 | 222.7 | 37.0 | 223.0 | 36.8 | 223.1 | 0.16 |
| N-7, P-1 | 3025619 | 629991 | 256.6 | Bedrock | 30.3 | 226.3 | 30.1 | 226.5 | 29.9 | 226.7 | 0.19 |
| N-7, P-2 | 3025619 | 629991 | 257.1 | Shallow Overburden/WT | 30.5 | 226.6 | 30.2 | 227.0 | 30.0 | 227.1 | 0.19 |
| PSP-01 | 3028179 | 630581 | 216.1 | Pond Stage | 2.2 | 213.9 | 1.8 | 214.4 | 1.8 | 214.3 | -0.05 |
| SHL-10 | 3026842 | 630878 | 248.5 | Shallow Overburden/WT | 29.2 | 219.3 | 29.6 | 218.9 | 30.0 | 218.5 | -0.43 |
| SHM-93-10C | 3026846 | 630886 | 248.6 | Bedrock | 28.1 | 220.5 | 28.4 | 220.2 | 28.6 | 220.0 | -0.26 |
| SHM-93-10D | 3026868 | 630877 | 248.9 | Bedrock | 28.9 | 220.0 | 29.0 | 219.9 | 29.3 | 219.6 | -0.34 |
| SHL-11 | 3027316 | 630496 | 236.5 | Shallow Overburden/WT | 17.8 | 218.7 | 18.1 | 218.4 | 18.2 | 218.3 | -0.06 |
| SHL-13 | 3028106 | 630540 | 221.8 | Shallow Overburden/WT | 5.5 | 216.3 | 5.8 | 216.0 | 6.1 | 215.8 | -0.26 |
| SHL-15 | 3025830 | 629326 | 260.9 | Shallow Overburden/WT | 15.3 | 245.6 | 15.5 | 245.4 | 15.8 | 245.1 | -0.27 |
| SHL-18 | 3026475 | 631186 | 238.6 | Shallow Overburden/WT | 17.6 | 221.0 | 17.9 | 220.7 | 18.2 | 220.4 | -0.32 |
| SHL-19 | 3026946 | 630665 | 241.5 | Shallow Overburden/WT | 21.5 | 220.0 | 21.9 | 219.6 | 22.3 | 219.2 | -0.41 |
| SHL-20 | 3027329 | 630463 | 237.0 | Deep Overburden/Till | 18.2 | 218.8 | 18.5 | 218.5 | 18.6 | 218.4 | -0.07 |
| SHL-21 | 3027884 | 630363 | 260.0 | Shallow Overburden/WT | 44.0 | 216.0 | 43.9 | 216.1 | 44.2 | 215.8 | -0.29 |
| SHL-22 | 3028163 | 630056 | 220.6 | Deep Overburden | 5.4 | 215.2 | 5.1 | 215.5 | 6.0 | 214.6 | -0.85 |
| SHL-23 | 3027917 | 629713 | 242.3 | Shallow Overburden/WT | 25.6 | 216.7 | 25.0 | 217.3 | 25.6 | 216.7 | -0.57 |
| SHL-24 | 3025636 | 631303 | 239.8 | Deep Overburden | 14.1 | 225.7 | 14.4 | 225.4 | 14.5 | 225.3 | -0.13 |
| SHL-3 | 3026706 | 630911 | 247.8 | Shallow Overburden/WT | 28.9 | 218.9 | 29.2 | 218.6 | 29.5 | 218.3 | -0.29 |
| SHL-4 | 3027057 | 630576 | 228.1 | Shallow Overburden/WT | 9.5 | 218.6 | 9.9 | 218.2 | 9.9 | 218.2 | -0.05 |
| SHL-5 | 3028125 | 630192 | 218.6 | Shallow Overburden/WT | 1.6 | 217.0 | 2.2 | 216.4 | 2.2 | 216.4 | 0.05 |
| SHL-8D | 3028128 | 630407 | 221.8 | Deep Overburden | 6.0 | 215.8 | 6.1 | 215.7 | 6.5 | 215.3 | -0.45 |
| SHL-8S | 3028128 | 630407 | 222.0 | Mid-Depth Overburden | 6.2 | 215.8 | 6.3 | 215.7 | 6.7 | 215.4 | -0.39 |
| SHL-9 | 3028147 | 630009 | 223.0 | Shallow Overburden/WT | 7.1 | 215.9 | 7.3 | 215.7 | 8.1 | 214.9 | -0.80 |
| SHM-05-39A | 3028544 | 629761 | 222.6 | Mid-Depth Overburden | 9.7 | 212.9 | 9.8 | 212.8 | flooded | | - |
| SHM-05-39B | 3028544 | 629766 | 222.6 | Deep Overburden | 10.5 | 212.1 | 10.6 | 212.0 | flooded | | - |
| SHM-05-40X | 3028514 | 629637 | 224.4 | Mid-Depth Overburden/Till | 12.3 | 212.1 | 12.3 | 212.1 | 12.8 | 211.6 | -0.50 |
| SHM-05-41A | 3028291 | 629796 | 223.5 | Shallow Overburden | 8.6 | 215.0 | 8.3 | 215.2 | 9.1 | 214.4 | -0.79 |
| SHM-05-41B | 3028299 | 629796 | 223.3 | Mid-Depth Overburden | 8.4 | 214.9 | 8.2 | 215.1 | 9.0 | 214.3 | -0.83 |
| SHM-05-41C | 3028285 | 629796 | 223.6 | Deep Overburden/Till | 8.6 | 215.0 | 8.4 | 215.2 | 9.0 | 214.6 | -0.63 |
| SHM-05-42A | 3028376 | 630018 | 217.8 | Shallow Overburden | Frozen | | 2.55 (frozen) | | 3.20 (frozen) | | - |
| SHM-05-42B | 3028376 | 630018 | 217.8 | Mid-Depth Overburden | Frozen | | 2.60 (frozen) | | 3.09 (frozen) | | - |
| SHM-93-18B | 3026453 | 631180 | 238.3 | Deep Overburden/Till | 17.3 | 221.0 | 17.6 | 220.7 | 17.9 | 220.4 | -0.30 |
| SHM-93-22C | 3028158 | 630046 | 221.7 | Bedrock | 6.1 | 215.6 | 6.2 | 215.5 | 6.9 | 214.8 | -0.78 |
| SHM-96-22B | 3028170 | 630072 | 220.4 | Mid-Depth Overburden | 6.1 | 214.3 | 6.2 | 214.2 | 6.9 | 213.5 | -0.78 |
| SHM-96-5B | 3028113 | 630158 | 220.0 | Base of Sand/Till | 4.5 | 215.6 | 4.3 | 215.8 | 5.0 | 215.0 | -0.78 |
| SHM-96-5C | 3028106 | 630174 | 219.4 | Mid-Depth Overburden | 3.9 | 215.5 | 3.7 | 215.7 | 4.5 | 214.9 | -0.72 |
| SHP-01-38A | 3027178 | 630544 | 221.8 | Shallow Overburden/WT | 3.3 | 218.5 | 3.7 | 218.2 | 3.5 | 218.3 | 0.14 |
| SHP-01-38B | 3027172 | 630545 | 222.0 | Deep Overburden | 3.4 | 218.6 | 3.7 | 218.3 | 3.6 | 218.4 | 0.10 |
| SHP-05-43 | 3027747 | 630533 | 261.7 | Shallow Overburden | 44.0 | 217.7 | 43.9 | 217.8 | 44.2 | 217.6 | -0.22 |
| SHP-05-44 | 3027589 | 630586 | 259.1 | Mid-Depth Overburden | 41.1 | 218.0 | 41.3 | 217.8 | 41.4 | 217.7 | -0.11 |
| SHM-05-45A | 3027962 | 629995 | 229.5 | Shallow Overburden | 14.1 | 215.5 | 13.4 | 216.2 | 14.7 | 214.8 | -1.31 |
| SHM-05-45B | 3027957 | 629995 | 230.1 | Mid-Depth Overburden | 14.8 | 215.3 | 14.0 | 216.1 | 15.4 | 214.8 | -1.34 |
| SHM-05-46A | 3027947 | 630042 | 229.3 | Shallow Overburden | 13.0 | 216.3 | 12.4 | 217.0 | 13.5 | 215.8 | -1.12 |
| SHM-05-46B | 3027941 | 630041 | 228.7 | Mid-Depth Overburden | 13.6 | 215.1 | 13.0 | 215.7 | 14.1 | 214.6 | -1.12 |
| SHP-05-47A | 3028227 | 630523 | 218.5 | Water Table | Flooded | | 4.3 | 214.2 | 4.3 | 214.2 | 0.00 |
| SHP-05-47B | 3028226 | 630524 | 216.3 | Water Table | Flooded | | 1.69 (frozen) | | 2.2 | 214.2 | - |
| SHP-05-48A | 3028570 | 630046 | 217.0 | Water Table | Frozen | | 2.19 (frozen) | | 2.58 (frozen) | | - |
| SHP-05-48B | 3028569 | 630046 | 218.4 | Water Table | Frozen | | 3.76 (frozen) | | 3.88 (frozen) | | - |
| SHP-05-49A | 3028664 | 630251 | 217.8 | Water Table | Frozen | | 3.8 | 214.0 | 3.9 | 213.9 | -0.09 |
| SHP-05-49B | 3028664 | 630251 | 216.2 | Water Table | 4.6 | 211.6 | 5.4 | 210.8 | 5.4 | 210.8 | 0.02 |
| SHP-01-36X | 3027689 | 630738 | 225.1 | Shallow Overburden/WT | 6.9 | 218.2 | 6.80 (dry/frozen) | | 7.3 | 217.8 | - |
| SHP-01-37X | 3027499 | 630697 | 223.7 | Shallow Overburden/WT | 5.6 | 218.1 | 6.0 | 217.7 | 6.0 | 217.7 | 0.04 |
| SHP-95-27X | 3026165 | 630753 | 238.5 | Shallow Overburden/WT | 13.8 | 224.7 | 14.1 | 224.4 | 14.5 | 224.0 | -0.46 |
| SHM-99-31A | 3028558 | 629895 | 215.4 | Shallow Overburden/WT | Frozen | | 1.8 | 213.7 | 1.8 | 213.6 | -0.06 |
| SHM-99-31B | 3028560 | 629900 | 215.4 | Mid-Depth Overburden | Frozen | | 2.4 | 213.0 | 2.8 | 212.6 | -0.40 |
| SHM-99-31C | 3028561 | 629909 | 215.8 | Deep Overburden | Frozen | | 2.6 | 213.2 | 3.1 | 212.8 | -0.41 |
| SHM-99-32X | 3028575 | 630170 | 222.3 | Deep Overburden | 37.0 | 185.3 | 36.9 | 185.4 | 36.8 | 185.5 | 0.12 |
| SHP-99-34A | 3028552 | 630295 | 225.7 | Shallow Overburden/WT | 11.5 | 214.2 | 12.3 | 213.4 | 12.3 | 213.4 | -0.05 |
| SHP-99-34B | 3028552 | 630291 | 225.6 | Deep Overburden | 12.3 | 213.3 | 11.6 | 214.0 | 11.8 | 213.8 | -0.14 |
| SHP-99-35X | 3026547 | 629723 | 259.2 | Shallow Overburden/WT | 37.0 | 222.2 | 36.9 | 222.3 | 36.8 | 222.4 | 0.12 |

**Notes:**

**1) Calculated from the 2/25 and 3/4/08 synoptic surveys.**

**DTW = Depth to Water (from top of casing)**

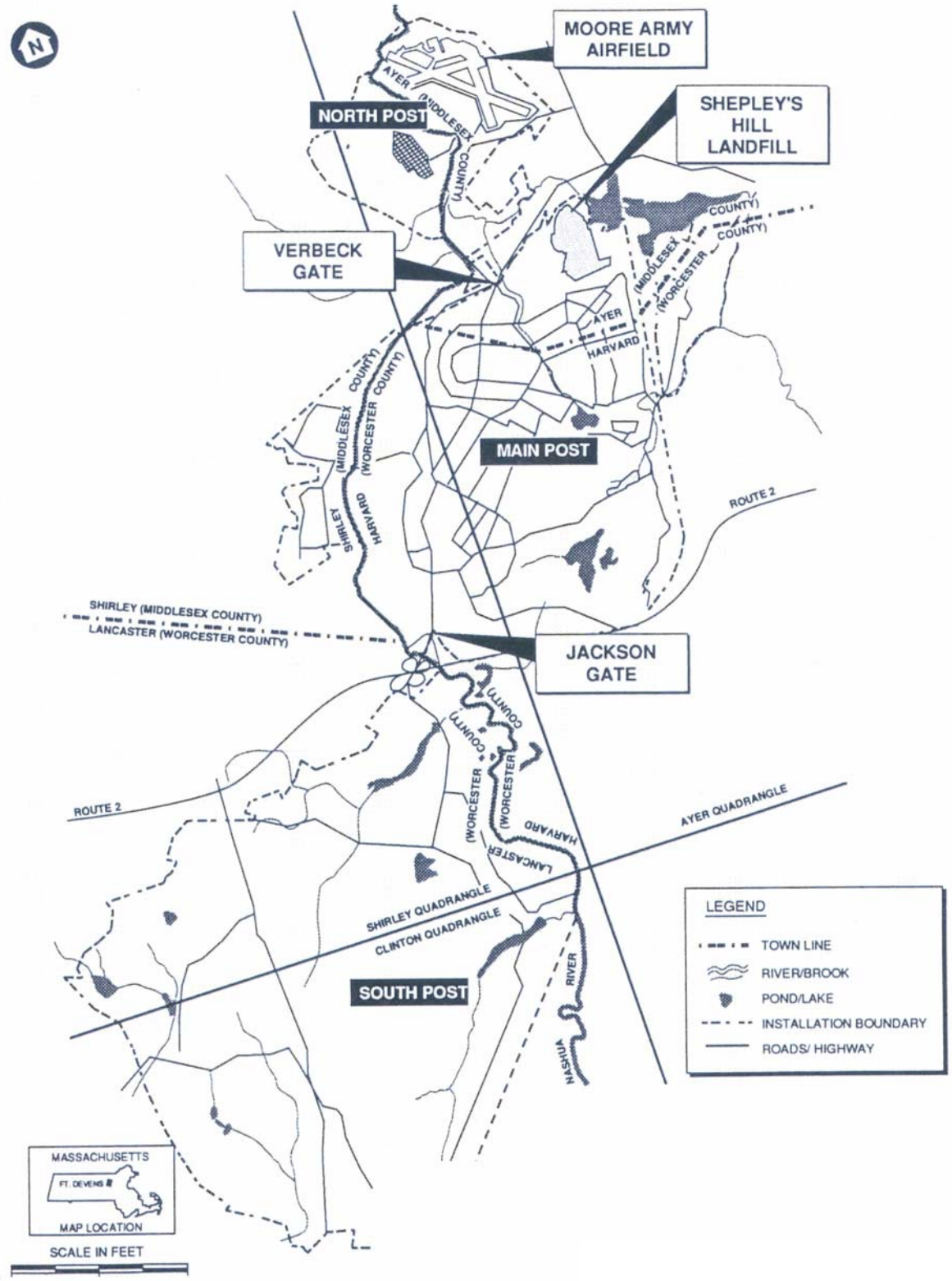
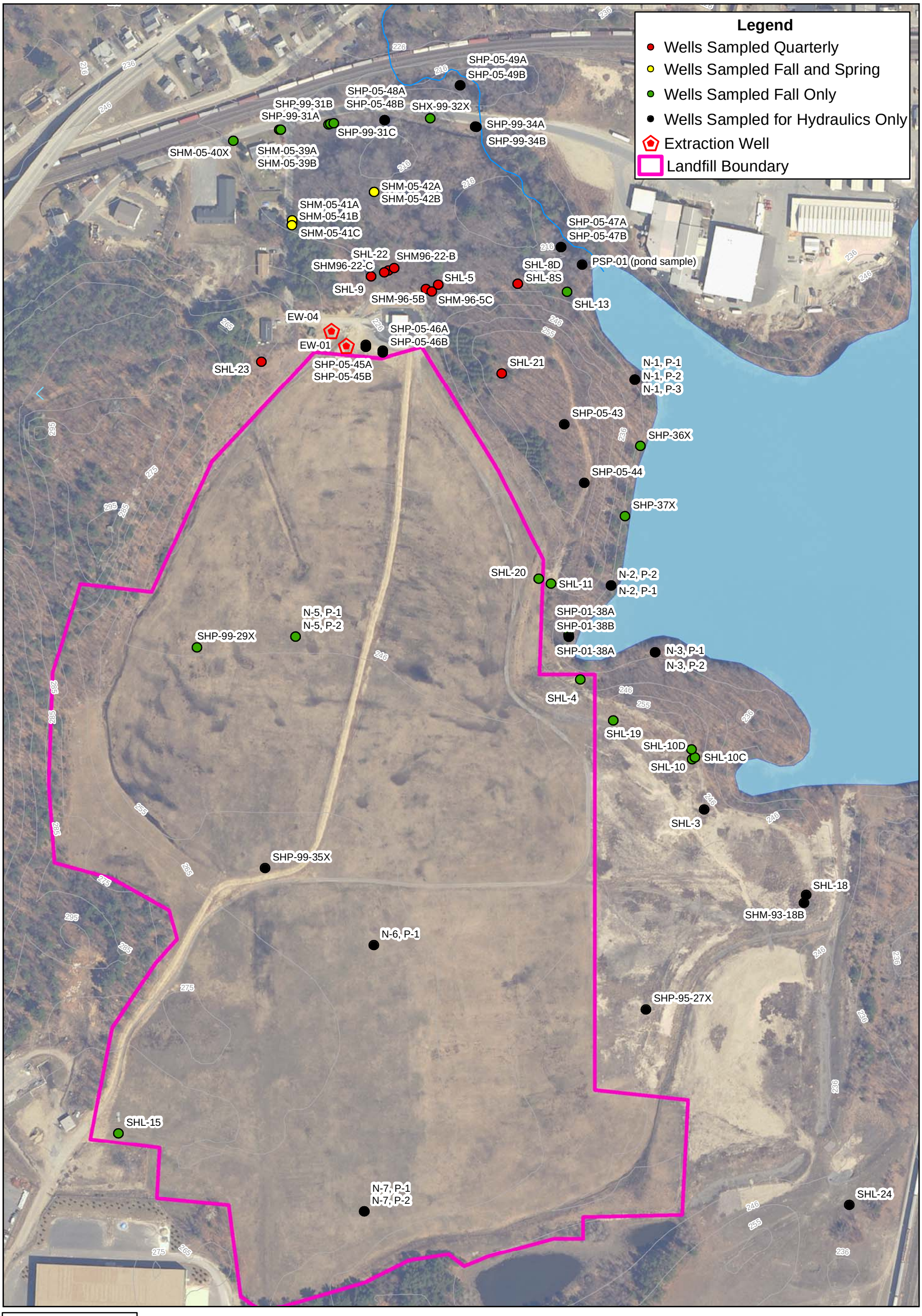



Figure 1-1
Former Fort Devens Vicinity and Shepley's Hill Landfill
(adapted from Harding ESE, 2003)




# LTMMP Well Network and Sampling Frequency

**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE
4-1

ECC

H:\ShepleyLandfill\Task11\MXD\Figure4-1.mxd H:\ShepleyLandfill\Task11\Export\Figure4-1.pdf April 10, 2008 DWN: DJK CHKD: KMP

## Legend

| | |
|---|---|
| SHL-19 | Location ID |
| 218.68 | Groundwater Elevation |
| | Well, Piezometer, or Stage Board |
| | Topographic Elevation Contour (ft msl) |
| | Groundwater Contours (ft msl) |
| | Extraction Well |
| | Landfill Cap Boundary |

SHM-99-31C 212.56
SHM-99-31B 212.44
SHM-99-31A 213.6
SHM-05-39B 211.22
SHM-05-39A 212.1
SHP-99-32X 213.48
SHP-99-34A 212.98
SHP-99-34B 213.23
SHM-05-40X 211.2
SHP-05-48A 213.55
SHP-05-48B 213.48
SHM-05-42A 214.33
SHM-05-42B 214.39
SHM-05-41B 214.26
SHM-05-41A 214.29
SHM-05-41C 214.33
SHM-93-22C 214.61
SHL-22 214.61
SHP-05-47A 212.93
SHP-05-47B 213.7
SHL-8S 214.49
PSP-01 214.82
SHL-9 214.97
SHL-5 216.43
SHM-96-5C 214.85
SHM-96-5B 214.9
SHL-8D 214.61
SHL-13 215.16
SHM-96-22B 214.53
SHL-23 215.89
SHM-05-45A 214.65
SHM-05-45B 214.63
SHM-05-46A 214.89
SHM-05-46B 214.92
SHL-21 214.89
N-1, P-1 216.27
N-1, P-2 216.43
N-1, P-3 215.79
SHP-05-43 209.38
SHP-01-36X 216.96
SHP-05-44 206.53
SHP-01-37X 216.87
SHL-20 218.08
SHL-11 217.93
N-2, P-1 217.2
N-2, P-2 216.86
N-5, P-1 220.02
N-5, P-2 223.66
SHP-01-38A 217.4
SHP-01-38B 217.55
N-3, P-1 216.66
N-3, P-2 213.29
SHL-4 217.88
SHL-19 219.01
SHM-93-10C 219.4
SHM-93-10D 218.73
SHL-10 218
SHL-3 219.16
SHP-99-35X 222.42
SHM-93-18B 219.77
SHL-18 219.75
N-6, P-1 222.98
SHP-95-27X 205.47
SHL-15 243.96
N-7, P-1 225.98
N-7, P-2 226.35
SHL-24 224.31

Location of Site

# Groundwater Elevations
# April 8, 2007

**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE
4-2

0 300
Feet

H:\ShepleyLandfill\Task11\MXD\Figure4-2.mxd H:\ShepleyLandfill\Task11\Export\Figure4-2.pdf April 16, 2008 DWN: DJK CHKD: KMP

## Legend

| | |
|---|---|
| SHL-19 | Location ID |
| 218.68 | Groundwater Elevation |
| | Well, Piezometer, or Stage Board |
| | Topographic Elevation Contour (ft msl) |
| | Groundwater Contours (ft msl) |
| | Extraction Well |
| | Landfill Cap Boundary |

SHM-99-31C 211.14
SHM-99-31B 211.01
SHM-99-31A 211.5
SHP-05-49A 213.28
SHM-05-40X 209.65
SHP-99-34A 212.39
SHP-99-34B 211.76
SHM-99-32X 212.04
SHM-05-39A 210.59
SHM-05-39B 209.94
SHM-05-42A 212.23
SHM-05-42B 212.16
SHP-05-47B 213.21
SHM-05-41B 211.94
SHM-05-41A 211.95
SHM-05-41C 211.99
SHL-22 212.34
SHM-93-22C 212.33
SHL-5 212.8
SHL-8S 213.86
SHL-8D 213.8
PSP-01 213.8
SHL-13 215.04
SHL-9 212.21
SHM-96-22B 212.35
SHM-96-5C 212.79
N-1, P-1 216.85
N-1, P-2 217.26
N-1, P-3 218.08
SHL-23 212.58
SHM-05-45A 212.31
SHM-05-46A 213.38
SHM-05-46B 212.1
SHL-21 210.88
SHM-05-45B 212.22
SHP-05-43 216.68
SHP-01-36X 218.98
SHP-05-44 218.03
SHP-01-37X 215.1
N-2, P-1 218.4
SHL-20 218.32
SHL-11 218.28
N-2, P-2 218.14
N-5, P-1 219.48
SHP-99-29X 219.85
N-5, P-2 219.29
SHP-01-38A 218.34
SHP-01-38B 218.41
SHL-4 218.09
N-3, P-2 217.96
N-3, P-1 217.58
SHM-93-10D 218.8
SHL-19 218.68
SHM-93-10C 219.25
SHL-10 218.31
SHL-3 219.42
SHP-99-35X 222.01
SHM-93-18B 219.49
SHL-18 219.48
N-6, P-1 222.26
SHP-95-27X 221.8
N-7, P-1 225.11
N-7, P-2 225.44
SHL-24 223.68

Location of Site

# Groundwater Elevations
# October 15, 2007

**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE 4-3

0 300
Feet

ECC

H:\ShepleyLandfill\Task11\MXD\Figure4-3.mxd H:\ShepleyLandfill\Task11\Export\Figure4-3.pdf April 16, 2008 DWN: DJK CHKD: KMP

| SHM-99-31A | | |
|---|---|---|
| 11-Apr-06 | 9 | ug/l |
| 20-Sep-06 | 23 | ug/l |
| 17-Oct-07 | 22.7 | ug/l |

| SHM-99-31B | | |
|---|---|---|
| 11-Apr-06 | 56 | ug/l |
| 20-Sep-06 | 74 | ug/l |
| 17-Oct-07 | 85.5 | ug/l |

| SHM-99-31C | | |
|---|---|---|
| 11-Apr-06 | 270 | ug/l |
| 20-Sep-06 | 305 | ug/l |
| 17-Oct-07 | 292 | ug/l |

| SHM-05-40X | | |
|---|---|---|
| 11-Apr-06 | 3,610 | ug/l |
| 20-Sep-06 | 3,510 | ug/l |
| 18-Oct-07 | 4445 | ug/l |

| SHM-05-39A | | |
|---|---|---|
| 11-Apr-06 | 289 | ug/l |
| 21-Sep-06 | 270 | ug/l |
| 17-Oct-07 | 241.5 | ug/l |

| SHM-05-39B | | |
|---|---|---|
| 11-Apr-06 | 590 | ug/l |
| 25-Sep-06 | 415 | ug/l |
| 17-Oct-07 | 309.4 | ug/l |

| SHM-05-41A | | |
|---|---|---|
| 11-Apr-06 | 54 | ug/l |
| 20-Sep-06 | 41 | ug/l |
| 10-Apr-07 | 30 | ug/l |
| 17-Oct-07 | 24.9 | ug/l |

| SHM-05-41B | | |
|---|---|---|
| 11-Apr-06 | 2,420 | ug/l |
| 20-Sep-06 | 2,730 | ug/l |
| 10-Apr-07 | 1990 | ug/l |
| 17-Oct-07 | 2591 | ug/l |

| SHM-05-41C | | |
|---|---|---|
| 13-Apr-06 | 626 | ug/l |
| 20-Sep-06 | 640 | ug/l |
| 10-Apr-07 | 627 | ug/l |
| 17-Oct-07 | 684.5 | ug/l |

| SHL-23 | | |
|---|---|---|
| 14-Apr-06 | 5 | U ug/l |
| 25-Sep-06 | 5 | U ug/l |
| 10-Apr-07 | 3 | U ug/l |
| 17-Oct-07 | 0.73 | J ug/l |

| SHL-9 | | |
|---|---|---|
| 10-Apr-06 | 21 | ug/l |
| 21-Sep-06 | 46 | ug/l |
| 10-Apr-07 | 26 | ug/l |
| 16-Oct-07 | 34.1 | ug/l |

| SHM-93-22C | | |
|---|---|---|
| 10-Apr-07 | 76 | ug/l |
| 16-Oct-07 | 72.5 | ug/l |

| SHL-22 | | |
|---|---|---|
| 10-Apr-06 | 171 | U ug/l |
| 21-Sep-06 | 109 | U ug/l |
| 10-Apr-07 | 98 | U ug/l |
| 16-Oct-07 | 55.1 | J ug/l |

| SHM-96-22B | | |
|---|---|---|
| 10-Apr-07 | 2800 | ug/l |
| 16-Oct-07 | 1978 | ug/l |

| SHP-99-29X | | |
|---|---|---|
| 18-Oct-07 | 2953 | ug/l |

| N-5, P-1 | | |
|---|---|---|
| 13-Apr-06 | 4940 | ug/l |
| 25-Sep-06 | 4560 | ug/l |
| 18-Oct-07 | 4856 | ug/l |

| N-5, P-2 | | |
|---|---|---|
| 13-Apr-06 | 22 | ug/l |
| 25-Sep-06 | 22 | ug/l |
| 18-Oct-07 | 28.1 | ug/l |

| SHL-15 | | |
|---|---|---|
| 13-Apr-06 | 18 | ug/l |
| 25-Sep-06 | 44 | ug/l |
| 16-Oct-07 | 42 | ug/l |

| SHM-99-32X | | |
|---|---|---|
| 11-Apr-06 | 168 | ug/l |
| 20-Sep-06 | 202 | ug/l |
| 17-Oct-07 | 206 | ug/l |

| SHM-05-42A | | |
|---|---|---|
| 14-Apr-06 | 5 | U ug/l |
| 21-Sep-06 | 5 | U ug/l |
| 10-Apr-07 | 3 | U ug/l |
| 17-Oct-07 | 1.01 | J ug/l |

| SHM-05-42B | | |
|---|---|---|
| 14-Apr-06 | 266 | ug/l |
| 21-Sep-06 | 276 | ug/l |
| 10-Apr-07 | 249 | ug/l |
| 17-Oct-07 | 304.4 | ug/l |

| SHL-20 | | |
|---|---|---|
| 16-Oct-07 | 336.2 | ug/l |

| SHL-21 | | |
|---|---|---|
| 10-Apr-06 | 171 | ug/l |
| 21-Sep-06 | 109 | ug/l |
| 10-Apr-07 | 98 | ug/l |
| 16-Oct-07 | 55.1 | ug/l |

| SHM-96-5B | | |
|---|---|---|
| 10-Apr-06 | 2110 | ug/l |
| 20-Sep-06 | 1570 | ug/l |
| 11-Apr-07 | 2030 | ug/l |
| 17-Oct-07 | 750 | ug/l |

| SHM-96-5C | | |
|---|---|---|
| 10-Apr-06 | 47 | ug/l |
| 20-Sep-06 | 37 | ug/l |
| 11-Apr-07 | 47 | ug/l |
| 17-Oct-07 | 61.1 | ug/l |

| SHL-5 | | |
|---|---|---|
| 18-Oct-07 | 16.2 | ug/l |

| SHL-8D | | |
|---|---|---|
| 18-Oct-07 | 16.2 | ug/l |

| SHL-8S | | |
|---|---|---|
| 10-Apr-06 | 5 | U ug/l |
| 21-Sep-06 | 5 | U ug/l |
| 11-Apr-07 | 3 | U ug/l |
| 18-Oct-07 | 22.6 | ug/l |

| SHL-13 | | |
|---|---|---|
| 10-Apr-06 | 5 | U ug/l |
| 21-Sep-06 | 5 | U ug/l |
| 18-Oct-07 | 1.6 | ug/l |

| SHP-01-36X | | |
|---|---|---|
| 13-Apr-06 | 24 | ug/l |
| 21-Sep-06 | 30 | ug/l |
| 16-Oct-07 | 16.7 | ug/l |

| SHP-01-37X | | |
|---|---|---|
| 13-Apr-06 | 41 | ug/l |
| 21-Sep-06 | 46 | ug/l |
| 16-Oct-07 | 26.6 | ug/l |

| SHL-11 | | |
|---|---|---|
| 16-Oct-07 | 686.5 | ug/l |

| SHP-01-38A | | |
|---|---|---|
| 13-Apr-06 | 550 | ug/l |
| 21-Sep-06 | 681 | ug/l |
| 16-Oct-07 | 781 | ug/l |

| SHL-4 | | |
|---|---|---|
| 16-Oct-07 | 7.5 | ug/l |

| SHL-19 | | |
|---|---|---|
| 16-Oct-07 | 885.1 | ug/l |

| SHM-93-10D | | |
|---|---|---|
| 14-Apr-06 | 14 | ug/l |
| 25-Sep-06 | 14 | ug/l |
| 18-Oct-07 | 10.3 | ug/l |

| SHL-10 | | |
|---|---|---|
| 16-Oct-07 | 0.59 | J ug/l |

| SHM-93-10C | | |
|---|---|---|
| 16-Oct-07 | 9.8 | ug/l |
| 14-Apr-06 | 14 | ug/l |
| 25-Sep-06 | 14 | ug/l |
| 18-Oct-07 | 10 | ug/l |

**Legend**

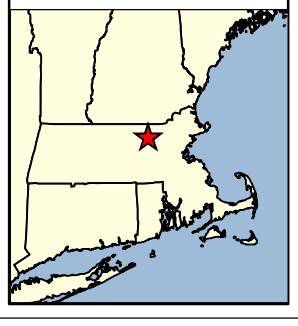
- Extraction Well
- Landfill Cap Boundary
- Sampled Wells

Chemical Boxes:

| SHL-10 | | |
|---|---|---|
| 16-Oct-07 | 0.59 | J ug/l |

Well ID
Date Amount Qualifier Units

Location of Site



# Arsenic Concentrations April 2006 through October 2007

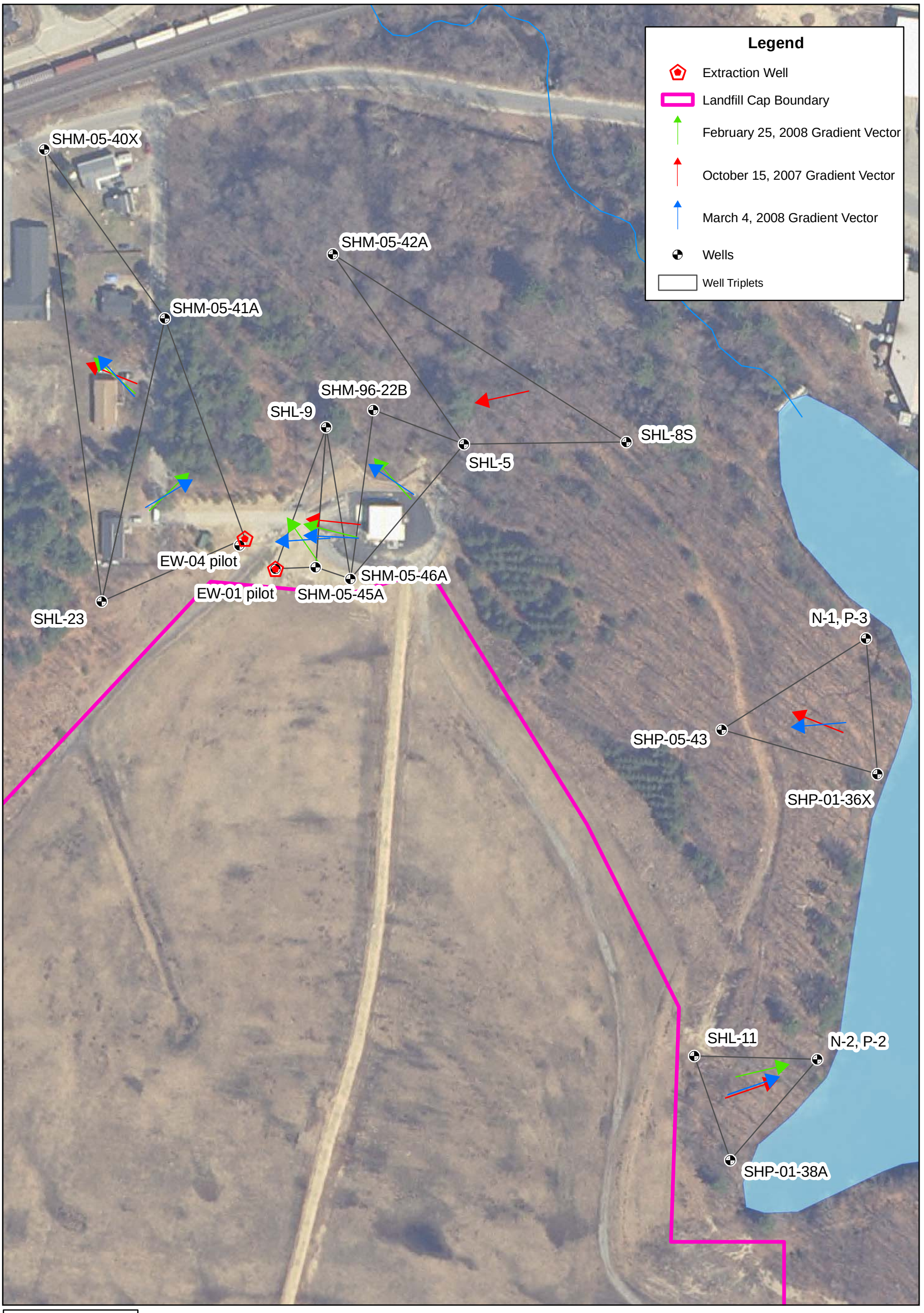
**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE
4-4

0 300
Feet

H:\ShepleyLandfill\Task11\MXD\LTMMP.mxd H:\ShepleyLandfill\Task11\Export\LTMMP.pdf April 10, 2008 DWN: DJK CHKD: KMP




Location of Site

# Horizontal Hydraulic Gradient Vectors: October 15, 2007, February 25, 2008, and March 4, 2008

**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

0 200
Feet

FIGURE
5-1

H:\ShepleyLandfill\Task11\MXD\OctFebCompare.mxd H:\ShepleyLandfill\Task11\Export\OctFebCompare.pdf April 10, 2008 DWN: DJK CHKD: KMP

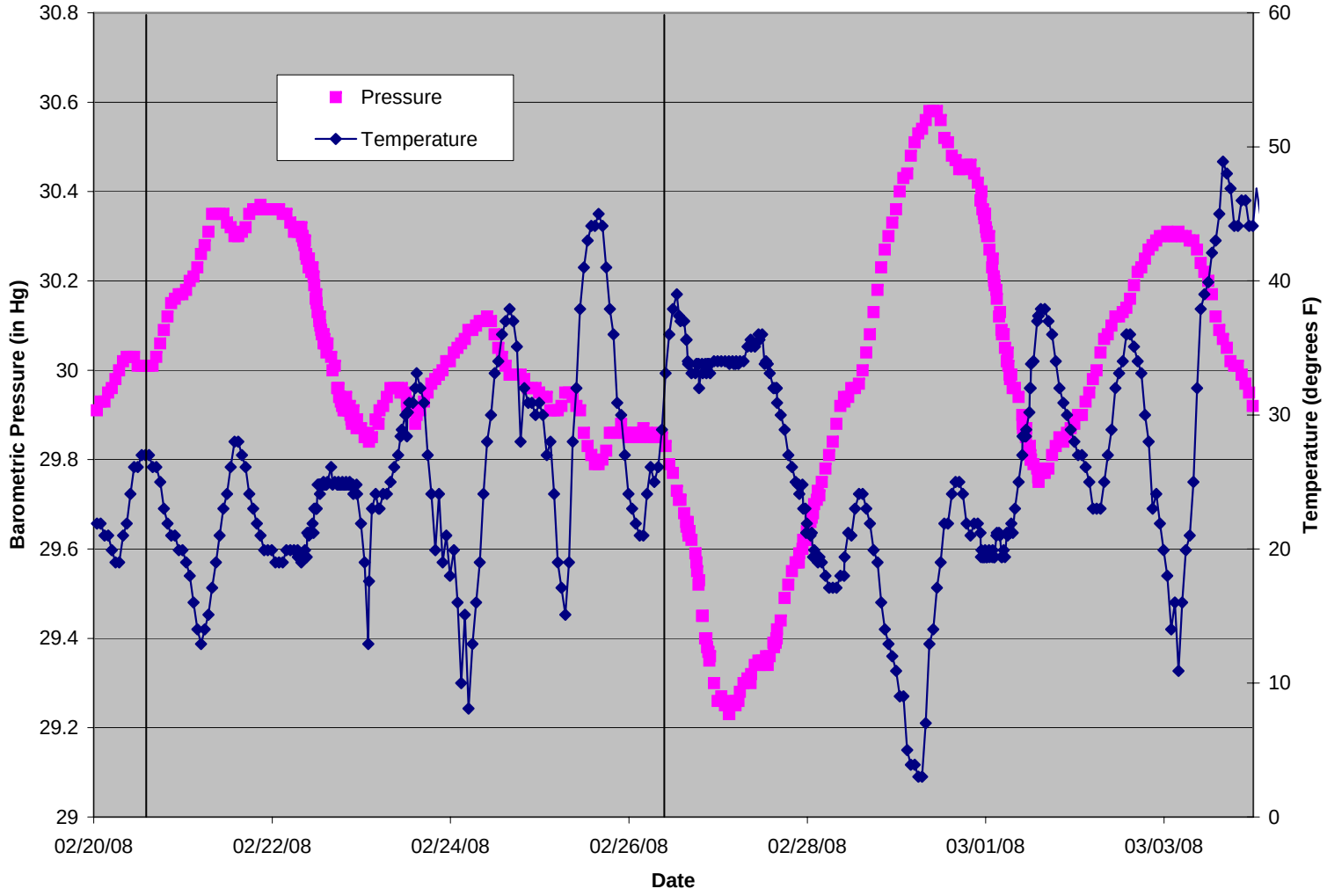



**Figure 5-2. Barometric Pressure and Temperature during Drawdown Assessment**

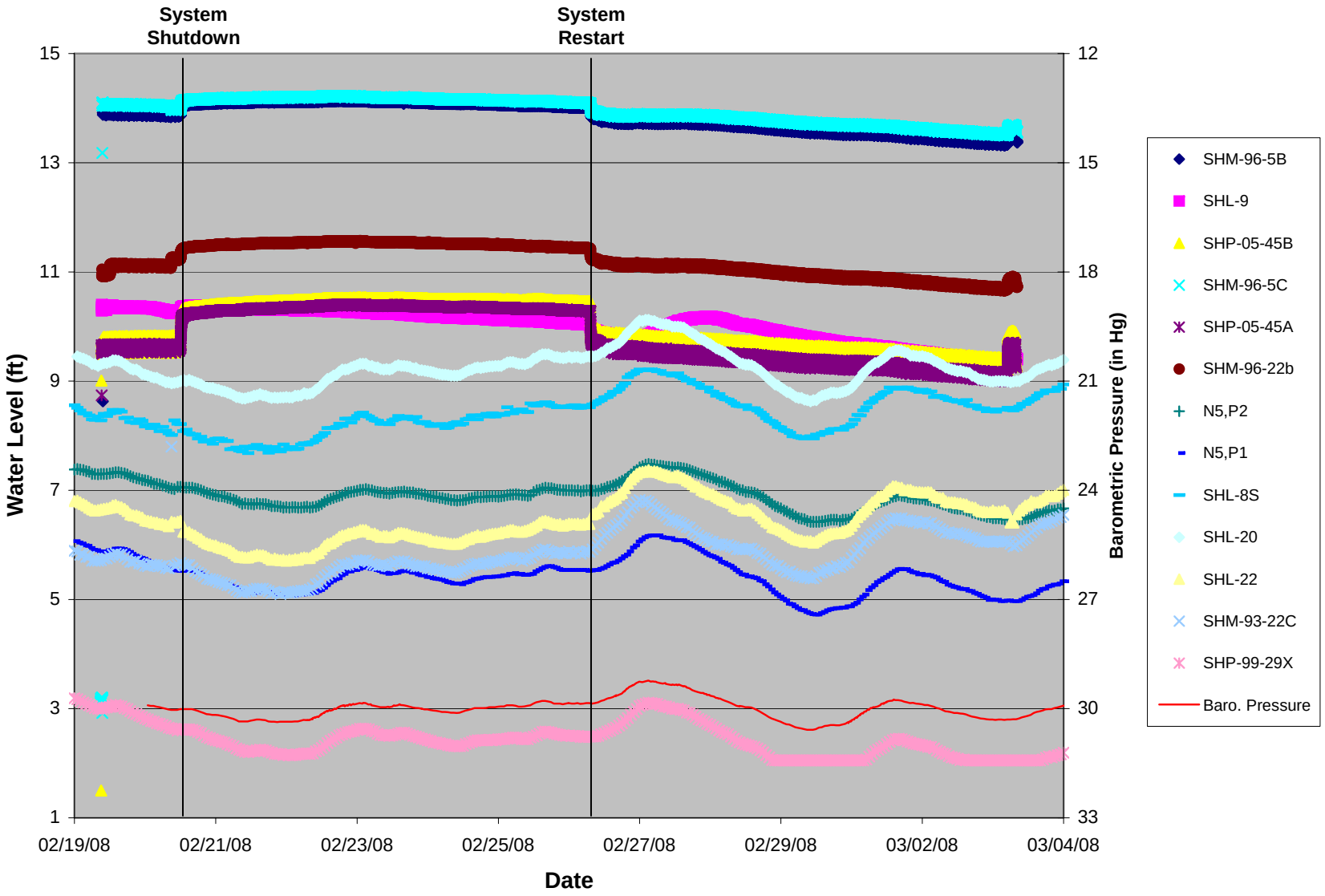



**Figure 5-3. Continuous Water Level Changes Recorded during Drawdown Assessment**

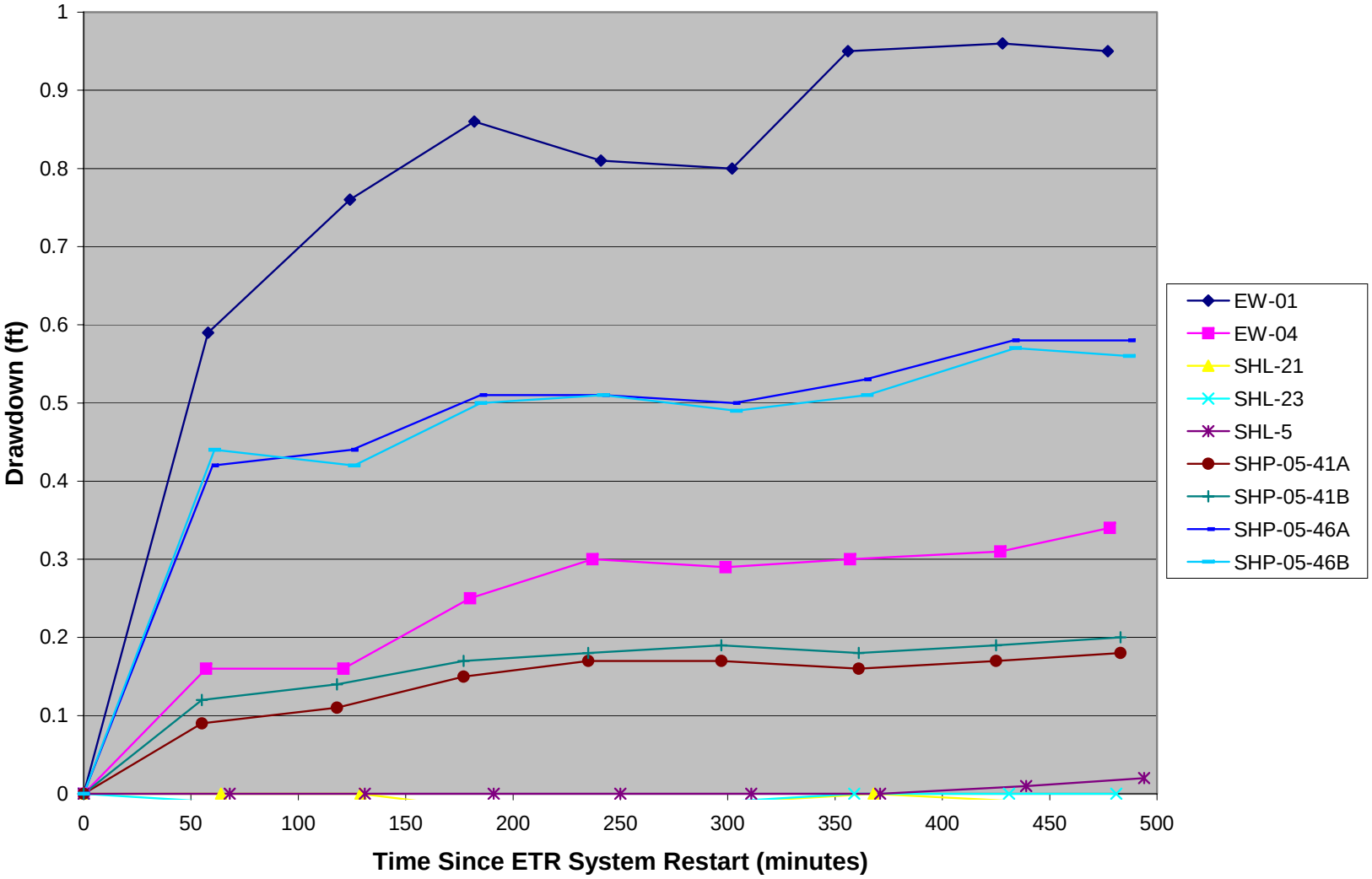
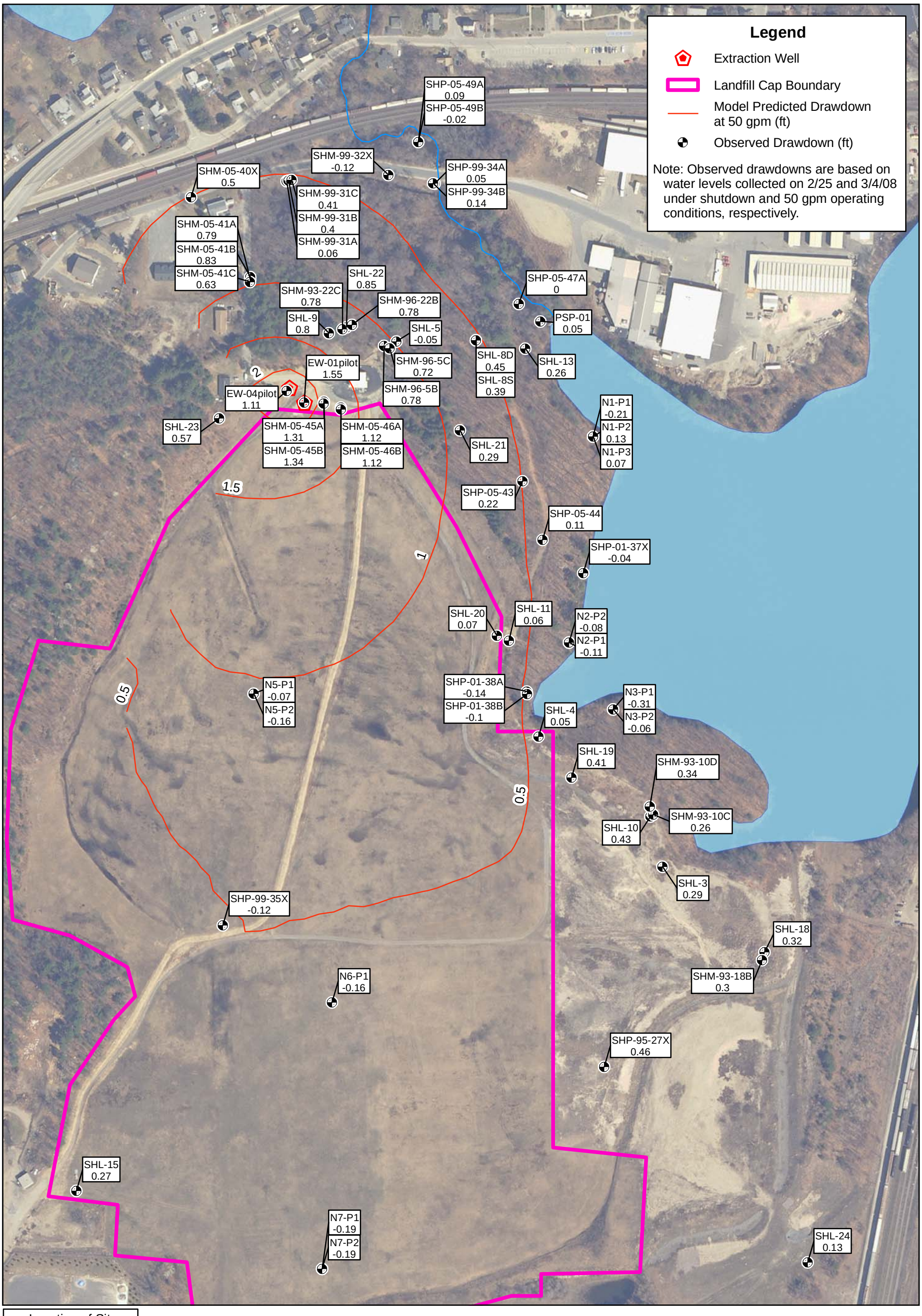



**Figure 5-4. Hourly Drawdown Values in Selected Nearfield Wells after System Restart**




# Drawdown Observed During February 2008 System Shutdown

**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE 5-5

0 300
Feet

H:\ShepleyLandfill\Task11\MXD\Figure5-5.mxd H:\ShepleyLandfill\Task11\Export\Figure5-5.pdf April 10, 2008 DWN: DJK CHKD: KMP

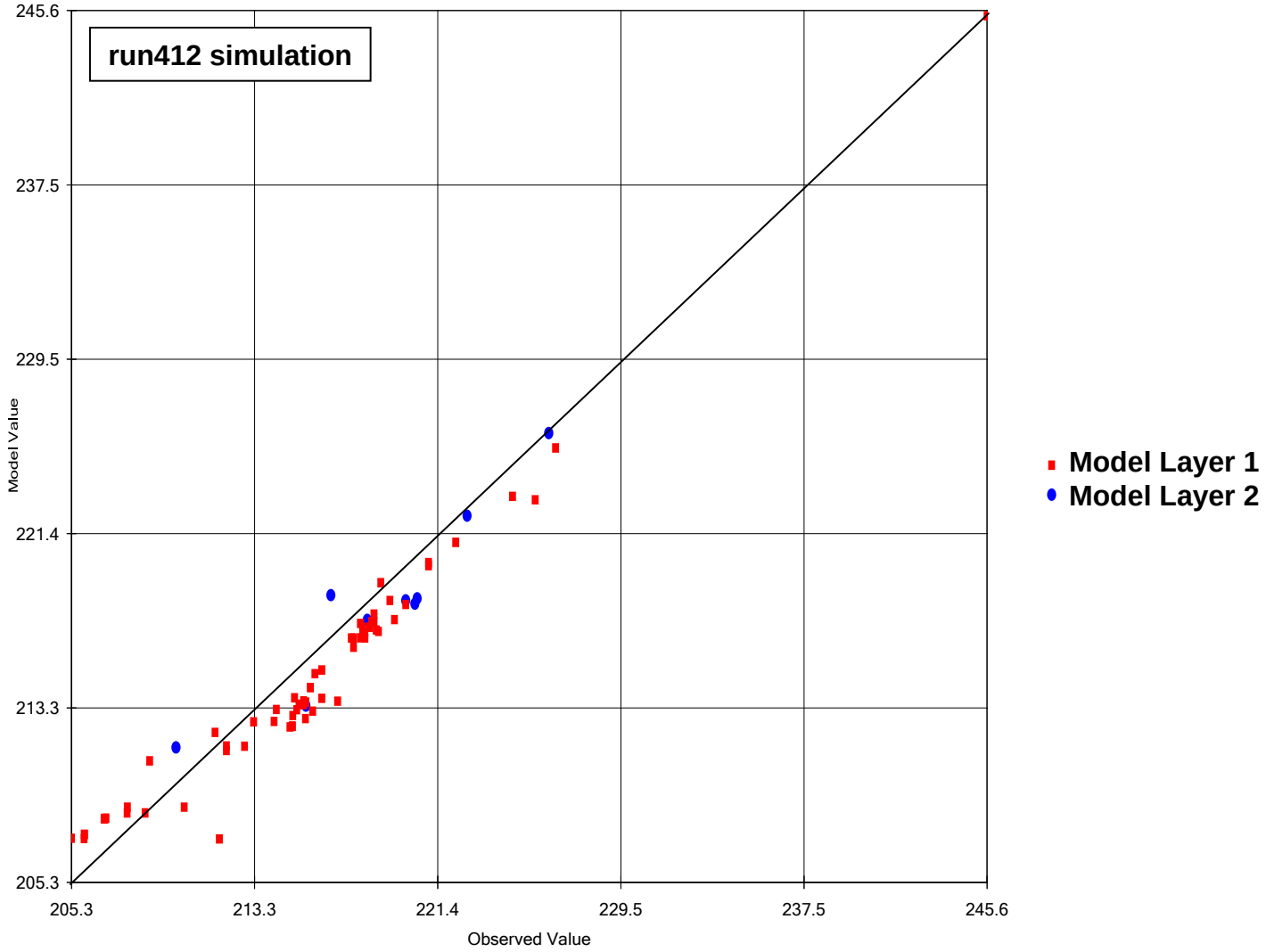
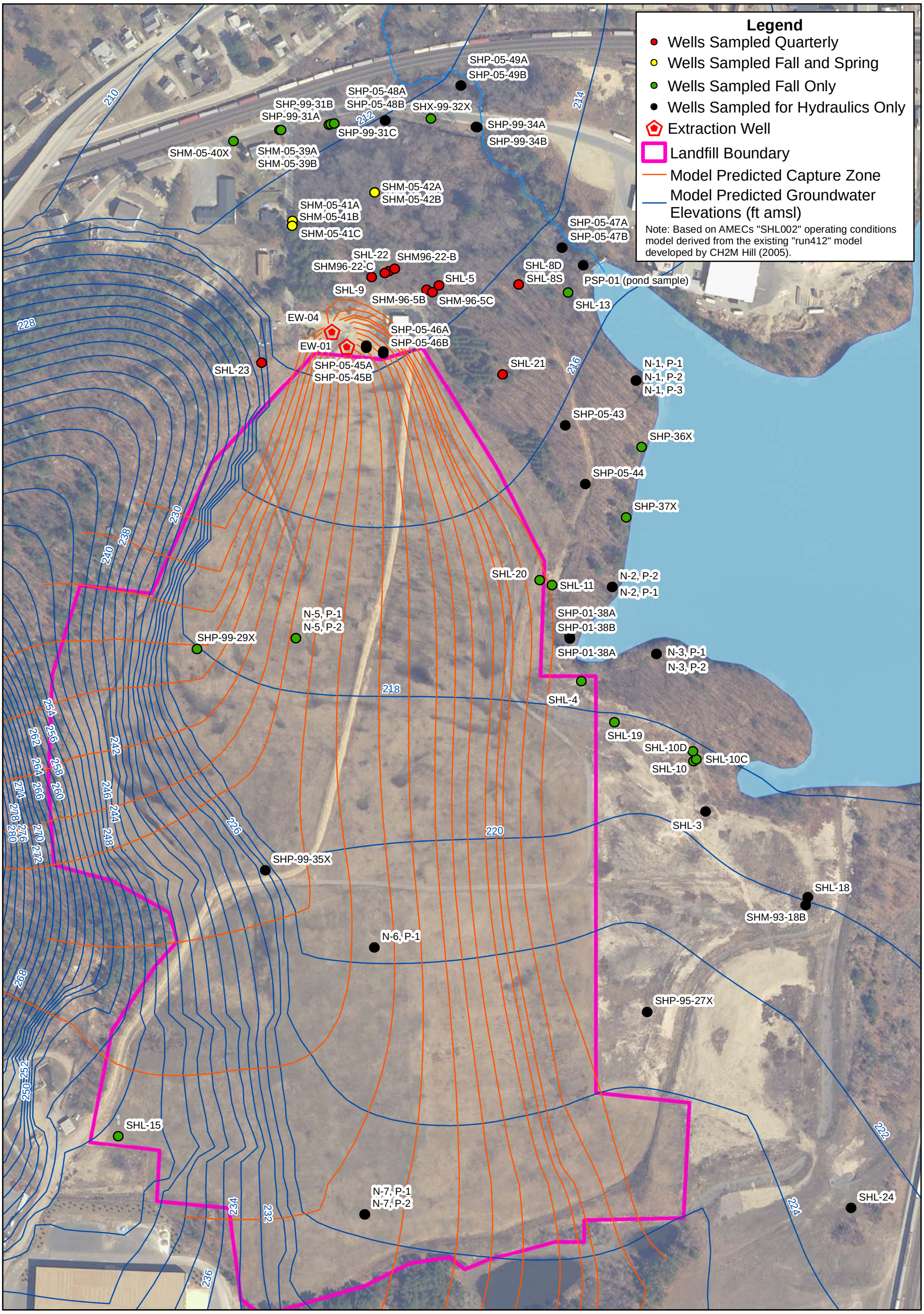



**Figure 5-6. Correlation Between Observed (2/20/08) and Predicted Groundwater Elevations**




Location of Site

# Model Predicted Capture Zone

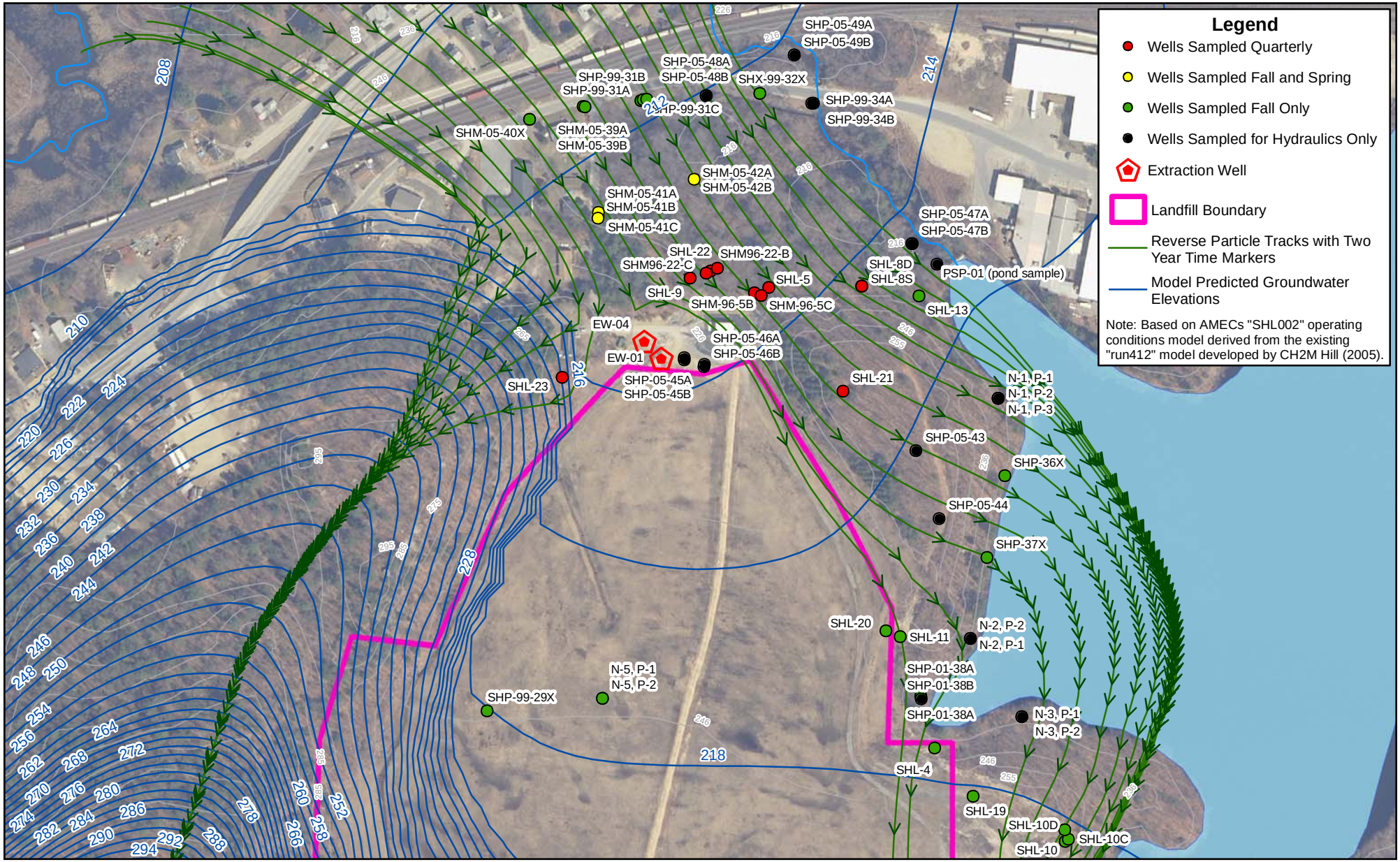
**2007 Annual Report**

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE
5-7

0 300
Feet

ECC




# Model Predicted Groundwater Travel Times

## 2007 Annual Report

Shepley's Hill Landfill
Ayer, Massachusetts

FIGURE
5-8

# Appendix A

# Landfill Inspection Report


| | |
|---|---|
| **Contract No.** | W91ZLK-05-D-0009 |
| **Description** | Fort Devens, MA |
| **Coordinate system** | NAD 1983, State Plane, Massachusetts Mainland, meters |
| **Sources** | |

| Date | 10-APR-2008 | Rev. | Date | App. By |
|---|---|---|---|---|
| DB | C. Guido | | | |
| CB | F. Santos | | | |
| AB | | | | |


**Legend**

- Monitoring Well
- Gas Vent
- Gas Probe
- 1-foot Contour
- Utility Dike
- Sparce Vegetation
- Standing Water
- Vehicle Damage
- Other Finding of Inspection
- Landfill Boundary

# Figure A-1

## Findings of Inspection October 9, 2007

Shepley Hill Landfill
Devens RFTA
Devens, MA

ECC Marlborough, MA
C:\OtherGIS\FtDevens\MapDocuments\FtDevens_FigA-1.mxd

0 125 250 500 Feet

# Landfill Maintenance Checklist
# Shepley's Hill Landfill Devens, Massachusetts

Date: October 9, 2007
Inspectors: Dave Reault / Willard Murray, Ph.D., P.E.

| LANDFILL ATTRIBUTE | OBSERVATIONS | RECOMMENDATIONS | SAT/UNSAT |
|---|---|---|---|
| **Cover Surface** | 1. Vegetative cover is generally satisfactory except as noted in the comments that follow. Various species growing; mowed to about four inches height in October 2007. | 1. See specific comments under the sections that follow. | SAT |
| | 2. There are several areas where settlement has occurred. | 2. A Supplemental Groundwater and Landfill Cap Assessment (AMEC, ongoing) is being conducted to address this condition. | SAT |
| | 3. No tree or shrub growth was observed on the landfill surface. Small shrubs/sapling growth was observed in riprap drainage areas along the northern perimeter | 3. Monitor for tree growth in future. Remove shrub/sapling growth as necessary. | SAT |
| | 4. A utility berm was constructed through the middle of the landfill in 2004. It provides utility service to the pumping station at the northeastern corner of the landfill. An access path was built over the utility berm in the fall of 2006 in the middle of the landfill, near GV-9. No adverse effects from this construction were observed. | 4. Continued observation of effects on drainage patterns in the vicinity of the utility berm during future inspections. | SAT |
| | 5. Several areas on the landfill which have historically exhibited poor drainage have sustained minor rutting damage, either from trespassing vehicles or lawn mowing equipment. The areas retain water for a considerable time after rain effects or melt offs, indicating that the rutting has not compromised the cap integrity. | 5. Affected area should be filled/regraded, damaged areas should be repaired as soon as possible. | UNSAT |

# Landfill Maintenance Checklist
# Shepley's Hill Landfill Devens, Massachusetts

| LANDFILL ATTRIBUTE | OBSERVATIONS | RECOMMENDATIONS | SAT/UNSAT |
|---|---|---|---|
| **Vegetative Growth** | 1. In the vicinity of gas vents 8, 11, and 12, the perimeter of the cap has some areas of sparse/eroded vegetation. The soil in the bare areas is mostly sand and is eroded in some areas. The areas should be graded to fill in the eroded areas and topsoil should be placed to a depth of six inches over the sand to allow grass to grow. The grass cover should extend at least twenty feet beyond the limits of the cap. | 1. These areas should be reseeded, with hay or straw placed on the surface, to prevent further erosion. | UNSAT |
| **Landfill Gas Vents and Monitoring Wells** | 1. The gas vents are in good condition. All screens and pipes are in functional condition. All of the non-galvanized vents are showing signs of rusting and corrosion. These include all gas vents except for GV-12 through GV-15.<br><br>2. Monitoring wells and piezometers are all in good condition with no damage observed. However, many monitoring wells and peizometers where without locks or the locks had been intentionally cut. | 1. All of the non-galvanized vents should be scraped, cleaned and painted.<br><br>2. The involvement of several different agencies has resulted in padlocks being intentionally cut to gain access for sampling or gauging. All monitoring wells and piezometers should be equipped with keyed-alike padlocks with keys issued to necessary personnel. | SAT<br><br>UNSAT |

# Landfill Maintenance Checklist
# Shepley's Hill Landfill Devens, Massachusetts

| LANDFILL ATTRIBUTE | OBSERVATIONS | RECOMMENDATIONS | SAT/UNSAT |
|---|---|---|---|
| **Drainage Swales** | 1. Some of the drainage swale on the south side is exhibiting growth of vegetation/wetland species. There are also intermittent zones of standing water, indicating a lack of proper channel slope and drainage.<br><br>2. In the south-east side drainage swale, in the vicinity of GV-13 and continuing downstream to the rip rap lined channel, the drainage swale is exhibiting growth of vegetation and wetlands species, and appears to be heavily silted in some areas. A silt fence along the newly constructed rail line south of the landfill exhibited several significant failures (see photos) which may have contributed to silt buildup in the drainage swale.<br><br>3. Vegetation growing in rip rap lined channel located in the northern side (under Sculley Road access road). | 1. The swale should be cleared of vegetation, accumulated sediment, and debris. The swale should then be regraded to promote adequate drainage.<br><br>2. The swale should be cleared of vegetation, accumulated sediment, and debris. The swale should then be regraded to promote adequate drainage. The silt fence should be repaired or the area otherwise loamed/seeded to prevent erosion.<br><br>3. The swale should be cleared of vegetation. | UNSAT<br><br>UNSAT<br><br>UNSAT |
| **Culverts** | 1. The concrete drainage structure at the terminus of the catch basin and underground conduit system on the southwest side is overgrown with vegetation and is silting in. Standing water is present and wetland species are becoming established as well. | 1. The structure and channel immediately downstream should be cleaned out and the channel regraded as required to properly drain. | UNSAT |

# Landfill Maintenance Checklist
# Shepley's Hill Landfill Devens, Massachusetts

| LANDFILL ATTRIBUTE | OBSERVATIONS | RECOMMENDATIONS | SAT/UNSAT |
|---|---|---|---|
| **Catch Basins** | 1. Catch Basin #2 near the entrance to the site has a broken surface grate.<br><br>2. Catch Basin #3 near the entrance to the site is not set to grade. The rim of the basin is about six to eight inches higher than the surrounding ground. | 1. The surface grate should be replaced.<br><br>2. The rim of this catch basin should be lowered to meet the surrounding grade. | UNSAT<br><br>UNSAT |
| **Settlement** | 1. It appears that many areas of the landfill may be settling. The extent and its effect on the function of the landfill is unknown. The settled areas maintain pooled water for significant times after rainfall, indicated the integrity of the cap has not been compromised. | 1. A Supplemental Groundwater and Landfill Cap Assessment (AMEC, ongoing) is underway to address this condition. | SAT |
| **Erosion** | 1. No substantial erosion observed. | 1. None | SAT |
| **Access Roads** | 1. The access roads on the landfill road are generally in good condition.<br><br>2. The access road entrance to the treatment plant had experience severe erosion and rutting. The damage was repaired in May 2007 with the addition of riprap. Repairs have not exhibited further damage. | 1. None<br><br>2. None | SAT<br><br>SAT |
| **Security/Fencing** | 1. Perimeter fencing is damage and non-existent along much of the western boundary of the landfill (wooded area along Shepley Hill). Existing fence gates are not locked. | 1. Secure existing gates with chains and padlocks. Extend perimeter fence around the entire landfill boundary. | UNSAT |

# Landfill Maintenance Checklist
# Shepley's Hill Landfill Devens, Massachusetts

| LANDFILL ATTRIBUTE | OBSERVATIONS | RECOMMENDATIONS | SAT/UNSAT |
|---|---|---|---|
| **Wetland Encroachment** | 1. Wetland encroachment is taking place at several locations, but is not happening on a wide scale. Overall, the areas of encroachment are small. Theses locations have been noted in above comments. | 1. Wetland encroachment should be eliminated by simple mowing in some areas, and by regrading channels in other areas. The above comments address the action to take at specific locations. | UNSAT |

Immediate Action Required: The following problem areas, from among those mentioned in the comments above, are the most critical and should be addressed before the next inspection:
1. Secure gates with locks to control access to the site.
2. Repair damage to cover surface caused by trespassers and lawn moving equipment.
3. Install keyed-alike padlocks on all monitoring wells and piezometers and issue keys as necessary.

NOTES:
SAT = satisfactory
UNSAT = unsatisfactory
NA = not applicable


**Top of Fill Pile Looking West**


Top of Fill Pile Looking Southwest

Top of Fill Pile Looking Southeast

Top of Fill Pile Looking South

Top of Fill Pile Looking Northeast

Top of Fill Pile Looking North (see Treatment Plant at north end)

Southern Drainage Swale

Southeast Drainage Swale #1

Southeast Drainage Swale towards Plow Shop Pond #1

Southeast Drainage Swale towards Plow Shop Pond #2

Southeast Corner of Landfill

Looking Southwest across Southern End of Landfill

Access Road from Treatment Plant to Landfill

Area of poor swale drainage on west side of landfill

Pooling area with minor tire damage #1

Pooling area with minor tire damage #2

Gas Vent (non-galvanized) Exhibiting Corrosion

Access Road Erosion #1

Access Road Erosion #2

Access Road Repair #1

Access Road Repair #2

# Appendix B

# Landfill Gas Results

# Landfill Gas Monitoring



**Date**: 10/22-23/2007 **Inspector**: Comeau/Cokinos **Title**:

**Organization**: ECC **Weather**: 10/22/07 partly cloudy, 49

10/23/2007 overcast, 74

**Barometer**: 10/22 30.23 am/29.97 pm

10/23 29.54 am/29.52 pm

| Vent No. | VOC ppm PID | O2 % IR | H2S ppm CGI | LEL % CGI | CO ppm CGI | CO2 % IR | CH4 % IR | Remarks |
|---|---|---|---|---|---|---|---|---|
| V-1 | 0 | 14.5 | 0 | 0 | 0 | 4.7 | 0 | |
| V-2 | 0 | 11.2 | 0 | 60 | 13 | 6.4 | 3.0 | |
| V-3 | 0 | 8.2 | 0 | 94 | 0 | 8.3 | 4.7 | |
| V-4 | 0 | 14.9 | 0 | 39 | 8 | 4.8 | 1.9 | |
| V-5 | 0 | 18.2 | 0 | 0 | 4 | 1.8 | 0 | |
| V-6 | 0 | 15.3 | 0 | 53 | 0 | 3.9 | 2.7 | |
| V-7 | 0 | 19.6 | 0 | 0 | 6 | 0.7 | 0 | |
| V-8 | 0 | 16.9 | 0 | 0 | 6 | 2.1 | 0 | |
| V-9 | 0 | 5.9 | 0 | >100 | 15 | 15.7 | 21.7 | |
| V-10 | 0 | 19.8 | 0 | 0 | 6 | 0.5 | 0 | |
| V-11 | 0 | 12.5 | 0 | 60 | 16 | 3.8 | 3.1 | |
| V-12 | 0 | 20.2 | 0 | 0 | 6 | 0.5 | 0 | |
| V-13 | 0 | 0.2 | 0 | >100 | 0 | 13.1 | 14.7 | |
| V-14 | 0 | 0.2 | 0 | >100 | 8 | 23.1 | 33.6 | |
| V-15 | 0 | 0.1 | 0 | >100 | 12 | 27.4 | 24.9 | |
| V-16 | 0 | 0.1 | 1 | >100 | 11 | 25.3 | 15.1 | |
| V-17 | 0 | 16.2 | 0 | >100 | 0 | 15.2 | 22.1 | |
| V-18 | 0 | 0.1 | 0 | >100 | 7 | 28.6 | 37.1 | |
| LGP-01-01X | 0 | 20.4 | 0 | 0 | 0 | 0.7 | 0 | |
| LGP-01-02X | 0 | 19.7 | 0 | 0 | 0 | 1.5 | 0 | |
| LGP-01-03X | 0 | 19.5 | 0 | 0 | 0 | 1.4 | 0 | |
| LGP-01-04X | 0 | 20.2 | 0 | 0 | 0 | 0.6 | 0 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| LGP-05-05X | 0 | 14.8 | 0 | 0 | 0 | 6.3 | 0 | |
| LGP-05-06X | 0 | 15.4 | 0 | 0 | 0 | 5.3 | 0 | |
| LGP-05-07X | 0 | 16.6 | 0 | 0 | 0 | 6.3 | 0 | |
| LGP-05-08X | 0 | 5.3 | 0 | 0 | 0 | 16 | 0 | |
| LGP-05-09X | 0 | 13.5 | 0 | 0 | 0 | 8.8 | 0 | |
| LGP-05-10X | 0 | 0.1 | 1 | >100 | 0 | 22.5 | 5.8 | |
| LGP-05-11X | 0 | 5.3 | 0 | >100 | 0 | 17.7 | 5.9 | |
| LGP-05-12X | -- | -- | -- | -- | -- | -- | -- | Not installed |
| LGP-05-13X | 0 | 2.9 | 0 | 88 | 0 | 14.5 | 4.4 | |
| LGP-05-14X | 0 | 2.1 | 0 | 37 | 0 | 13.8 | 1.8 | |
| Cook St. Manhole (GWTP discharge) | 0 | 19.5 | 0 | 2 | 8 | 5.3 | 0.1 | |

**Calibration Information:**

Instrument: GEM 2000 Landtec (GEM0853)
Calibrated by: Geoff Cokinos
Calibrated with: 35% CO2, 50% CH4, 25 ppm H2S, 50 ppm CO, 2.5% CH4 (50% LEL), 70.9% O2

Instrument: PE PhotoVac PID (EDFN311)
Calibrated by: David Comeau
Calibrated with: 100 ppm Isobutylene

Instrument: Gilian, Gilair 5 air pump (07051/09808)
Calibrated by: US Environmental
Calibrated with:

Notes:

# Shepley Hill LF
# LGP Sampling Data

Date: 03/18/2008 Weather: Clear, 50s. BP @ 1200 @ 30.13, BP @ 1400 @ 29.92 Field Team: Fred Santos, Dave Reault, Bob Simeone (Army BRAC)

| | Initial Readings | | | | | | | | | Post Purge Readings | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Well** | **VOC ppm PID** | **O2 %** | **H2S ppm** | **LEL %** | **CO ppm** | **CO2 %** | **CH4 %** | **Purge Rate (lpm)** | **Purge Time (sec)** | **VOC ppm PID** | **O2 %** | **H2S ppm** | **LEL %** | **CO ppm** | **CO2 %** | **CH4 %** |
| LGP-1 | 0 | 21.2 | 0 | 0 | 0 | 0.1 | 0 | 2 | 60 | 0 | 20.9 | 0 | 0 | 0 | 0.1 | 0 |
| LGP-2 | 0 | 20.5 | 0 | 1 | 0 | 0.6 | 0.1 | 2 | 60 | 0 | 20.2 | 0 | 0 | 0 | 0.6 | 0 |
| LGP-3 | 0 | 20.5 | 0 | 0 | 2 | 0.4 | 0 | 2 | 60 | 0 | 20.5 | 0 | 0 | 0 | 0.4 | 0 |
| LGP-4 | 0 | 20.2 | 0 | 1 | 0 | 0.1 | 0.1 | 2 | 60 | 0 | 20.4 | 0 | 0 | 0 | 0.1 | 0.1 |
| LGP-5 | 0 | 19.9 | 1 | 2 | 2 | 1.8 | 0.1 | 2 | 120 | 0 | 21 | 0 | 1 | 0 | 0.5 | 0.1 |
| LGP-6 | 0 | 18.5 | 0 | 0 | 0 | 0.6 | 0.1 | 2 | 120 | 0 | 17.2 | 0 | 0 | 0 | 1.2 | 0 |
| LGP-7 | 0 | 19.7 | 0 | 0 | 0 | 1 | 0 | 2 | 110 | 0 | 17.8 | 0 | 0 | 0 | 2.1 | 0 |
| LGP-8 | 0 | 20.9 | 0 | 0 | 0 | 0.4 | 0 | 2 | 120 | 0 | 15.7 | 1 | 0 | 0 | 6.7 | 0 |
| LGP-9 | 0 | 13.5 | 0 | 5 | 0 | 4 | 0.3 | 2 | 120 | 0 | 15.6 | 0 | 1 | 0 | 4.8 | 0.1 |
| LGP-10 | 0 | 21.4 | 0 | 0 | 0 | 0.3 | 0 | 2 | 120 | 0 | 18.1 | 0 | 1 | 0 | 5.5 | 0.1 |
| LGP-11 | 0 | 17.1 | 0 | 0 | 0 | 8 | 0.1 | 2 | 120 | 0 | 20.3 | 0 | 0 | 0 | 2.8 | 0 |
| LGP-11 | | | | | | | | 5 | 600 | 0 | 20.9 | 0 | 0 | 0 | 1.2 | 0 |
| LGP-13 | 0 | 20.9 | 0 | 0 | 0 | 0.7 | 0 | 2 | 60 | 0 | 18.9 | 0 | 1 | 0 | 2.9 | 0.1 |
| LGP-14 | 0 | 11.8 | 0 | 0 | 0 | 1.5 | 0.1 | 2 | 120 | 0 | 13.7 | 0 | 1 | 0 | 1.3 | 0.1 |

# Appendix C

# Discharge Permit Correspondence/Modification

Permit No. 020

# MASSDEVELOPMENT

**33 Andrews Parkway**
**Devens, MA 01434**

## *LANDFILL DISCHARGE PERMIT*

| | |
|---|---|
| Permittee Name: | U.S Army Corp of Engineers |
| Mailing Address: | 50 MacArthur Avenue<br>Box 90<br>Devens, MA 01434 |
| Facility Address: | Shepley's Hill Landfill<br>Devens, Massachusetts 01434 |
| Contact Name: | Robert Simeone, BRAC Environmental Coordinator |
| Contact Address: | 30 Quebec St., Box 100<br>Devens, MA 01434 |
| Contact Phone: | (978) 796-2205 |

The above permittee is authorized to discharge treated groundwater from the Shepley's Hill Landfill to the Devens Sewerage System in compliance with the *Sewer Rules and Regulations for the Devens Sewerage Service Area*, as adopted by MassDevelopment (MDFA), including any applicable provisions of Federal or Commonwealth of Massachusetts laws or regulations, and in accordance with discharge point(s), effluent limitations, monitoring requirements and other conditions set forth herein.

Effective Date of Permit: June 28, 2007

Expiration Date of Permit: June 28, 2010

Issued by: _____
Mark Cohen
Utilities Engineer
MassDevelopment

Issued by: _____
Richard Montuori
Executive V.P., Devens Operations
MassDevelopment

## PART I - Wastewater Discharge Limitations and Monitoring Requirements

**A.** The permittee shall comply with all Local Effluent Limitations and monitor the discharge as specified below:

| Parameter | Limitations | Type | Frequency |
|---|---|---|---|
| Arsenic | 0.15 mg/l* | Composite | Monthly |
| Chromium (total) | 2.0 mg/l | Composite | Quarterly |
| Cadmium | 0.038 mg/l | Composite | Quarterly |
| Copper | 1.0 mg/l | Composite | Quarterly |
| Lead | 0.25 mg/l | Composite | Quarterly |
| Silver | 0.0146 mg/l | Composite | Quarterly |
| Selenium | 2.5 mg/l | Composite | Quarterly |
| Mercury | 0.001 mg/l | Composite | Quarterly |
| Total Toxic Organics | 5.0 mg/l | Composite | Annually |
| Total Petroleum Hydrocarbons | 100 mg/l | Composite | Annually |
| pH (units) | 5.5 - 9.5 | Meter | Continuous |

* Maximum daily loading for Arsenic shall not exceed 0.07 pounds per day.

**B.** The permittee shall comply with the additional effluent monitoring requirements specified below:

| Parameter | Type | Frequency |
|---|---|---|
| Flow (MGD) | Meter | Continuous |
| Barium | Composite | Quarterly |
| Manganese | Composite | Quarterly |
| Magnesium | Composite | Quarterly |
| Chloride | Composite | Quarterly |
| Nitrate | Composite | Quarterly |
| Sulfate | Composite | Quarterly |

**Notes:**

**(1)** A flow meter shall be used for recording effluent discharge into the Devens sewer system. The flowmeter shall be properly maintained in accordance with the manufacturer's requirements and it shall be calibrated at least annually by a certified and qualified manufacturer's representative. A copy of the "Certificate of Calibration" shall be submitted to MDFA following each calibration.

**(2)** A pH meter shall be used to continuously measure the pH of the discharge. The pH meter shall be a continuous monitoring instrument with a chart recorder. All charts shall be maintained on file onsite for a minimum of 3 years. At a minimum, the pH meter shall be calibrated weekly and a calibration log maintained on file onsite for a minimum of 3 years. The pH meter shall be properly maintained in accordance with the manufacturer's requirements and it shall be calibrated at least every six months by a certified and qualified manufacturer's representative. A copy of the "Certificate of Calibration" shall be submitted to the MDFA following each calibration.

**(3)** Spill protection shall be provided for all chemicals stored at the site. Adequate spill protection must be capable of containing all chemical spills and preventing them from entering the sewer or harming the environment.

**C.** Samples shall be obtained from the discharge of individual extraction wells or the discharge of a pretreatment system installed to reduce pollutant levels. The location of the sampling point and discharge pipeline are shown on the attached drawing.

(1) Composite Sample - A composite sample shall be the collection of individual grab samples obtained at regular intervals either based on time intervals or flow intervals. Each individual grab sample is either combined with the others or analyzed individually and the results averaged. In time composite sampling the samples are collected after equal time intervals and combined in proportion to the rate of flow when the sample was collected. Flow composite sampling can be produced by varying the volume of the aliquot collected in proportion to the amount of flow that passed over the time interval which the sample represents. Composite samples are designed to be representative of the effluent conditions by reflecting the average conditions during the entire sampling period.

(2) Grab Sample - A grab sample shall be a sample, which is taken from a wastestream without regard to the flow in the wastestream and over a period of time not to exceed 15 minutes.

(3) Representative Sample - A representative sample shall mean a sample taken from a wastestream that is nearly identical in composition to that in the larger volume of wastewater being discharged during a normal production day as approved by MDFA.

**D.** Approved flow for the permittee :

Due to seasonal and climatic variation to the groundwater remediation and leachate flow, flow rate cannot be accurately predicted. However, the average flow is initially anticipated to be 36,000 gallons per day (25 gallons per minute), with possible future increase to 72,000 gallons per day (50 gallons per minute).

E. Automatic Re-sampling: If the results of the permittee's wastewater analyses indicate that a violation of this permit has occurred, the permittee must:

(1) Inform the Industrial Pretreatment Coordinator and the Utilities Supervisor of MDFA/Devens of the violation within 24 hours; and,

(2) Repeat the sampling and pollutant analysis for the parameters that exceeded the permit limit and submit, in writing to MDFA, the results of the second analysis within 30 days of the first violation; and,

(3) If the re-sample results still exceed the permit limit, submit an explanation for the violation and an action plan to prevent a recurrence of the non-compliance event within 30 days of the violation.

**Part II - Special Conditions**

A. **The Army shall take all reasonable steps to prevent any adverse impact to the Devens wastewater treatment facility or the environment due to the operation of the facility and shall assure the proper operation of the facility as specified in the treatment system manufacturer specifications and operating manual, a copy of which shall be provided to MDFA. If the arsenic level in the effluent exceeds 30 ug/l for a monthly sample event, the permittee shall commence weekly sampling of arsenic until a concentration of 30 ug/l is met for four (4) consecutive weeks.**

**In the event that any monthly composite sample result for arsenic exceeds 50 ug/l, the permittee shall resample and take all necessary corrective actions. If within thirty days the corrective actions are not effective in achieving results within the expected treatment range, the permittee shall shut down plant operation. The corrective actions shall include the submittal of a written explanation of the event and/or a Corrective Action Plan to MDFA for review and comment. Resumption of operation and discharge to the Devens wastewater treatment facility will require written authorization of MDFA.**

B. **The MDFA's wastewater contractor and MDFA Devens Utilities Department staff will review the facility Self-Monitoring data, and Devens wastewater treatment facility influent, effluent and sludge monitoring "baseline" data and operational data on an ongoing basis to determine whether there is any potential adverse affect on the Devens wastewater treatment facility influent, effluent or sludge quality, or any adverse impact on the Devens wastewater treatment facility operation or environment due to the operation of the Army's treatment facility. In the event that MDFA determines the data analysis indicates that an adverse affect has taken place, MDFA shall notify the Army and the Army shall immediately cease all discharge and shall disconnect from the Devens sewer system. (Initial notification may be made verbally with a written notice to follow.) For the purpose of this section, cessation of discharge and disconnection is required if:**

**(1) The arsenic level in the effluent from the Shepley's Hill treatment system is greater than 50 ug/l, and**

**(2) The arsenic level in the Devens wastewater treatment facility effluent is greater than 10 ug/l or sludge is greater than 40 mg/kg, or**

**(3) There is some other indication of adverse environmental impact resulting from the Shepley's Hill discharge.**

C. **The permittee, at no cost to the MDFA, shall be responsible for paying for additional laboratory tests for arsenic required to monitor the arsenic concentrations at the Devens wastewater treatment facility. MDFA's wastewater contract operator will arrange to have samples collected for these additional tests to be performed monthly on the wastewater influent, effluent and sludge. All analytical costs associated with this arsenic sampling shall be included in the permittee's regular sewer discharge fee and shall be billed along with such. (Billing is currently done on a quarterly cycle.)**

**Part III - Monitoring Requirements**

A. The permittee shall provide monthly, quarterly and annual sampling and analysis for the parameters listed in Part I, Section A and Section B of this Permit.

B. All sampling and analysis shall be performed in accordance with 40 CFR Part 136 and amendments thereto.

C. All sample analysis required by this permit shall be performed by an independent laboratory certified by the MADEP for the parameters being analyzed. The use of a laboratory with provisional MADEP certification is prohibited.

D. The permittee shall submit a copy of the "Massachusetts Certification for Chemical Analysis of Water" for each laboratory that performs an analysis submitted to MassDevelopment by or on behalf of the permittee.

E. The Self-Monitoring results shall be submitted to MDFA/Devens within 30 days of the analysis.

F. Each Self-Monitoring Report shall be signed by an authorized representative of the permittee submitting the Report, and shall be certified as accurate. An authorized representative shall be an individual described in 40 C.F.R. Part 403.12(I). The Self Monitoring Report shall contain a certification statement consistent with the following:

*"I certify under the penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

**Part IV - Reporting Requirements**

A. As required in the MDFA *Sewer Use Rules and Regulations*, Section 1.012, the permittee shall notify MDFA/Devens and the MADEP immediately by telephone of any accidental or slug discharge to the sewer. Formal written notification addressing the circumstances and remedies shall be submitted to MDFA/Devens within 5 days of the occurrence. Furthermore, a notice shall be permanently posted on the permittee's bulletin board or other prominent location advising employees whom to call in the event of an accidental, slug or dangerous discharge. The permittee shall instruct all necessary employees of the emergency notification procedure.

B. The permittee shall notify MDFA/Devens prior to the introduction of new wastewater or pollutants or any substantial change in volume or characteristics of the wastewater being introduced to the sewer from the permittee's industrial process. Formal written notification shall follow within thirty (30) days of such introduction.

C. The permittee shall submit a monitoring report that tabulates the flow and sample analysis results for the composite samples and grab samples required in Part I. The monitoring quarters and due dates are as follows:

| Quarter | Report Due Date | Data |
|---|---|---|
| January 1 - March 31 | April 5th | Quarterly Sampling, Flows |
| April 1 - June 30 | July 5th | Quarterly Sampling, Flows |
| July 1 - September 30 | October 5th | Quarterly/Annual Sampling, Flows |
| October 1 - December 31 | January 5th | Quarterly Sampling, Flows |

The monthly analysis results for arsenic samples required in Part I are due no later than the 5th of the month following the month the sample was taken.

D. All reports shall be submitted to the following address:

Utilities Supervisor
MassDevelopment
33 Andrews Parkway
Devens, Massachusetts 01434

With copy to: Industrial Pretreatment Coordinator
Earth Tech, Inc.
85 Walker Rd
Shirley MA, 01464

E. Emergency notifications shall be made to:

Devens Dispatch
Phone: (978) 772-7200

-and-

Earth Tech – Devens Wastewater Operations
Phone: (978) 772-4250

**Part V - Standard Conditions**

A. *General Prohibitions.* The permittee shall comply with all general and specific prohibitive discharge standards described in Sections 1.021, 1.022 and 1.023 of the MassDevelopment, *Sewer Use Rules and Regulations*.

B. *Right of Entry.* The permittee shall, in accordance with Section 1.011 (3) of the Sewer Use Rules and Regulations, allow MassDevelopment or their representatives to enter upon the premises of the permittee, at any time, for the purpose of inspection, sampling or records inspection.

C. *Records Retention.* The permittee shall retain and preserve for no less than three (3) years, any records, books, documents, memoranda, reports, correspondence and any and all summaries thereof, relating to monitoring, sampling and chemical analyses made by or in behalf of the permittee in connection with its discharge. All records that pertain to matters that are the subject of special orders or any other enforcement or litigation activities brought by MassDevelopment shall be retained and preserved by the permittee until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired. Copies must be provided as required by MassDevelopment.

D. *Confidential Information.* Information and data on a permittee obtained from reports, questionnaires, permit applications, permits and monitoring programs and from inspections shall be available to the public or other governmental agency without restriction unless the permittee specifically requests and is able to demonstrate to the satisfaction of MassDevelopment that the release of such information would divulge information, process or methods of production entitled to protection as trade secrets of the permittee.

When requested by the person furnishing a report, the portions of a report which might disclose trade secrets or secret processes shall not be made available for inspection by the public, but shall be made available upon written request to governmental agencies for uses related to the Rules and Regulations, the Devens wastewater treatment facility's Groundwater Discharge Permit, State Disposal System permit and/or the Pretreatment Programs and also provided that such portions of a report shall be available for use by the State or any State agency in judicial review, or enforcement proceedings involving the person furnishing the report. Wastewater constituents and characteristics will not be recognized as confidential information. Information accepted by MassDevelopment as confidential shall not be transmitted to the general public until notice is given to the permittee. EPA officials shall have unrestricted and immediate access to all information

collected by MassDevelopment.

E. *Recording of Results.* For each measurement or sample taken pursuant to the requirements of this permit, the permittee shall have the following information recorded:

1. The exact place, date, time of sampling and the person performing the sampling;
2. The dates the analyses were performed;
3. The person(s) who performed the analyses;
4. The analytical techniques or methods used;
5. Sample preservation; and,
6. The results of all required analyses.

F. *Dilution.* The permittee shall not increase the use of potable water or process water or, in anyway, attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

G. *Proper Disposal of Pretreatment Sludges and Spent Chemicals.* The disposal of sludges and spent chemicals generated shall be done in accordance with Section 405 of the Clean Water Act and Subtitles C and D of the Resource Conservation and Recovery Act.

H. *Signatory Requirements.* All applications, reports, or information submitted to MassDevelopment, must contain the following certification statement and be signed as required in Sections 1, 2, 3, or 4 below:

*"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."*

*Authorized Representative of the Permittee:*

1. If the permittee is a corporation, a responsible corporate officer means:

   a. The president, secretary, treasurer, or a vice-president of the corporation in charge of a principle business function or any other person who performs similar policy or decision-making functions for the corporation; or

   b. The manager of one or more manufacturing, production, or operation facilities employing more than two hundred fifty (250) persons or having a gross annual sales or expenditures exceeding twenty five (25) million dollars, if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

2. If the permittee is a partnership or sole proprietorship: a general partner or proprietor, respectively.

3. If the permittee is a Federal, State or local governmental facility: a director or highest official appointed or designated to oversee the operation and performance of the activities of the government facility, or their designee.

4. The individuals described in paragraphs 1 through 3 above may designate another authorized representative if the authorization is in writing, the authorization specifies the individual or person responsible for the overall operation of the facility from which the discharge originates or having overall responsibility for the environmental matters for the company, and the written authorization is submitted to MassDevelopment.

5. If the authorization under paragraph 4 above is no longer accurate because a different individual or position has responsibility for the overall operation of the facility or company, a new authorization satisfying the requirements of paragraph 4 of this section must be submitted to MassDevelopment prior to or together with any reports to be signed by an authorized representative.

I. *Revocation of Permit.* The permit issued to the permittee by MassDevelopment may be revoked when, after inspection, monitoring or analyses it is determined that the discharge of wastewater to the sanitary sewer is in violation of Federal, State or Local laws, ordinances or regulations. Additionally, falsification or intentional misrepresentation of data or statements pertaining to the permit application or any other required reporting form, shall be cause for permit revocation and possible criminal prosecution.

J. *Limitation of Permit Transfer.* Wastewater discharge permits are issued to a specific permittee for a specific operation and are not assignable to another user or transferable to any other location without the prior written approval of MassDevelopment. Sale of a permitted facility shall obligate the purchaser to seek prior written approval of MassDevelopment for continued discharge to the Devens Regional Wastewater Treatment Facility.

K. *Falsifying Information or Tampering With Monitoring Equipment.* Any person who knowingly makes any false statements, representation or certification in any application, record, report, plan or other document filed or required to be maintained pursuant to the *Sewer Use Rules and Regulations*, or permit, or who falsifies, tampers with or knowingly renders inaccurate, any monitoring device or method required under these Rules and Regulations, may, upon conviction, be punished by fine of up to $10,000 per day and imprisonment up to six months, or by both.

L. *Civil Penalties.* Any permittee who is found to have violated an Order of MassDevelopment or who failed to comply with any provision of the Rules and Regulations, and the orders, rules, regulations and permits issued hereunder, may be fined up to $10,000 for each offense. Each day on which a violation shall occur or continue shall be deemed a separate and distinct offense. In addition to the penalties provided herein, MassDevelopment may recover reasonable attorney's fees, court costs, court reporters' fees and other expenses of litigation by

appropriate suit at law against the person found to have violated the Rules and Regulations or the orders, rules, regulations and permits issued hereunder. Nothing in the permit shall be construed to relieve the permittee from civil and/or criminal penalties for noncompliance under these Rules and Regulations or State or Federal laws or regulations.

M. *Recovery of Cost Incurred.* In addition to civil and criminal liability, the permittee violating any of the provisions of this permit or causing damage to or otherwise inhibiting the Agency's wastewater disposal system shall be liable to the Agency for any expenses, loss, or damage caused by such violation or discharge. The Agency shall assess the permittee for the cost incurred by the Agency for any cleaning, repair, or replacement work caused by the violation or discharge.

N. *Duty to Comply.* The permittee must comply with all conditions of this permit. Failure to comply with the requirements of this permit may be grounds for administrative action, or enforcement proceedings including civil or criminal penalties, injunctive relief and summary abatements.

O. *Duty to Mitigate.* The permittee shall take all reasonable steps to minimize or correct any adverse impact to the public treatment plant or to the environment resulting from noncompliance with this permit, including such accelerated monitoring as necessary to determine the nature and impact of the noncompliance discharge.

P. *Duty to Halt or Reduce Activity.* Upon reduction of efficiency of operation, or loss or failure of all or part of the treatment facility, the permittee shall, to the extent necessary to maintain compliance with its permit, control the production or discharges, or both, until operation of the treatment facility is restored or an alternate method of treatment is provided.

Q. *Modification or Revision of the Permit.* The terms and conditions of this permit may be subject to modifications by MassDevelopment at any time as limitations or requirements are modified or other just cause exists. This permit may be modified for other just cause. This permit may also be modified to incorporate special conditions resulting from the issuance of a special order promulgating a new pretreatment standard. Any permit modifications which result in new conditions in the permit shall include a reasonable time schedule for compliance.

R. *Duty to Reapply.* The permittee shall apply for permit renewal a minimum of sixty (60) days prior to the expiration of the Permittee's existing permit.

S. *Severability.* The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit are deemed invalid, the remainder of this permit shall not be affected thereby.

T. *Property Rights.* The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges, nor does it authorize any invasion of personal rights, nor any infringement of Federal, State or Local regulations.

# MassDevelopment

# LANDFILL DISCHARGE PERMIT

Please complete this page, keep a copy with your Landfill Discharge Permit and return the original to the following address:

MassDevelopment
Attn: Utilities Supervisor
33 Andrews Parkway
Devens, MA 01434

**Acknowledgment of permit terms, conditions and limitations:**

The undersigned acknowledges receipt of a renewal of Permit Number 020 authorizing a discharge of treated landfill wastewater to the Devens Wastewater Treatment Facility sewer system. The permittee also acknowledges that this permit is issued at its request based upon the application for the permit and the information provided and acknowledges the conditions and limitations set forth in said permit, **including the requirement for the permittee to pay for additional arsenic tests at the Devens wastewater treatment facility as described in Special Conditions paragraph II.C of this permit**. All information and data contained in this document may be made available to the public without restriction.

U.S Army Corp of Engineers
Permittee Name

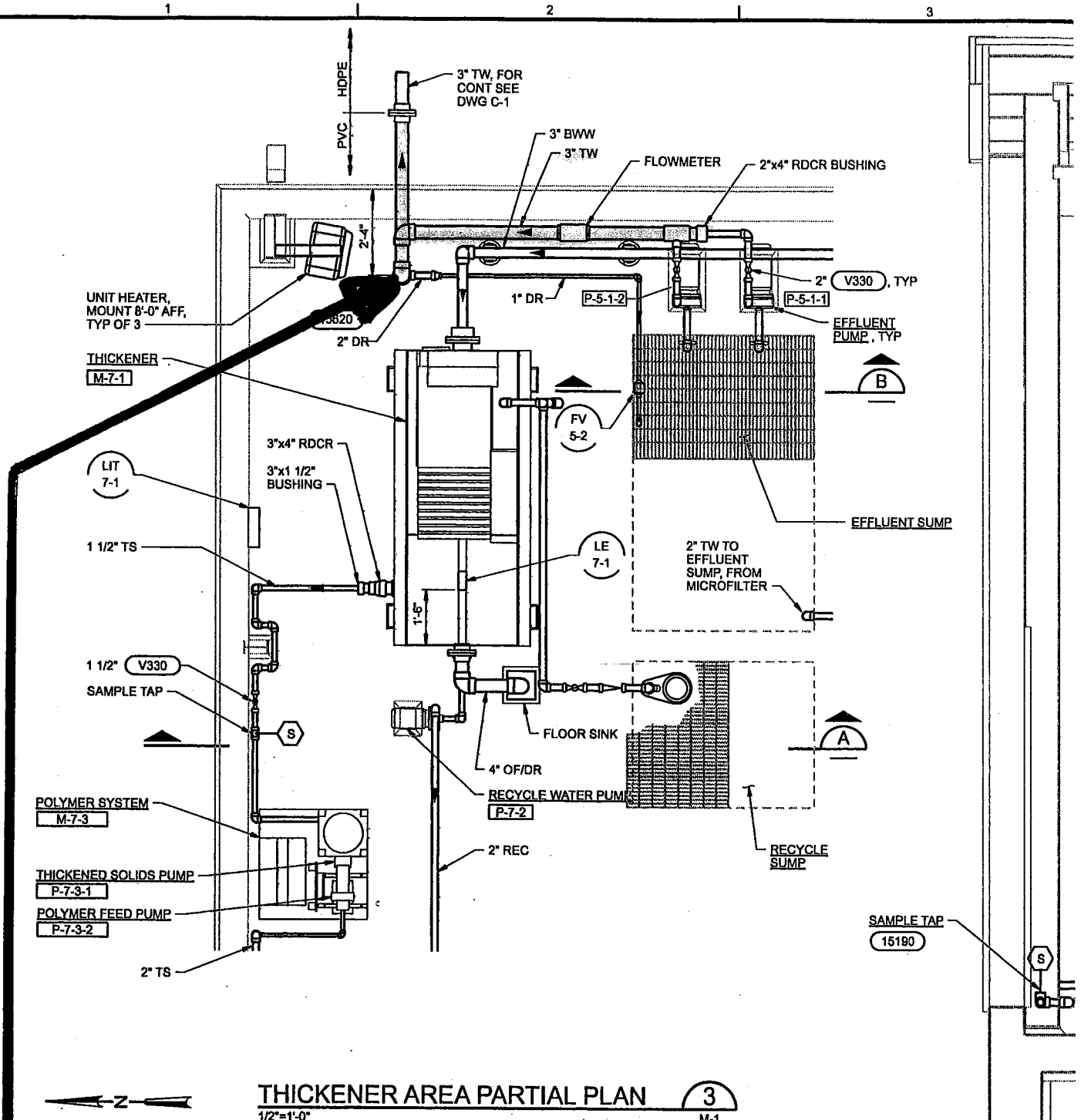
50 MacArthur Ave.
Box 90
Devens, MA 01434
Permittee Address

By:_____
Authorized Representative - Please Print or Type

_____
Signature

_____
Title

_____
Date




Z

## THICKENER AREA PARTIAL PLAN 3

1/2"=1'-0" M-1

**SAMPLES TO BE OBTAINED FROM EFFLUENT DISCHARGE PIPING**

**(see piping labeled 3" TW above)**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DSGN S BUECKER | | | | | | | VERIFY SCALE |
| DR C WORRALL | | | | | | | BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1" |
| CHK S KADER | | | | | | | IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY. |
| APVD S KADER | NO. | DATE | REVISION | | BY | APVD | |

# Appendix D

# Field Forms

# Shepley Hill Water Levels

**Date:** 4/9/07

**Project Site:** Shepley Hill Landfill

**Location:** Devens, Ma

**Date:** _____

**Water Level Meter:** Solinst

**Weather:** Clear, 50's

**Field Crew:** DR + FS

| Well | Time | DTW | Well | Time | DTW |
|---|---|---|---|---|---|
| SHL-15 | 0905 | 16.94 | SHM-96-5B | | 5.10 |
| N7-P1 | | 30.62 | SHM-96-5C | | 4.55 |
| N7-P2 | | 30.75 | SHL-8S | | 7.51 |
| SHP-99-35X | | 36.78 | SHL-8D | | 7.19 |
| N6-P1 | | 36.92 | SHL-13 | | 6.64 |
| SHP-95-27X | | 33.03 | PSP-01 | | 1.28 |
| SHL-24 | | 15.49 | SHP-05-47A H | | 5.57 |
| SHM-93-18B | | 18.53 | SHP-05-47B L | | 2.60 |
| SHL-18 | | 18.85 | SHM-93-22B | | 5.87 |
| SHL3 | | 29.44 | SHM-93-22C | | 7.01 |
| SHL-10D | | 30.17 | SHL-22 | | 5.99 |
| SHL-10C | 29.20 | ~~30.17~~ | SHL-9 | | 8.03 |
| SHL-10 | | 30.80 | SHL-23 | | 26.41 |
| SHL-19 | | 22.49 | SHM-05-41A | | 9.21 |
| SHL-4 | | 10.22 | SHM-05-41B | | 9.04 |
| SHL-11 | | 18.57 | SHM-05-41C | | 9.27 |
| SHL-20 | | 18.92 | SHM-05-42A | | 3.47 |
| SHP-01-38A | | 4.40 | SHM-05-42B | | 3.41 |
| SHP-01-38B | | 4.45 | SHM-05-39A | | 10.50 |
| N3-P1 | | 5.14 | SHM-05-39B | | 11.38 |
| N3-P2 | | 8.21 | SHM-05-40X | | 13.20 |
| N2-P1 | | 5.90 | SHP-99-31A | | 1.80 |
| N2-P2 | | 6.14 | SHP-99-31B | | 2.96 |
| SHP-36X | | 8.14 | SHP-99-31C | | 3.24 |
| SHP-37X | | 6.83 | SHP-05-48A | | 3.45 |
| N1-P1 | | 14.73 | SHP-05-48B | | 4.92 |
| N1-P2 | | 14.57 | SHP-99-32X | | 8.82 |
| N1-P3 | | 15.41 | SHP-99-34A | | 12.72 |
| SHL-21 | | 45.11 | SHP-99-34B | | 12.37 |
| SHP-05-43 | | 57.32 | SHP-05-49A | | 5.59 |
| SHP-05-44 | | 52.57 | SHP-05-49B | 1340 | 4.23 |
| N5-P1 | | 23.68 | SHP-05-45A | | 14.65 |
| N5-P2 | | 20.04 | SHP-05-45B | | 15.47 |
| SHP-99-29X | | 23.07 | SHP-05-46A | | 14.41 |
| SHL-5 | | 2.17 | SHP-05-46B | | 13.78 |

WS 0.39

4.23 (short)
5.59 (Tall)

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-23

**Date:** 4/10/07
**Sampler:** DR/FS
**PID Reading:** 0

**Start Time:** 1050 **End Time:** 1145
**Well Construction:**
**Depth to water:** 26.74'
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 23

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 6600 XL | 04J15999AD |
| Grundfos Controller | | |
| Solonist WL | | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1115 | | 500 | 26.93 | 10.37 | 5.67 | 0.057 | 11.07 | 191 | 0.61 | Clear |
| 1120 | | 500 | 26.86 | 10.59 | 5.49 | 0.059 | 11.08 | 214 | 0.41 | Clear |
| 1125 | | 400 | 26.98 | 10.70 | 5.48 | 0.059 | 11.07 | 216 | 0.24 | Clear |
| 1130 | | 400 | 26.85 | 10.86 | 5.45 | 0.059 | 11.07 | 217 | 0.38 | Clear |
| 1135 | | 400 | 26.84 | 11.11 | 5.42 | 0.059 | 11.07 | 223 | 0.37 | Clear |
| 1140 | | 400 | 26.84 | 11.33 | 5.36 | 0.058 | 11.12 | 232 | 0.16 | Clear |
| 1145 | 23 | 400 | 26.84 | 11.33 | 5.35 | 0.058 | 11.11 | 234 | 0.11 | Clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1145 | SHL23-041007 | | | | |
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**Comments**

D Ramsey
**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-05-41A
**Start Time:** 1215 **End Time:** 1315
**Well Construction:**
**Depth to water:** 9.69
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 18

**Date:** 4/10/07
**Sampler:** SDV/FS
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| ~~Fronds Catcher~~ | | |
| Solonist | WL | |
| Geo pump | peristaltic | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1250 | | 300 | 9.69 | 8.43 | 6.51 | 0.192 | 0.25 | -40 | 5.11 | Clear |
| 1255 | | 300 | 9.69 | 8.43 | 6.41 | 0.182 | 0.23 | -25 | 3.93 | Clear |
| 1300 | | 300 | 9.69 | 8.47 | 6.32 | 0.174 | 0.24 | -15 | 3.21 | Clear |
| 1305 | | 300 | 9.69 | 8.50 | 6.29 | 0.174 | 0.27 | -11 | 1.15 | Clear |
| 1310 | | 300 | 9.69 | 8.49 | 6.28 | 0.174 | 0.27 | -11 | 0.28 | Clear |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1315 | SHM0541A-041007 | | | | |
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**Comments**

SDV/Reamis
Signature

4/10/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-05-41B
**Start Time:** 1210 **End Time:** 1245
**Well Construction:**
**Depth to water:** 9.44
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 18

**Date:** 4/10/07
**Sampler:** DR | KS
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump Peristaltic | | |
| Solonist | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1220 | 8.5 | 425 | 9.47 | 8.33 | 6.26 | 0.954 | 0.46 | -88 | | |
| 1225 | | | 9.47 | 8.49 | 6.32 | 0.943 | 0.22 | -97 | 26.9 | |
| 1230 | 12 | 400 | 9.47 | 8.51 | 6.35 | 0.937 | 0.18 | -99 | | |
| 1235 | | | 9.47 | 8.56 | 6.37 | 0.931 | 0.17 | -101 | 9.46 | |
| 1240 | 16 | 400 | 9.47 | 8.57 | 6.36 | 0.929 | 0.17 | -102 | 4.95 | |
| 1245 | | | 9.47 | 8.57 | 6.37 | 0.928 | 0.18 | -102 | 5.53 | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1245 | SHM05418-041007 | | | | |
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**Comments**

D Kenneth
**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-05-42B
**Start Time:** ~~1350~~ 1430 **End Time:** 1430
**Well Construction:**
**Depth to water:** 3.57
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 18

**Date:** 4/10/07
**Sampler:** DRL/ES
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | Peristaltic | |
| Solinst | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1410 | 4.5 | 450 | 3.66 | 7.83 | 6.40 | 1.218 | 0.27 | -94 | | |
| 1415 | | | 3.67 | 7.82 | 6.47 | 1.258 | 0.19 | -100 | 10.78 | |
| 1420 | 9.0 | | 3.68 | 7.82 | 6.51 | 1.297 | 0.15 | -104 | | |
| 1425 | | | 3.68 | 7.91 | 6.52 | 1.307 | 0.14 | -107 | 10.71 | |
| 1430 | | | 3.68 | 7.96 | 6.54 | 1.311 | 0.14 | -108 | | |
| | | | | | | | | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1430 | SHM05420-041007 | | | | |
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**Comments**

DJ Reuter
**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-05-42A
**Start Time:** 1330 **End Time:** 1415
**Well Construction:**
**Depth to water:** 3.62
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 18 L

**Date:** 4/10/07
**Sampler:** DK/FS
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15299AD |
| Geopump Peristaltic | | |
| Solinst WL | | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1345 | | 475 | 3.75 | 7.66 | 7.29 | 0.411 | 6.05 | -50 | 11.21 | Cloudy/orange |
| 1350 | | 450 | 3.74 | 7.53 | 6.88 | 0.208 | 6.00 | 76 | 9.12 | " |
| 1355 | | 400 | 3.73 | 7.52 | 6.81 | 0.198 | 5.99 | 80 | 7.78 | " |
| 1400 | | 400 | 3.72 | 7.56 | 6.46 | 0.162 | 6.11 | 125 | 3.27 | Clear |
| 1405 | | 400 | 3.72 | 7.54 | 6.44 | 0.158 | 6.12 | 128 | 1.89 | Clear |
| 1410 | | 400 | 3.72 | 7.58 | 6.23 | 0.134 | 6.21 | 147 | 1.63 | Clear |
| 1415 | | 400 | 3.72 | 7.59 | 6.25 | 0.129 | 6.26 | 150 | 0.76 | Clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1415 | SHM0542A-041007 | | | | |
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**Comments**

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**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-22
**Start Time:** 0755 **End Time:** 0925
**Well Construction:**
**Depth to water:** 6.38
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 31.5 L

**Date:** 4-10-07
**Sampler:** DL / FS
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600 XL | 04J1599AD |
| Geopump Peristaltic Sampling Pump | | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 0910 | | 350 | 6.87 | 7.75 | 6.74 | 1.111 | 0.20 | -41 | | clear |
| 0915 | | | 6.88 | 7.78 | 6.72 | 1.110 | 0.19 | -46 | | |
| 0920 | | 350 | 6.88 | 7.89 | 6.70 | 1.108 | 0.19 | -49 | | |
| 0925 | 31.5 | | 6.85 | 7.73 | 6.70 | 1.109 | 0.19 | -51 | 0.10 | |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0930 | SHL-22-041007 | | | | |
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**Comments**

Signature

4/10/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-05-41C
**Start Time:** 1255 **End Time:** 1325
**Well Construction:**
**Depth to water:** 9.67
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 16 L

**Date:** 4-10-07
**Sampler:** DR/AS
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J1589KD |
| Geopump peristaltic | | |
| Solinst WL | | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1315 | | 480 | 9.88 | 8.61 | 6.89 | 1.109 | 0.14 | -156 | 17.11 | Clear |
| 1320 | | | 9.83 | 8.68 | 7.02 | 1.119 | 0.12 | -163 | 14.78 | Cloudy/Grey |
| 1325 | | 480 | 9.83 | 8.67 | 7.02 | 1.119 | 0.11 | -161 | 8.71 | |
| 1330 | | | 9.83 | 8.66 | 7.03 | 1.118 | 0.11 | -163 | 8.01 | |
| 1335 | | 400 | 9.83 | 8.66 | 7.04 | 1.120 | 0.11 | -163 | 7.16 | |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1335 | SHM05-41C-041007 | | | | |
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**Comments**

Signature

4/6/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-9

**Date:** 4/10/07
**Sampler:** DR | FS
**PID Reading:** 0

**Start Time:** 0930 **End Time:** 1045
**Well Construction:**
**Depth to water:** 8.60
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 30L

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | Peristaltic | |
| Solinst | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | | 400 | 8.97 | 6.42 | 6.57 | 0.240 | 0.73 | -44 | 78.4 | cloudy/orang |
| 1015 | | 400 | 9.01 | 6.42 | 6.54 | 0.243 | 0.67 | -43 | 75 | cloudy/orang |
| 1020 | | 400 | 9.04 | 6.23 | 6.49 | 0.258 | 0.52 | -50 | 37.8 | cloudy |
| 1025 | | 400 | 9.06 | 6.34 | 6.49 | 0.259 | 0.45 | -50 | 15.2 | cloudy |
| 1030 | | 400 | 9.05 | 6.40 | 6.49 | 0.260 | 0.38 | -50 | 8.97 | clear |
| 1035 | | 400 | 9.05 | 6.39 | 6.47 | 0.261 | 0.37 | -51 | 8.11 | clear |
| 1040 | | 400 | 9.06 | 6.38 | 6.48 | 0.263 | 0.36 | -51 | 7.29 | clear |
| 1045 | | 400 | 9.05 | 6.37 | 6.47 | 0.262 | 0.36 | -52 | 7.09 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1045 | SHL9-041007 | | | | |
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**Comments**

D M Rand
**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-96-22B

**Date:** 4/10/07
**Sampler:** DR / FS
**PID Reading:** 0

**Start Time:** 0915 **End Time:** 0955
**Well Construction:**
**Depth to water:** 6.27
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 13

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | Peristaltic | |
| Solonist | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 0940 | | 325 | 6.25 | 7.12 | 6.63 | 1.239 | 0.16 | -140 | 6.05 | clear |
| 0945 | 1L | 325 | 6.27 | 7.05 | 6.63 | 1.239 | 0.16 | -141 | 5.85 | clear |
| 0950 | | 325 | 6.26 | 6.99 | 6.63 | 1.237 | 0.14 | -141 | 5.69 | clear |
| 0955 | 1L | | 6.26 | 7.10 | 6.63 | 1.235 | 0.15 | -141 | 5.80 | " |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1000 | SHM-96-22B-041007 | | 2 | | |
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**Comments**

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**Signature**

4/10/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-93-22C

**Date:** 4-10-07
**Sampler:** DR/FS
**PID Reading:** 0

**Start Time:** 0740 **End Time:** 0850
**Well Construction:**
**Depth to water:** 8.72
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 21

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999 AD |
| Grundos | Controller | |
| Solinst | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 0745 | 1.5 | 300 | 9.76 | 7.29 | 7.19 | 1.077 | 1.07 | -161 | | clear |
| 0750 | 3.0 | 300 | 10.80 | 7.22 | 7.28 | 1.121 | 0.65 | -175 | | |
| 0755 | 4.5 | 300 | 11.38 | 7.03 | 7.30 | 1.116 | 0.64 | -178 | | |
| 0805 | 7.5 | 300 | 12.50 | 7.03 | 7.34 | 1.092 | 0.42 | -158 | | |
| 0810 | 9.0 | | 13.20 | 7.60 | 7.36 | 1.085 | 0.39 | -170 | | |
| 0815 | 10.5 | | 13.86 | 7.45 | 7.36 | 1.076 | 0.37 | -173 | | |
| 0820 | 12 | | 14.65 | 7.53 | 7.36 | 1.071 | 0.35 | -175 | | |
| 0825 | | | 15.43 | 8.00 | 7.37 | 1.066 | 0.29 | -180 | | |
| 0830 | 15 | | 16.31 | 8.02 | 7.38 | 1.060 | 0.24 | -183 | 2.06 | |
| 0835 | | | 17.42 | 8.32 | 7.38 | 1.055 | 0.21 | -186 | | |
| 0840 | 18 | | 18.15 | 8.21 | 7.40 | 1.053 | 0.19 | -187 | | |
| 0845 | | | 18.87 | 8.06 | 7.40 | 1051 | 0.20 | -188 | 2.29 | |
| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0850 | SHM-93-22C-041007 | | 2 | | |
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**Comments**

Signature

4/10/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-21

**Date:** 4/11/07
**Sampler:** DR
**PID Reading:** 0

**Start Time:** 1200 **End Time:** 1230
**Well Construction:**
**Depth to water:** 44.66
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 15

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J1599AD |
| Grundfos | Controller | |
| Solonist | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1210 | 5 | 500 | 44.72 | 11.42 | 5.70 | 0.107 | 8.21 | 176 | | |
| 1215 | | | | 11.58 | 5.73 | 0.106 | 8.88 | 176 | | |
| 1220 | 10 | 500 | 44.72 | 11.74 | 5.73 | 0.106 | 9.12 | 176 | | |
| 1225 | | | | 11.69 | 5.73 | 0.105 | [illegible] | 178 | 9.16 | |
| 1230 | 15 | 500 | 44.72 | 11.76 | 5.72 | 0.104 | 9.20 | 179 | | |
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**Acceptance Criteria:** < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10%

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1230 | SHL21-041107 | | 2 | | |
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**Comments**

D Reault
**Signature**

4/11/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-8D
**Start Time:** 1035 **End Time:** 1110
**Well Construction:**
**Depth to water:** 6.81
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 14

**Date:** 4/11/07
**Sampler:** DR
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | peristaltic | |
| Solonist | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1045 | 4 | 400 | | 8.00 | 6.02 | 0.171 | 1.98 | 138 | | |
| 1050 | | | 7.09 | 8.13 | 5.96 | 0.171 | 1.97 | 150 | <1 | |
| 1055 | 8 | 400 | 7.10 | 8.16 | 5.92 | 0.171 | 1.96 | 160 | | |
| 1100 | | | | 8.22 | 5.90 | 0.171 | 1.90 | 165 | | |
| 1105 | 12 | | 7.10 | 8.22 | 5.89 | 0.171 | 1.89 | 168 | | |
| 1110 | | | 7.10 | 8.20 | 5.88 | 0.171 | 1.90 | 169 | <1 | |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1110 | SHL8D-041107 | | 2 | | |
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**Comments**

D J Ramsdell
**Signature**

4/11/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHL-85
**Start Time:** 1045 **End Time:** 1135
**Well Construction:**
**Depth to water:** 6.92
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 20

**Date:** 4/11/07
**Sampler:** DVR
**PID Reading:** 0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | Peristaltic | |
| Solinst | | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1115 | 12 | 400 | 9.12 | 8.07 | 6.10 | 0.092 | 2.76 | 154 | <1 | |
| 1120 | | | 9.12 | 8.17 | 6.09 | 0.090 | 2.55 | 156 | | |
| 1125 | 16 | 400 | 9.12 | 8.18 | 6.06 | 0.090 | 2.27 | 158 | | |
| 1130 | | | | 8.20 | 6.06 | 0.090 | 2.16 | 158 | <1 | |
| 1135 | 20 | | 9.12 | 8.18 | 6.06 | 0.090 | 2.13 | 158 | | |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1135 | SHL85-041107 | | 2 | | |
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**Comments**

DV Reault
Signature

4/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM-96-5C

**Date:** 4/11/07
**Sampler:** DR
**PID Reading:** 0

**Start Time:** 0920 **End Time:** 1020
**Well Construction:**
**Depth to water:** 4.65
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 24

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15899AD |
| Geopump | Peristaltic | |
| Solinst | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 1005 | | 400 | 4.67 | 7.46 | 6.37 | 1.161 | 0.17 | -95 | 31.14 | |
| 1010 | 20 | | 4.67 | 7.52 | 6.37 | 1.162 | 0.14 | -100 | | |
| 1015 | | | 4.67 | 7.62 | 6.37 | 1.162 | 0.13 | -102 | | |
| 1020 | 24 | | 4.67 | 7.63 | 6.38 | 1.161 | 0.13 | -102 | 23.7 | |
| | | | | | | | | | | |
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**Acceptance Criteria:** < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10%

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1020 | SHM96SC-041107 | | 2 | | |
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**Comments**

D J Kean
**Signature**

4/11/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Shepley Hill Landfill
**Location:** Devens, MA
**Well ID:** SHM96SB
**Start Time:** 0915 **End Time:** 1000
**Well Construction:**
**Depth to water:** 5.20
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 18

**Date:** 4/11/07
**Sampler:** DR
**PID Reading:** ~~0.0~~ N/A

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04J15999AD |
| Geopump | Peristaltic | |
| Solinst | WL | |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 0920 | | 400 | 5.51 | 7.27 | 6.46 | 0.937 | 1.18 | -79 | | |
| 0925 | 4 | | | 7.31 | 6.43 | 0.937 | 0.67 | -80 | | |
| 0930 | | | | 7.43 | 6.45 | 0.936 | 0.47 | -81 | <1.0 | |
| 0935 | 8 | | 5.52 | 7.58 | 6.46 | 0.935 | 0.35 | -82 | | |
| 0940 | | | | 7.52 | 6.46 | 0.936 | 0.37 | -82 | | |
| 0945 | 12 | | | 7.50 | 6.47 | 0.936 | 0.29 | -82 | <1.0 | |
| 0950 | | | 5.52 | 7.50 | 6.47 | 0.936 | 0.24 | -82 | | |
| 0955 | 16 | | | 7.52 | 6.47 | 0.935 | 0.25 | -82 | | |
| 1000 | | | 5.52 | 7.52 | 6.47 | 0.936 | 0.24 | -82 | <1.0 | |
| | | | | | | | | | | |
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| | | | | | | | | | | |
| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1000 | SHM96[redacted]SB-041107 | | 2 | | |
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**Comments**

D Reen
**Signature**

4/11/07
**Date**

**Pine Environmental Services, Inc**
155-E New Boston St., Woburn, MA 01801
800-519-PINE(Toll-Free)
781-932-9698(Phone)
781-932-9729(Fax)
pine-ma@pine-environmental.com

## *YSI 600 XL Packing List*

**Pine No:** 5704 **Serial No:** 04J15999AD

| Standard Items | Prepared | QC Check | Received by Customer | Return to Pine |
|---|---|---|---|---|
| 650 MDS Display | ✓ | ✓ | | |
| Manual | ✓ | ✓ | | |
| Quick reference card | ✓ | ✓ | | |
| Field cable | ✓ | ✓ | | |
| Stand (base, claw, and rod) | ✓ | ✓ | | |
| Probe guard w/ weight | ✓ | ✓ | | |
| Storage/ calibration cup w/ sponge | ✓ | ✓ | | |
| Flow through cell | ✓ | ✓ | | |
| 2 of each barb size (1/4, 3/8, and 1/2) | ✓ | ✓ | | |
| DO probe reconditioning kit | ✓ | ✓ | | |
| C alkaline batteries (4) | ✓ | ✓ | | |
| 6-series communications cable | ✓ | ✓ | | |
| YSI Ecowatch software | ✓ | ✓ | | |
| Calibration kit (pH, conductivity, and ORP) | ✓ | ✓ | | |
| NIST traceable calibration sheet | ✓ | ✓ | | |

**Prepared By:** BD
**QC By:** CC
**Date:** 4/5/2007

***This packing list is to ensure that every item needed to operate the unit was sent and received. Upon receiving a shipment, please fill out the "Received by customer" column. Call Pine within 24 hrs. of receiving the equipment if any pieces are missing, damaged, or malfunctioning. Thank you for choosing Pine Environmental Services, Inc.***

**For Technical Support call 800-519-PINE**

**Pine Environmental Services, Inc**
155-E New Boston St., Woburn, MA 01801
800-519-PINE(Toll-Free)
781-932-9698(Phone)
781-932-9729(Fax)
pine-ma@pine-environmental.com

## *Certificate of YSI Calibration*

This is to certify that the YSI 600 XL Serial Number 04J15999AD was calibrated with standard units traceable to manufacturer's specification

**Model:** 600 XL
**Pine No:** 5704
**Serial No:** 04J15999AD

**lot Number:**ORP

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Redox: 240mv | 239.9mv | 228-252 mv | -0.04% |

**lot Number:**DO_100

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Dissolve Oxygen-Span1: 100% | 100% | 95-105 % | 0% |

**lot Number:**Cond_1413

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Conductivity-Span2: 1.413ms/cm | 1.413ms/cm | 1.34-1.48 ms/cm | 0% |

**lot Number:**PH_7

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| PH-Zero1: 7PH | 7PH | 6.65-7.35 PH | 0% |

**lot Number:**PH_4

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| PH-Span1: 4PH | 4PH | 3.8-4.2 PH | 0% |

**lot Number:**DO_0

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Dissolve Oxygen-Zero1: 0mg/L | 0.18mg/L | 0-0 mg/L | 0.18% |

**Environmental Conditions of Test Area:**

Temperature Degree F: 71 %Relative Humidity 29

**Calibrated By:** Elig Demorais **Date:** 4/5/2007 12:52:00 PM

All instruments are calibrated by Pine Environmental Services, Inc. according to the manufacturer's specifications. It is the customer's responsibility to calibrate and maintain this unit in accordance with the manufacturer's specifications and/or the customer's own specific needs.

**Customer must notify PES of any defect within 24 hours of receipt of equipment**
**Please call 800-519-PINE for Technical Assistance**

See Attach Packing List

# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Shepley Hill LF **Date** 4/10/07 **Weather** Clear, 40's

**Calibrated By** DR/KS **Instrument** YSI-600XL **Serial Number** 04J15999 AD

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.354 | 1.413 | 9.65 | |
| pH (7) | 6.96 | 7.00 | 8.65 | |
| pH (4) | 3.98 | 4.01 | 8.65 | |
| pH (10) | 9.96 | 10.00 | 8.99 | |
| ORP | 253 | 240 | 9.62 | |
| Dissolved Oxygen | 100.5 % | ~~101.8 %~~ 99.5 % | 13.94 | |
| Barometric Pressure | 749.9 | 749.9 | 13.94 | |
| | | | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** DEVENS **Date** 4/11/07 **Weather** Clear, 40's

**Calibrated By** Dave Rennett **Instrument** 451 **Serial Number** _____

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.505 | 1.414 | 13.01 | |
| pH (7) | 6.95 | 7.00 | 13.42 | |
| pH (4) | 4.11 | 3.99 | 12.30 | |
| pH (10) | 9.98 | 10.00 | 12.92 | |
| ORP | 235 | 240 | 12.66 | |
| Dissolved Oxygen | 94.5 | 99.8 | 12.53 | |
| Barometric Pressure | | | | |
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# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ DEVENS
**Location:** ~~New London, CT~~
**Well ID:** JHM-96-5B

**Date:** 7/11/07
**Sampler:** DR + HC
**PID Reading:** N/A

**Start Time:** 13:20 **End Time:** 13:50
**Well Construction:**
**Depth to water:** 6.18
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 07D0864 AA |
| YSI | 650 MDS | 00L1207 AA |
| Geotech | GRDPUMP 2 | 110771 |
| ORION | 230A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13:35 | | 500 | 6.52 | 12.94 | 6.28 | 0.689 | 0.25 | 72.5 | | | |
| 13:40 | | 500 | 6.52 | 12.96 | 6.29 | 0.689 | 0.26 | 95.6 | | | |
| 13:45 | | 500 | 6.52 | 12.97 | 6.31 | 0.689 | 0.25 | 97.4 | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| | | | | | |
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**Comments**

Helen Cavanaugh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ **Date:** 7/11/07

**Location:** ~~New London, CT~~ **Sampler:** DR + HC

**Well ID:** SHL-5 **PID Reading:** N/A

**Start Time:** 12:10 **End Time:** :

**Well Construction:**

**Depth to water:** 4.48

**Well Depth:**

**Water Column:**

**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 6000xl | 02P0864 AA |
| YSI | 1650 MPS | 00L1207 AA |
| Geotech | Geopump Z | 11071 |
| ORION | 230A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12:30 | | 375 | 5.15 | 12.95 | 5.79 | 0.098 | 0.22 | 93.7 | | | |
| 12:35 | | 375 | 5.15 | 12.91 | 5.80 | 0.098 | 0.21 | 95.0 | | | |
| 12:40 | | 375 | 5.15 | 13.03 | 5.85 | 0.098 | 0.20 | 94.4 | | | |
| | | | | | | | | | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Cavanagh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

Project: ~~Site 3 & 7~~ DEVENS
Location: ~~New London, CT~~
Well ID: SHL-8S

Date: 7/11/07
Sampler: DR + HC
PID Reading: N/A

Start Time: 10:40 End Time: ~~11:05~~ 11:05
Well Construction:
Depth to water: 7.75
Well Depth:
Water Column:
Total Volume Removed (L)

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 02D0864 AA |
| YSI | 650 MDS | 00L1207 AA |
| Geotech | Geopump 2 | 11071 |
| ORION | 230 A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11:40 | | 325 | 11.02 | 10.87 | 5.89 | 0.072 | 1.29 | 116.1 | | | |
| 11:45 | | 325 | 11.02 | 10.57 | 6.04 | 0.070 | 1.07 | 116.7 | | | |
| 11:50 | | 325 | ~~10.57~~ 11.03 | 10.60 | 5.89 | 0.070 | 0.89 | 117.7 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Canavaugh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

Project: ~~Site 3 & 7~~ DEVENS

Location: ~~New London, CT~~ HC

Well ID: SHL-21

Date: 7/11/07

Sampler: DR + HC

PID Reading: N/A

Start Time: 10:05 End Time: 11:20

Well Construction: 4" PVC

Depth to water: 45.29

Well Depth:

Water Column:

Total Volume Removed (L)

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 02D0864 AA |
| YSI | 650 MDS | 00L1207 AA |
| GRUNFOS | Controller | HC ~~HC~~ 5463 |
| ORION | 230A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10:55 | | 500 ~~600~~ HC | 45.36 | 13.68 | 5.62 | 0.089 | 7.81 | 123.4 | | | |
| 11:00 | | 500 | 45.36 | 13.47 | 4.72 | 0.086 | 7.54 | 117.5 | | | |
| 11:05 | | 500 | 45.36 | 13.51 | 4.24 | 0.085 | 7.34 | 117.4 | | | |
| 11:10 | | 500 | 45.36 | 13.47 | 3.97 | 0.084 | 7.49 | 118.5 | | | |
| 11:15 | | 500 | 45.36 | 13.49 | 5.81 | 0.084 | 7.45 | 118.4 | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

* pH SENSOR NOT WORKING PROPERLY, Readings drifting significantly
* Started to use ORION benchmeter to Read pH @ 11:15, stabilized quickly @ 5.81 (STD)

Helen Cavanagh
Signature

7/11/07
Date

~~NOTE:~~ HC

*NOTE: ORION WAS calibrated PRIOR to use.

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 9 & 7~~ DEVENS
**Location:** ~~New London, CT~~
**Well ID:** SHL-8D

**Date:** 7/11/07
**Sampler:** DR + HV
**PID Reading:** N/A

**Start Time:** 0950 **End Time:** 1033
**Well Construction:**
**Depth to water:** 7.56*
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 02D0864AA |
| YSI | 650 MDS | 00L1207 AA |
| GeoTech | GeoPump2 | 11071 |
| ORION | 230A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10:13 | | 475 | 7.92 | 10.74 | 4.40 | 0.167 | 0.92 | 87.0 | | | |
| 10:18 | | 475 | 7.92 | 10.76 | 4.40 | 0.166 | 0.96 | 88.6 | | | |
| 10:23 | | 475 | 7.92 | 10.80 | 4.41 | 0.165 | 0.99 | 86.3 | | | |
| 10:28 | | | | | 5.94 | | | | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

* Re-checked calibration, which checked out.
* Re-calibrated for pH 7 and 4
* The pH's taken with the YSI were NOT VALID
* A grab sample was taken after well was purged for 5 min. more
* pH was taken with ORION benchmeter and it stabilized @ 5.94

Helen Cavanaugh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Site 3 & 7 **Date:** 7/11/07

**Location:** New London, CT **Sampler:** DR & HC

**Well ID:** ~~#GHC-56~~ GHM-96-5C **PID Reading:** N/A

**Start Time:** 12:50 **End Time:** 13:20

**Well Construction:**

**Depth to water:** 5.67

**Well Depth:**

**Water Column:**

**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 02D0864 AA |
| YSI | 650 MDS | 00L1207 AA |
| Geotech | Geopump Z | 11071 |
| ORION | 230A | 012650 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 13:05 | | 260 | 5.67 | 12.24 | 6.53 | 0.866 | 0.23 | 48.2 | | | |
| 13:10 | | 260 | 5.67 | 11.95 | 6.52 | 0.864 | 0.23 | 54.6 | | | |
| 13:15 | | 260 | 5.67 | 11.95 | 6.52 | 0.864 | 0.23 | 56.1 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Cavanaugh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

Project: ~~Site 3 & 7~~ DEVENS

Location: ~~New London, CT~~

Well ID: SHL-22

Date: 7/11/07

Sampler: DR + MC

PID Reading: N/A

Start Time: 14:00 End Time: 14:45

Well Construction:

Depth to water: 7.11

Well Depth:

Water Column:

Total Volume Removed (L)

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 6600XL | 02D0364 AA |
| YSI | 650MDS | 00L1207 AA |
| Geotech | Geopump 2 | 11071 |
| ORION | 230A | 0121656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 14:25 | | 380 | 7.89 | 11.98 | 6.81 | 0.756 | 0.21 | 113.8 | | | |
| 14:30 | | 380 | 7.89 | 11.70 | 6.77 | 0.756 | 0.20 | 114.1 | | | |
| 14:35 | | 380 | 7.89 | 11.72 | 6.80 | 0.757 | 0.19 | 114.5 | | | |
| 14:40 | | 380 | 7.89 | 11.65 | 6.79 | 0.756 | 0.19 | 114.2 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Cavanagh
Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

Project: ~~Site 9 & 7~~ DEVENS
Location: ~~New London, CT~~ MC
Well ID: GHM-93-22C

Date: 7/11/07
Sampler: DR + HC
PID Reading: N/A

Start Time: 14:10 End Time: 15:15
Well Construction:
Depth to water: 11.23
Well Depth:
Water Column:
Total Volume Removed (L)

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 6600XL | 07D 0364 AA |
| YSI | 650 MDS | 00L 1207 AA |
| Grundfos | Grundfos 2 | 11071 |
| ORION | 230 A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 14:45 | | 400 | 19.22 | 17.69 | 7.08 | 0.659 | 0.51 | 98.3 | | | |
| 14:50 | | ~~250~~ 400 * | 19.48 | 19.21 | 7.28 | 0.639 | 0.40 | 56.1 | | | |
| 14:55 | | 250 | 19.71 | 21.37 | 7.37 | 0.648 | 0.52 | 51.2 | | | |
| 15:00 | | 250 | 19.85 | 22.71 | 7.41 | 0.648 | 0.49 | 59.2 | | | |
| 15:05 | | 250 | 19.89 | 22.93 | 7.41 | 0.648 | 0.42 | 54.1 | | | |
| 15:10 | | 250 | 19.90 | 22.74 | 7.43 | 0.647 | 0.40 | 53.7 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

* 95.20 Hz for GRUNFOS

Signature

7/11/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Site 3 & 7 **Date:** 7/12/07

**Location:** New London, CT **Sampler:** DR + HV

**Well ID:** SHL-23 **PID Reading:** N/A

**Start Time:** 9:00 **End Time:** _____

**Well Construction:** _____

**Depth to water:** _____

**Well Depth:** _____

**Water Column:** _____

**Total Volume Removed (L)** _____

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 600XL | 04I15499 MD |
| YSI | 650 MDS | 00M0745 AH |
| GeoTech | Geopump | 11071 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 930 | | 500 | 27.90 | 11.97 | 4.99 | 0.033 | 11.33 | 110 | | | |
| 0935 | | | | 11.61 | 4.60 | 0.032 | 11.20 | 113 | | | |
| 0945 | | | 27.90 | | 7.14 | 0.030 | 11.24 | 113 | | | |
| 0950 | | | 27.90 | 11.72 | 6.53 | 0.030 | 11.22 | 112 | | | |
| 0955 | | | 27.90 | 11.83 | 6.18 | 0.030 | 11.21 | 112 | | | |
| 1000 | | | 27.90 | 11.90 | 6.16 | 0.030 | 11.20 | 112 | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments** Used bench pH meter after 0935

_____ _____

**Signature** **Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

Project: ~~Site 3 & 7~~ DEVENS

Location: ~~New London, CT~~

Well ID: SHM-96-22B

Start Time: 8:35 End Time: 9:15

Well Construction:

Depth to water: 6.98

Well Depth:

Water Column:

Total Volume Removed (L)

Date: 7/12/07

Sampler: DR + HC

PID Reading: N/A

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 6000 XL | 04J15779 AB |
| YSI | 650 MDS | 00M0743 AH |
| Geotech | Geopump Z | 11071 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 9:00 | | 400 | 7.05 | 10.00 | 6.28 | 0.833 | 0.16 | -77.9 | | | |
| 9:05 | | 400 | 7.05 | 10.02 | 6.28 | 0.831 | 0.13 | -78.0 | | | |
| 9:10 | | 400 | 7.05 | 10.03 | 6.29 | 0.830 | 0.12 | -77.6 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Cavanagh
Signature

7/12/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ DEVENS
**Location:** ~~New London, CT~~
**Well ID:** SHL-9

**Date:** 7/12/07
**Sampler:** DR + HC
**PID Reading:** N/A

**Start Time:** 9:25 **End Time:**
**Well Construction:**
**Depth to water:** 9.41
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 1200XL | 09J15999 AB |
| YSI | 1050MDS | 00M0743 AH |
| Geotech | GeoPump2 | 11071 |
| ORION | 230A | 012656 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10:10 | | 375 | 9.94 | 9.49 | 6.39 | 0.198 | 0.19 | 0.1 | | | |
| 10:15 | | 375 | 9.94 | 9.39 | 6.47 | 0.199 | 0.20 | -3.7 | | | |
| 10:20 | | 375 | 9.94 | 9.37 | 6.48 | 0.199 | 0.19 | -5.6 | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
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**Comments**

Helen Cavanaugh
Signature

7/12/07
Date

# INSTRUMENT CALIBRATION LOG

**Project/Site Name** DEVANS **Date** 7/11/07 **Weather**

**Calibrated By** Helen Cavanagh **Instrument** YSI 600XL **Serial Number** 02D0846 AA
YSI 650 MDS 001I207 AA

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | | 21.64 | |
| pH (7) | 7.00 | | 21.57 | |
| pH (4) | 4.00 | | 21.86 | |
| pH (10) | | | | |
| ORP | 240 | | 22.16 | |
| Dissolved Oxygen | 99% | | 21.73 | |
| Barometric Pressure | 755.7 | | 21.73 | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Devens **Date** 7/12/07 **Weather** Sunny, 80's

**Calibrated By** Dave Reau **Instrument** YSI 600 XL **Serial Number** 04315999AB

Post Field Calibration

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.362 | 1.413 | 20.79 | 1.408 |
| pH (7) | 7.07 | 7.00 | 20.86 | 6.88 |
| pH (4) | 3.94 | 4.00 | 20.86 | 4.08 |
| pH (10) | | | | |
| ORP | ~~89.7~~ 275 | ~~99.6~~ 240 | ~~20.86~~ 20.75 | 248 |
| Dissolved Oxygen | 89.2 | 99.6 | 20.81 | 100.2% |
| Barometric Pressure | | | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Devens **Date** 7/13/07 **Weather** Clear, 80's

**Calibrated By** DR **Instrument** 451 600XL **Serial Number** 04515999AB

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.406 | 19.54 | |
| pH (7) | 7.02 | 7.04 | 19.03 | |
| pH (4) | 4.00 | 4.07 | 19.00 | |
| pH (10) | | | | |
| ORP | 240.1 | 232 | 18.89 | |
| Dissolved Oxygen | 100.2% | 101.2 | 24.90 | |
| Barometric Pressure | | | | |
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**Pine Environmental Services, Inc**
155-E New Boston St., Woburn, MA 01801
800-519-PINE(Toll-Free)
781-932-9698(Phone)
781-932-9729(Fax)
pine-ma@pine-environmental.com

## *Certificate of YSI Calibration*

This is to certify that the YSI 600 XL Serial Number 02D0846AA was calibrated with standard units traceable to manufacturer's specification

**Model:** 600 XL
**Pine No:** 3178
**Serial No:** 02D0846AA

**lot Number:**ORP

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Redox: 240mv | 240.1mv | 228-252 mv | 0.04% |

**lot Number:**DO_100

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Dissolve Oxygen-Span1: 100% | 100% | 95-105 % | 0% |

**lot Number:**Cond_1413

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Conductivity-Span2: 1.413ms/cm | 1.413ms/cm | 1.34-1.48 ms/cm | 0% |

**lot Number:**PH_7

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| PH-Zero1: 7PH | 7PH | 6.65-7.35 PH | 0% |

**lot Number:**PH_4

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| PH-Span1: 4PH | 3.99PH | 3.8-4.2 PH | -0.25% |

**lot Number:**DO_0

| Calibration Standard | Instrument Output | Allowable Range | % Difference |
|---|---|---|---|
| Dissolve Oxygen-Zero1: 0mg/L | 0.35mg/L | 0-0 mg/L | 0.35% |

**Environmental Conditions of Test Area:**

Temperature Degree F: 77 %Relative Humidity 47

**Calibrated By:** Elig Demorais **Date:** 7/9/2007 5:39:00 PM

All instruments are calibrated by Pine Environmental Services, Inc. according to the manufacturer's specifications. It is the customer's responsibility to calibrate and maintain this unit in accordance with the manufacturer's specifications and/or the customer's own specific needs.

**Customer must notify PES of any defect within 24 hours of receipt of equipment**
**Please call 800-519-PINE for Technical Assistance**

See Attach Packing List

## Shepley Hill Water Levels

**Date:** _____

**Project Site:** Shepley Hill Landfill

**Water Level Meter:** Solinst 33236

**Location:** Devens, Ma

**Weather:** Clear, 50's

**Date:** 10/15/07

**Field Crew:** Dave Beauth, Dave Comeau

| Well | Time | DTW | Well | Time | DTW |
|---|---|---|---|---|---|
| SHL-15 | 10:30 | 20.61 | SHM-96-5B | 12:26 | ~~6.61~~ GC 7.12 |
| N7-P1 | 10:34 | 31.49 | SHM-96-5C | 12:27 | 6.61 |
| N7-P2 | 10:35 | 31.66 | SHL-8S | 12:29 | 8.14 |
| SHP-99-35X | 10:57 | 37.19 | SHL-8D | 12:30 | 8.00 |
| N6-P1 | 11:00 | 37.64 | SHL-13 | 12:31 | 6.76 |
| SHP-95-27X | 10:47 | 16.70 | PSP-01 | 12:34 | 2.30 |
| SHL-24 | 10:53 | 16.12 | SHP-05-47A | 12:37 | 5.46 ~~5.9~~ GC |
| SHM-93-18B | 11:09 | 18.81 | SHP-05-47B | 12:38 | 3.09 |
| SHL-18 | 11:11 | 19.12 | SHM-93-22B | 12:46 | 8.05 |
| SHL3 | 11:06 | 29.18 | SHM-93-22C | 12:44 | 9.37 |
| SHL-10D | 11:16 | 30.10 | SHL-22 | 12:45 | 8.26 |
| SHL-10C | 11:17 | 29.35 | SHL-9 | 12:47 | 10.79 |
| SHL-10 | 11:19 | 30.49 | SHL-23 | 12:57 | 29.72 |
| SHL-19 | 11:20 | 22.82 | SHM-05-41A | 13:05 | 11.55 |
| SHL-4 | 11:21 | 10.01 | SHM-05-41B | 13:06 | 11.36 |
| SHL-11 | 11:25 | 18.22 | SHM-05-41C | 13:04 | 11.61 |
| SHL-20 | 11:24 | 18.68 | SHM-05-42A | 13:09 | 5.57 |
| SHP-01-38A | 11:28 | 3.46 | SHM-05-42B | 13:10 | 5.64 |
| SHP-01-38B | 11:27 | 3.54 | SHM-05-39A | 13:18 | 12.01 |
| N3-P1 | 11:31 | 4.22 | SHM-05-39B | 13:17 | 12.66 |
| N3-P2 | 11:32 | 3.54 | SHM-05-40X | 13:26 | 14.75 |
| N2-P1 | 11:39 | 4.70 | SHP-99-31A | 13:21 | 3.90 |
| N2-P2 | 11:40 | 4.86 | SHP-99-31B | 13:22 | 4.39 |
| SHP-36X | 11:47 | 6.12 | SHP-99-31C | 13:23 | 4.66 |
| SHP-37X | 11:43 | 8.60 | SHP-05-48A | 13:28 | ~~Dry~~ GC Dry @ 4.98 |
| N1-P1 | 11:51 | 14.15 | SHP-05-48B | 13:29 | Dry @ 5.21 |
| N1-P2 | 11:52 | 13.74 | SHP-99-32X | 13:31 | 10.26 |
| N1-P3 | 11:53 | 13.12 | SHP-99-34A | 13:32 | 13.31 |
| SHL-21 | 12:00 | 49.12 | SHP-99-34B | 13:33 | 13.84 |
| SHP-05-43 | 11:57 | 45.02 | SHP-05-49A | 13:35 | 4.52 |
| SHP-05-44 | 12:03 | 41.70 | SHP-05-49B | 13:36 | Dry @ 5.78 |
| N5-P1 | 12:08 | 24.22 | SHP-05-45A | 12:49 | 17.14 |
| N5-P2 | 12:09 | 24.41 | SHP-05-45B | 12:50 | ~~17.88~~ GC 17.88 |
| SHP-99-29X | 12:11 | 24.56 | SHP-05-46A | 12:55 | 15.92 |
| SHL-5 | 12:25 | 5.80 | SHP-05-46B | 12:54 | 16.60 |

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-93-22C

**Date:** 10/16/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1250 **End Time:** 1405
**Well Construction:** 4" PVC
**Depth to water:** 9.24'
**Well Depth:** >100.00'
**Water Column:** 90.76'
**Total Volume Removed (L)** 33.75

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598 AG |
| YSI | 600XL | 02D0846 AA |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1320 | 13.5 | 450 | 15.05 | 11.10 | 6.01 | 0.705 | 0.15 | -23 | clear |
| 1325 | 2.25 | 450 | 15.57 | 11.54 | 6.15 | 0.707 | 0.16 | -30 | clear |
| 1330 | 2.25 | 450 | 16.04 | 11.45 | 6.28 | 0.657 | 0.17 | -31 | clear |
| 1335 | 2.25 | 450 | 16.52 | 11.30 | 6.30 | 0.651 | 0.16 | -34 | clear |
| 1340 | 2.25 | 450 | 17.13 | 11.28 | 6.42 | 0.658 | 0.14 | -42 | clear |
| 1345 | 2.25 | 450 | 17.44 | 11.36 | 6.49 | 0.664 | 0.15 | -45 | clear |
| 1350 | 2.25 | 450 | 17.54 | 11.43 | 6.57 | 0.666 | 0.17 | -45 | clear |
| 1355 | 2.25 | 450 | 17.72 | 12.01 | 6.67 | 0.657 | 0.20 | -42 | clear |
| 1400 | 2.25 | 450 | 17.83 | 12.07 | 6.69 | 0.662 | 0.20 | -42 | clear |
| 1405 | 2.25 | 450 | 17.92 | 12.11 | 6.72 | 0.667 | 0.20 | -41 | clear |
| | | | | | | | | | |
| | | | | | | | | | |
| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1405 | SHM-93-22C-101607 | 250ml Poly | 1 | NONE | Alk |
| 1405 | SHM-93-22C-101607 | 250ml Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1405 | SHM-93-22C-101607 | 500ml Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
| | | | | | |
| 1405 | SHM-93-22C-101607-MS | → Same containers | | | 1 Analysis as above |
| 1405 | SHM-93-22C-101607-MSD | | | | |
| 00:00 | DUP01-101607 | | | | |

**Comments**

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_____ 10/16/07
**Signature** **Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-9

**Date:** 10/16/07
**Sampler:** DR
**PID Reading:** N/A

**Start Time:** 1340 **End Time:**
**Well Construction:**
**Depth to water:** ~~13~~ 10.79
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650 MDS | 02B0644AH |
| YSI | 600 XL | 01K0643AD |
| Geopump peristaltic | | C04000300 |
| Solinst | WL | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1355 | | 500 | 10.99 | 10.16 | 6.20 | 0.160 | 0.12 | -68 | |
| 1400 | 15 | 500 | 10.99 | 10.15 | 6.24 | 0.159 | 0.10 | -69 | |
| 1405 | | | | 10.13 | 6.26 | 0.159 | 0.10 | -67 | |
| 1410 | 20 | 500 | 10.99 | 10.11 | 6.25 | 0.158 | 0.08 | -65 | |
| 1415 | | | | 10.14 | 6.18 | 0.158 | 0.08 | -63 | |
| 1420 | 25 | 500 | 10.99 | 10.14 | 6.21 | 0.158 | 0.08 | -62 | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1420 | SHL-9-101607 | (MS/MSD) | | | |
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**Comments** DUP02-101607

Signature

10/16/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Site 3 & 7 **Date:** 10/16/07

**Location:** New London, CT **Sampler:** DR

**Well ID:** SHP-01-37X **PID Reading:** N/A

**Start Time:** 1115 **End Time:**

**Well Construction:** 1" SS

**Depth to water:**

**Well Depth:**

**Water Column:**

**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| Geopump 2 | | 05654 |
| YSI | 650 MDS | 02B0644AN |
| YSI | 600XL | 01K0643MD |
| Solonist | | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1140 | 12.5 | 500 | | 16.73 | 6.17 | 0.218 | 0.17 | -35.8 | | | |
| 1145 | | | | 16.72 | 6.16 | 0.218 | 0.13 | -37.9 | | | |
| 1150 | | | | 16.70 | 6.13 | 0.218 | 0.12 | -40.0 | | | |
| 1155 | 20 | 500 | | 16.73 | 6.12 | 0.218 | 0.12 | -41.3 | | | |
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| Acceptance Criteria: | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1200 | SHP-01-37X-101607 | | | | |
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**Comments**

Signature

10/16/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Site 3 & 7 **Date:** 10/16/07

**Location:** New London, CT **Sampler:** DR

**Well ID:** SHL-4 **PID Reading:** N/A

**Start Time:** 0830 **End Time:**

**Well Construction:** 2" PVC

**Depth to water:** 10.05

**Well Depth:** —

**Water Column:**

**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644AH |
| YSI | 600XL | 01K0643AD |
| geopump peristaltic | | C4000300 |
| Solonist | | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0900 | 15 | 500 | 10.05 | 11.25 | 5.86 | 0.241 | 0.21 | 19.2 | | | |
| 0905 | | | | 11.25 | 5.86 | 0.240 | 0.16 | 17.1 | | | |
| 0910 | | | | 11.26 | 5.87 | 0.239 | 0.14 | 16.4 | | | |
| 0915 | 22.5 | 500 | 10.05 | 11.26 | 5.88 | 0.238 | 0.15 | 16.4 | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0920 | SHL-4-101607 | | 3 | | |
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**Comments**

D. Reed
**Signature**

10/16/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-93-22B

**Date:** 10/16/07
**Sampler:** DR
**PID Reading:** N/A

**Start Time:** 1245 **End Time:**
**Well Construction:** 5" PVC
**Depth to water:** 8.07
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644AH |
| YSI | 600XL | 01K0643AD |
| Geopump | peristaltic | 04000300 |
| Solonist | WL | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1255 | 5 | 500 | 8.10 | 9.86 | 6.21 | 0.510 | 0.25 | -106 | |
| 1300 | | | 8.10 | 9.89 | 6.24 | 0.509 | 0.19 | -108 | |
| 1305 | 10 | | 8.10 | 9.91 | 6.28 | 0.508 | 0.17 | -110 | |
| 1310 | | | | 9.87 | 6.29 | 0.507 | 0.15 | -110 | |
| 1315 | 15 | | 8.10 | 9.86 | 6.31 | 0.506 | 0.12 | -111 | |
| 1320 | | | | 9.85 | 6.33 | 0.506 | 0.11 | -112 | |
| 1325 | 20 | | 8.10 | 9.84 | 6.34 | 0.506 | 0.12 | -112 | |
| 1330 | 22.5 | | 8.10 | 9.84 | 6.35 | 0.506 | 0.11 | -113 | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1330 | SHM-93-22B-101607 | | 3 | | |
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**Comments**

D J Beaudet
**Signature**

10/16/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Site 3 & 7 **Date:** 10/16/07

**Location:** New London, CT **Sampler:** DR

**Well ID:** SHL-20 **PID Reading:** N/A

**Start Time:** 1000 **End Time:**

**Well Construction:** 5" PVC

**Depth to water:** 18.71

**Well Depth:** 50.32

**Water Column:**

**Total Volume Removed (L)**

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| Geopump 2 | | 05654 |
| YSI | 600XL | 01K0643 AG |
| YSI | 650 MDS | 02B0644AH |
| Solinst | WL | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1040 | 16 | 400 | 18.71 | 11.57 | 6.43 | 0.418 | 0.72 | -66.9 | | | |
| 1045 | | | | 11.69 | 6.35 | 0.420 | 0.15 | -62.8 | | | |
| 1050 | 20 | 400 | 18.71 | 11.73 | 6.24 | 0.421 | 0.11 | -61.9 | | | |
| | | | | 11.75 | 6.20 | 0.422 | 0.12 | -60.8 | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1100 | SHL-20 | | | | |
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**Comments**

Signature

10/16/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3&T~~ DL Devens **Date:** 10/16/07

**Location:** ~~New London, CT~~ DL Fort Devens Ayer, Ma. **Sampler:** David Comeau

**Well ID:** SHL-21 **PID Reading:** ____

**Start Time:** 1110 **End Time:** 1155

**Well Construction:** 4" PVC

**Depth to water:** 46.08'

**Well Depth:** 54.80'

**Water Column:** 8.72'

**Total Volume Removed (L)** 22.5

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1135 | 12.5 | 500 | 46.14 | 13.59 | 5.69 | 0.061 | 9.88 | 46 | — | clear | — |
| 1140 | 2.5 | 500 | 46.15 | 13.83 | 5.69 | 0.061 | 9.91 | 46 | — | clear | — |
| 1145 | 2.5 | 500 | 46.15 | 13.97 | 5.69 | 0.061 | 9.89 | 46 | — | clear | — |
| 1150 | 2.5 | 500 | 46.15 | 14.05 | 5.67 | 0.061 | 9.87 | 46 | — | clear | — |
| 1155 | 2.5 | 500 | 46.16 | 14.10 | 5.66 | 0.061 | 9.86 | 46 | — | clear | — |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1155 | SHL-21-101607 | 250ml poly | 1 | NONE | Alk |
| 1155 | SHL-21-101607 | 250ml poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1155 | SHL-21-101607 | 500ml poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
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**Comments**

Signature

10/16/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-22

**Date:** 16 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** N/A

**Start Time:** 1040 **End Time:** 1350
**Well Construction:** 4" PVC
**Depth to water:** 8.24
**Well Depth:** >100'
**Water Column:** >91.76
**Total Volume Removed (L)** 26

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 07B0644AH |
| YSI | 600XL | 01K0643AD |
| geopump 2 | peristaltic | C04000300 |
| Solonist | Waterlevel | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1330 | 20 | 400 | 8.67 | 10.24 | 6.45 | 0.512 | 0.29 | -108.9 | Clear |
| 1335 | 2 | " " | " " | 10.25 | 6.46 | 0.529 | 0.11 | -64.7 | " " |
| 1340 | 2 | " " | " " | 10.25 | 6.40 | 0.536 | 0.11 | -65.2 | " " |
| 1345 | 2 | " " | " " | 10.25 | 6.40 | 0.536 | 0.11 | -65.1 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1350 | SHL-22-101607 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None / HNO3 | As, Fe, Mn, Ca, Mg, K, Na, |
| | | | | | |
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**Comments**

Signature

16 OCT 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ DC Fort Devens, Ma. **Date:** 10/16/07

**Location:** ~~New London, CT~~ DC Devens **Sampler:** David Comeau

**Well ID:** SHL-10 **PID Reading:** _____

**Start Time:** 0950 **End Time:** 1035

**Well Construction:** 2" PVC

**Depth to water:** 30.49'

**Well Depth:** 38.72'

**Water Column:** 8.23'

**Total Volume Removed (L)** 18.0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598 AG |
| YSI | 600XL | 02D0846 AA |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1015 | 10.0 | 400 | 30.57 | 14.78 | 6.89 | 0.068 | 10.47 | 30 | — | clear | — |
| 1020 | 2.0 | 400 | 30.57 | 14.42 | 6.75 | 0.067 | 10.46 | 34 | — | clear | — |
| 1025 | 2.0 | 400 | 30.57 | 14.37 | 6.69 | 0.067 | 10.42 | 35 | — | clear | — |
| 1030 | 2.0 | 400 | 30.57 | 14.34 | 6.63 | 0.068 | 10.37 | 37 | — | clear | — |
| 1035 | 2.0 | 400 | 30.57 | 14.39 | 6.60 | 0.067 | 10.36 | 37 | — | clear | — |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1035 | SHL-10-101607 | 250ml Poly | 1 | NONE | Alk |
| 1035 | SHL-10-101607 | 250ml Poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1035 | SHL-10-101607 | 500ml Poly | 1 | NONE | Cl, NO3, SO4 |
| | | | | | |
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**Comments**

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D Comeau
**Signature**

10/16/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ OC Fort Devens, Ma.
**Location:** ~~New London, CT~~ OC Devens
**Well ID:** SHM-93-10C

**Date:** 10/16/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 0825 **End Time:** 0915
**Well Construction:** 4" PVC
**Depth to water:** 29.15'
**Well Depth:** 56.52'
**Water Column:** 27.37'
**Total Volume Removed (L)** 30

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598 AG |
| YSI | 600XL | 02D0846 AA |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0840 | 9.0 | 600 | 31.15 | 12.12 | 7.52 | 0.452 | 0.70 | 26 | - | clear | - |
| 0845 | 3.0 | 600 | 31.43 | 12.34 | 7.50 | 0.451 | 0.47 | 25 | - | clear | - |
| 0850 | 3.0 | 600 | 31.52 | 12.16 | 7.48 | 0.451 | 0.46 | 25 | - | clear | - |
| 0855 | 3.0 | 600 | 31.69 | 12.24 | 7.48 | 0.451 | 0.43 | 23 | - | clear | - |
| 0900 | 3.0 | 600 | 31.90 | 12.25 | 7.47 | 0.451 | 0.35 | 22 | - | clear | - |
| 0905 | 3.0 | 600 | 31.86 | 12.36 | 7.47 | 0.451 | 0.32 | 21 | - | clear | - |
| 0910 | 3.0 | 600 | 31.90 | 12.43 | 7.45 | 0.451 | 0.34 | 20 | - | clear | - |
| 0915 | 3.0 | 600 | 31.94 | 12.47 | 7.46 | 0.451 | 0.35 | 19 | - | clear | - |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0915 | SHM-93-10C-101607 | 250 Poly | 1 | NONE | Alk |
| 0915 | SHM-93-10C-101607 | 250 Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 0915 | SHM-93-10C-101607 | 500 Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
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**Comments**

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D. Comeau
**Signature**

10/16/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ Fort Devens
**Location:** ~~New London, CT~~ Devens
**Well ID:** SHP-01-38A

**Date:** 16 Oct 07
**Sampler:** Geoff Collinos
**PID Reading:** N/A

**Start Time:** 1050 **End Time:** 1135
**Well Construction:** 1" Stainless steel
**Depth to water:** 3.46
**Well Depth:** 8.89
**Water Column:** 5.43
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 07B0644AH |
| YSI | 600XL | 01K0643AD |
| peristaltic | geopump? | C04000300 |
| Solonist | water level | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1100 | 3.5 | 350 | 3.52 | 12.50 | 6.12 | 0.389 | 0.32 | -75.7 | | | |
| 1105 | 1.75 | " " | 3.52 | 12.46 | 6.16 | 0.387 | 0.17 | -79.1 | | | |
| 1110 | " " | " " | 3.52 | 12.46 | 6.16 | 0.387 | 0.14 | -80.4 | | | |
| 1115 | " " | " " | 3.52 | 12.45 | 6.16 | 0.386 | 0.13 | -81.1 | | | |
| 1120 | " " | " " | 3.52 | 12.46 | 6.18 | 0.386 | 0.12 | -82.7 | | | |
| 1125 | " " | " " | 3.52 | 12.46 | 6.19 | 0.386 | 0.12 | -83.0 | | | |
| 1130 | " " | " " | 3.52 | 12.46 | 6.19 | 0.386 | 0.12 | -82.9 | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1135 | SHP-01-38A-101607 | 500 ml poly | 1 | NONE | Cl, NO3, SO4 |
| " " | " " | 250 ml poly | 2 | NONE/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

Signature

16 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ Fort Devens
**Location:** ~~New London, CT~~ Devens
**Well ID:** SHL-11

**Date:** 16 Oct 2007
**Sampler:** Geoff Cokines
**PID Reading:** 0

**Start Time:** 1000 **End Time:** 1045
**Well Construction:** 2" pvc
**Depth to water:** 18.21
**Well Depth:** 29.50
**Water Column:** 11.29
**Total Volume Removed (L)** 16

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644AH |
| YSI | 600XL | 01K0643AD |
| Geopump2 | peristaltic | C04060300 |
| Solonist | water level | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1010 | 4 | 400 | 18.24 | 11.84 | 6.15 | 0.384 | 0.44 | -72.6 | | | |
| 1015 | 2 | " " | 18.24 | 11.84 | 6.20 | 0.390 | 0.32 | -80.6 | | | |
| 1020 | " " | " " | 18.24 | 11.84 | 6.20 | 0.392 | 0.30 | -87.7 | | | |
| 1025 | " " | " " | 18.24 | 11.86 | 6.24 | 0.392 | 0.23 | -86.4 | | | |
| 1030 | " " | " " | 18.24 | 11.86 | 6.25 | 0.394 | 0.21 | -90.6 | | | |
| 1035 | " " | " " | 18.24 | 11.87 | 6.26 | 0.394 | 0.21 | -91.1 | | | |
| 1040 | " " | " " | 18.24 | 11.87 | 6.26 | 0.394 | 0.21 | -91.0 | | | |
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| **Acceptance Criteria:** | | | < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10 | | |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1045 | SHL-11-101607 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None / HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

Signature

16 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ OF Fort Devens, Ma. **Date:** 10/16/07

**Location:** ~~New London, CT~~ OF Devens **Sampler:** Geoff Cokinos

**Well ID:** SHL-15 **PID Reading:** 0.0

**Start Time:** 0755 **End Time:** 0840

**Well Construction:** 4" PVC

**Depth to water:** 20.62'

**Well Depth:** 26.40'

**Water Column:** 5.78'

**Total Volume Removed (L)** 18

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644AH |
| YSI | 600xl | 01K0643AD |
| Geopump 2 | peristaltic | C04000300 |
| Solinst | water level | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0805 | 4.5 | 450 | 20.91 | 11.71 | 5.54 | 0.163 | 0.23 | 6.6 | | | |
| 0810 | 2.25 | " " | " " | 11.61 | 5.58 | 0.162 | 0.18 | 1.3 | | | |
| 0815 | " " | " " | " " | 11.52 | 5.60 | 0.162 | 0.19 | -0.5 | | | |
| 0820 | " " | " " | " " | 11.38 | 5.62 | 0.159 | 0.18 | -1.2 | | | |
| 0825 | " " | " " | " " | 11.39 | 5.64 | 0.157 | 0.25 | -2.0 | | | |
| 0830 | " " | " " | " " | 11.38 | 5.63 | 0.157 | 0.24 | -2.1 | | | |
| 0835 | " " | " " | " " | 11.39 | 5.63 | 0.158 | 0.24 | -2.0 | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0840 | SHL-15-101607 | 500ml poly | 1 | NONE | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | HNO3/NONE | AS, FE, MN, Ca, Mg, K, Na, Al |
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**Comments**

Signature

16 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** ~~NASB, Brunswick, ME~~ Devens
**Well ID:** SHL-14

**Date:** 16 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** N/A

**Start Time:** 0855 **End Time:** 0940
**Well Construction:** 4" PVC
**Depth to water:** 22.62
**Well Depth:** 32.30
**Water Column:** 9.68
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 07B0644/AH |
| YSI | 600XL | 01K0643AD |
| geopump 2 | peristaltic | C04000300 |
| Solinist Levelogge | water level | 3788 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC uS/cm$^{c}$ | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color |
|---|---|---|---|---|---|---|---|---|---|---|
| 0920 | 8.75 | 350 | 22.82 | 11.33 | 6.01 | 0.186 | 0.35 | -44.2 | | |
| 0925 | 1.75 | " " | 22.82 | 11.38 | 6.00 | 0.187 | 0.29 | -45.3 | | |
| 0930 | " " | " " | 22.82 | 11.35 | 6.00 | 0.187 | 0.29 | -45.0 | | |
| 0935 | " " | " " | 22.82 | 11.39 | 6.00 | 0.187 | 0.29 | -43.9 | | |
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**Acceptance Criteria:** 10% 10% 10% 10% <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0940 | SHL-14-101607 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250 ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Al |
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**Comments**

High Iron content; Orange Color

Signature

16 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** ~~Site 3 & 7~~ Fort Devens
**Location:** ~~New London, CT~~ Devens
**Well ID:** SHP-01-36X

**Date:** 16 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** N/A

**Start Time:** 1140 **End Time:** 1225
**Well Construction:** 1" Stainless Steel
**Depth to water:**
**Well Depth:**
**Water Column:**
**Total Volume Removed (L)** 12

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644AH |
| YSI | 600XL | 01K0643AD |
| geopump 2 & GC | peristaltic | C04000300 |

| Time | volume removed (liters) | Flow Rate (ml/min) | Depth To Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | Turbidity (NTU) | color | Salinity |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1155 | 4.5 | 300 | N/A* | 17.22 | 6.94 | 0.197 | 0.61 | -12.6 | | | |
| 1200 | 1.5 | " " | " " | 17.22 | 5.88 | 0.196 | 0.25 | -11.3 | | | |
| 1205 | " " | " " | " " | 17.24 | 5.86 | 0.196 | 0.21 | -11.4 | | | |
| 1210 | " " | " " | " " | 17.23 | 5.85 | 0.196 | 0.17 | -12.0 | | | |
| 1215 | " " | " " | " " | 17.24 | 5.85 | 0.196 | 0.17 | -13.1 | | | |
| 1220 | " " | " " | " " | 17.24 | 5.85 | 0.196 | 0.17 | -13.6 | | | |
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**Acceptance Criteria:** < 0.3 ft | 10% | ± 0.2 | 10% | 10% | ±10mv | <10

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1225 | SHP-01-36X-101607 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

* Unable to obtain depth to water when sample tube is in well

Signature

16 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-99-32X

**Date:** 10/17/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1120 **End Time:** 1205
**Well Construction:** 2" PVC
**Depth to water:** 10.26'
**Well Depth:** 84.10'
**Water Column:** 73.84'
**Total Volume Removed (L)** 22.5

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Solinst | water level | 33236 |
| Geopump² | Peristaltic | 05654 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1140 | 10.0 | 500 | 10.33 | 10.21 | 6.40 | 0.874 | 0.17 | -85 | clear |
| 1145 | 2.5 | 500 | 10.34 | 10.23 | 6.41 | 0.875 | 0.17 | -87 | clear |
| 1150 | 2.5 | 500 | 10.34 | 10.16 | 6.41 | 0.874 | 0.15 | -88 | clear |
| 1155 | 2.5 | 500 | 10.35 | 10.19 | 6.40 | 0.874 | 0.14 | -88 | clear |
| 1200 | 2.5 | 500 | 10.35 | 10.19 | 6.41 | 0.874 | 0.13 | -89 | clear |
| 1205 | 2.5 | 500 | 10.35 | 10.18 | 6.41 | 0.874 | 0.14 | -89 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1205 | SHM-99-32X-101707 | 250ml poly | 1 | NONE | Alk |
| 1205 | SHM-99-32X-101707 | 250ml Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1205 | SHM-99-32X-101707 | 500ml Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
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**Comments**

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Signature

10/17/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-96-5C

**Date:** 10/17/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1240 **End Time:** 1325
**Well Construction:** 5" PVC
**Depth to water:** 6.61'
**Well Depth:** 79.65'
**Water Column:** 73.04'
**Total Volume Removed (L)** 22.5

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643AD |
| Solinst | water level | 332136 |
| Geopump² | Peristaltic | 05654 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1300 | 10.0 | 500 | 6.65 | 10.26 | 6.12 | 0.860 | 0.13 | -56 | clear |
| 1305 | 2.5 | 500 | 6.65 | 10.31 | 6.12 | 0.857 | 0.12 | -55 | clear |
| 1310 | 2.5 | 500 | 6.65 | 10.46 | 6.00 | 0.857 | 0.12 | -54 | clear |
| 1315 | 2.5 | 500 | 6.65 | 10.34 | 5.89 | 0.855 | 0.11 | -53 | clear |
| 1320 | 2.5 | 500 | 6.65 | 10.43 | 5.87 | 0.854 | 0.10 | -53 | clear |
| 1325 | 2.5 | 500 | 6.65 | 10.39 | 5.85 | 0.854 | 0.10 | -54 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1325 | SHM-96-5C-101707 | 250 ml poly | 1 | NONE | Alk |
| 1325 | SHM-96-5C-101707 | 250ml poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1325 | SHM-96-5C-101707 | 500ml poly | 1 | NONE | Cl, NO3, SO4 |
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**Comments**

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Signature

10/17/07
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-96-5B

**Date:** 10/17/07
**Sampler:** David Gmeau
**PID Reading:** _____

**Start Time:** 1330 **End Time:** 1410
**Well Construction:** 5" PVC
**Depth to water:** 7.20'
**Well Depth:** 90.05'
**Water Column:** 82.85'
**Total Volume Removed (L)** 20.0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Solinst | water meter | 33236 |
| Geopump² | Peristaltic | 05654 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1350 | 10.0 | 500 | 7.55 | 11.03 | 5.83 | 0.695 | 0.13 | 15 | clear |
| 1355 | 2.5 | 500 | 7.55 | 11.06 | 5.79 | 0.693 | 0.13 | 18 | clear |
| 1400 | 2.5 | 500 | 7.55 | 11.02 | 5.78 | 0.693 | 0.14 | 20 | clear |
| 1405 | 2.5 | 500 | 7.55 | 11.07 | 5.76 | 0.692 | 0.13 | 21 | clear |
| 1410 | 2.5 | 500 | 7.55 | 11.04 | 5.75 | 0.692 | 0.13 | 22 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1410 | SHM-96-5B-101707 | 250ml poly | 1 | NONE | Alk |
| 1410 | SHM-96-5B-101707 | 250ml poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1410 | SHM-96-5B-101707 | 500ml poly | 1 | NONE | Cl, NO3, SO4 |
| | | | | | |
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**Comments**

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_____ 10/17/07
**Signature** **Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-41C

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 0725 **End Time:** 0810
**Well Construction:** 2" PVC
**Depth to water:** 11.57
**Well Depth:** >100
**Water Column:** >88.43
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solinist | Water level | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0735 | 3.5 | 350 | 11.77 | 10.24 | 7.62 | 0.563 | 0.42 | -23.3 | clear |
| 0740 | 1.75 | " " | " " | 10.24 | 7.58 | 0.562 | 0.25 | -23.7 | " " |
| 0745 | " " | " " | " " | 10.25 | 7.53 | 0.562 | 0.25 | -24.2 | " " |
| 0750 | " " | " " | " " | 10.20 | 7.49 | 0.562 | 0.14 | -27.3 | " " |
| 0755 | " " | " " | " " | 10.18 | 7.48 | 0.562 | 0.14 | -27.2 | " " |
| 0800 | " " | " " | " " | 10.17 | 7.46 | 0.563 | 0.14 | -28.8 | " " |
| 0805 | " " | " " | " " | 10.17 | 7.46 | 0.563 | 0.14 | -28.9 | " " |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0810 | SHM-05-41C-101707 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-41A

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 0725 **End Time:** 0830
**Well Construction:** 2" PVC
**Depth to water:** 11.51
**Well Depth:** 40.15
**Water Column:** 28.64
**Total Volume Removed (L)** 24

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | Water level | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| ~~0800~~ 0815 | 20 | 400 | 11.57 | 10.23 | 7.25 | 0.080 | 0.12 | -12.9 | Clear |
| 0820 | 2 | " " | " " | 10.22 | 7.20 | 0.079 | 0.12 | -13.4 | " " |
| 0825 | 2 | " " | " " | 10.22 | 7.20 | 0.079 | 0.12 | -12.6 | " " |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0830 | SHM-05-41A-101707 | 500 ml poly | 1 | None | Cl, $NO_3$, $SO_4$ |
| " " | " " | 250 ml poly | 2 | None/$HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na, Al |
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**Comments**

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Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-39A

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 0910 **End Time:** 0955
**Well Construction:** 2" PVC
**Depth to water:** 12.01
**Well Depth:** 38.66
**Water Column:** 26.65
**Total Volume Removed (L)** 16

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598A6 |
| YSI | 600XL | 02D0846AA |
| Solonist | waterkeel | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0920 | 4 | 400 | 12.24 | 10.91 | 6.65 | 0.323 | 0.14 | 7.5 | Clear |
| 0925 | 2 | " " | 12.24 | 10.92 | 6.61 | 0.334 | 0.12 | 6.2 | " " |
| 0930 | " " | " " | 12.24 | 10.92 | 6.62 | 0.334 | 0.12 | 6.2 | " " |
| 0935 | " " | " " | 12.24 | 10.90 | 6.61 | 0.335 | 0.11 | 5.2 | " " |
| 0940 | " " | " " | 12.24 | 10.86 | 6.57 | 0.339 | 0.10 | 5.1 | " " |
| 0945 | " " | " " | 12.24 | 10.88 | 6.57 | 0.342 | 0.10 | 5.3 | " " |
| 0950 | " " | " " | 12.24 | 10.88 | 6.58 | 0.342 | 0.10 | 5.2 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0955 | SHM-05-39A-101707 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-4/B

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokines
**PID Reading:** _____

**Start Time:** 0815 **End Time:** 0900
**Well Construction:** 2" PVC
**Depth to water:** 11.32
**Well Depth:** 84.00
**Water Column:** 72.68
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solinst | waterlevel | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0835 | 7 | 350 | 11.35 | 10.14 | 6.51 | 0.516 | 0.11 | 7.5 | clear |
| 0840 | 1.75 | " " | " " | 10.14 | 6.51 | 0.524 | 0.10 | 5.9 | " " |
| 0845 | " " | " " | " " | 10.20 | 6.49 | 0.527 | 0.10 | 7.8 | " " |
| 0850 | " " | " " | " " | 10.20 | 6.47 | 0.527 | 0.10 | 3.6 | " " |
| 0855 | " " | " " | " " | 10.21 | 6.47 | 0.527 | 0.10 | 3.5 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0900 | SHM-05-4/B-101707 | 500 ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250 ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-99-31C

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 1100 **End Time:** 1145
**Well Construction:** 2" PVC
**Depth to water:** 4.70
**Well Depth:** 78.21
**Water Column:** 73.51
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598A6 |
| YSI | 600XL | 02D0846AA |
| Solonist | water level | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1115 | 5.25 | 350 | 4.89 | 10.49 | 6.10 | 0.628 | 0.14 | 37.4 | Clear |
| 1120 | 1.75 | " | " | 10.50 | 6.12 | 0.628 | 0.11 | 34.7 | " |
| 1125 | " | " | " | 10.50 | 6.12 | 0.628 | 0.11 | 34.5 | " |
| 1130 | " | " | " | 10.53 | 6.12 | 0.626 | 0.10 | 32.1 | " |
| 1135 | " | " | " | 10.53 | 6.12 | 0.626 | 0.10 | 30.3 | " |
| 1140 | " | " | " | 10.53 | 6.12 | 0.626 | 0.10 | 30.2 | " |
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| Acceptance Criteria: | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |
|---|---|---|---|---|---|---|---|

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1145 | SHM-99-31C-101707 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " | " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-42B

**Date:** 17 Oct 2007
**Sampler:** Geoff Gokmos
**PID Reading:** 0

**Start Time:** 1235 **End Time:** 1320
**Well Construction:** 1" PVC
**Depth to water:** 5.60
**Well Depth:** 73.30
**Water Column:** 67.70
**Total Volume Removed (L)** 12

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | Water level | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1245 | 3 | 300 | N/A * | 10.32 | 6.05 | 0.737 | 0.11 | 15.2 | Clear |
| 1250 | 1.5 | " " | " " | 10.33 | 6.05 | 0.737 | 0.11 | 15.8 | " " |
| 1255 | " " | " " | " " | 10.33 | 6.05 | 0.737 | 0.10 | 17.3 | " " |
| 1300 | " " | " " | " " | 10.34 | 6.07 | 0.737 | 0.10 | 18.3 | " " |
| 1305 | " " | " " | " " | 10.34 | 6.08 | 0.737 | 0.09 | 18.5 | " " |
| 1310 | " " | " " | " " | 10.34 | 6.08 | 0.737 | 0.09 | 18.3 | " " |
| 1315 | " " | " " | " " | 10.34 | 6.09 | 0.737 | 0.09 | 17.9 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1320 | SHM-05-42B-101707 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Al |
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**Comments**

* Unable to obtain water level when sample tubing is in well

Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-99-31A

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 1005 **End Time:** 1055
**Well Construction:** 2" PVC
**Depth to water:** 4.02
**Well Depth:** 15.62
**Water Column:** 11.60
**Total Volume Removed (L)** 67.50

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | Waterlevel | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1015 | 50 | 500 | 4.18 | 13.04 | 6.08 | 0.147 | 0.33 | 47.6 | Clear |
| 1020 | 2.5 | " " | " " | 13.17 | 5.87 | 0.147 | 0.30 | 53.4 | " " |
| 1025 | " " | " " | " " | 13.17 | 5.86 | 0.147 | 0.28 | 53.2 | " " |
| 1030 | " " | " " | " " | 13.16 | 5.76 | 0.145 | 0.19 | 58.6 | " " |
| 1035 | " " | " " | " " | 13.16 | 5.77 | 0.145 | 0.19 | 57.7 | " " |
| 1040 | " " | " " | " " | 13.20 | 5.76 | 0.148 | 0.20 | 59.2 | " " |
| 1045 | " " | " " | " " | 13.21 | 5.75 | 0.147 | 0.20 | 59.6 | " " |
| 1050 | " " | " " | " " | 13.21 | 5.75 | 0.148 | 0.20 | 59.5 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1055 | SHM-99-31A-101707 | 500 ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250 ml poly | 2 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

17 OCT 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-42A

**Date:** 17 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 1325 **End Time:** 1410
**Well Construction:** 1" PVC
**Depth to water:** 5.53
**Well Depth:** 44.70
**Water Column:** 39.17
**Total Volume Removed (L)** 16

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | water level | 3788 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1335 | 4 | 400 | N/A * | 10.12 | 5.15 | 0.052 | 0.22 | 40.4 | Clear |
| 1340 | 6 | " " | " " | 10.09 | 5.11 | 0.049 | 0.22 | 43.1 | " " |
| 1345 | " " | " " | " " | 10.04 | 5.10 | 0.045 | 0.21 | 65.2 | " " |
| 1350 | " " | " " | " " | 10.03 | 5.10 | 0.046 | 0.15 | 70.5 | " " |
| 1355 | " " | " " | " " | 10.03 | 5.08 | 0.046 | 0.09 | 77.6 | " " |
| ~~1400~~ 1401 | " " | " " | " " | 10.03 | 5.08 | 0.046 | 0.09 | 77.9 | " " |
| 1405 | " " | " " | " " | 10.02 | 5.08 | 0.046 | 0.09 | 78.6 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1410 | SHM-05-42A-101707 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | As, Fe, Mn, Cu, Mg, K, Na, Al |
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**Comments**

* Unable to obtain water level when sample tube is in use

Signature

17 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-39B

**Date:** 10/17/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 0905 **End Time:** 1005
**Well Construction:** 2" pvc
**Depth to water:** 11.72'
**Well Depth:** 67.15'
**Water Column:** 55.43'
**Total Volume Removed (L)** 30.0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0950 | 22.5 | 500 | 31.28 | 12.80 | 6.85 | 0.888 | 0.14 | -100 | clear |
| 0955 | 2.5 | 500 | 32.17 | 12.47 | 6.84 | 0.892 | 0.14 | -96 | clear |
| 1000 | 2.5 | 500 | 32.49 | 12.56 | 6.84 | 0.890 | 0.12 | -92 | clear |
| 1005 | 2.5 | 500 | 33.03 | 12.66 | 6.85 | 0.892 | 0.12 | -90 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1005 | SHM-05-39B-101707 | 250ml Poly | 1 | NONE | Alk |
| 1005 | SHM-05-39B-101707 | 250ml Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1005 | SHM-05-39B-101707 | 500ml Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
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**Comments**

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D Comeau
**Signature**

10/17/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-99-31B

**Date:** ~~10/10~~ DC 10/17/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1010 **End Time:** 1100
**Well Construction:** 2" PVC
**Depth to water:** 4.39'
**Well Depth:** 61.34'
**Water Column:** 56.95'
**Total Volume Removed (L)** 22.5

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1030 | 9.0 | 450 | 4.49 | 10.17 | 6.23 | 0.427 | 0.14 | -45 | clear |
| ~~1035~~ | 2.25 | 450 | 4.49 | 10.14 | 6.20 | 0.443 | 0.15 | -45 | clear |
| 1040 | 2.25 | 450 | 4.49 | 10.12 | 6.18 | 0.457 | 0.12 | -44 | clear |
| 1045 | 2.25 | 450 | 4.49 | 10.13 | 6.17 | 0.471 | 0.12 | -44 | clear |
| 1050 | 2.25 | 450 | 4.49 | 10.09 | 6.16 | 0.483 | 0.12 | -44 | clear |
| 1055 | 2.25 | 450 | 4.49 | 10.11 | 6.15 | 0.488 | 0.12 | -44 | clear |
| 1100 | 2.25 | 450 | 4.49 | 10.10 | 6.15 | 0.492 | 0.13 | -44 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1100 | SHM-99-31B-101707 | 250ml Poly | 1 | NONE | Alk |
| 1100 | SHM-99-31B-101707 | 250ml Poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1100 | SHM-99-31B-101707 | 500ml Poly | 1 | NONE | Cl, NO3, SO4 |
| | | | | | |
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**Comments**

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_____ 10/17/07
**Signature** **Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-23

**Date:** 10/17/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 0740 **End Time:** 0830
**Well Construction:** 5" PVC
**Depth to water:** 29.68'
**Well Depth:** 35.55'
**Water Column:** 5.87'
**Total Volume Removed (L)** 25.0

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Redi-Flo | Controller | 128 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0810 | 15.0 | 500 | 30.09 | 11.80 | 5.63 | 0.045 | 11.19 | 176 | clear |
| 0815 | 2.5 | 500 | 30.10 | 12.04 | 5.57 | 0.044 | 11.13 | 179 | clear |
| 0820 | 2.5 | 500 | 30.10 | 12.11 | 5.57 | 0.045 | 11.06 | 180 | clear |
| 0825 | 2.5 | 500 | 30.11 | 11.92 | 5.56 | 0.044 | 11.08 | 181 | clear |
| 0830 | 2.5 | 500 | 30.11 | 11.79 | 5.54 | 0.044 | 11.03 | 182 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0830 | SHL-23-101707 | 250ml Poly | 1 | NONE | Alk |
| 0830 | SHL-23-101707 | 250ml Poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 0830 | SHL-23-101707 | 500ml Poly | 1 | NONE | Cl, NO3, SO4 |
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**Comments**

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D Comeau
**Signature**

10/17/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-13

**Date:** 18 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 0755 **End Time:** 0840
**Well Construction:** 2" PVC
**Depth to water:** 6.71
**Well Depth:** 21.64
**Water Column:** 14.93
**Total Volume Removed (L)** 14

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02F0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | water level | 3788 |
| geopump 2 | peristaltic | C04000300 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0805 | 3.5 | 350 | 6.74 | 17.05 | 6.72 | 0.177 | 0.59 | 147.4 | Clear |
| 0810 | 1.75 | " " | 6.74 | 17.09 | 6.51 | 0.176 | 0.74 | 147.9 | " " |
| 0815 | " " | " " | 6.74 | 17.12 | 6.38 | 0.175 | 0.99 | 148.6 | " " |
| 0820 | " " | " " | 6.75 | 17.09 | 6.32 | 0.175 | 1.04 | 148.4 | " " |
| 0825 | " " | " " | 6.75 | 17.17 | 6.21 | 0.175 | 0.66 | 148.4 | " " |
| 0830 | " " | " " | 6.75 | 17.18 | 6.10 | 0.175 | 0.67 | 148.0 | " " |
| 0835 | " " | " " | 6.75 | 17.18 | 6.10 | 0.175 | 0.60 | 148.3 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0840 | SHL-13-101807 | 500 ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250 ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, ALK |
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**Comments**

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Signature

18 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-8D

**Date:** 18 Oct 2007
**Sampler:** Geoff Cokkinos
**PID Reading:** _____

**Start Time:** 0900 **End Time:** 0945
**Well Construction:** 2" PVC
**Depth to water:** 7.98
**Well Depth:** 68.71
**Water Column:** 60.73
**Total Volume Removed (L)** 12

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | water level | 3788 |
| geopump2 | peristaltic | col/000300 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0910 | 3 | 300 | 8.11 | 10.37 | 5.99 | 0.135 | 1.54 | 145.3 | Clear |
| 0915 | 1.5 | " " | 8.27 | 10.38 | 5.98 | 0.135 | 1.56 | 142.9 | " " |
| 0920 | " " | " " | 8.25 | 10.38 | 5.98 | 0.135 | 1.58 | 142.5 | " " |
| 0925 | " " | " " | 8.25 | 10.41 | 5.97 | 0.131 | 1.60 | 139.7 | " " |
| 0930 | " " | " " | 8.25 | 10.45 | 5.97 | 0.134 | 1.61 | 139.6 | " " |
| 0935 | " " | " " | 8.25 | 10.44 | 5.98 | 0.133 | 1.64 | 138.5 | " " |
| 0940 | " " | " " | 8.25 | 10.44 | 5.98 | 0.133 | 1.65 | 137.9 | " " |
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**Acceptance Criteria:** < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10%

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 0945 | SHL-8D-101807 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None / HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Al |
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**Comments**

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Signature

18 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-8S

**Date:** 18 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 0950 **End Time:** 1035
**Well Construction:** 2" PVC
**Depth to water:** 8.08
**Well Depth:** 55.91
**Water Column:** 47.83
**Total Volume Removed (L)** 16

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MPS | 02K0598AG |
| YSI | 600x1 | 02D0846AA |
| Solonist | Water level | 3788 |
| geopump2 | peristaltic | C04000300 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1000 | 4 | 400 | 9.22 | 10.23 | 6.01 | 0.061 | 0.67 | 131.1 | Clear |
| 1005 | 2 | " | 9.51 | 10.26 | 6.04 | 0.061 | 0.67 | 131.0 | " |
| 1010 | " | " | 10.34 | 10.27 | 6.03 | 0.061 | 0.67 | 132.0 | " |
| 1015 | " | " | 10.34 | 10.25 | 6.04 | 0.060 | 0.69 | 131.7 | " |
| 1020 | " | " | 10.34 | 10.30 | 6.06 | 0.058 | 0.69 | 130.0 | " |
| 1025 | " | " | 10.34 | 10.31 | 6.07 | 0.059 | 0.69 | 130.0 | " |
| 1030 | " | " | 10.34 | 10.32 | 6.06 | 0.059 | 0.69 | 131.3 | " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1035 | SHL-8S-101807 | 500 ml poly | 1 | None | Cl, SO4, NO3 |
| " | " | 250 ml poly | 2 | None/HNO3 | As, Fe, Mn, Ca, Mg, K, Na, Alk |
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**Comments**

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Signature

18 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHM-05-40X

**Date:** 18 Oct 2007
**Sampler:** Geoff Cokins
**PID Reading:** _____

**Start Time:** 1050 **End Time:** 1135
**Well Construction:** 2" PVC
**Depth to water:** 14.77
**Well Depth:** 33.57
**Water Column:** 18.8
**Total Volume Removed (L)** 16

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02F0598AG |
| YSI | 600XL | 02D0846AA |
| Solonist | Watr level | 3788 |
| geopump 2 | peristaltic | C04000300 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1100 | 4 | 400 | 14.85 | 11.68 | 6.50 | 0.474 | 0.18 | 77.6 | clear |
| 1105 | 2 | " " | 14.85 | 11.72 | 6.52 | 0.470 | 0.17 | 78.1 | " " |
| 1110 | " " | " " | 14.85 | 11.63 | 6.47 | 0.473 | 0.14 | 74.3 | " " |
| 1115 | " " | " " | 14.85 | 11.66 | 6.44 | 0.473 | 0.13 | 73.3 | " " |
| 1120 | " " | " " | 14.85 | 11.71 | 6.43 | 0.472 | 0.12 | 71.7 | " " |
| 1125 | " " | " " | 14.85 | 11.71 | 6.41 | 0.473 | 0.12 | 70.9 | " " |
| 1130 | " " | " " | 14.85 | 11.72 | 6.41 | 0.473 | 0.12 | 70.4 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1135 | SHM-05-40X-101807 | 500 ml poly | 1 | None | Cl, SO4, NO3 |
| " " | " " | 250 ml poly | 2 | None/HNO3 | AS, Fe, Mn, Ca, Mg, K, Na, ALK |
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**Comments**

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Signature

18 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHP-99-29x

**Date:** 18 Oct 2007
**Sampler:** Geoff Cokinos
**PID Reading:** _____

**Start Time:** 1205 **End Time:** 1250
**Well Construction:** 2" PVC
**Depth to water:** 24.55
**Well Depth:** 30.80
**Water Column:** 6.25
**Total Volume Removed (L)** 10

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02K0598AG |
| YSI | 600xl | 02D0846AA |
| Solonist | waterlevel | 3788 |
| geopump? | peristaltic | C04000306 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1215 | 2.5 | 250 | 24.64 | 12.48 | 5.02 | 0.212 | 0.31 | 147.4 | Clear |
| 1220 | 1.25 | " " | " " | 12.50 | 4.99 | 0.212 | 0.30 | 148.6 | " " |
| 1225 | " " | " " | " " | 12.53 | 4.98 | 0.212 | 0.29 | 148.9 | " " |
| 1230 | " " | " " | " " | 12.47 | 4.88 | 0.211 | 0.24 | 152.6 | " " |
| 1235 | " " | " " | " " | 12.45 | 4.82 | 0.211 | 0.21 | 155.2 | " " |
| 1240 | " " | " " | " " | 12.45 | 4.82 | 0.211 | 0.21 | 155.3 | " " |
| 1245 | " " | " " | " " | 12.44 | 4.82 | 0.211 | 0.21 | 155.2 | " " |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1250 | SHP-99-29x-101807 | 500ml poly | 1 | None | Cl, NO3, SO4 |
| " " | " " | 250ml poly | 2 | None/HNO3 | Alk, Fe, Mn, TS, Mg, Ca, Na, A |
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**Comments**

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Signature

18 Oct 2007
Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHL-5

**Date:** 10/18/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 0917 **End Time:** 1000
**Well Construction:** 2" PVC
**Depth to water:** 5.76'
**Well Depth:** 14.00'
**Water Column:** 8.24'
**Total Volume Removed (L)** 19.35

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650 MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Geopump² | Peristaltic | ~~128~~ PC 05654 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0940 | 10.35 | 450 | 6.27 | 12.82 | 6.19 | 0.112 | 0.13 | 4 | clear |
| 0945 | 2.25 | 450 | 6.28 | 12.83 | 6.13 | 0.111 | 0.11 | 5 | clear |
| 0950 | 2.25 | 450 | 6.29 | 12.92 | 6.08 | 0.111 | 0.11 | 6 | clear |
| 0955 | 2.25 | 450 | 6.30 | 12.83 | 6.04 | 0.110 | 0.10 | 7 | clear |
| 1000 | 2.25 | 450 | 6.31 | 12.84 | 6.01 | 0.110 | 0.10 | 8 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1000 | SHL-5-101807 | 250ml Poly | 1 | NONE | Alk |
| 1000 | SHL-5-101807 | 250ml Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1000 | SHL-5-101807 | 500ml Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
| | | | | | |
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**Comments**

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_____ 10/18/07
Signature Date

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** N5-P1

**Date:** 10/18/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1102 **End Time:** 1150
**Well Construction:** 1" PVC
**Depth to water:** 24.57'
**Well Depth:** >100'
**Water Column:** >75.43'
**Total Volume Removed (L)** 18.24

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Geopump 2 | Peristaltic | 05654 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1125 | 8.74 | 380 | ☆ | 11.77 | 6.29 | 0.694 | 0.17 | -58 | clear |
| 1130 | 1.9 | 380 | ☆ | 11.96 | 6.21 | 0.687 | 0.16 | -55 | clear |
| 1135 | 1.9 | 380 | ☆ | 11.90 | 6.02 | 0.665 | 0.16 | -54 | clear |
| 1140 | 1.9 | 380 | ☆ | 11.83 | 5.95 | 0.649 | 0.14 | -55 | clear |
| 1145 | 1.9 | 380 | ☆ | 11.89 | 5.96 | 0.640 | 0.14 | -57 | clear |
| 1150 | 1.9 | 380 | ☆ | 11.86 | 5.98 | 0.638 | 0.13 | -60 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1150 | N5-P1-101807 | 250ml Poly | 1 | NONE | AlK |
| 1150 | N5-P1-101807 | 250ml Poly | 1 | $HNO_3$ | As, Fe, Mn, Ca, Mg, K, Na |
| 1150 | N5-P1-101807 | 500ml Poly | 1 | NONE | Cl, $NO_3$, $SO_4$ |
| | | | | | |
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**Comments**

☆ unable to obtain water level due to 1" PVC. Sample tubing in PVC, water level probe, unable to insert.

D Comeau
**Signature**

10/18/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** N5-P2

**Date:** 10/18/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 1205 **End Time:** 1245
**Well Construction:** 1" PVC
**Depth to water:** 24.34'
**Well Depth:** 32.75'
**Water Column:** 8.41'
**Total Volume Removed (L)** 12.8

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Geopump7 | Peristaltic | 05654 |
| Solinst | water level | 33236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 1230 | 8.0 | 320 | ☆ | 11.94 | 5.76 | 1.272 | 0.16 | -40 | clear |
| 1235 | 1.6 | 320 | ☆ | 11.98 | 5.76 | 1.270 | 0.16 | -41 | clear |
| 1240 | 1.6 | 320 | ☆ | 12.12 | 5.77 | 1.272 | 0.15 | -41 | clear |
| 1245 | 1.6 | 320 | ☆ | 12.03 | 5.75 | 1.271 | 0.15 | -41 | clear |
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| **Acceptance Criteria:** | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1245 | N5-P2-101807 | 250ml Poly | 1 | NONE | ALK |
| 1245 | N5-P2-101807 | 250ml Poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1245 | N5-P2-101807 | 500ml Poly | 1 | NONE | Cl, NO3, SO4 |
| | | | | | |
| | | | | | |
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**Comments** ☆ unable to obtain water level due to sample tubing in 1" PVC well.

D Comeau
**Signature**

10/18/07
**Date**

# Environmental Chemical Corporation

## Low Flow/Low Stress Groundwater Sampling Log

**Project:** Fort Devens
**Location:** Ayer, MA
**Well ID:** SHP-93-10D

**Date:** 10/18/07
**Sampler:** David Comeau
**PID Reading:** _____

**Start Time:** 0755 **End Time:** 1315
**Well Construction:** 4" Stainless steel
**Depth to water:** 29.81'
**Well Depth:** 57.85'
**Water Column:** 28.04'
**Total Volume Removed (L)** 32.5

**Field Testing Equipment**

| Make | Model | Serial # |
|---|---|---|
| YSI | 650MDS | 02B0644 AH |
| YSI | 600XL | 01K0643 AD |
| Redi-Flo | Controller | 129 |
| Solinst | water level | 39236 |

| Time | Volume Removed (liters) | Flow Rate (ml/min) | Depth to Water (ft) | Temp (celsius) | pH (STD) | SPC mS/cm | DO (mg/L) | ORP (mV) | color |
|---|---|---|---|---|---|---|---|---|---|
| 0810 | 7.5 | 500 | 34.02 | 11.86 | 11.37 | 0.522 | 0.25 | 71 | clear |
| 0815 | 2.5 | 500 | 34.90 | 12.08 | 11.42 | 0.523 | 0.73 | 68 | clear |
| 0820 | 2.5 | 500 | 36.51 | 12.22 | 11.44 | 0.529 | 0.22 | 68 | clear |
| 0825 | 2.5 | 500 | 38.27 | 12.33 | 11.44 | 0.528 | 0.24 | 68 | clear |
| 0830 | 2.5 | 500 | 41.33 | 12.69 | 11.43 | 0.527 | 0.26 | 67 | clear |
| 0835 | 3.0 | 600 | 43.68 | 12.41 | 11.42 | 0.521 | 0.34 | 70 | clear |
| 0840 | 3.0 | 600 | 45.63 | 13.01 | 11.45 | 0.521 | 0.38 | 67 | clear |
| 0845 | 3.0 | 600 | 48.65 | 13.24 | 11.46 | 0.519 | 0.56 | 68 | clear |
| 0855 | 6.0 | 600 | 54.04 | 13.48 | 11.44 | 0.513 | 0.71 | 73 | clear |
| *0857 | well went "dry". | | | | | | | | |
| | | | | | | | | | |
| 1315 | well recharged, collected Sample | | | | | | | | |
| Acceptance Criteria: | | | < 0.3 ft | 3% | ± 0.1 | 3% | 10% | ±10mv | 10% |

2" screen volume = 0.163 gal/ft or 616 ml per foot

**Sample Collection**

| Time | Sample ID | Container | # of Bottles | Preservative | Analyses |
|---|---|---|---|---|---|
| 1315 | SHP-93-10D-101807 | 250ml Poly | 1 | NONE | Alk |
| 1315 | SHP-93-10D-101807 | 250ml Poly | 1 | HNO3 | As, Fe, Mn, Ca, Mg, K, Na |
| 1315 | SHP-93-10D-101807 | 500ml Poly | 1 | NONE | Cl, NO3, SO4 |
| | | | | | |
| | | | | | |
| | | | | | |

**Comments**

* well dry during low-flow process. wait for recharge, then collect samples.

D Comeau
**Signature**

10/18/07
**Date**

# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Deltas **Date** 16 Oct 2007 **Weather** 69°F Clear Sky

**Calibrated By** Geoff Cokinos **Instrument** YSI 6COMDS / YSI 600XL **Serial Number** 02K0598A6 / 02D0846AA

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.413 | 15.70 | |
| pH (7) | 7.00 | 7.00 | 15.43 | |
| pH (4) | 4.00 | 4.04 | 15.48 | |
| pH (10) | 10.00 | 9.97 | 15.71 | |
| ORP | 240 | 241.1 | 15.65 | |
| Dissolved Oxygen | 100% | 101% | 15.41 | |
| Barometric Pressure | 771.7 | 774.1 | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Devens **Date** 10/16/07 **Weather** 69°F clear sky

**Calibrated By** David Comeau **Instrument** YSI 650 MDS / ~~YSI 600XL~~ **Serial Number** 02B0644 AH / 01K0643 AD

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.411 | 15.41 | |
| pH (7) | 7.00 | 6.98 | 15.09 | |
| pH (4) | 3.99 | 4.00 | 15.16 | |
| pH (10) | 10.04 | 10.03 | 15.37 | |
| ORP | 240 | 238.9 | 15.33 | |
| Dissolved Oxygen | 101.6% | 100.1% | 14.76 | |
| Barometric Pressure | 771.8 | 770.5 | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Fort Devens, Ayer, Ma. **Date** 17 Oct 2007 **Weather** 70°, clear sky

**Calibrated By** Geoff Gikins **Instrument** YSI 650MDS / YSI 600XL **Serial Number** 02K0598AG / 02D0846AA

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.416 | 18.03 | |
| pH (7) | 7.00 | 6.98 | 18.80 | |
| pH (4) | 4.00 | 4.02 | 18.79 | |
| pH (10) | 10.00 | 10.05 | 18.98 | |
| ORP | 240 | 238.9 | 18.94 | |
| Dissolved Oxygen | 100 % | 102 % | 18.03 | |
| Barometric Pressure | 774.1 | 776.5 | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Fort Devens, Ayer, Ma. **Date** 17 Oct 2007 **Weather** 70°, clear sky

**Calibrated By** David Conley **Instrument** YSI 650MDS / YSI 600XL **Serial Number** 02B0644AH / 01K0643AD

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.418 | 18.14 | |
| pH (7) | 7.00 | 6.98 | 18.53 | |
| pH (4) | 4.00 | 3.91 | 18.53 | |
| pH (10) | 10.00 | 9.99 | 18.82 | |
| ORP | 240 | 242.5 | 18.76 | |
| Dissolved Oxygen | 100.1% | 99.1% | 18.32 | |
| Barometric Pressure | 770.5 | | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Fort Devens, Ayer, Ma. **Date** 10/18/07 **Weather** 76°, Hazy

**Calibrated By** David Comeau **Instrument** YSI 650 MDS / YSI 600 XL **Serial Number** 02B0644 AH / 01K0643 AD

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.396 | 16.27 | |
| pH (7) | 7.00 | 6.92 | 16.37 | |
| pH (4) | 4.00 | 4.12 | 16.46 | |
| pH (10) | 10.00 | 9.89 | 16.58 | |
| ORP | 240 | 232.9 | 16.54 | |
| Dissolved Oxygen | 101.0% | 102.8% | 16.53 | |
| Barometric Pressure | 767.7 | | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name** Fort Devens, Ayer, Ma. **Date** 18 Oct 2007 **Weather** 70°, overcast

**Calibrated By** Geoff Gokios **Instrument** YSI 650MDS / YSI 600XL **Serial Number** 02K0548AG / 02D0846AA

| Parameters | Pre-calibration Reading | Post-calibration Reading | Temperature °C | Comments |
|---|---|---|---|---|
| Conductivity | 1.413 | 1.405 | 16.52 | |
| pH (7) | 7.00 | 6.99 | 16.66 | |
| pH (4) | 4.00 | 4.01 | 16.77 | |
| pH (10) | 10.00 | 10.03 | 16.83 | |
| ORP | 240 | 238.9 | 16.76 | |
| Dissolved Oxygen | 101.2% | 101% | 16.75 | |
| Barometric Pressure | 776.5 | | | |
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# INSTRUMENT CALIBRATION LOG

**Project/Site Name:** Shepley Hill Landfill, Devens, MA **Calibrated By:** David Comeau

| Instrument/Serial Number | Calibration Reading (PPM) | Calibration Gas | Date |
|---|---|---|---|
| PID / ED FN311 | 100 | Isobutylene 100 PPM | ~~8/7~~ 10/22/07 |
| PID ED FN311 | 100 | Isobutylene 100 PPM | 10/23/07 |
| | | Isobutylene 100 PPM | |
| | | Isobutylene 100 PPM | |
| | | Isobutylene 100 PPM | |
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| | | Isobutylene 100 PPM | |
| | | Isobutylene 100 PPM | |

# Appendix G

## Landfill Gas Monitoring



Date: 22-23 OCT 2007 Inspector: Comeau/Cokinos Title:

Organization: ECC Weather: 10/22 partly cloudy, 49° 10/23 overcast, 74° Barometer: 10/22: 30.23(AM) 29.97(PM) 10/23: 29.54(AM) 29.52(PM)

| Vent No. | VOC ppm PID | O2 % IR | H2S ppm IR | LEL % IR | CO ppm IR | CO2 % IR | CH4 % IR | Remarks |
|---|---|---|---|---|---|---|---|---|
| V-1 | 0 | 14.5 | 0 | 0 | 0 | 4.7 | 0 | |
| V-2 | 0 | 11.2 | 0 | 60 | 13 | 6.4 | 3.0 | |
| V-3 | 0 | 8.2 | 0 | 94 | 0 | 8.3 | 4.7 | |
| V-4 | 0 | 14.9 | 0 | 39 | 8 | 4.8 | 1.9 | |
| V-5 | 0 | 18.2 | 0 | 0 | 4 | 1.8 | 0 | |
| V-6 | 0 | 15.3 | 0 | 53 | 0 | 3.9 | 2.7 | |
| V-7 | 0 | 19.6 | 0 | 0 | 6 | 0.7 | 0 | |
| V-8 | 0 | 16.9 | 0 | 0 | 6 | 2.1 | 0 | |
| V-9 | 0 | 5.9 | 0 | >100 | 15 | 15.7 | 21.7 | |
| V-10 | 0 | 19.8 | 0 | 0 | 6 | 0.5 | 0 | |
| V-11 | 0 | 12.5 | 0 | 60 | 16 | 3.8 | 3.1 | |
| V-12 | 0 | 20.2 | 0 | 0 | 6 | 0.5 | 0 | |
| V-13 | 0 | 0.2 | 0 | >100 | 0 | 13.1 | 14.7 | |
| V-14 | 0 | 0.2 | 0 | >100 | 8 | 23.1 | 33.6 | |
| V-15 | 0 | 0.1 | 0 | >100 | 12 | 27.4 | 24.9 | |
| V-16 | 0 | 0.1 | 1 | >100 | 17 | 25.3 | 15.1 | |
| V-17 | 0 | 16.2 | 0 | >100 | 0 | 15.2 | 22.1 | |
| V-18 | 0 | 0.1 | 0 | >100 | 7 | 28.6 | 37.1 | |
| LGP-01-01X | 0 | 20.4 | 0 | 0 | 0 | 0.7 | 0 | |
| LGP-01-02X | 0 | 19.7 | 0 | 0 | 0 | 1.5 | 0 | |
| LGP-01-03X | 0 | 19.5 | 0 | 0 | 0 | 1.4 | 0 | |
| LGP-01-04X | 0 | 20.2 | 0 | 0 | 0 | 0.6 | 0 | |

## Landfill Gas Monitoring



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|---|---|---|---|---|---|---|---|---|
| LGP-05-05X | 0 | 14.8 | 0 | 0 | 0 | 6.3 | 0 | |
| LGP-05-06X | 0 | 15.4 | 0 | 0 | 0 | 5.3 | 0 | |
| LGP-05-07X | 0 | 16.6 | 0 | 0 | 0 | 6.3 | 0 | |
| LGP-05-08X | 0 | 5.3 | 0 | 0 | 0 | 16 | 0 | |
| LGP-05-09X | 0 | 13.5 | 0 | 0 | 0 | 8.8 | 0 | |
| LGP-05-10X | 0 | 0.1 | 1 | >100 | 0 | 22.5 | 5.8 | |
| LGP-05-11X | 0 | 5.3 | 0 | >100 | 0 | 17.7 | 5.9 | |
| LGP-05-12X | -- | -- | -- | -- | -- | -- | -- | Not installed |
| LGP-05-13X | 0 | 2.9 | 0 | 88 | 0 | 14.5 | 4.4 | |
| LGP-05-14X | 0 | 2.1 | 0 | 37 | 0 | 13.8 | 1.8 | |

**Calibration Information:**

Instrument: GEM 2000 Landtec (GEM0853)
Calibrated by: Geoff Cokinos
Calibrated with:

Instrument: PE Photovac, PID (EDFN311)
Calibrated by: David Comeau
Calibrated with: 100 ppm Isobutylene

Instrument: Gilian, Gilair 5 air pump (C07051/09808)
Calibrated by: Geoff Cokinos
Calibrated with: 35% $CO_2$, 50% CH4, 25ppm $H_2S$, 50ppm CO, 2.5% (50% lel) CH4, 20.9% $O_2$

Notes: Discharge Manhole (Cook ST.):

| PID VOC ppm | O2 % | H2S ppm | LEL % | CO ppm | CO2 % | CH4 % |
|---|---|---|---|---|---|---|
| 0 | 19.5 | 0 | 2 | 8 | 5.3 | 0.1 |

# Appendix E

# Analytical Data Summary

**May 7, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2/325.2/300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on March 22, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on March 22, 2007 and assigned sample delivery group (SDG) number L0703917, upon receipt. Alpha analyzed the sample for total metals using USEPA 6000/7000 methods, bis(2-ethylhexyl)phthalate (BEHP) using USEPA Method 8270C, total cyanide using USEPA Method 9014, chloride using USEPA Method 325.2, sulfate using USEPA Method 300.0, and nitrate using USEPA Method 353.2. The associated field sample identification (ID) and Alpha sample ID are presented in Table 3.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 4, Table 5 and Table 6. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data and detected results are listed below.

**Table 1. Detected Results**

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units |
|---|---|---|---|---|---|---|
| EFF-032207 | 03/22/2007 | E 325.2 | L0703917-01 | Chloride | 68 | mg/l |
| EFF-032207 | 03/22/2007 | E 300.0 | L0703917-01 | Sulfate | 70 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6010 | L0703917-01 | Magnesium | 8.1 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6010 | L0703917-01 | Manganese | 0.709 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6010 | L0703917-01 | Nickel | 0.0102 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6010 | L0703917-01 | Barium | 0.029 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6010 | L0703917-01 | Copper | 0.017 | mg/l |
| EFF-032207 | 03/22/2007 | SW 6020 | L0703917-01 | Arsenic | 0.0020 | mg/l |

## Table 2. Sample Status

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 3/22/07 at a temperature of 2.3ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | **L0703917** |

## Table 3. Field Sample List

| Lab Sample Number | Field ID |
|---|---|
| L0703917-01 | EFF-032207 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

## Table 4. Metals by USEPA 6010B, 6020A, and USEPA 7470A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.3ºC. Sample was preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | All reported results were within calibration range. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Silver (0.0008 mg/L) and zinc (0.0018 mg/L) were detected in preparation blank WG274824-1, and arsenic (0.00038 mg/L) was detected in method blank WG275648-1. | AMEC U qualified the zinc result from sample EFF-032207, because the sample concentration was less than 5 times the blank concentration. Therefore a B (blank contamination) reason code was applied | High |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Metals were not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |

**May 7, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2/325.2/300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFF-032207 was used as source for the PDS for arsenic. The recovery was acceptable at 92%. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analysis on sample EFF-032207. The %D was 34%. | AMEC J qualified the detected arsenic result from sample EFF-032207, with an A (ICP serial dilution) reason code. | High |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nickel (0.0102 mg/L) was detected below the RL of 0.025 mg/L. | AMEC J qualified the nickel result with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Bis(2-Ethylhexyl)phthalate (BEHP) by USEPA 8270C

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) No sample preservation required.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.3ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 7 days to extraction; soil 14 days to extraction. Extracts – analyzed within 40 days of extraction.<br>2) If extraction or analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Sample was extracted and analyzed within holding time. | | |
| GC/MS instrument performance check (DFTPP) | 1) Samples analyzed beyond tune time flag all detected results "J" and nondetected results "UJ" | DFTPP tune met acceptance criteria | | |
| Initial Calibration | 1) Compounds with RSDs≤15% or r or $r^2$≥ 0.99 values flag detected results "J" and nondetected results "UJ"<br>2) Compounds with very low RRFs (<0.01) flag detected results "J" and nondetected results "R | Initial calibration met established criteria. Calibration was performed on 01/20/2007. | | |
| Continuing Calibration Verification (CCV) | 1) No qualification if recovery between 80 – 120%.<br>a) %R >120% flag detected results "J"<br>b) %R <80% flag detected results "J" and nondetected results "UJ" | CCV recovery was within acceptance limits. | | |

**May 7, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2/325.2/300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Should be < MRL for the analyte .<br>a) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>b) If sample result is <5x contaminant concentration and ≥ MRL flag, "U"<br>c) Sample results ≥5x contaminant concentration no qualification required.<br>d) If gross contamination exists flag detected results "R"<br>2) Apply FB, EB, RB results to samples with same collection date. | Bis(2-Ethylhexyl)phthalate was not detected in the method blank WG274501. | | |
| Surrogates | 1) 30-130% recovery for samples.<br>2) 40-140% for method blanks, matrix spikes and LCS. | All surrogate recoveries met established criteria. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 40-140% recovery; ≤20%RPD<br>a) %R<40% flag detected results "J" and nondetected results "UJ"<br>b) %R>140% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | LCS/LCSD recoveries and RPD were within acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 40-140%.<br>a) %R<40% flag detected results "J" and nondetected results "UJ"<br>b) %R<140% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>20% waters (>30% soils) flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Internal Standards | 1) 50%-200% of area counts in associated CCAL standard.<br>2) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Bis(2-Ethylhexyl)phthalate was reported as not detected at the method-detection limit. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

**Table 6. Cyanide by USEPA 9014, Chloride by USEPA 325.2, Nitrate by USEPA 353.2, and Sulfate by USEPA 300.00**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.3ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 300.0) | The sample was analyzed and preserved as per EPA Method requirements. | | |

**May 7, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2/325.2/300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration | 1) r ≥ 0.995 for Cyanide and r ≥ 0.99 for chloride, sulfate and nitrate, linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. Cyanide calibration was performed on 03/27/2007. Chloride calibration preformed on 03/26/2007. Sulfate calibration was performed on 01/26/2007. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No cyanide, sulfate or nitrate were detected in the associated method blanks.<br>Chloride was detected in method blank WG274551-0 at 0.68 mg/l. | AMEC did not qualify the chloride result from sample EFF-032207, because the sample concentration is more than 5 times the blank concentration. | None |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample EFF-032207 was analyzed in duplicate for sulfate. The RPD was 1%. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample EFF-032207 was used as source sample for MS/MSD for sulfate. The recovery, at 74%, met the 4x rule. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Cyanide and nitrate were reported as not detected at the method-detection limit of 0.005 mg/L and 0.1 mg/L, respectively.<br>Chloride and sulfate were reported as detects at 68 mg/L and 70 mg/L, respectively. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

**May 7, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2/325.2/300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

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**May 14, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers 17 water samples collected on April 10 and April 11, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on April 10 and 11, 2007 and assigned sample delivery groups (SDGs) numbers L0704945 and L0705032 upon receipt. Alpha analyzed the samples for total metals using USEPA 6000/7000 methods, turbidity using USEPA method 2130B, total alkalinity using USEPA Method 2320B, chloride using USEPA Method 9251, sulfate using USEPA Method 300.0, and nitrogen-nitrate using USEPA Method 4500NO3-F. The associated field sample identification (ID) and Alpha sample ID are presented in Table 1.

The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3, Table 4 and Table 5. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 6 attached to this report.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0704945-01 | EQBLANK-041007 | Equipment Blank |
| L0704945-02 | SHM9322C-041007 | |
| L0704945-03 | SHM9622B-041007 | |
| L0704945-04 | SHM0542A-041007 | |
| L0704945-05 | SHM0541A-041007 | |
| L0704945-06 | SHL23-041007 | MS/MSD |
| L0704945-07 | DUP-041007 | Field Duplicate of SHL23-041007 |
| L0704945-08 | SHL9-041007 | |
| L0704945-09 | SHM0541B-041007 | |
| L0704945-10 | SHL22-041007 | |
| L0704945-11 | SHM0541C-041007 | |
| L0704945-12 | SHM0542B-041007 | |
| L0705032-01 | SHM965B-041107 | |
| L0705032-02 | SHM965C-041107 | |
| L0705032-03 | SHL8D-041107 | |
| L0705032-04 | SHL8S-041107 | |
| L0705032-05 | SHL21-041107 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 4/10/07 and one sample cooler was received on 4/11/2007 at a temperature of 2.5ºC and 3.0°C, respectively. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | **L0704945 L0705032** |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

**Table 3. Metals by USEPA 6010B, 6020A, and USEPA 7470A**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.5 and 3.0ºC. Samples were preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | Not applicable. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Metals were detected in samples EQBLANK-041007, DUP-041007, SHL23-041007, SHL9-041007, SHM0541A-041007, SHM0542A-041007, SHL8D-041107, SHL8S-041107 and SHL21-041107 at concentrations below the method reporting limit. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified detection below the reporting limit, with a TR (Trace level detected), reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic (0.0012 mg/L), calcium (0.086 mg/L), and magnesium (0.012 mg/L) were detected in the equipment blank EQBLANK-041007. | AMEC U qualified the arsenic result from sample SHM0542A-041007, because the sample concentration was less than 5 times the EB concentration. The F (blank contamination) reason code was applied. | High |

**May 14, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Metals were not detected in the ICB or in CCBs at concentrations greater than the MDL. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | Not applicable. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | Sample SHL23-041007 was analyzed in duplicate. The RPDs were less than 20%. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | Sample DUP-041007 was collected as a field duplicate of SHL23-041007. The RPDs were within limits. | | |

**May 14, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHL23-041007 was used as a source for the MS/MSD. Recoveries were within method acceptance limits. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHL23-041007 was used as source for the PDS. The recoveries were acceptable. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed a serial dilution analysis on sample SHL23-041007 for calcium. The %D was within acceptance limits at 4.5%. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | The laboratory J qualified detected results with concentrations between the RL and MDL and AMEC concurs with these qualifications. | AMEC J qualified these results with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Turbidity by USEPA 2130B and Total Alkalinity by USEPA 2320B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.5 and 3.0ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that samples integrities were maintained during transport. | | |
| Holding Times (HT) | 1) 14 days, preservation not required (Alkalinity) (EPA Method 2320B)<br>2) 48 hours, preservation not required (Turbidity)(EPA Method 2130B) | Samples were analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for alkalinity linear calibration<br>Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met.<br>Total alkalinity calibration was performed on 04/12/2007. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (alkalinity).<br>a) %R >110% (alkalinity) flag detected results "J"<br>b) %R <90% (alkalinity) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Turbidity and total alkalinity were detected in the method blanks (WG276383-1/WG276512-1) at 0.13 NTU and 0.6 mg/L, respectively.<br><br>Turbidity and total alkalinity were detected in the equipment blank EQBLANK-041007 at 0.15 NTU and 0.5 mg/L, respectively. | AMEC U qualified the detected turbidity for samples SHL22-041007, DUP-041007, SHL23-041007, SHL8D-041107, SHL8S-041107, and SHL21-041107 because the sample concentrations were less than 5 times the blank concentrations. | High |

**May 14, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Samples SHL23-041007 and SHM965B-041107 were analyzed in duplicate for turbidity and total alkalinity. The RPDs were within the specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | Sample DUP-041007 was collected as a field duplicate of sample SHL23-041007. RPDs were in the method specified limits. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample SHL23-041007 was used as a source for the MS/MSD. Recoveries were within method acceptance limits. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Turbidity and total alkalinity were detected in sample EQBLANK-041007 at a concentration below the method reporting limit of 0.20NTU and 2.0 mg/L, respectively. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified the turbidity and total alkalinity results from sample EQBLANK-041007 with a TR (Trace level detected), reason code. | Estimation |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | Samples SHM0541B-041007, SHM0541C-041007, SHM0542B-041007, SHM9622B-041007, SHM9322B-041007, and SHM965C-041107 have elevated limits of detection due to dilutions required for analysis. | No qualification warranted | |

**Table 5. Chloride by USEPA 9251, Nitrate by USEPA 4500NO3-F, and Sulfate by USEPA 300.0**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.5 and 3.0ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 9251 and 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 4500NO3-F) | The sample was analyzed and preserved per EPA Method requirements. | | |
| Initial Calibration | 1) $r \geq 0.995$ for Cyanide and $r \geq 0.99$ for chloride, sulfate and nitrate, linear calibration Analytes with low $r < 0.99$ flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. Nitrate calibration was performed on 04/10/2007. Chloride calibration preformed on 04/12/2007. Sulfate calibration was performed on 01/23/2007. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Chloride was detected in the method blank WG276599-2 at 0.79 mg/L concentration.<br><br>Nitrate was detected in the method blank WG276463-2 at a 0.021 mg/L concentration.<br><br>Chloride and nitrate were detected in equipment blank EQBLANK-041007 at 0.72 and 0.036 mg/L, respectively. | AMEC U qualified the detected chloride results from samples DUP-041007, SHL23-041007, SHL9-041007 SHM0542A-041007, and SHL21-041107 and U qualified the detected nitrate results from samples SHL22-041007, DUP-041007, SHM0541A-041007, SHM0541B-041007, SHM0541C-041007, SHM0542A-041007, SHM0542B-041007, SHM9322C-041007, SHM9622B-041007, SHL21-041107, SHL8S-041107 and SHM965B-041107 because the sample concentrations are less than 5 times the blank concentrations. | High |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHL23-041007 was analyzed in duplicate for sulfate, chloride, and nitrate. The RPDs were within the method specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | Sample DUP-041007 was collected as a field duplicate of sample SHL23-041007. RPDs were within the method specified limits. | | |

**May 14, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

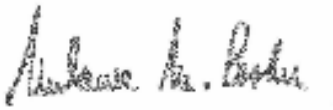
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample SHL23-041007 was used as a source for the MS/MSD. Recoveries were within method acceptance limits. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nitrate was detected in samples EQBLANK-041007, SHL21-041107, SHL8S-041107, and SHM965B-041107 at a concentration below the method reporting limit of 0.1 mg/L.<br>Sulfate was detected in sample SHL8S-041107 at a concentration below the RL of 1.0 mg/L.<br>Chloride was detected in sample EQBLANK-041007 at a concentration below the RL of 1.0 mg/L. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified the nitrate, sulfate and chloride detections below the reporting limit with a TR (Trace level detected), reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
Environmental Chemist

REVIEWED BY:

Denise Ladebauche
Environmental Chemist

TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR2 SDG_L0704945_L0705032

| Sample ID | Sample Date | EPA Analytical Method | Total or Dissolved | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|---|
| EQBLANK-041007 | 04/10/2007 | 2320B | T | L0704945-01 | ALKALINITY, TOTAL (AS CACO3) | 0.5 | mg/L | J | TR |
| EQBLANK-041007 | 04/10/2007 | 9251 | T | L0704945-01 | CHLORIDE | 0.72 | mg/l | J | TR |
| EQBLANK-041007 | 04/10/2007 | 6010B | T | L0704945-01 | MAGNESIUM | 0.012 | mg/l | J | TR |
| EQBLANK-041007 | 04/10/2007 | 6010B | T | L0704945-01 | ARSENIC | 0.0012 | mg/l | J | TR |
| EQBLANK-041007 | 04/10/2007 | 6010B | T | L0704945-01 | CALCIUM METAL | 0.086 | mg/l | J | TR |
| EQBLANK-041007 | 04/10/2007 | 2130B | T | L0704945-01 | TURBIDITY | 0.15 | NTU | J | TR |
| EQBLANK-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-01 | NITRATE (AS N) | 0.036 | mg/l | J | TR |
| SHL21-041107 | 04/11/2007 | 9251 | T | L0705032-05 | CHLORIDE | 2.2 | mg/l | U | B |
| SHL21-041107 | 04/11/2007 | 2130B | T | L0705032-05 | TURBIDITY | 0.45 | NTU | U | B |
| SHL21-041107 | 04/11/2007 | 6010B | T | L0705032-05 | MANGANESE | 0.0013 | mg/l | J | TR |
| SHL21-041107 | 04/11/2007 | 6010B | T | L0705032-05 | IRON | 0.027 | mg/l | J | TR |
| SHL21-041107 | 04/11/2007 | 6010B | T | L0705032-05 | POTASSIUM | 1.3 | mg/l | J | TR |
| SHL21-041107 | 04/11/2007 | 4500no-3-F | T | L0705032-05 | NITRATE (AS N) | 0.036 | mg/l | U | B |
| SHL22-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-10 | NITRATE (AS N) | 0.045 | mg/l | U | F |
| SHL22-041007 | 04/10/2007 | 2130B | T | L0704945-10 | TURBIDITY | 0.73 | NTU | U | F |
| DUP-041007 | 04/10/2007 | 6010B | T | L0704945-07 | POTASSIUM | 0.9 | mg/l | J | TR |
| DUP-041007 | 04/10/2007 | 6010B | T | L0704945-07 | SODIUM | 1 | mg/l | J | TR |
| DUP-041007 | 04/10/2007 | 9251 | T | L0704945-07 | CHLORIDE | 2.1 | mg/l | U | F, B |
| DUP-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-07 | NITRATE (AS N) | 0.17 | mg/l | U | F |
| DUP-041007 | 04/10/2007 | 2130B | T | L0704945-07 | TURBIDITY | 0.47 | NTU | U | F |
| SHL23-041007 | 04/10/2007 | 9251 | T | L0704945-06 | CHLORIDE | 2.0 | mg/l | U | F, B |
| SHL23-041007 | 04/10/2007 | 6010B | T | L0704945-06 | IRON | 0.023 | mg/l | J | TR |
| SHL23-041007 | 04/10/2007 | 6010B | T | L0704945-06 | POTASSIUM | 0.9 | mg/l | J | TR |
| SHL23-041007 | 04/10/2007 | 6010B | T | L0704945-06 | SODIUM | 1.3 | mg/l | J | TR |
| SHL23-041007 | 04/10/2007 | 2130B | T | L0704945-06 | TURBIDITY | 0.31 | NTU | U | F |
| SHL8D-041107 | 04/11/2007 | 6010B | T | L0705032-03 | POTASSIUM | 0.87 | mg/l | J | TR |
| SHL8D-041107 | 04/11/2007 | 6010B | T | L0705032-03 | IRON | 0.029 | mg/l | J | TR |

TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR2 SDG_L0704945_L0705032

| Sample ID | Sample Date | EPA Analytical Method | Total or Dissolved | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|---|
| SHL8D-041107 | 04/11/2007 | 2130B | T | L0705032-03 | TURBIDITY | 0.22 | NTU | U | B |
| SHL8S-041107 | 04/11/2007 | 6010B | T | L0705032-04 | IRON | 0.022 | mg/l | J | TR |
| SHL8S-041107 | 04/11/2007 | 6010B | T | L0705032-04 | POTASSIUM | 1.3 | mg/l | J | TR |
| SHL8S-041107 | 04/11/2007 | 4500no-3-F | T | L0705032-04 | NITRATE (AS N) | 0.066 | mg/l | U | B |
| SHL8S-041107 | 04/11/2007 | 2130B | T | L0705032-04 | TURBIDITY | 0.42 | NTU | U | B |
| SHL8S-041107 | 04/11/2007 | 300.00 | T | L0705032-04 | SULFATE | 0.8 | mg/l | J | TR |
| SHL9-041007 | 04/10/2007 | 9251 | T | L0704945-08 | CHLORIDE | 3.6 | mg/l | U | F, B |
| SHL9-041007 | 04/10/2007 | 6010B | T | L0704945-08 | POTASSIUM | 1.9 | mg/l | J | TR |
| SHM0541A-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-05 | NITRATE (AS N) | 0.04 | mg/l | U | F |
| SHM0541A-041007 | 04/10/2007 | 6010B | T | L0704945-05 | POTASSIUM | 2.2 | mg/l | J | TR |
| SHM0541B-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-09 | NITRATE (AS N) | 0.072 | mg/l | U | F |
| SHM0541C-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-11 | NITRATE (AS N) | 0.069 | mg/l | U | F |
| SHM0542A-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-04 | NITRATE (AS N) | 0.12 | mg/l | U | F |
| SHM0542A-041007 | 04/10/2007 | 9251 | T | L0704945-04 | CHLORIDE | 0.82 | mg/l | U | F, B |
| SHM0542A-041007 | 04/10/2007 | 6010B | T | L0704945-04 | POTASSIUM | 1.7 | mg/l | J | TR |
| SHM0542A-041007 | 04/10/2007 | 6010B | T | L0704945-04 | SODIUM | 0.99 | mg/l | J | TR |
| SHM0542A-041007 | 04/10/2007 | 6010B | T | L0704945-04 | ARSENIC | 0.0011 | mg/l | U | F |
| SHM0542B-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-12 | NITRATE (AS N) | 0.079 | mg/l | U | F |
| SHM9322C-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-02 | NITRATE (AS N) | 0.069 | mg/l | U | F |
| SHM9622B-041007 | 04/10/2007 | 4500no-3-F | T | L0704945-03 | NITRATE (AS N) | 0.077 | mg/l | U | F |
| SHM965B-041107 | 04/11/2007 | 4500no-3-F | T | L0705032-01 | NITRATE (AS N) | 0.087 | mg/l | U | B |

**Validation Qualifiers:**

R — The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample.

U — The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks.

J — The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits.

TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR2 SDG_L0704945_L0705032

| | |
|---|---|
| UJ | The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits. |

**Reason Code:**

| | |
|---|---|
| B | Contaminant detected in preparation (method) or calibration blank |
| E | Sample duplicates (field or laboratory) showed poor agreement with parent sample |
| F | Presumed contamination from field blank (FB), equipment rinsate (ER), or holding/ambient blank (AB) |
| TR | Trace level detect |

**May 14, 2007** **Arsenic by USEPA Method 6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on April 11, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on April 11, 2007 and assigned sample delivery group (SDG) number L0705038 upon receipt. Alpha analyzed the sample for total arsenic using USEPA Method 6010B. The associated field sample identification (ID) and Alpha sample ID is presented in Table 1.

The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality.

Arsenic in sample EFFLUENT-041107 is reported as not detected at 0.003 mg/L detection limit.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0705038-01 | EFFLUENT-041107 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 4/11/2007 at a temperature of 3.0°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | **L0705038** |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Arsenic by USEPA 6010B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 3.0ºC. Sample was preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | The sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | Not applicable. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**May 14, 2007** **Arsenic by USEPA Method 6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Arsenic was reported as not detected at the reported detection limit (RDL) of 0.003 mg/L. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic was not detected in the associated method blank. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | Not applicable. | | |

**May 14, 2007** **Arsenic by USEPA Method 6010B**

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits at 92% and 90%. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | Sample EFFLUENT-041107 was analyzed in duplicate. Both results were reported as non detects. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | The MS was associated with a different SDG. The recovery was acceptable. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | The PDS was associated with a different SDG. The recoveries were acceptable. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The SD was performed on a sample associated with a different SDG. The %D was acceptable at 4.5%. | | |

**May 14, 2007** **Arsenic by USEPA Method 6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

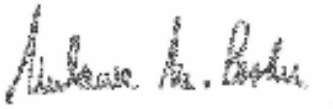
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Arsenic for sample EFFLUENT-041107 was reported as not detected at the reporting limit of 0.003 mg/L. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
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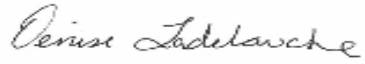
REVIEWED BY:



Denise Ladebauche
Environmental Chemist

**June 26, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on May 16, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on May 16, 2007 and assigned sample delivery group (SDG) number L0707044, upon receipt. Alpha analyzed the sample for total arsenic using USEPA Method 6020A. The associated field sample identification (ID) and Alpha sample ID are presented in Table 2.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Method outlined in Table 3. The level of data validation specified in Table 1 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 4 attached to this report.

**Table 1. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 5/16/07 at a temperature of 2.0ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0707044 |

**Table 2. Field Sample List**

| Lab Sample Number | Field ID |
|---|---|
| L0707044-01 | EFFLUENT-051607 |

**June 26, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Total Arsenic by USEPA 6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.0ºC. Sample was preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero). | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**June 26, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | The reported result was within calibration range. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic was not detected in the associated method blank. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |

**June 26, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs flag "J" | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFFLUENT-051607 was used as source for the PDS for arsenic. The recovery was acceptable at 102%. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analysis on sample EFFLUENT-051607. The %D was 14.2%. | AMEC J qualified the detected arsenic result from sample EFFLUENT-051607, with an A (ICP serial dilution) reason code. | |

**June 26, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

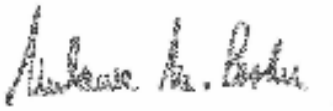
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Arsenic was detected above the method reporting limit of 0.0005 mg/L. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
Environmental Chemist

REVIEWED BY:

Denise Ladebauche
Environmental Chemist

TABLE 4
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR2_ SDG_L0707044

| Sample ID | Sample Date | EPA Analytical Method | Total or Dissolved | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|---|
| EFFLUENT-051607 | 05/16/2007 | SW6020 | T | L0707044-01 | ARSENIC | 0.0012 | mg/l | J | A |

**Validation Qualifiers:**

R — The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample.

U — The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks.

J — The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits.

UJ — The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits.

**Reason Code:**

A — ICP Serial Dilution %difference was not within control limits

**June 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on May 29, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on May 29, 2007 and assigned sample delivery group (SDG) number L0707704 upon receipt. Alpha analyzed the sample for total metals using USEPA 6010/6020 methods, turbidity using USEPA method 2130B, total alkalinity using USEPA Method 2320B, chloride using USEPA Method 9251, sulfate using USEPA Method 300.0, and nitrate-nitrogen using USEPA Method 4500NO3-F. The associated field sample identification (ID) and Alpha sample ID are presented in Table 1.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3, Table 4 and Table 5. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and USEPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 6 attached to this report.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0707704-01 | SHL-05-052907 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 5/29/07 at a temperature of 5ºC. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0707704 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Metals by USEPA 6010B/6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 5°C. Sample was preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICM-MS tune solution met the required limit. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**June 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Potasium and sodium were detected in sample SHL-05-052907 at concentrations below the method reporting limit. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified detections below the reporting limit, with a TR (Trace level detected), reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Metals were not detected in the method blank at concentrations greater than the MDL. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Iron (0.02227, 0.02308, 0.02157 mg/L) was detected in the CCBs (2,3,4). | The iron (2.4 mg/L) concentration detected in the sample was more than 5 times the CCBs concentrations. No qualification is warranted. | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | The IS %Rs were within acceptable limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | The laboratory duplicate was not associated with this sample | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this sample. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD associated with this sample. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHL-05-052907 was used as source for the PDS. The recoveries were acceptable. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analysis on sample SHL-05-052907. The %Ds were within acceptance limits. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | The laboratory J qualified detected results with concentrations between the RL and MDL and AMEC concurs with these qualifications. | AMEC J qualified these results with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Turbidity by USEPA 2130B and Total Alkalinity by USEPA 2320B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperature upon arrival at Alpha was 5ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |

**June 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Holding Times (HT) | 1) 14 days, preservation not required (Alkalinity) (EPA Method 2320B)<br>2) 48 hours, preservation not required (Turbidity)(EPA Method 2130B) | Sample was analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for alkalinity linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (alkalinity).<br>a) %R >110% (alkalinity) flag detected results "J"<br>b) %R <90% (alkalinity) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Turbidity and total alkalinity were detected in the method blanks (WG281913-1/WG282555-1) at 0.14 NTU and 0.6 mg/L, respectively.<br><br>Turbidity and total alkalinity were detected in sample SHL-05-052907 at 1.9 NTU and 28 mg/L, respectively. | AMEC did not qualify the data because the sample concentrations were more than 5 times the method blank concentrations. Data usability is not adversely affected. | |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHL-05-052907 was analyzed in duplicate for turbidity and total alkalinity. The RPDs were within the specified limit. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was associated with sample SHL-05-052907. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD was associated with sample SHL-05-052907 for these methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Turbidity and total alkalinity were detected in sample SHL-05-052907 at a concentration above the method reporting limit of 0.20 NTU and 2.0 mg/L, respectively. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

**Table 5. Chloride by USEPA 9251, Nitrate by USEPA 4500NO3-F, and Sulfate by USEPA 300.0**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperature upon arrival at Alpha was 5ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| | | during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 9251 and 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 4500NO3-F) | The sample was analyzed and preserved per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.995 for Cyanide and r ≥ 0.99 for chloride, sulfate and nitrate, linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Chloride was detected in the method blank WG282548-2 at 0.48 mg/L concentration.<br><br>Nitrate was detected in the method blank WG282075-2 at a 0.034 mg/L concentration. | The chloride concentration in the associated sample was more than 5 times the method blank contamination. No qualification required.<br>AMEC U qualified the detected nitrate result from sample SHL-05-052907 because of laboratory blank contamination. (B-reason code) | High |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |

**June 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

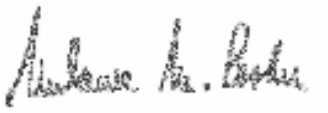
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHL-05-052907 was analyzed in duplicate for sulfate, chloride, and nitrate. The RPDs were within the method specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was associated with this sample. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD associated with this sample. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nitrate was detected at a concentration below the method reporting limit of 0.1 mg/L.<br>Sulfate was detected at a concentration above the RL of 1.0 mg/L.<br>Chloride was detected at a concentration above the RL of 1.0 mg/L. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
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REVIEWED BY:

Denise Ladebauche
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TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR1_ SDG_L0707704

| Sample ID | Sample Date | EPA Analytical Method | Total or Dissolved | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|---|
| SHL-05-052907 | 05/29/2007 | A4500F | T | L0707704-01 | NITRATE (AS N) | 0.08 | mg/l | U | B |
| SHL-05-052907 | 05/29/2007 | SW6010 | T | L0707704-01 | POTASSIUM | 1.6 | mg/l | J | TR |
| SHL-05-052907 | 05/29/2007 | SW6010 | T | L0707704-01 | SODIUM | 1.4 | mg/l | J | TR |

**Validation Qualifiers:**

| | |
|---|---|
| R | The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample. |
| U | The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks. |
| J | The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits. |
| UJ | The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits. |

**Reason Code:**

| | |
|---|---|
| B | Contaminant detected in preparation (method) or calibration blank |
| TR | Trace level detect |

**July 18, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Other Inorganics by USEPA 353.2//300.0/9014**

## INTRODUCTION

This data validation report covers one water sample collected on June 13, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on June 13, 2007 and assigned sample delivery group (SDG) number L0708435, upon receipt. Alpha analyzed the sample for total metals using USEPA 6000/7000 methods, bis(2-ethylhexyl)phthalate (BEHP) using USEPA Method 8270C, total cyanide using USEPA Method 9014, chloride and sulfate using USEPA Method 300.0, and nitrate using USEPA Method 353.2. The associated field sample identification (ID) and Alpha sample ID are presented in Table 3.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 4, Table 5 and Table 6. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data and detected results are listed below.

**Table 1. Detected Results**

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units |
|---|---|---|---|---|---|---|
| EFF-061307 | 06/13/2007 | SW6020 | L0708435-01 | ARSENIC | 0.0013 | mg/l |
| EFF-061307 | 06/13/2007 | E300 | L0708435-01 | SULFATE | 2.2 | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | ZINC | 0.0053 **U** | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | BARIUM | 0.023 | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | NICKEL | 0.0052 **J** | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | MANGANESE | 0.001 **U** | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | MAGNESIUM | 7.5 **J** | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | COPPER | 0.015 | mg/l |
| EFF-061307 | 06/13/2007 | SW6010 | L0708435-01 | IRON | 0.09 | mg/l |
| EFF-061307 | 06/13/2007 | E353.2 | L0708435-01 | NITRATE (AS N) | 0.18 | mg/l |
| EFF-061307 | 06/13/2007 | E300 | L0708435-01 | CHLORIDE | 56 | mg/l |

## Table 2. Sample Status

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 6/13/07 at a temperature of 6ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0708435 |

## Table 3. Field Sample List

| Lab Sample Number | Field ID |
|---|---|
| L0708435-01 | EFF-061307 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

## Table 4. Metals by USEPA 6010B, 6020A, and USEPA 7470A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 6ºC. Sample was preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |

**July 18, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2//300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Manganese (0.001 mg/L), nickel (0.0052 mg/L) and zinc (0.0053 mg/L) were reported below the method reporting limit. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Zinc was detected in preparation blank WG284166-1at a 0.003 mg/L concentration. | AMEC U qualified the zinc result from sample EFF-061307, because the sample concentration was less than 5 times the blank concentration. Therefore a B (blank contamination) reason code was applied | High |

**July 18, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2//300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Beryllium (0.00088 mg/L) and manganese (0.00078 mg/L) were detected in the ICB and CCB associated with this sample. | AMEC U qualified the detected manganese result from sample EFF-061307, because the sample concentration was less than 5 times the blank concentration. Therefore a B (blank contamination) reason code was applied | High |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | Aluminum ICS-AB recovery was high at 163%. | Aluminum was not detected in sample EFF-061307, therefore no qualification is required. | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |

**July 18, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2//300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFF-061307 was used as source for the PDS. The recoveries were within acceptance limits. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analyses on sample EFF-061307. The %Ds were less than 10%, except for magnesium at 12%. | AMEC J qualified the detected magnesium result from sample EFF-061307, with an A (ICP serial dilution) reason code. | High |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nickel (0.0052 mg/L) was detected below the RL of 0.025 mg/L. | AMEC J qualified the nickel result with a TR (trace level) reason code. | Estimation |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Bis(2-Ethylhexyl)phthalate (BEHP) by USEPA 8270C

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) No sample preservation required.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 6ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 7 days to extraction; soil 14 days to extraction. Extracts – analyzed within 40 days of extraction.<br>2) If extraction or analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Sample was extracted and analyzed within holding time. | | |
| GC/MS instrument performance check (DFTPP) | 1) Samples analyzed beyond tune time flag all detected results "J" and nondetected results "UJ" | DFTPP tune met acceptance criteria | | |
| Initial Calibration | 1) Compounds with RSDs≤15% or r or $r^2$≥ 0.99 values flag detected results "J" and nondetected results "UJ"<br>2) Compounds with very low RRFs (<0.01) flag detected results "J" and nondetected results "R | Initial calibration met established criteria. Calibration was performed on 06/13/2007. | | |
| Continuing Calibration Verification (CCV) | 1) No qualification if recovery between 80 – 120%.<br>a) %R >120% flag detected results "J"<br>b) %R <80% flag detected results "J" and nondetected results "UJ" | CCV recovery was within acceptance limits. | | |

**July 18, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2//300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Should be < MRL for the analyte .<br>a) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>b) If sample result is <5x contaminant concentration and ≥ MRL flag, "U"<br>c) Sample results ≥5x contaminant concentration no qualification required.<br>d) If gross contamination exists flag detected results "R"<br>2) Apply FB, EB, RB results to samples with same collection date. | Bis(2-Ethylhexyl)phthalate was not detected in the method blank WG283765. | | |
| Surrogates | 1) 30-130% recovery for samples.<br>2) 40-140% for method blanks, matrix spikes and LCS. | All surrogate recoveries met established criteria. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 40-140% recovery; ≤20%RPD<br>a) %R<40% flag detected results "J" and nondetected results "UJ"<br>b) %R>140% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | LCS/LCSD recoveries and RPD were within acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 40-140%.<br>a) %R<40% flag detected results "J" and nondetected results "UJ"<br>b) %R<140% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>20% waters (>30% soils) flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Internal Standards | 1) 50%-200% of area counts in associated CCAL standard.<br>2) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Bis(2-Ethylhexyl)phthalate was reported as not detected at the method-detection limit. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

**Table 6. Cyanide by USEPA 9014, Nitrate by USEPA 353.2, and Chloride and Sulfate by USEPA 300.00**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 6ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 300.0) | The sample was analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) $r \geq 0.995$ for Cyanide and $r \geq 0.99$ for chloride, sulfate and nitrate, linear calibration Analytes with low $r < 0.99$ flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. Cyanide calibration was performed on 06/15/2007. Chloride and sulfate calibration preformed on 06/08/2007. | | |

**July 18, 2007** **Metals by USEPA Methods 6000/7000**
**Region I Data Review Worksheet** **Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Project: SHL, Fort Devens** **Other Inorganics by USEPA 353.2//300.0/9014**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No cyanide, chloride, sulfate, or nitrate was detected in the associated method blanks. | | |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample EFF-061307 was analyzed in duplicate for chloride, sulfate, and nitrate. The RPDs were within acceptance criteria. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

**July 18, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Bis(2-Ethylhexyl)phthalate by USEPA 8270C**
**Other Inorganics by USEPA 353.2//300.0/9014**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample EFF-061307 was used as source sample for MS/MSD for chloride, sulfate, and nitrate. The recoveries were within acceptance criteria. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Cyanide was reported as not detected at the method-detection limit of 0.005 mg/L.<br>Chloride, sulfate, and nitrate were reported as detected above the method reporting limits. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:

Melanie Roshu
Environmental Chemist

REVIEWED BY:

Denise Ladebauche
Environmental Chemist

**August 7, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on July 12, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on July 12, 2007 and assigned sample delivery group (SDG) number L0709910 upon receipt. Alpha analyzed the sample for total arsenic using USEPA Method 6020A. The associated field sample identification (ID) and Alpha sample ID is presented in Table 1.

The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality.

Arsenic in sample EFFLUENT-071207 was detected and reported at 1.4 µg/L concentration.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0709910-01 | EFFLUENT-071207 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 7/12/2007 at a temperature of 12°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0709910 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Arsenic by USEPA 6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 12ºC. The sample was transported to the laboratory, directly from the sampling site.<br>Sample was preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | Not required, because there was not sufficient time allowed for sample to cool down. | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | The sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | The tune standard met established criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**August 7, 2007** **Arsenic by USEPA Method 6020A**

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Arsenic was detected and reported within the calibration range. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic was not detected in the associated method blank. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | IS recoveries were within the acceptance limits. | | |

**August 7, 2007** **Arsenic by USEPA Method 6020A**

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits at 96% and 94%. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this sample. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No PDS was associated with this SDG. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The %D for the SD performed on this sample could not be calculated due to the concentration < 50 times the IDL. | Not required. | |

**August 7, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

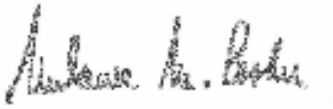
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Arsenic for sample EFFLUENT-071207 was reported as detected at 0.00140 mg/L concentration. The required reporting limit of 0.003 mg/L was met. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

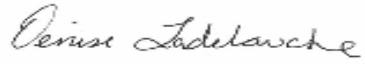
**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
Environmental Chemist

REVIEWED BY:



Denise Ladebauche
Environmental Chemist

**September 24, 2007** **Total Metals by USEPA Methods 6020A/6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers three water samples collected on August 7, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on August 7, 2007 and assigned sample delivery group (SDG) number L0711284, upon receipt. Alpha analyzed the samples for total arsenic using USEPA Method 6020A and for total iron and manganese using USEPA Method 6010B. The associated field samples identification (ID) and Alpha sample IDs are presented in Table 3.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 4. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data and detected results are listed below.

**Table 1. Detected Results**

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units |
|---|---|---|---|---|---|---|
| EFF-080707 | 08/07/2007 | SW6010 | L0711284-01 | MANGANESE | 0.0014 **J** | mg/l |
| EFF-080707 | 08/07/2007 | SW6020 | L0711284-01 | ARSENIC | 0.0015 **U** | mg/l |
| EW1-080707 | 08/07/2007 | SW6010 | L0711284-02 | IRON | 88 | mg/l |
| EW1-080707 | 08/07/2007 | SW6010 | L0711284-02 | MANGANESE | 2.46 | mg/l |
| EW1-080707 | 08/07/2007 | SW6020 | L0711284-02 | ARSENIC | 2.402 | mg/l |
| EW2-080707 | 08/07/2007 | SW6010 | L0711284-03 | IRON | 67 | mg/l |
| EW2-080707 | 08/07/2007 | SW6010 | L0711284-03 | MANGANESE | 1.71 | mg/l |
| EW2-080707 | 08/07/2007 | SW6020 | L0711284-03 | ARSENIC | 4.096 | mg/l |

## Table 2. Sample Status

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 8/07/07 at a temperature of 5ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0711284 |

## Table 3. Field Sample List

| Lab Sample Number | Field ID |
|---|---|
| L0711284-01 | EFF-080707 |
| L0711284-02 | EW1-080707 |
| L0711284-03 | EW2-080707 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

## Table 4. Total Arsenic by USEPA 6020A and Total Iron and Manganese by USEPA 6010B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 5ºC. Sample was preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |

**September 24, 2007** **Total Metals by USEPA Methods 6020A/6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero) | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Manganese, from sample EFF-080707 was reported at a 0.0014 mg/L, value that is below the method reporting limit. | AMEC J qualified this analyte on the data tables, with a TR (trace level) reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No arsenic, iron or manganese were detected in the method blanks associated with these samples. | | |

**September 24, 2007** **Total Metals by USEPA Methods 6020A/6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was detected in the CCB associated with these samples, at 0.00092 mg/L. | AMEC U qualified the detected arsenic result from sample EFF-080707, because the sample concentration was less than 5 times the blank concentration. Therefore a B (blank contamination) reason code was applied. | High |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | All ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |

**September 24, 2007** **Total Metals by USEPA Methods 6020A/6010B**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

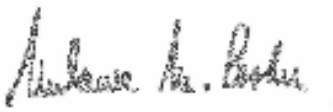
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFF-080707 was used as source for the PDS. The recoveries were within acceptance limits. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analyses on sample EFF-080707. The %Ds were less than 10%. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Manganese (0.0014 mg/L) was detected below the RL of 0.010 mg/L. | AMEC J qualified the manganese result from sample EFF-080707, with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



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REVIEWED BY:

Denise Ladebauche
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**October 16, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Semivolatile Organic Compounds by USEPA 8270C**
**Volatile Organic Compounds by USEPA Method 8260B**
**Total Petroleum Hydrocarbons by USEPA Method 1664A**
**Anions by USEPA Methods 300.0/353.2**

## INTRODUCTION

This data validation report covers three primary water samples and one trip blank collected on September 11, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on September 11, 2007 and assigned sample delivery group (SDG) number L0713121, upon receipt. Alpha analyzed the samples for total metals using USEPA 6000/7000 methods, semivolatile organic compounds using USEPA Method 8270C, volatile organic compounds using USEPA method 8260B, total petroleum hydrocarbons using USEPA method 1664A, chloride and sulfate using USEPA Method 300.0, and nitrate using USEPA Method 353.2. The associated field sample identification (ID) and Alpha sample ID are presented in Table 2.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3, Table 4, Table 5, Table 6 and Table 7. The level of data validation specified in Table 1 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data and detected results are listed below.

**Table 1. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 9/11/07 at a temperature of 4.1ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0713121 |

**Table 2. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0713121-01 | EFF-091107 | Metals, 8270C, 8260B, TPH, Anions |
| L0713121-02 | EW1-091107 | Analyzed only for As, Fe, Mn |
| L0713121-03 | EW2-091107 | Analyzed only for As, Fe, Mn |
| L0713121-04 | TRIP BLANK | Only 8260B |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Metals by USEPA Methods 6010B, 6020A, and USEPA Method 7470A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.1°C. Sample was preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**October 16, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Semivolatile Organic Compounds by USEPA 8270C**
**Volatile Organic Compounds by USEPA Method 8260B**
**Total Petroleum Hydrocarbons by USEPA Method 1664A**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Manganese (0.0026 mg/L) and copper (0.0049 mg/L) from sample EFF-091107 were reported below the method reporting limit. | These analytes were J qualified on the data tables, with a TR (trace level) reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No analytes were detected in the preparation blanks associated with these samples. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic at different concentrations was detected in the CCBs associated with all samples. The detected arsenic concentrations in all samples were more than 5 times the blank concentrations. Data usability was not affected.<br>Manganese at 0.00053 mg/L was detected in the CCB associated with sample EFF-091107. | AMEC U qualified the detected manganese result from sample EFF-091107, because the sample concentration was less than 5 times the blank concentration. Therefore a B (blank contamination) reason code was applied. | High |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFF-091107 was used as source for the PDS. The recoveries were within acceptance limits. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analyses on sample EFF-091107. The %Ds were less than 10%. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Copper (0.0049 mg/L) was detected below the RL of 0.01 mg/L in sample EFF-091107. | AMEC J qualified the copper result with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Semivolatile Organic Compounds by USEPA Method 8270C

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) No sample preservation required.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.1°C.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 7 days to extraction; soil 14 days to extraction. Extracts – analyzed within 40 days of extraction. | Sample was extracted and analyzed within holding time. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| | 2) If extraction or analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | | | |
| GC/MS instrument performance check (DFTPP) | 1) Samples analyzed beyond tune time flag all detected results "J" and nondetected results "UJ" | DFTPP tune met acceptance criteria. | | |
| Initial Calibration | 1) Compounds with RSDs≤15% or r or $r^2$≥ 0.99 values flag detected results "J" and nondetected results "UJ"<br>2) Compounds with very low RRFs (<0.01) flag detected results "J" and nondetected results "R | Initial calibration met established criteria. Calibration was performed on 09/15/2007. | | |
| Continuing Calibration Verification (CCV) | 1) No qualification if recovery between 80 – 120%.<br>a) %R >120% flag detected results "J"<br>b) %R <80% flag detected results "J" and nondetected results "UJ" | CCV recovery was within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Should be < MRL for the analyte<br>a) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>b) If sample result is <5x contaminant concentration and ≥ MRL flag, "U"<br>c) Sample results ≥5x contaminant concentration no qualification required.<br>d) If gross contamination exists flag detected results "R"<br>2) Apply FB, EB, RB results to samples with same collection date. | Analytes were not detected in the method blank WG294107. | | |
| Surrogates | 1) 30-130% recovery for base-neutral compounds and 15-110% recovery for acid compounds for samples.<br>2) 40-140% for method blanks, matrix spikes and LCS. | Surrogate phenol-D6 was recovered at 27% in sample EFF-091107. The other two surrogate compounds from the same fraction met established criteria; therefore data usability is not affected. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 40-140% recovery for base-neutral compounds and 30-130% for acid compounds; ≤20%RPD<br>a) %R<40% or 30% flag detected results "J" and nondetected results "UJ"<br>b) %R>140% or 130% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | Hexachlorobutadiene (33%/41%), hexachloroethane (32%/36%), aniline (33%/26%), and phenol (27%/29%) were outside of the acceptance criteria, in the LCS/LCSD associated with sample EFF-091107. | AMEC UJ qualified the associated analytes from sample EFF-091107, with an L (LCS % recoveries were not within control limits) reason code. | Low |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 40-140% for base-neutral compounds and 30-130% for acid compounds.<br>a) %R<40% or 30% flag detected results "J" and nondetected results "UJ"<br>b) %R<140% or 130% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>20% waters (>30% soils) flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |
| Internal Standards | 1) 50%-200% of area counts in associated CCAL standard.<br>2) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | SVOCs compounds were reported as not detected at the method-detection limit for sample EFF-091107. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Volatile Organic Compounds by USEPA Method 8260B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |

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**Review Criteria: Fort Devens QAPP and MADEP MCP**
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**Metals by USEPA Methods 6000/7000**
**Semivolatile Organic Compounds by USEPA 8270C**
**Volatile Organic Compounds by USEPA Method 8260B**
**Total Petroleum Hydrocarbons by USEPA Method 1664A**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) No sample preservation required.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.1°C.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous unpreserved sample 7 days and aqueous preserved 14 days.<br>2) If analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Sample was extracted and analyzed within holding time. | | |
| GC/MS tunes with BFB | 1) Every 12 hours.<br>2) Samples analyzed beyond tune time flag all detected results "J" and nondetected results "UJ" | BFB tune met acceptance criteria. | | |
| Initial Calibration | 1) Minimum of 5 standards.<br>2) Compounds with RSDs ≤ 15% or "r" ≥ 0.99, except CCCs which must be ≤ 30%RSD or "r" ≥ 0.99, values flag detected results "J" and nondetected results "UJ"<br>2) Compounds with very low RRFs (<0.01) flag detected results "J" and nondetected results "R | Initial calibration met established criteria. Calibration was performed on 08/31/2007. | | |
| Continuing Calibration Verification (CCV) | 1) No qualification if recovery between 80 – 120% for CCCs and 70%-130% for other analytes.<br>a) %R >120 or 130% flag detected results "J"<br>b) %R <80 or 70% flag detected results "J" and nondetected results "UJ" | CCV recovery was within acceptance limits. | | |
| Blanks (Method, Trip, Field, Rinsate, etc.) | 1) Every 20 samples prior to running samples and after calibration standards;<br>2) Matrix and preservative specific;<br>3) Target analytes must be < RL except for common laboratory contaminants (e.g. acetone, methylene chloride, MEK which must be <5x the RL)<br>2) Apply TB, FB, RB results to samples with same collection date. | VOCs were not detected in the method blank WG294297 or Trip Blank. | | |
| Surrogates | 1) 70-130% recovery for samples.<br>2) 80-120% for method blanks, matrix spikes and LCS. | All surrogate recoveries met established criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 70-130% recovery; ≤25%RPD<br>a) %R<70% flag detected results "J" and nondetected results "UJ"<br>b) %R>130% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) Qualify all associated samples. | LCS/LCSD recoveries and RPD were within acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 70-130%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>30% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Internal Standards (IS) | 1) 50%-200% of area counts in associated CCAL standard.<br>2) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | 1,4-Dichlorobenzene, tetrahydrofuran, 2-phenylbutane, carbon tetrachloride, vinyl chloride, 1,1-dichloroethane and isopropylbenzene from sample EFF-091107 were detected and reported between the MDL and the RL. | AMEC J qualified these analytes from the sample EFF-091107 on the data tables, with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 6. Total Petroleum Hydrocarbons by USEPA Method 1664A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Aqueous samples preserved at the time of collection to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.1ºC.<br>The sample was preserved to pH<2 at the laboratory.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | AMEC UJ qualified the TPH result from sample EFF-091107, because the pH adjustment was done more than 4 hours after time of | Estimation |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| | | | collection. Therefore an M (Method QC criteria not met) reason code was applied. | |
| Holding Time | 1) Aqueous and solid samples must be analyzed within 28 days from sample collection.<br>2) If extraction or analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Sample was extracted and analyzed within holding time. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Should be < MRL for the analyte.<br>a) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>b) If sample result is <5x contaminant concentration and ≥ MRL flag, "U"<br>c) Sample results ≥5x contaminant concentration no qualification required.<br>d) If gross contamination exists flag detected results "R"<br>2) Apply FB, EB, RB results to samples with same collection date. | TPH was not detected in the method blank. | | |
| Laboratory Control Sample Recoveries | 1) 64-132% recovery;<br>a) %R<64% flag detected results "J" and nondetected results "UJ"<br>b) %R>132% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) Qualify all associated samples. | LCS recovery was within acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 64-132%.<br>a) %R<64% flag detected results "J" and nondetected results "UJ"<br>b) %R<132% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>50 flag detected results "J" | MS was performed on a sample from a different SDG and is not applicable to this sample. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | TPH was reported as not detected at the method-detection limit of 4 mg/L. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 7. Nitrate by USEPA 353.2, and Chloride and Sulfate by USEPA 300.00

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.1°C.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 300.0)<br>2) 48 hours, preservation not required (Nitrate-N)(EPA Method 353.2) | The sample was analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) $r \geq 0.99$ for chloride, sulfate and nitrate, linear calibration<br>Analytes with low $r < 0.99$ flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met.<br>Chloride and sulfate calibration preformed on 06/08/2007. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No nitrate, chloride, or sulfate was detected in the associated method blanks. | | |

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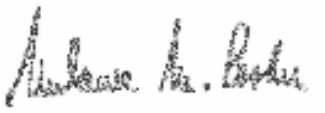
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample EFF-091107 was analyzed in duplicate for chloride, sulfate, and nitrate. The RPDs were within acceptance criteria. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample EFF-091107 was used as source sample for MS/MSD for chloride and sulfate. The chloride recovery was low at 61%, but the sample concentration at 60 mg/L was more than 4 times the spike concentration. The sulfate recovery was within acceptance criteria. | No qualification is required for the low chloride recovery. | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported RL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Chloride, sulfate, and nitrate were reported as detected above the method reporting limits. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
Environmental Chemist

REVIEWED BY:

Denise Ladebauche
Environmental Chemist

**November 9, 2007** **Organochlorine Pesticides and Polychlorinated Biphenyls (PCBs) by EPA Method 608**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one primary water sample collected on September 26, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on September 26, 2007 and assigned sample delivery group (SDG) number L0714175, upon receipt. Alpha analyzed the sample for organochlorine pesticides and polychlorinated biphenyls (PCBs) using USEPA Method 608. The associated field sample identification (ID) and Alpha sample ID is presented in Table 2.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Method outlined in Table 3. The level of data validation specified in Table 1 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data and detected results are listed below.

**Table 1. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 9/26/07 at a temperature of 4.8ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0714175 |

**Table 2. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0714175-01 | EFF-092607 | Pesticides, PCBs |

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Organochlorine Pesticides and Polychlorinated Biphenyls by USEPA Method 608

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature ≤6°C<br>3) No sample preservation required.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 4.8ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 7 days to extraction; soil 14 days to extraction. Extracts – analyzed within 40 days of extraction.<br>2) If extraction or analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Sample was extracted and analyzed within holding time. | | |
| Endrin/DDT Breakdown | 1) Before samples are analyzed.<br>2) % Breakdown must be ≤ 15 and must be evaluated using peak areas. | Endrin and DDT breakdown met the acceptance criteria. | | |
| Initial Calibration | 1) Compounds with RSDs ≤20% or r or $r^2$≥ 0.99 values; flag detected results "J" and nondetected results use professional judgment.<br>2) Curves must be verified by an independent ICV before analysis. | Initial calibration met established criteria. Calibrations were performed on 11/06/2006 (primary column) and 05/11/2007 (secondary column). | | |
| Continuing Calibration Verification (CCV) | 1) Prior to samples, every 12 hours or every 20 samples, whichever is more frequent, and at the end of the analytical sequence.<br>2) No qualification if recovery between 85 – 115%.<br>a) %R >115% flag detected results "J"<br>b) %R <85% flag detected results "J" and nondetected results "UJ" | The Endrin recovery was high at 24% and 20% in the bracketing CCVs associated with sample EFF-092607. Aroclor 1260 was above the method acceptance criteria in the bracketing CCVs. | Endrin and Aroclor 1260 were reported as not detected in sample EFF-092607. Data usability is not adversely affected. | |

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Should be < MRL for the analyte<br>a) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>b) If sample result is <5x contaminant concentration and ≥ MRL flag, "U"<br>c) Sample results ≥5x contaminant concentration no qualification required.<br>d) If gross contamination exists flag detected results "R"<br>2) Apply FB, EB, RB results to samples with same collection date. | Analytes were not detected in the method blank WG296218-1. | | |
| Surrogates | 1) Minimum of 2<br>2) 30-150% recovery for both surrogates on both columns | Surrogate recoveries were within established criteria. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 40-140% recovery<br>≤20%RPD for waters and ≤30% for solids<br>a) %R<40% flag detected results "J" and nondetected results "UJ"<br>b) %R>140% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | LCS/LCSD recoveries met the acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 40-140% for PCBs and 30-150% for pesticides.<br>a) %R<40% or 30% flag detected results "J" and nondetected results "UJ"<br>b) %R<140% or 150% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>30% for congeners, single-component pesticides (>50% aroclors, multi-component analytes) flag detected results "J" | Pesticides MS recoveries were within the established criteria. | | |
| Internal Standards (Congeners only) | 1) Minimum of 1.<br>2) 50%-200% of area counts in associated CCAL standard.<br>3) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |

**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

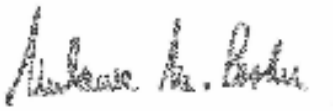
| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Identification and Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J"<br>3) Secondary column analysis: RPD <40% for positive results. "J" qualify results that exceed 40%. | Pesticide / PCB compounds were reported as not detected at the method-detection limit for sample EFF-092607. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

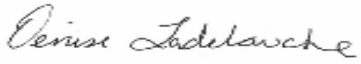
**AMEC Earth & Environmental, Inc.**

PREPARED BY:



Melanie Roshu
Environmental Chemist

REVIEWED BY:



Denise Ladebauche
Environmental Chemist

**November 13, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers one water sample collected on October 10, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The sample was dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on October 10, 2007 and assigned sample delivery group (SDG) number L0715010 upon receipt. Alpha analyzed the sample for total arsenic using USEPA Method 6020A. The associated field sample identification (ID) and Alpha sample ID is presented in Table 1.

The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality.

Arsenic in sample EFF-101007 was detected and reported at 1.2 µg/L concentration.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0715010-01 | EFF-101007 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 10/10/2007 at a temperature of 3.5°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0715010 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Arsenic by USEPA 6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 3.5ºC. The sample was transported to the laboratory, directly from the sampling site.<br>Sample was preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | The sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | The tune standard met established criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Arsenic was detected and reported within the calibration range. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic was not detected in the associated method blank. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | IS recoveries were within the acceptance limits. | | |

**November 13, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits at 101% and 98%. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this sample. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | The PDS recovery was within acceptance criteria at 106%. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The %D for the SD performed on this sample was within acceptance criteria at 10%. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Arsenic for sample EFF-101007 was reported as detected at 0.0012 mg/L concentration. The required reporting limit of 0.003 mg/L was met. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:

Melanie Roshu
Environmental Chemist

REVIEWED BY:

Denise Ladebauche
Environmental Chemist

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers fifteen primary water samples and two field duplicate samples collected on October 16, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on October 16, 2007 and assigned sample delivery group (SDG) number L0715369 upon receipt. Alpha analyzed the sample for total metals using USEPA 6010/6020 methods, turbidity using USEPA method 2130B, total alkalinity using USEPA Method 2320B, chloride using USEPA Method 9251, sulfate using USEPA Method 300.0, and nitrate-nitrogen using USEPA Method 4500NO3-F. The associated field sample identification (ID) and Alpha sample ID are presented in Table 1.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3, Table 4 and Table 5. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and USEPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 6 attached to this report.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0715369-01 | DUP02-101607 | Field Duplicate of SHL-9-101607 |
| L0715369-02 | SHP-01-36X-101607 | |
| L0715369-03 | SHL-19-101607 | |
| L0715369-04 | SHL-15-101607 | |
| L0715369-05 | SHL-11-101607 | |
| L0715369-06 | SHP-01-38A-101607 | |
| L0715369-07 | SHL-22-101607 | |
| L0715369-08 | SHM-93-10C-101607 | |
| L0715369-09 | SHL-10-101607 | |
| L0715369-10 | SHL-21-101607 | |
| L0715369-11 | SHM-93-22C-101607 | |
| L0715369-12 | SHM-93-22B-101607 | |
| L0715369-13 | SHL-9-101607 | |
| L0715369-14 | SHP-01-37X-101607 | |
| L0715369-15 | SHL-20-101607 | |
| L0715369-16 | SHL-4-101607 | |
| L0715369-17 | DUP01-101607 | Field Duplicate of SHM-93-22C-101607 |

## Table 2. Sample Status

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | Two sample coolers were received on 10/16/07 at temperatures of 3 and 4°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0715369 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

## Table 3. Metals by USEPA 6010B/6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 3 and 4°C. Samples were preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS tune solution met the required limit. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Iron, potassium, sodium and arsenic from sample SHL-10-101607; iron, manganese, potassium and arsenic from sample SHL-21-101607; and potassium from samples SHP-01-36X-101607 and SHP-01-37X-101607 were detected at concentrations below the method reporting limit. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified detections below the reporting limit, with a TR (Trace level detected), reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Calcium at 0.024 mg/L was detected in the method blank.<br>All other metals were not detected in the method blank at concentrations greater than the MDL. | The calcium concentrations detected in the associated samples were more than 5 times the MB concentration. No qualification is warranted. | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Metals were not detected in the ICB/CCBs associated with these samples. | | |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | The IS %Rs were within acceptable limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | The laboratory duplicate was not associated with any sample from this SDG. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | The field duplicate RPDs were within method requirements. | | |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHM-93-22C-101607 was used as parent for MS/MSD. The recoveries for total calcium at 60 and 70% were below acceptance criteria. Sample SHL-9-101607 was used as source sample for MS/MSD. Total Iron was not recovered. | The samples concentrations for these analytes were more than 4 times the spike concentration. No qualification is required. | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHM-93-22C-101607 was used as source for the PDS. The recoveries were acceptable. Sample SHL-9-101607 was used as source for PDS. Iron was not recovered, but the background concentration is more than 4 times the spike concentration. | No qualification is required. | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analysis on samples SHM-93-22C-101607 and SHL-9-101607. The %Ds were within acceptance limits, except for potassium at 15% and sodium at 20%. | Potassium and sodium concentration were <50 times the IDL, therefore no qualification is required. | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | The laboratory J qualified detected results with concentrations between the RL and MDL and AMEC concurs with these qualifications. | AMEC J qualified these results with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Turbidity by USEPA 2130B and Total Alkalinity by USEPA 2320B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature ≤6°C<br>3) Sample delivery documentation. | Coolers temperature upon arrival at Alpha was 3 and 4ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days, preservation not required (Alkalinity) (EPA Method 2320B)<br>2) 48 hours, preservation not required (Turbidity)(EPA Method 2130B) | Samples were analyzed as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for alkalinity linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (alkalinity).<br>a) %R >110% (alkalinity) flag detected results "J"<br>b) %R <90% (alkalinity) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Turbidity was detected in the method blanks (WG298379-2/WG298382-2) at 0.17 NTU,<br><br>Total alkalinity was detected in the method blanks (WG298859-1/ WG298981-1) at 1 mg/L and 1.6 mg/L, respectively. The concentrations in the associated samples were more than 5 times the MB concentrations, therefore, no alkalinity results were qualified. | AMEC U qualified the detected turbidity results from samples SHL-10-101607, SHL-21-101607, SHL-22-101607, SHP-01-36X-101607 and SHP-01-37X-101607 because the samples concentrations were less than 5x the MB concentration. A B (contamination detected) reason code was applied. | High |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCSs recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHL-9-101607 was analyzed in duplicate for turbidity and sample SHM-93-22C-101607 was analyzed in duplicate for total alkalinity. The RPDs were within the specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | Field duplicates RPDs were within method specified criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD was associated with samples from this SDG for these methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Turbidity and total alkalinity were detected in all associated samples at a concentrations above the method reporting limit of 0.20 NTU and 2.0 mg/L, respectively. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Chloride by USEPA 9251, Nitrate by USEPA 4500NO3-F, and Sulfate by USEPA 300.0

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 3 and 4ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 9251 and 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 4500NO3-F) | The samples were analyzed and preserved per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.995 for Cyanide and r ≥ 0.99 for chloride, sulfate and nitrate, linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Chloride was detected in the method blanks WG298703-2 and WG298704-2 at 0.57 mg/L and 0.53 mg/L concentration. | AMEC U qualified the detected chloride results from samples SHL-10-101607, SHL-19-101607 and SHL-21-101607 because of laboratory blank contamination. (B-reason code) | High |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Samples SHL-9-101607 and SHM-93-22C-101607 were analyzed in duplicate for sulfate, chloride, and nitrate. The RPDs were within the method specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | Field duplicates RPDs were within method specified limits. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | The MS/MSD recoveries for sulfate analysis were within acceptance criteria. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nitrate was detected at concentrations below and above the method reporting limit of 0.1 mg/L.<br><br>Chloride and sulfate were detected at concentrations above the RL of 1.0 mg/L. | AMEC J qualified nitrate detections below the reporting limit, from samples DUP01-101607, SHL-21-101607, SHL-4-101607, SHL-9-101607 and SHM-93-22C-101607, with a TR (Trace level detected), reason code. | Estimation |

**November 14, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

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TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR_ SDG_L0715369

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|
| DUP01-101607 | 10/16/2007 | A4500F | L0715369-17 | NITRATE (AS N) | 0.062 | mg/l | J | TR |
| SHL-10-101607 | 10/16/2007 | 2130B | L0715369-09 | TURBIDITY | 0.81 | NTU | U | B |
| SHL-10-101607 | 10/16/2007 | SW6010 | L0715369-09 | IRON | 0.045 | mg/l | J | TR |
| SHL-10-101607 | 10/16/2007 | SW6010 | L0715369-09 | POTASSIUM | 0.83 | mg/l | J | TR |
| SHL-10-101607 | 10/16/2007 | SW6010 | L0715369-09 | SODIUM | 1.2 | mg/l | J | TR |
| SHL-10-101607 | 10/16/2007 | SW6020 | L0715369-09 | ARSENIC | 0.00059 | mg/l | J | TR |
| SHL-10-101607 | 10/16/2007 | SW9251 | L0715369-09 | CHLORIDE | 2.2 | mg/l | U | B |
| SHL-19-101607 | 10/16/2007 | SW9251 | L0715369-03 | CHLORIDE | 2.8 | mg/l | U | B |
| SHL-21-101607 | 10/16/2007 | 2130B | L0715369-10 | TURBIDITY | 0.56 | NTU | U | B |
| SHL-21-101607 | 10/16/2007 | A4500F | L0715369-10 | NITRATE (AS N) | 0.092 | mg/l | J | TR |
| SHL-21-101607 | 10/16/2007 | SW6010 | L0715369-10 | IRON | 0.04 | mg/l | J | TR |
| SHL-21-101607 | 10/16/2007 | SW6010 | L0715369-10 | MANGANESE | 0.0046 | mg/l | J | TR |
| SHL-21-101607 | 10/16/2007 | SW6010 | L0715369-10 | POTASSIUM | 1 | mg/l | J | TR |
| SHL-21-101607 | 10/16/2007 | SW6020 | L0715369-10 | ARSENIC | 0.00081 | mg/l | J | TR |
| SHL-21-101607 | 10/16/2007 | SW9251 | L0715369-10 | CHLORIDE | 1.9 | mg/l | U | B |
| SHL-22-101607 | 10/16/2007 | 2130B | L0715369-07 | TURBIDITY | 0.39 | NTU | U | B |
| SHL-4-101607 | 10/16/2007 | A4500F | L0715369-16 | NITRATE (AS N) | 0.079 | mg/l | J | TR |
| SHL-9-101607 | 10/16/2007 | A4500F | L0715369-13 | NITRATE (AS N) | 0.091 | mg/l | J | TR |
| SHM-93-22C-101607 | 10/16/2007 | A4500F | L0715369-11 | NITRATE (AS N) | 0.038 | mg/l | J | TR |
| SHP-01-36X-101607 | 10/16/2007 | 2130B | L0715369-02 | TURBIDITY | 0.46 | NTU | U | B |
| SHP-01-36X-101607 | 10/16/2007 | SW6010 | L0715369-02 | POTASSIUM | 1.5 | mg/l | J | TR |
| SHP-01-37X-101607 | 10/16/2007 | 2130B | L0715369-14 | TURBIDITY | 0.67 | NTU | U | B |
| SHP-01-37X-101607 | 10/16/2007 | SW6010 | L0715369-14 | POTASSIUM | 2.2 | mg/l | J | TR |

**Validation Qualifiers:**

R — The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample.

U — The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks.

J — The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits.

TABLE 6
Data Validation Qualifiers
Fort Devens, Shepley's Hill Landfill
DVR_ SDG_L0715369

| | |
|---|---|
| UJ | The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits. |

**Reason Code:**

| | |
|---|---|
| B | Contaminant detected in preparation (method) or calibration blank |
| TR | Trace level detect |

**November 26, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

## INTRODUCTION

This data validation report covers sixteen primary water samples, one trip blank and one equipment blank collected on October 17, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on October 17, 2007 and assigned sample delivery group (SDG) number L0715441, upon receipt. Alpha analyzed the samples for total metals using USEPA 6020A/6010B methods, volatile organic compounds using USEPA method 8260B, turbidity using Standard method 2130B, total alkalinity using Standard Method 2320B, chloride and sulfate using USEPA Method 300.0, and nitrate using USEPA Method 353.2. The associated field sample identification (ID) and Alpha sample ID are presented in Table 2.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3, Table 4, Table 5, and Table 6. The level of data validation specified in Table 1 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 7 attached to this report.

**Table 1. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | Two sample coolers were received on 10/17/07 at temperatures of 4.7 and 5.5°C | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0715441 |

**Table 2. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0715441-01 | EQG-101707 | Metals, Other inorganics |
| L0715441-02 | EW1-101707 | Analyzed only for 8260B |
| L0715441-03 | EW2-101707 | Analyzed only for 8260B |
| L0715441-04 | TRIP BLANK | Only 8260B |
| L0715441-05 | SHM-05-42A-101707 | Metals, Other inorganics |
| L0715441-06 | SHM-99-31A-101707 | Metals, Other inorganics |
| L0715441-07 | SHM-05-42B-101707 | Metals, Other inorganics |

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0715441-08 | SHM-99-31C-101707 | Metals, Other inorganics |
| L0715441-09 | SHM-05-41B-101707 | Metals, Other inorganics |
| L0715441-10 | SHM-05-39A-101707 | Metals, Other inorganics |
| L0715441-11 | SHM-05-41A-101707 | Metals, Other inorganics |
| L0715441-12 | SHM-05-41C-101707 | Metals, Other inorganics |
| L0715441-13 | SHM-96-5B-101707 | Metals, Other inorganics |
| L0715441-14 | SHM-96-5C-101707 | Metals, Other inorganics |
| L0715441-15 | SHM-99-32X-101707 | Metals, Other inorganics |
| L0715441-16 | SHM-99-31B-101707 | Metals, Other inorganics |
| L0715441-17 | SHM-05-39B-101707 | Metals, Other inorganics |
| L0715441-18 | SHL-23-101707 | Metals, Other inorganics |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Metals by USEPA Methods 6010B and 6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 4.7 and 5.5ºC. Samples were preserved with $HNO_3$ to pH<2. The Chain of Custody is intact. The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2 | Sample was analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Calcium from sample EQG-101707, potassium, sodium and arsenic from sample SHL-23-101707, potassium from samples SHM-05-41A-101707 and SHM-99-31A-101707, manganese, potassium, sodium and arsenic from sample SHM-05-42A-101707 were reported below the method reporting limit. | These analytes were J qualified on the data tables, with a TR (trace level) reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No analytes were detected in the preparation blanks associated with these samples.<br>Calcium at 0.062 mg/L was detected in the equipment blank EQG-101707. | Calcium concentrations in the associated samples were more than 5 times the equipment blank concentration. No qualification is required. | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | No analytes were detected in the laboratory blanks associated with these samples. | | |

**November 26, 2007**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standard %Rs were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EQG-101707 was used as source for the PDS. The recoveries were within acceptance limits. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analyses on sample EQG-101707. The %Ds could not be calculated due to non-detection of the analytes. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Calcium from sample EQG-101707, potassium, sodium and arsenic from sample SHL-23-101707, potassium from samples SHM-05-41A-101707 and SHM-99-31A-101707, manganese, potassium, sodium and arsenic from sample SHM-05-42A-101707 were reported below the method reporting limit. | These analytes were J qualified on the data tables, with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Volatile Organic Compounds by USEPA Method 8260B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data, and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample preserved with HCl.<br>4) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 4.7 and 5.5ºC.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous unpreserved sample 7 days and aqueous preserved 14 days.<br>2) If analysis HT exceeded flag all detected results "J" and nondetected results "UJ"<br>3) If HT grossly exceeded (≥ 3x HT) flag all detected results "J" and nondetected results "R" | Samples were analyzed within holding time. | | |
| GC/MS tunes with BFB | 1) Every 12 hours.<br>2) Samples analyzed beyond tune time flag all detected results "J" and nondetected results "UJ" | BFB tune met acceptance criteria. | | |
| Initial Calibration | 1) Minimum of 5 standards.<br>2) Compounds with RSDs ≤ 15% or "r" ≥ 0.99, except CCCs which must be ≤ 30%RSD or "r" ≥ 0.99, values flag detected results "J" and nondetected results "UJ"<br>2) Compounds with very low RRFs (<0.01) flag detected results "J" and nondetected results "R | Initial calibration met established criteria. Calibration was performed on 10/24/2007. | | |
| Continuing Calibration Verification (CCV) | 1) No qualification if recovery between 80 – 120% for CCCs and 70%-130% for other analytes.<br>a) %R >120 or 130% flag detected results "J"<br>b) %R <80 or 70% flag detected results "J" and nondetected results "UJ" | CCV recovery was within acceptance limits. | | |
| Blanks (Method, Trip, Field, Rinsate, etc.) | 1) Every 20 samples prior to running samples and after calibration standards;<br>2) Matrix and preservative specific;<br>3) Target analytes must be < RL except for common laboratory contaminants (e.g. acetone, methylene chloride, MEK which must be <5x the RL)<br>2) Apply TB, FB, RB results to samples with same collection date. | VOCs were not detected in the method blank WG299626 or Trip Blank. | | |
| Surrogates | 1) 70-130% recovery for samples.<br>2) 80-120% for method blanks, matrix spikes and LCS. | All surrogate recoveries met established criteria. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recoveries | 1) 70-130% recovery; ≤25%RPD<br>a) %R<70% flag detected results "J" and nondetected results "UJ"<br>b) %R>130% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>2) Qualify all associated samples. | LCS/LCSD recoveries and RPD were within acceptance criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 70-130%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>3) RPD>30% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Internal Standards (IS) | 1) 50%-200% of area counts in associated CCAL standard.<br>2) ±30 seconds of RT in associated CCAL standard. | Internal standards were within acceptance criteria. | | |
| Compound Quantitation | 1) Qualify detected results with concentrations greater than the highest ICAL standard concentration "J"<br>2) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | 1,4-Dichlorobenzene, tetrahydrofuran, p-dioxane, MTBE, chloroethane, vinyl chloride, naphthalene and isopropylbenzene from sample EW1-101707 and 1,4-dichlorobenzene and naphthalene from sample EW2-101707 were detected and reported between the MDL and the RL. | AMEC J qualified these analytes from the samples EW1-101707 and EW2-101707 on the data tables, with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Turbidity by Standard Method 2130B and Total Alkalinity by Standard Method 2320B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |

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**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| COC | 1) Sample custody documentation.<br>2) Temperature ≤6°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 4.7 and 5.5ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days, preservation not required (Alkalinity) (EPA Method 2320B)<br>2) 48 hours, preservation not required (Turbidity)(EPA Method 2130B) | Samples were analyzed as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for alkalinity linear calibration<br>Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (alkalinity).<br>a) %R >110% (alkalinity) flag detected results "J"<br>b) %R <90% (alkalinity) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Turbidity was detected in the method blank WG298607-2 at 0.16 NTU and the equipment blank (EQG-101707) at 0.18 NTU.<br>Total alkalinity was detected in the method blanks (WG298859-1/WG298862-1) at 1 mg/L and 1.4 mg/L, respectively, and the equipment blank at 1.6 mg/L.<br>The concentrations in the associated samples were more than 5 times the MB and EB concentrations, except for what was qualified by AMEC. | AMEC U qualified the detected turbidity result from samples EQG-101707 and the detected alkalinity results from samples EQG-101707 and SHL-23-101707 because the samples concentrations were less than 5x the MB concentration. A B (contamination detected) reason code was applied. | High |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |

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**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCSs recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample EQG-101707 was analyzed in duplicate for turbidity and samples SHM-05-41A-101707 and SHL-23-101707 were analyzed in duplicate for total alkalinity. The RPDs were within the specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicates were associated with samples from this SDG. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD was associated with samples from this SDG for these methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Turbidity and total alkalinity were detected in all associated samples at a concentrations above the method reporting limit of 0.20 NTU and 2.0 mg/L, respectively. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 6. Nitrate by USEPA 353.2, and Chloride and Sulfate by USEPA 300.00

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 4.7 and 5.5°C.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 300.0)<br>2) 48 hours, preservation not required (Nitrate-N)(EPA Method 353.2) | The samples were analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) $r \geq 0.99$ for chloride, sulfate and nitrate, linear calibration<br>Analytes with low $r < 0.99$ flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |

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**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No nitrate or sulfate was detected in the associated method blanks.<br><br>Nitrate was detected in the equipment blank (EQG-101707) at 0.049 mg/L.<br><br>Chloride was detected in the method blank WG298705-2 at 0.51 mg/L and the equipment blank (EQG-101707) at 0.53 mg/L. | AMEC U qualified the detected nitrate results from samples SHM-05-41A-101707, SHM-05-41C-101707, SHM-05-42A-101707 and SHM-05-42B-101707 and the detected chloride results from samples EQG-101707, SHL-23-101707, SHM-05-41A-101707 and SHM-05-42A-101707 because the sample concentrations were less than 5x the MB concentration. A B (contamination detected) reason code was applied. | High |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHL-23-101707 was analyzed in duplicate for chloride, sample SHM-96-5B-101707 was analyzed in duplicate for sulfate and sample SHM-05-41A-101707 was analyzed in duplicate for nitrate. The RPDs were within acceptance criteria. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

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**Metals by USEPA Methods 6020A/6010B**
**Volatile Organic Compounds by USEPA Method 8260B**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample SHM-96-5B-101707 was used as the source sample for the MS/MSD for sulfate. The recovery was within acceptance criteria.<br>No MS/MSD was associated with samples from this SDG for the chloride and nitrate methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported RL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Chloride was reported as detected above the method reporting limits in all samples.<br>Sulfate and nitrate were reported as detected above the method reporting limits, except for what was qualified. | AMEC J qualified the detected sulfate result from sample SHM-05-42B-101707 and the detected nitrate result from sample EQG-101707 on the data tables, with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

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**TABLE 7**
**Data Validation Qualifiers**
**Fort Devens, Shepley's Hill Landfill**
**DVR_ SDG_L0715441**

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|
| EQG-101707 | 10/17/2007 | 2130B | L0715441-01 | TURBIDITY | 0.18 | NTU | U | B |
| EQG-101707 | 10/17/2007 | A2320 | L0715441-01 | ALKALINITY, TOTAL | 1.6 | mg/L | U | B |
| EQG-101707 | 10/17/2007 | A4500F | L0715441-01 | NITRATE (AS N) | 0.049 | mg/l | J | TR |
| EQG-101707 | 10/17/2007 | SW6010 | L0715441-01 | CALCIUM METAL | 0.062 | mg/l | J | TR |
| EQG-101707 | 10/17/2007 | SW9251 | L0715441-01 | CHLORIDE | 0.53 | mg/l | U | B |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | 1,4-DICHLOROBENZENE | 1.4 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | TETRAHYDROFURAN | 2.2 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | P-DIOXANE | 78 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | Methyl tert butyl ether | 0.37 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | CHLOROETHANE | 0.76 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | VINYL CHLORIDE | 0.52 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | NAPHTHALENE | 2.2 | ug/l | J | TR |
| EW1-101707 | 10/17/2007 | SW8260 | L0715441-02 | ISOPROPYLBENZENE | 0.36 | ug/l | J | TR |
| EW-2-101707 | 10/17/2007 | SW8260 | L0715441-03 | 1,4-DICHLOROBENZENE | 0.62 | ug/l | J | TR |
| EW-2-101707 | 10/17/2007 | SW8260 | L0715441-03 | NAPHTHALENE | 2.1 | ug/l | J | TR |
| SHL-23-101707 | 10/17/2007 | A2320 | L0715441-18 | ALKALINITY, TOTAL | 4.5 | mg/L | U | B |
| SHL-23-101707 | 10/17/2007 | SW6010 | L0715441-18 | POTASSIUM | 0.99 | mg/l | J | TR |
| SHL-23-101707 | 10/17/2007 | SW6010 | L0715441-18 | SODIUM | 1 | mg/l | J | TR |
| SHL-23-101707 | 10/17/2007 | SW6020 | L0715441-18 | ARSENIC | 0.00073 | mg/l | J | TR |
| SHL-23-101707 | 10/17/2007 | SW9251 | L0715441-18 | CHLORIDE | 1.9 | mg/l | U | B |
| SHM-05-41A-101707 | 10/17/2007 | A4500F | L0715441-11 | NITRATE (AS N) | 0.067 | mg/l | U | B |
| SHM-05-41A-101707 | 10/17/2007 | SW6010 | L0715441-11 | POTASSIUM | 1.8 | mg/l | J | TR |
| SHM-05-41A-101707 | 10/17/2007 | SW9251 | L0715441-11 | CHLORIDE | 1.9 | mg/l | U | B |
| SHM-05-41C-101707 | 10/17/2007 | A4500F | L0715441-12 | NITRATE (AS N) | 0.097 | mg/l | U | B |
| SHM-05-42A-101707 | 10/17/2007 | A4500F | L0715441-05 | NITRATE (AS N) | 0.06 | mg/l | U | B |
| SHM-05-42A-101707 | 10/17/2007 | SW6010 | L0715441-05 | MANGANESE | 0.0081 | mg/l | J | TR |
| SHM-05-42A-101707 | 10/17/2007 | SW6010 | L0715441-05 | POTASSIUM | 1.9 | mg/l | J | TR |
| SHM-05-42A-101707 | 10/17/2007 | SW6010 | L0715441-05 | SODIUM | 1 | mg/l | J | TR |
| SHM-05-42A-101707 | 10/17/2007 | SW6020 | L0715441-05 | ARSENIC | 0.00101 | mg/l | J | TR |
| SHM-05-42A-101707 | 10/17/2007 | SW9251 | L0715441-05 | CHLORIDE | 1.6 | mg/l | U | B |
| SHM-05-42B-101707 | 10/17/2007 | A4500F | L0715441-07 | NITRATE (AS N) | 0.095 | mg/l | U | B |
| SHM-05-42B-101707 | 10/17/2007 | E300 | L0715441-07 | SULFATE | 0.13 | mg/l | J | TR |
| SHM-99-31A-101707 | 10/17/2007 | SW6010 | L0715441-06 | POTASSIUM | 0.68 | mg/l | J | TR |

# TABLE 7
# Data Validation Qualifiers
# Fort Devens, Shepley's Hill Landfill
# DVR_ SDG_L0715441

**Validation Qualifiers:**

| | |
|---|---|
| R | The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample. |
| U | The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks. |
| J | The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits. |
| UJ | The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits. |

**Reason Code:**

| | |
|---|---|
| B | Contaminant detected in preparation (method) or calibration blank |
| TR | Trace level detect |

**November 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers nine primary water samples and one field QC (equipment blank) sample collected on October 18, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on October 18, 2007 and assigned sample delivery group (SDG) number L0715525 upon receipt. Alpha analyzed the samples for total metals using USEPA 6010/6020 methods, turbidity using Standard method 2130B, total alkalinity using Standard Method 2320B, chloride using USEPA Method 9251, sulfate using USEPA Method 300.0, and nitrate-nitrogen using Standard Method 4500NO3-F. The associated field sample identification (ID) and Alpha sample ID are presented in Table 1.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA and Standard Methods outlined in Table 3, Table 4 and Table 5. The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and USEPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below. Definitions of data qualifiers added during validation and summaries of specific qualifiers added to each affected sample as a result of the data validation findings are presented in Table 6 attached to this report.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0715525-01 | SHP-93-10D-101807 | |
| L0715525-02 | N5-P2-101807 | |
| L0715525-03 | N5-P1-101807 | |
| L0715525-04 | SHL-5-101807 | |
| L0715525-05 | SHP-99-29X-101807 | |
| L0715525-06 | SHM-05-40X-101807 | |
| L0715525-07 | SHL-8S-101807 | |
| L0715525-08 | SHL-8D-101807 | |
| L0715525-09 | SHL-13-101807 | |
| L0715525-10 | EQP-101807 | Field QC (Equipment Blank) |

## Table 2. Sample Status

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | Two sample coolers were received on 10/18/07 at temperatures of 2.8 and 4°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0715525 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

## Table 3. Metals by USEPA 6010B/6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.8 and 4°C. Samples were preserved with $HNO_3$ to pH<2. The Chain of Custody is intact. The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS tune solution met the required limit. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |

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**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Manganese and calcium from sample EQP-101807; potassium from samples SHL-13-101807, SHL-8S-101807, and SHP-29-99X-101807; potassium and sodium from sample SHL-5-101807; and iron and potassium from sample SHL-8D-101807 were detected at concentrations below the method reporting limit. Alpha J qualified the results less than the method reporting limit and AMEC concurs with these qualifications. | AMEC J qualified detections below the reporting limit, with a TR (Trace level detected), reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Metals were not detected in the method blank at concentrations greater than the MDL.<br>Arsenic (0.00025 mg/L), calcium (0.018 mg/L) and manganese (0.0005 mg/L) were detected in the equipment blank. | The arsenic, calcium and manganese concentrations detected in the associated samples were more than 5 times the equipment blank concentrations. No qualification is warranted. | |

**November 26, 2007** **Metals by USEPA Methods 6010/6020**
**Region I Data Review Worksheet** **Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was detected in multiple CCBs in the sequence.<br>All other metals were not detected in the ICB/CCBs associated with these samples. | The arsenic concentrations detected in the associated samples were more than 5 times the CCBs concentrations. No qualification warranted. | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | The IS %Rs were within acceptable limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | The laboratory duplicate was not associated with any sample from this SDG. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this SDG. | | |

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**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with samples from this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample SHP-93-10D-101807 was used as source for the PDS. The recoveries were acceptable for all analytes except calcium with 70% recovery. The calcium background concentration is more than 4 times the spike concentration. | No qualification is required. | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analysis on samples SHP-93-10D-101807. The %Ds were within acceptance limits, except for manganese (11.7%), potassium (15.3%) and sodium (23.3%). | Manganese, potassium and sodium concentration were <50 times the MDL, therefore no qualification is required. | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the IDL but below the RL should be considered estimated and be flagged "J" | The laboratory J qualified detected results with concentrations between the RL and MDL and AMEC concurs with these qualifications. | AMEC J qualified these results with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Turbidity by USEPA 2130B and Total Alkalinity by USEPA 2320B

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature ≤6°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.8 and 4ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days, preservation not required (Alkalinity) (EPA Method 2320B)<br>2) 48 hours, preservation not required (Turbidity)(EPA Method 2130B) | Samples were analyzed as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for alkalinity linear calibration Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (alkalinity).<br>a) %R >110% (alkalinity) flag detected results "J"<br>b) %R <90% (alkalinity) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Turbidity was detected in the method blank WG298775-2 at 0.17 NTU. Total alkalinity was detected in the method blank WG298998-1 at 1.2 mg/L and the equipment blank at 1.6 mg/L.<br>The concentrations in the associated samples were more than 5 times the MB and EB concentrations, therefore, no alkalinity results were qualified. | AMEC U qualified the detected turbidity results from samples SHL-13-101807, EQP-101807, and SHL-8D-101807 because the sample concentrations were less than 5x the MB concentration. A B (contamination detected) reason code was applied. | High |

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**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample SHP-93-10D-101807 was analyzed in duplicate for turbidity and sample SHL-13-101807 was analyzed in duplicate for total alkalinity. The RPDs were within the specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | Field duplicate RPDs were within method specified criteria. | | |
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD was associated with samples from this SDG for these methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Turbidity and total alkalinity were detected in all associated samples at a concentrations above the method reporting limit of 0.20 NTU and 2.0 mg/L, respectively. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 5. Chloride by USEPA 9251, Nitrate by USEPA 4500NO3-F, and Sulfate by USEPA 300.0

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Coolers temperatures upon arrival at Alpha were 2.8 and 4ºC.<br>The laboratory Sample Receipt and Log-in Checklist indicates that sample integrity was maintained during transport. | | |
| Holding Times (HT) | 1) 14 days if the samples preserved to pH>12 (EPA Method 9014)<br>2) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 9251 and 300.0)<br>3) 48 hours, preservation not required (Nitrate-N)(EPA Method 4500NO3-F) | The samples were analyzed and preserved per EPA Method requirements. | | |
| Initial Calibration | 1) $r \geq 0.995$ for Cyanide and $r \geq 0.99$ for chloride, sulfate and nitrate, linear calibration<br>Analytes with low $r < 0.99$ flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |

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**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Chloride was detected in the method blank (WG298729-2) and equipment blank (EQP-101807) at 0.8 mg/L and 0.5 mg/L, respectively.<br>Sulfate was detected in the method blank (WG299333-1) at 0.16 mg/L concentration.<br>Nitrate was detected at 0.01 mg/L concentration in the equipment blank (EQP-101807). | AMEC U qualified the detected chloride results from samples SHL-5-101807 and SHP-99-29X-101807; the detected sulfate results from samples N5-P2-101807 and SHL-8S-101807; and the detected nitrate result from sample SHL-13-101807 because of laboratory and field blank contamination. (B-reason code) | High |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Samples SHP-99-29X-101807, SHL-8D-101807 and SHL-13-101807 were analyzed in duplicate for nitrate, chloride and sulfate. The RPDs were within the method specified limit. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicates were associated with samples from this SDG. | | |

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**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6010/6020**
**Other Inorganics by USEPA 2130B/2320B/300.0/9251/4500NO3-F**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | No MS/MSD was associated with samples from this SDG for these methods. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Nitrate was detected at concentrations below and above the method reporting limit of 0.1 mg/L.<br><br>Chloride and sulfate were detected at concentrations above the RL of 1.0 mg/L. | AMEC J qualified nitrate detections below the reporting limit, from samples EQP-101807, SHL-8S-101807 and SHP-93-10D-101807, with a TR (Trace level detected), reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:

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**TABLE 6**
**Data Validation Qualifiers**
**Fort Devens, Shepley's Hill Landfill**
**DVR_ SDG_L0715525**

| Sample ID | Sample Date | EPA Analytical Method | Lab Sample ID | Analyte | Result | Units | Validation Qualifiers | Reason Code |
|---|---|---|---|---|---|---|---|---|
| EQP-101807 | 10/18/2007 | SW6010 | L0715525-10 | MANGANESE | 0.0005 | mg/l | J | TR |
| EQP-101807 | 10/18/2007 | SW6010 | L0715525-10 | CALCIUM METAL | 0.018 | mg/l | J | TR |
| EQP-101807 | 10/18/2007 | SW6020 | L0715525-10 | ARSENIC | 0.00025 | mg/l | J | TR |
| EQP-101807 | 10/18/2007 | SW9251 | L0715525-10 | CHLORIDE | 0.5 | mg/l | U | B |
| N5-P2-101807 | 10/18/2007 | E300 | L0715525-02 | SULFATE | 0.31 | mg/l | U | B |
| SHL-13-101807 | 10/18/2007 | 2130B | L0715525-09 | TURBIDITY | 0.25 | NTU | U | B |
| SHL-13-101807 | 10/18/2007 | A4500F | L0715525-09 | NITRATE (AS N) | 0.018 | mg/l | U | B |
| SHL-13-101807 | 10/18/2007 | SW6010 | L0715525-09 | POTASSIUM | 0.98 | mg/l | J | TR |
| SHL-5-101807 | 10/18/2007 | SW6010 | L0715525-04 | POTASSIUM | 1.9 | mg/l | J | TR |
| EQP-101807 | 10/18/2007 | 2130B | L0715525-10 | TURBIDITY | 0.19 | NTU | U | B |
| EQP-101807 | 10/18/2007 | A2320 | L0715525-10 | ALKALINITY, TOTAL | 1.6 | mg/L | J | TR |
| EQP-101807 | 10/18/2007 | A4500F | L0715525-10 | NITRATE (AS N) | 0.01 | mg/l | J | TR |
| SHL-5-101807 | 10/18/2007 | SW6010 | L0715525-04 | SODIUM | 1.4 | mg/l | J | TR |
| SHL-5-101807 | 10/18/2007 | SW9251 | L0715525-04 | CHLORIDE | 2.7 | mg/l | U | B |
| SHL-8D-101807 | 10/18/2007 | 2130B | L0715525-08 | TURBIDITY | 0.48 | NTU | U | B |
| SHL-8D-101807 | 10/18/2007 | SW6010 | L0715525-08 | IRON | 0.022 | mg/l | J | TR |
| SHL-8D-101807 | 10/18/2007 | SW6010 | L0715525-08 | POTASSIUM | 0.97 | mg/l | J | TR |
| SHL-8S-101807 | 10/18/2007 | A4500F | L0715525-07 | NITRATE (AS N) | 0.08 | mg/l | J | TR |
| SHL-8S-101807 | 10/18/2007 | E300 | L0715525-07 | SULFATE | 0.64 | mg/l | U | B |
| SHL-8S-101807 | 10/18/2007 | SW6010 | L0715525-07 | POTASSIUM | 1.3 | mg/l | J | TR |
| SHP-93-10D-101807 | 10/18/2007 | A4500F | L0715525-01 | NITRATE (AS N) | 0.07 | mg/l | J | TR |
| SHP-99-29X-101807 | 10/18/2007 | SW6010 | L0715525-05 | POTASSIUM | 0.53 | mg/l | J | TR |
| SHP-99-29X-101807 | 10/18/2007 | SW9251 | L0715525-05 | CHLORIDE | 3.1 | mg/l | U | B |

**Validation Qualifiers:**

R — The R qualifier indicates that a result has been rejected due to serious QC problems. It is not possible to definitively determine whether the analyte is present or absent in the sample.

U — The U qualifier indicates that the analyte must be considered to be nondetected at the concentration listed. U qualifiers added during data quality review are typically a result of detections of target analytes in field, trip, or laboratory blanks.

J — The J qualifier indicates that the associated result is quantitatively uncertain. J qualifiers added during validation may indicate a concentration between the method detection limit (MDL) and the method reporting limit (MRL) or a data limitation related to a QC element that exceeds required acceptance limits.

**TABLE 6**
**Data Validation Qualifiers**
**Fort Devens, Shepley's Hill Landfill**
**DVR_ SDG_L0715525**

| | |
|---|---|
| UJ | The UJ qualifier indicates reporting limit is estimated. UJ qualifiers added during validation may indicate either a high or low bias related to a QC element that exceeds required acceptance limits. |

**Reason Code:**

| | |
|---|---|
| B | Contaminant detected in preparation (method) or calibration blank |
| TR | Trace level detect |

**December 20, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

## INTRODUCTION

This data validation report covers three water samples collected on November 6, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on November 6, 2007 and assigned sample delivery group (SDG) number L0716507 upon receipt. Alpha analyzed the samples for total arsenic using USEPA Method 6020A. The associated field sample identification (ID) and Alpha sample ID is presented in Table 1.

The level of data validation specified in Table 2 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality.

Arsenic was detected and reported in all three samples as follows: EFF-110607 at a 1.3 µg/L concentration, RECY-110607 at a 372.3 µg/L concentration, and RECYFIL-110607 at a 372.2 µg/L concentration.

**Table 1. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0716507-01 | EFF-110607 | |
| L0716507-02 | RECY-110607 | |
| L0716507-03 | RECYFIL-110607 | |

**Table 2. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 11/06/2007 at a temperature of 2°C. | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0716507 |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Arsenic by USEPA 6020A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2ºC. The samples were transported to the laboratory, directly from the sampling site.<br>Sample was preserved with HNO3 to pH<2.<br>The Chain of Custody is intact.<br>The laboratory Sample Receipt and Log-in Checklist indicates that samples integrity were maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | The samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | The tune standard met established criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero, are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**December 20, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020) ; J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Arsenic was detected and reported within the calibration range. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Arsenic was not detected in the associated method blank. | | |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | Arsenic was not detected in the ICB or in CCBs at concentrations greater than the method-detection limit. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | IS recoveries were within the acceptance limits. | | |

**December 20, 2007** **Arsenic by USEPA Method 6020A**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits at 99% and 102%. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with these samples. | | |
| Field Duplicate RPD | 1) RPD ≤ 30% (waters); ≤ 40% (soils)<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | PDS recovery was within acceptance limits at 108%. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times IDL<br>3) %D>10% flag detected results "J" | The %D for the SD performed on sample EFF-110607 could not be calculated due to sample concentration less than 50 times the IDL. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Arsenic was reported as detected in all three samples and the required reporting limit of 0.003 mg/L was met. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

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**January 28, 2008**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Anions by USEPA Methods 300.0/353.2**

## INTRODUCTION

This data validation report covers three primary water samples collected on December 27, 2007 from the Shepley's Hill Landfill at the former Fort Devens, in Ayer, Massachusetts. The samples were dropped off by ECC at Alpha Woods Hole Laboratory in Westborough, MA (Alpha) on December 27, 2007 and assigned sample delivery group (SDG) number L0719131, upon receipt. Alpha analyzed the samples for total metals using USEPA 6000/7000 methods; chloride and sulfate using USEPA Method 300.0; and, nitrate using USEPA Method 353.2. The associated field sample identification (ID) and Alpha sample IDs are presented in Table 2.

AMEC reviewed the laboratory's analytical data package to assess for adherence to acceptable laboratory practices and the data validation requirements as specified in MADEP Massachusetts Contingency Plan Compendium of Analytical Methods and applicable USEPA Methods outlined in Table 3 and Table 4. The level of data validation specified in Table 1 was performed with reference to the Fort Devens Quality Assurance Project Plan (QAPP) and EPA Region I Tier II Guidance. For Tier II data review, data quality objectives are assessed by review of the CLP summary forms, with no review of the associated raw data.

## EXECUTIVE SUMMARY

All data is generally usable and of good quality. Any limitations on the data are listed below.

**Table 1. Sample Status**

| Data Validation Level | Matrix | Preservation | Temperature Sample Receipt | Laboratory | SDG Number |
|---|---|---|---|---|---|
| Tier II | Aqueous | As required by method | One sample cooler was received on 12/27/07 at a temperature of 2.4ºC | Alpha Woods Hole Laboratory, 8 Walkup Drive, Westborough, MA 01581 | L0719131 |

**Table 2. Field Sample List**

| Lab Sample Number | Field ID | Comments |
|---|---|---|
| L0719131-01 | EFF-122707 | Metals, Anions |
| L0719131-02 | EW1-122707 | Analyzed only for As, Fe, Mn |
| L0719131-03 | EW2-122707 | Analyzed only for As, Fe, Mn |

## DATA QUALITY OBJECTIVES AND VALIDATION FINDINGS

### Table 3. Metals by USEPA Methods 6010B, 6020A, and USEPA Method 7470A

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C for soils.<br>3) Aqueous sample preserved to pH<2.<br>4) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.4ºC. Samples were preserved with $HNO_3$ to pH<2.<br>The Chain of Custody is intact.<br>The laboratory sample receipt and log in checklist indicates that samples integrity was maintained during transport. | | |
| Holding Time | 1) Aqueous sample 180 days if preserved to pH<2<br>2) Hg - 28 days to analysis | Samples were analyzed within holding time. | | |
| ICP-MS Tune | 1) Tuning solution analyzed at least four times. RSD ≤ 5% for each component.<br>2) Mass calibration not within 0.1 AMU, qualify detected results "J" and nondetected results "UJ" | ICP-MS Tune met acceptance criteria. | | |
| Initial Calibration | 1) Correct calibration standards. At least 3 standards points not forced through zero are required for linear calibration, r≥0.995 (EPA Method 6010/6020/7470).<br>2) $r^2$ ≥0.995, quadratic calibration (at least 6 points, not forced through zero), | Initial calibration met established criteria. | | |
| 2nd Source Initial Calibration Verification (ICV) | 1) Following the calibration.<br>2) 90-110% recovery (EPA 6010/6020)<br>3) 75-89% recovery, J qualify detects and UJ qualify nondetects.<br>4) 111-125% recovery, J qualify detects.<br>5) 80-120% recovery (EPA 7470)<br>6) RSD <5% for the replicate | ICVs met acceptance criteria. | | |

**January 28, 2008**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Continuing Calibration Verification (CCV) | 1) CCV using mid and high level standards; analyzed after every 10 samples and at the end of batch.<br>2) Concentrations 80-120% (EPA Method 7470) and 90-110% of expected value (EPA Method 6010/6020).<br>a) CCV >120% (EPA Method 7470) or 110% (EPA Method 6010/6020); J qualify detects, no qualification is necessary for non detects.<br>b) CCV <80% (EPA Method 7470) or 90% (EPA Method 6010/6020); J qualify detects; UJ qualify non detects.<br>c) CCV outside 65-135%, reject data | All CCV recoveries were within acceptance limits. | | |
| Calibration Range/ Results | 1) Results >Upper calibration range J qualify detects.<br>2) Results <Method reporting limit, >method detection limit; J qualify detects (estimated). | Manganese (0.0011 mg/L), silver (0.0009 mg/L), copper (0.0076 mg/L), and mercury (0.00002 mg/L) from sample EFF-122707 were reported below the method reporting limit. | These analytes were J qualified on the data tables, with a TR (trace level) reason code. | Estimation |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) Evaluate down to the MDL.<br>2) If sample result is <5x contaminant concentration; flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | Copper (0.0025 mg/L) and silver (0.0009 mg/L) were detected in the method blank associated with sample EFF-122707. | AMEC U qualified the detected copper and silver results from sample EFF-122707, because the sample concentrations were less than 5 times the blank concentrations. Therefore a B (blank contamination) reason code was applied. | High |
| Initial Calibration Blanks and Continuing Calibration Blanks (ICB/CCB) | 1) ICB and CCB after every ten samples or every batch whichever is greater.<br>2) Evaluate absolute values down to the MDL.<br>3) Sample results < 5x blank sample, U qualify detects<br>4) Sample results >5x blank level, no action required. | No analytes were detected in the ICB or CCBs associated with these samples. | | |
| Negative blanks | 1) If the blank has a negative result with an absolute value >MDL, qualify detected results ≤5× the absolute value of the contaminant concentration as estimated "J" and qualify nondetected results "UJ". | No negative blank concentrations were detected. | | |

**January 28, 2008**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Interelement checks ICS-A/ICS-AB Instrument performance check | 1) No qualification required if recovery between 80-120%.<br>a)%R< 80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R" | ICS-A/ICS-AB recoveries were within acceptance limits. | | |
| Internal Standards (IS) | 1) Intensity of IS must be 30-120% of intensity of IS in the initial calibration standard.<br>a)%R<30% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J" and nondetected results "UJ" | All internal standards %R were within acceptance limits. | | |
| Laboratory Control Sample/ Laboratory Control Sample Duplicate (LCS/LCSD) Recovery | 1) LCS acceptance limits 80-120%, method requirements (EPA Method 6010/6020/7470)<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R>120% flag detected results "J"<br>c) %R<10% flag detected results "J" and nondetected results "R"<br>Qualify all associated samples. | The LCS/LCSD recoveries were within acceptable limits. | | |
| Laboratory Duplicate RPD | 1) RPD ≤ 20%<br>a) If exceeds RPD limit; J qualify detects, UJ qualify non detects.<br>b) If one result > MRL and other ND; J-detections, UJ qualify non detects<br>2) ± MRL for results ≤ 5x the MRL | No laboratory duplicate was associated with this SDG. | | |
| Field Duplicate RPD | 1) RPD >20% waters (>30% soils)<br>2) For detected results more than 5 times their PQLs flag "J"<br>3) Differences in concentrations > the MRL for analytes with concentrations less than 5 times their PQLs. flag "J" | No field duplicate was associated with this SDG. | | |
| MS/MSD Recovery | 1) MS/MSD acceptance limits are 75-125% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | No MS/MSD was associated with this SDG. | | |

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Post Digestion Spike (PDS) | 1) Acceptance limits are 75-150% (EPA Method 6000/7000).<br>2) Qualify results in the batch or of similar type.<br>3) If background concentration is >4x spike concentration qualification is not required<br>a) Recoveries <10% J qualify detects, R qualify non detects<br>b) Recoveries <75% flag detected results "J" and nondetected results "UJ"<br>c) Recoveries >125% flag detected results "J" | Sample EFF-122707 was used as source for the PDS. The recoveries were within acceptance limits. | | |
| Serial Dilution | 1) Once per digestion batch (EPA 6000 series)<br>2) ≤10% for analytes with concentration >50-times MDL<br>3) %D>10% flag detected results "J" | The laboratory performed serial dilution analyses on sample EFF-122707. The %Ds was less than 10% for sample concentrations more than 50 times the MDL. | | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear dynamic range (LDR).<br>a) Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported MRL should not be below the lowest ICAL standard concentration.<br>a) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Manganese (0.0011 mg/L) and mercury (0.00002 mg/L) were detected below the RL of 0.01 mg/L and 0.0002 mg/L, respectively, in sample EFF-122707. | AMEC J qualified the manganese and mercury results with a TR (trace level) reason code. | Estimation |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

## Table 4. Nitrate by USEPA 353.2, and Chloride and Sulfate by USEPA 300.00

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Data Completeness | 1) Complete SDG file.<br>a. Sample data package including case narrative, QC data and raw data.<br>b. Shipping and receiving documents.<br>c. All lab records of sample receipt, preparation and analysis. | All required deliverables were present in the data package. | | |
| COC | 1) Sample custody documentation.<br>2) Temperature 4±2°C<br>3) Sample delivery documentation. | Cooler temperature upon arrival at Alpha was 2.4°C.<br>The laboratory sample receipt and log in checklist indicates that sample integrity was maintained during transport. | | |

**January 28, 2008**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| Holding Times (HT) | 1) 28 days, preservation not required (Chloride, Sulfate) (EPA Method 300.0)<br>2) 48 hours, preservation not required (Nitrate-N)(EPA Method 353.2) | The sample was analyzed and preserved as per EPA Method requirements. | | |
| Initial Calibration | 1) r ≥ 0.99 for chloride, sulfate and nitrate, linear calibration<br>Analytes with low r <0.99 flag detected results "J" and nondetected results "UJ"<br>2) Use professional judgment if not enough points were used for curves. Determine if system imprecision or bias | Initial calibration criteria were met. Chloride and sulfate calibration preformed on 12/28/2007. Nitrate calibration preformed on 12/27/2007. | | |
| ICV/CCV | 1) No qualification if recovery between 90-110% (chloride, sulfate and nitrate) and 85-115% (cyanide).<br>a) %R >110% (chloride, sulfate and nitrate) and 115% (cyanide) flag detected results "J"<br>b) %R <90% (chloride, sulfate and nitrate) and 85% (cyanide) flag detected results "J" and nondetected results "UJ" | ICVs were within acceptance limits. | | |
| Blanks (Method, Field, Equipment, Rinsate, etc.) | 1) If sample result is <5x contaminant concentration and between MDL and MRL, raise result to MRL and flag "U"<br>2) If sample result is <5x contaminant concentration and ≥ MRL flag "U"<br>3) Sample result ≥5x contaminant concentration; no qualification required. | No nitrate, chloride, or sulfate were detected in the associated method blanks. | | |
| ICBs/CCBs | 1) Evaluate absolute values down to the MDL. Evaluate ICBs/CCBs that bracket samples. | ICB/CCBs were analyzed every 10 samples with no detections. | | |
| LCS | 1) No qualification if recovery between 80-120%<br>a) %R<80% flag detected results "J" and nondetected results "UJ"<br>b) %R >120% flag detected results "J"<br>c) %R <10% flag detected results "J" and nondetected results "R" | LCS recoveries were within acceptance criteria. | | |
| Lab Duplicate | 1) 20% ≤RPD, RPD >20% flag detected results "J" and nondetected results "UJ"<br>2) ± MRL for results ≤ 5x the MRL. Difference >MRL, flag detected results "J" and nondetected results "UJ" | Sample EFF-122707 was analyzed in duplicate for chloride, sulfate, and nitrate. The RPDs were within acceptance criteria. | | |
| Field Duplicates | 1) RPD ≤ 20% for aqueous samples (≤ 30% soil samples) for analytes with concentrations more than 5 times their PQLs, and concentrations within one MRL for analytes with concentrations less than 5 times their PQLs | No field duplicate was collected with this SDG. | | |

**January 28, 2008**
**Region I Data Review Worksheet**
**Project: SHL, Fort Devens**
**Review Criteria: Fort Devens QAPP and MADEP MCP**
**USEPA Region I Tier II Guidance**

**Metals by USEPA Methods 6000/7000**
**Anions by USEPA Methods 300.0/353.2**

| Review Items | Acceptance Criteria | Samples affected | Qualifications | Bias |
|---|---|---|---|---|
| MS/MSD | 1) No qualification required if recovery between 75-125%.<br>2) If background concentration is greater than 4x the spike concentration qualification is not required<br>%R< 75% flag detected results "J" and nondetected results "UJ"<br>%R < 125% flag detected results "J"<br>%R<10% flag detected results "J" and nondetected results "R"<br>Qualify only results in the spiked sample. (Qualify results for samples collected at same location but differing depths as well) | Sample EFF-122707 was used as the source sample for MS/MSD for chloride and sulfate. The chloride recovery was low at 50%, but the sample concentration at 67 mg/L was more than 4 times the spike concentration. The sulfate recovery was within acceptance criteria. | No qualification is required for the low chloride recovery. | |
| Compound Quantitation | 1) Instrument level concentrations should be less than the linear range. Qualify detected results with concentrations greater than the LDR "J"<br>2) The reported RL should not be below the lowest ICAL standard concentration.<br>3) Positive results reported above the MDL but below the RL should be considered estimated and be flagged "J" | Chloride, sulfate, and nitrate were reported as detected above the method reporting limits. | | |
| Overall Evaluation of Data | 1) Appropriate method.<br>2) Evaluate any analytical problems with laboratory results.<br>3) Evaluate sampling errors – field contamination, sample hold times. | No anomalies. | | |

If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Sincerely,

**AMEC Earth & Environmental, Inc.**

PREPARED BY:

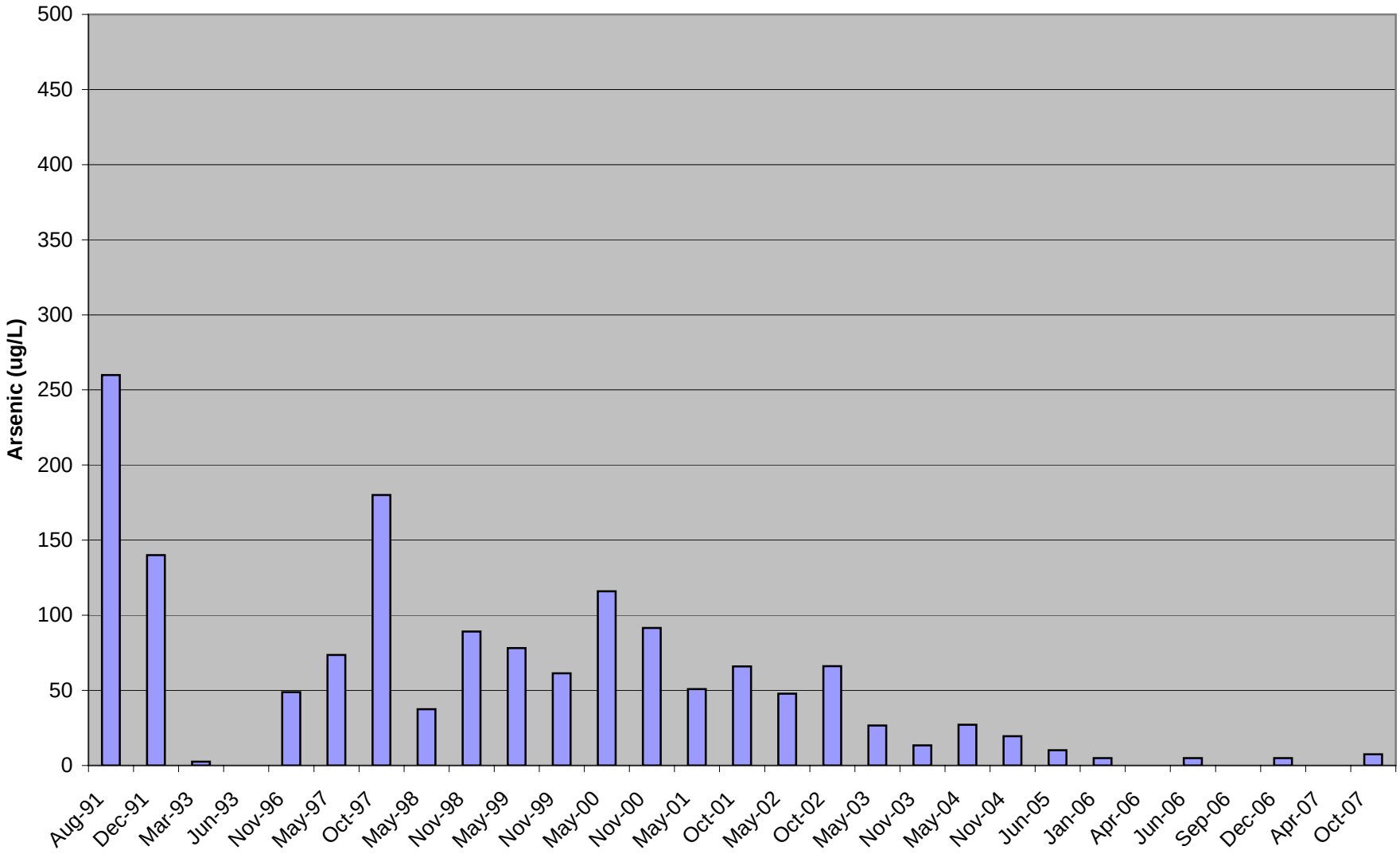
Melanie Roshu
Environmental Chemist

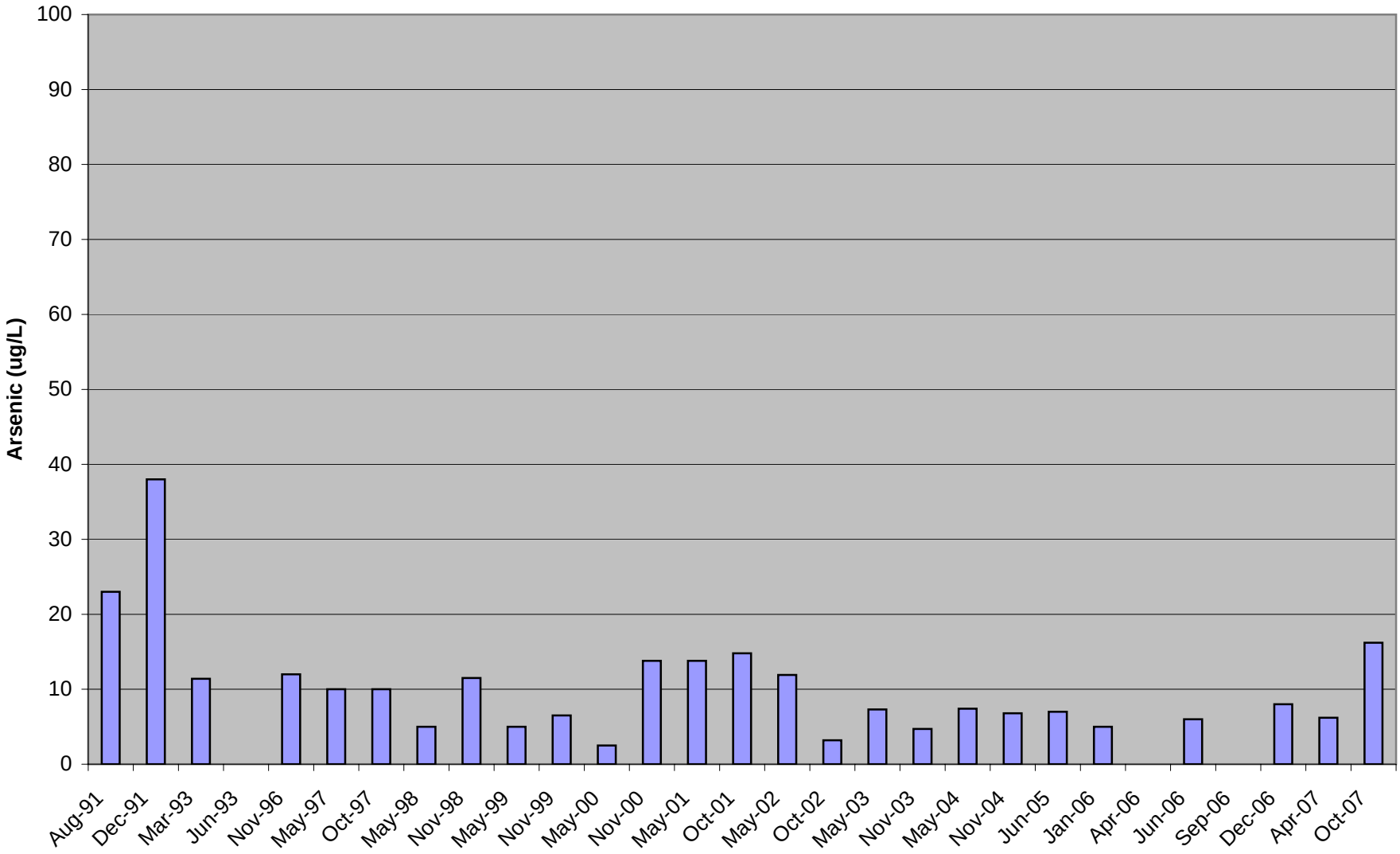
REVIEWED BY:

Denise Ladebauche
Environmental Chemist

# Appendix F

# Arsenic Trends


SHL-4
Arsenic (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07


SHL-5
Arsenic (ug/L)
100
90
80
70
60
50
40
30
20
10
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
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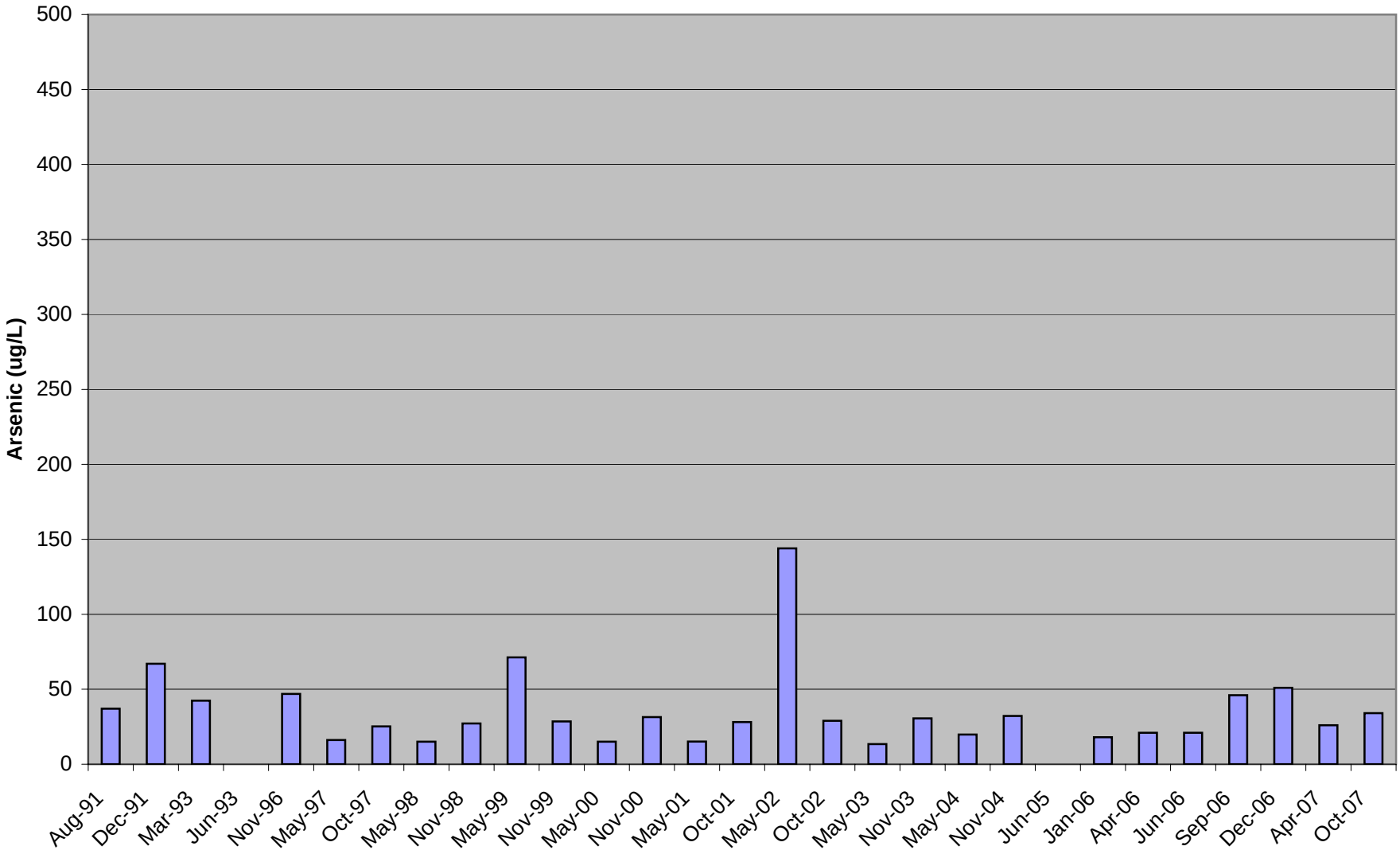
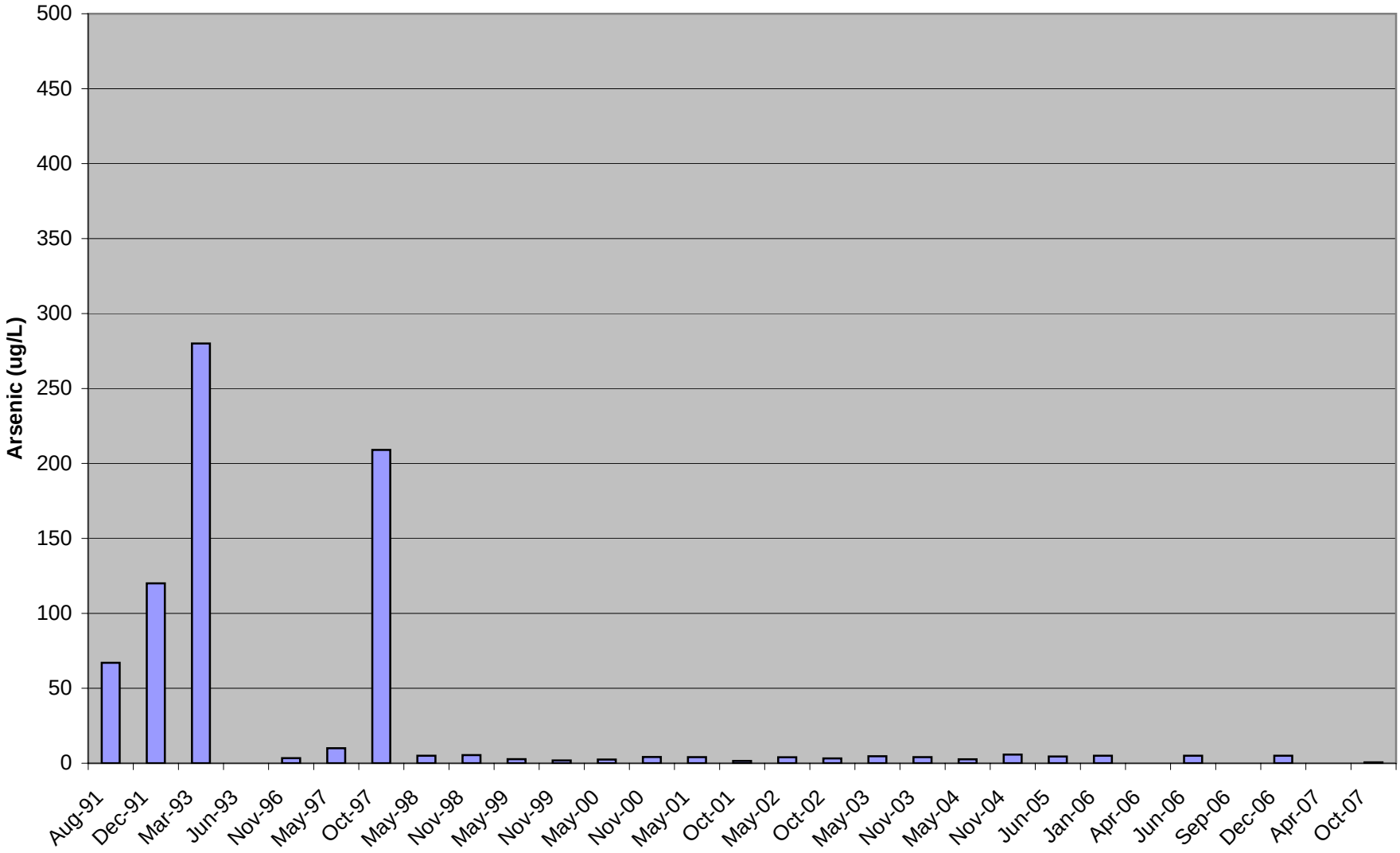
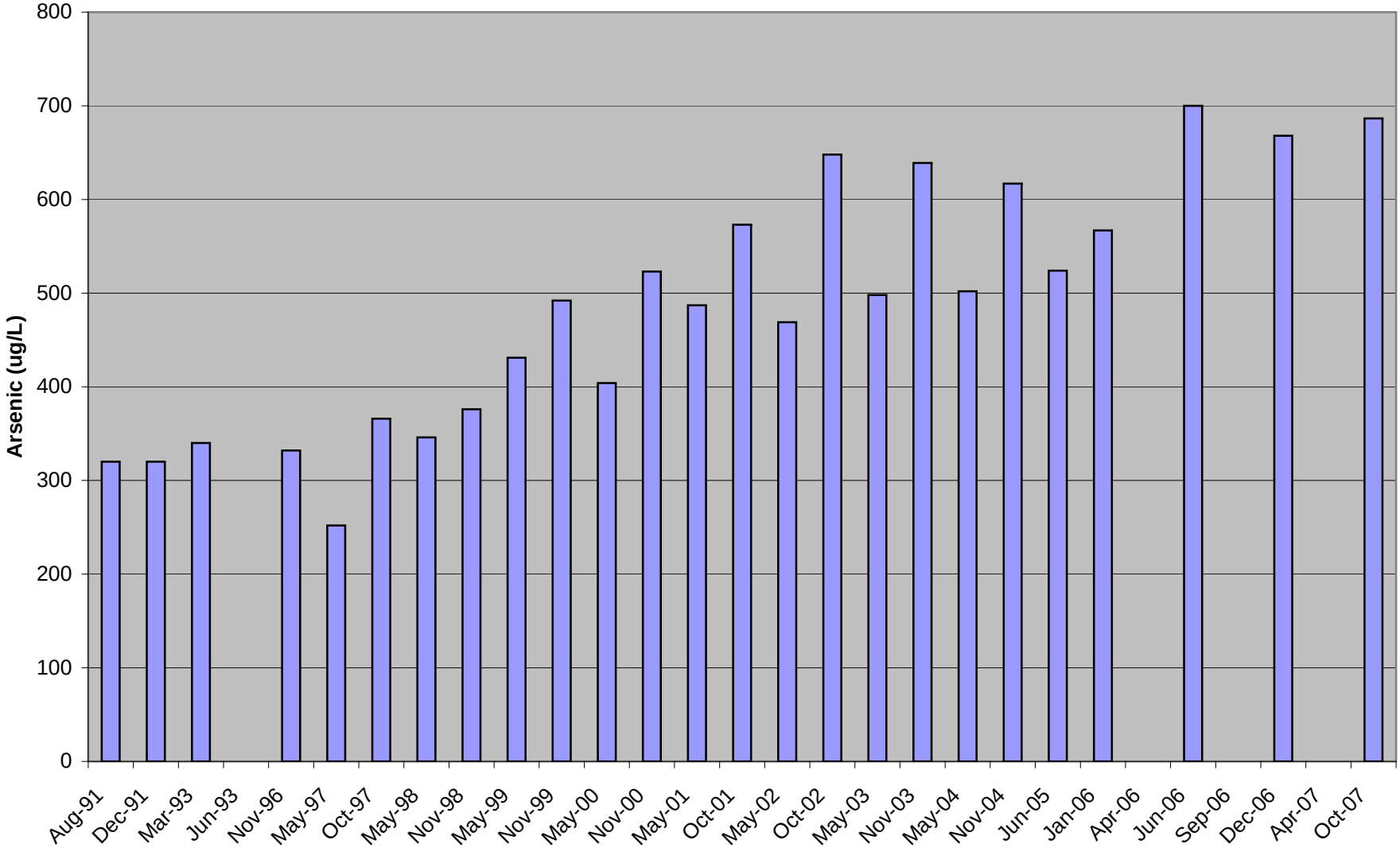
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07


SHL-9
Arsenic (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

## SHL-10


Arsenic (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

## SHL-11


Arsenic (ug/L)
800
700
600
500
400
300
200
100
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
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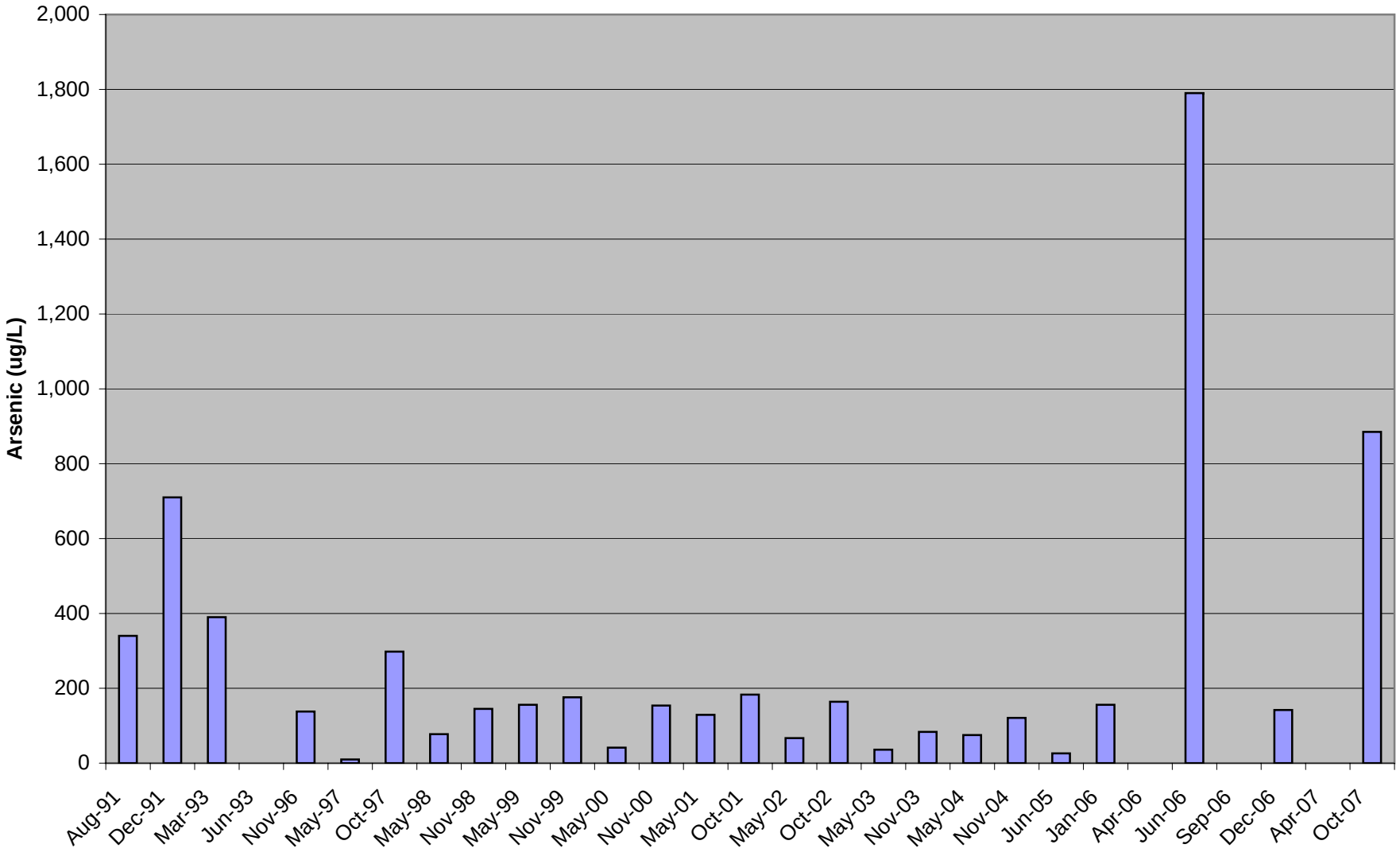
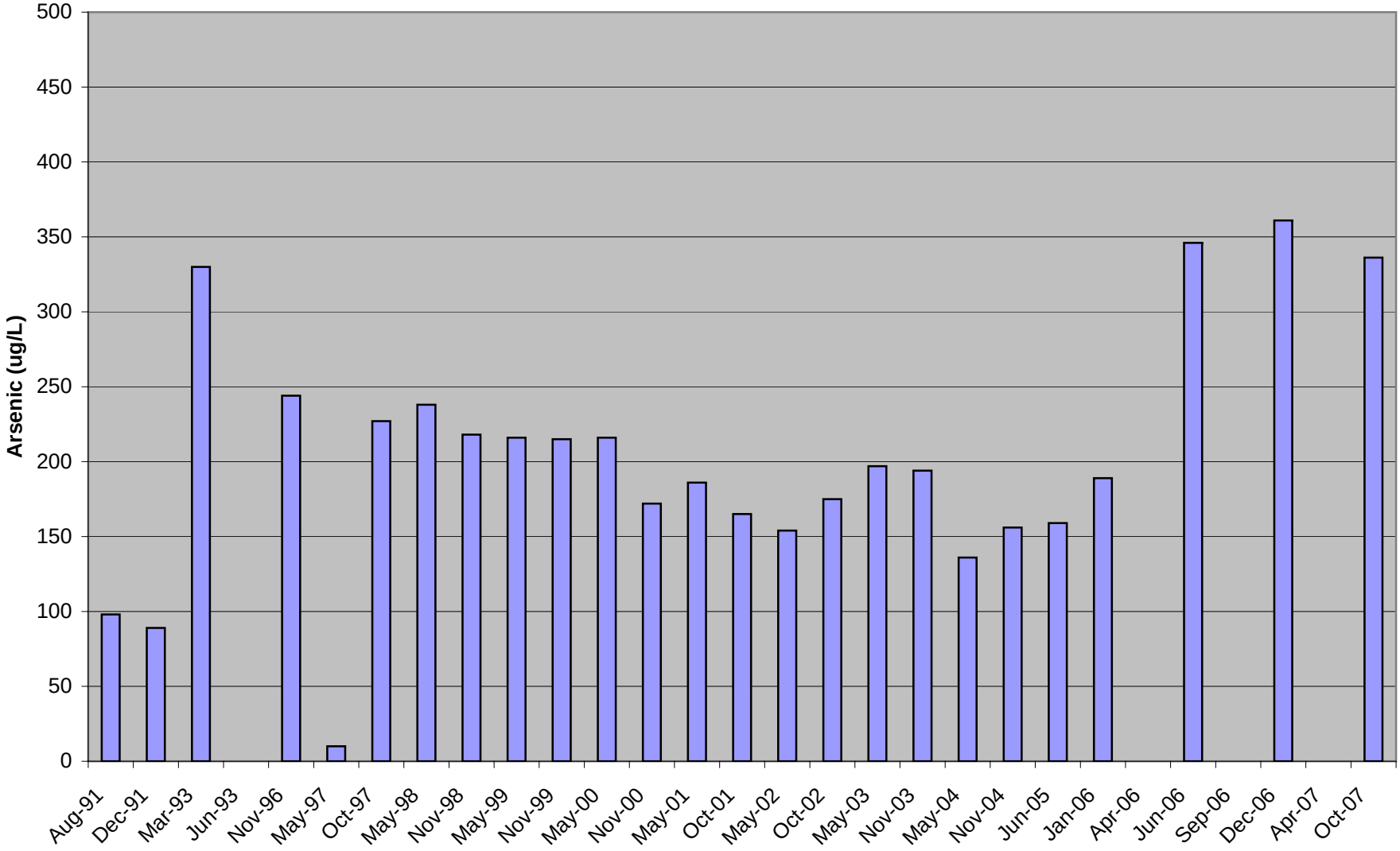
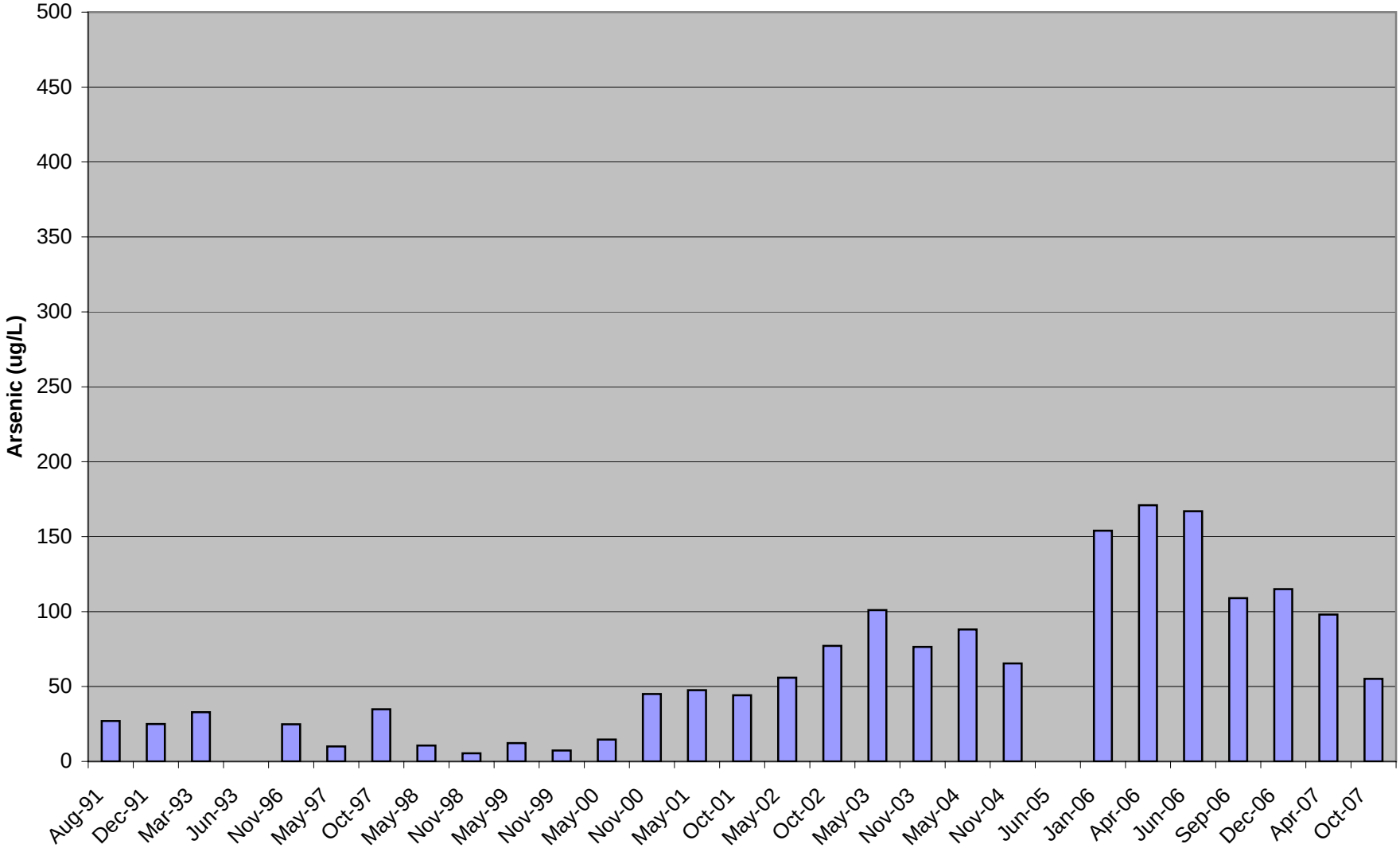
Dec-06
Apr-07
Oct-07


SHL-19
Arsenic (ug/L)
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

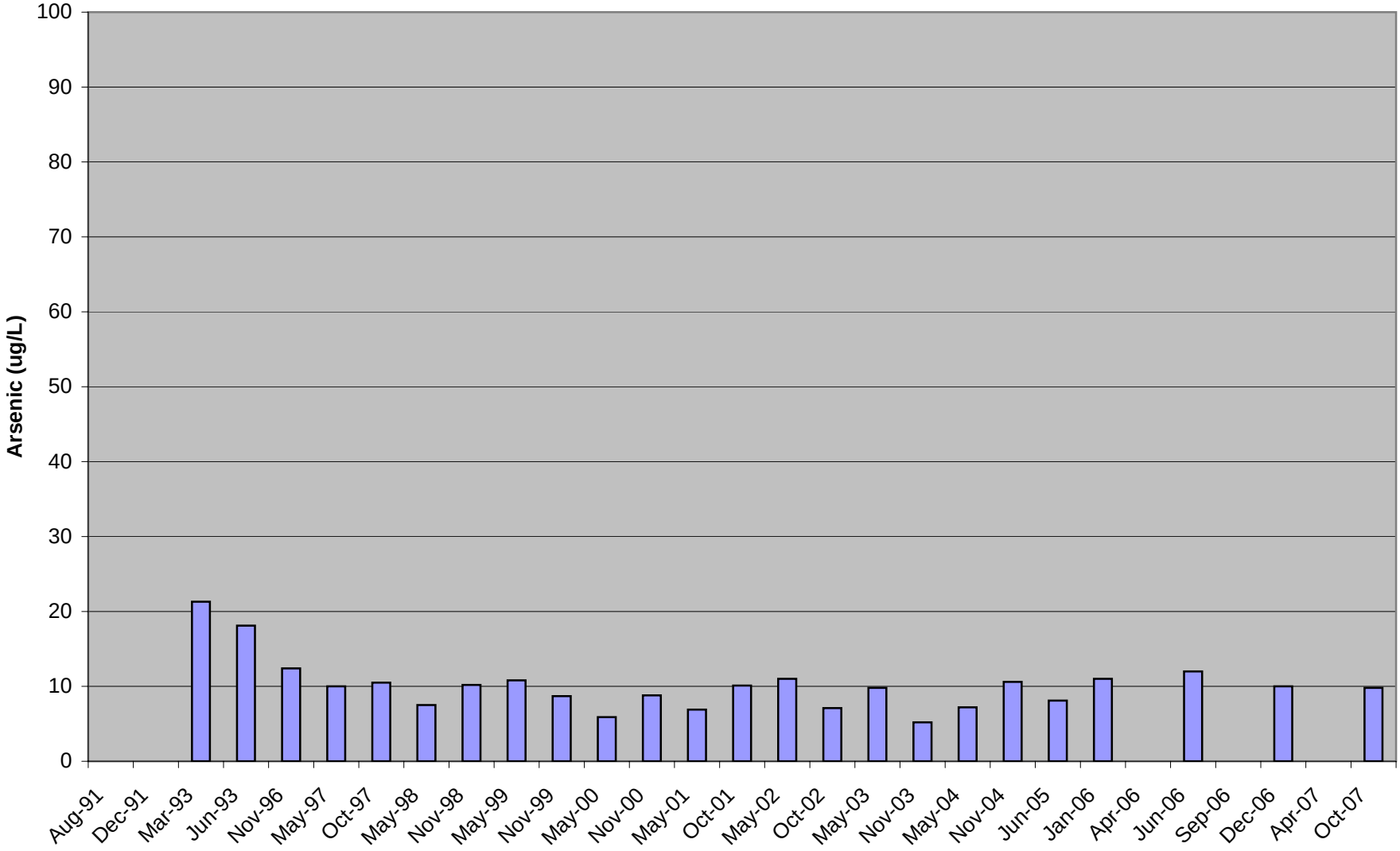
## SHL-20


Arsenic (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

## SHL-22


Arsenic (ug/L)
500
450
400
350
300
250
200
150
100
50
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

## SHM-93-10C


Arsenic (ug/L)
100
90
80
70
60
50
40
30
20
10
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
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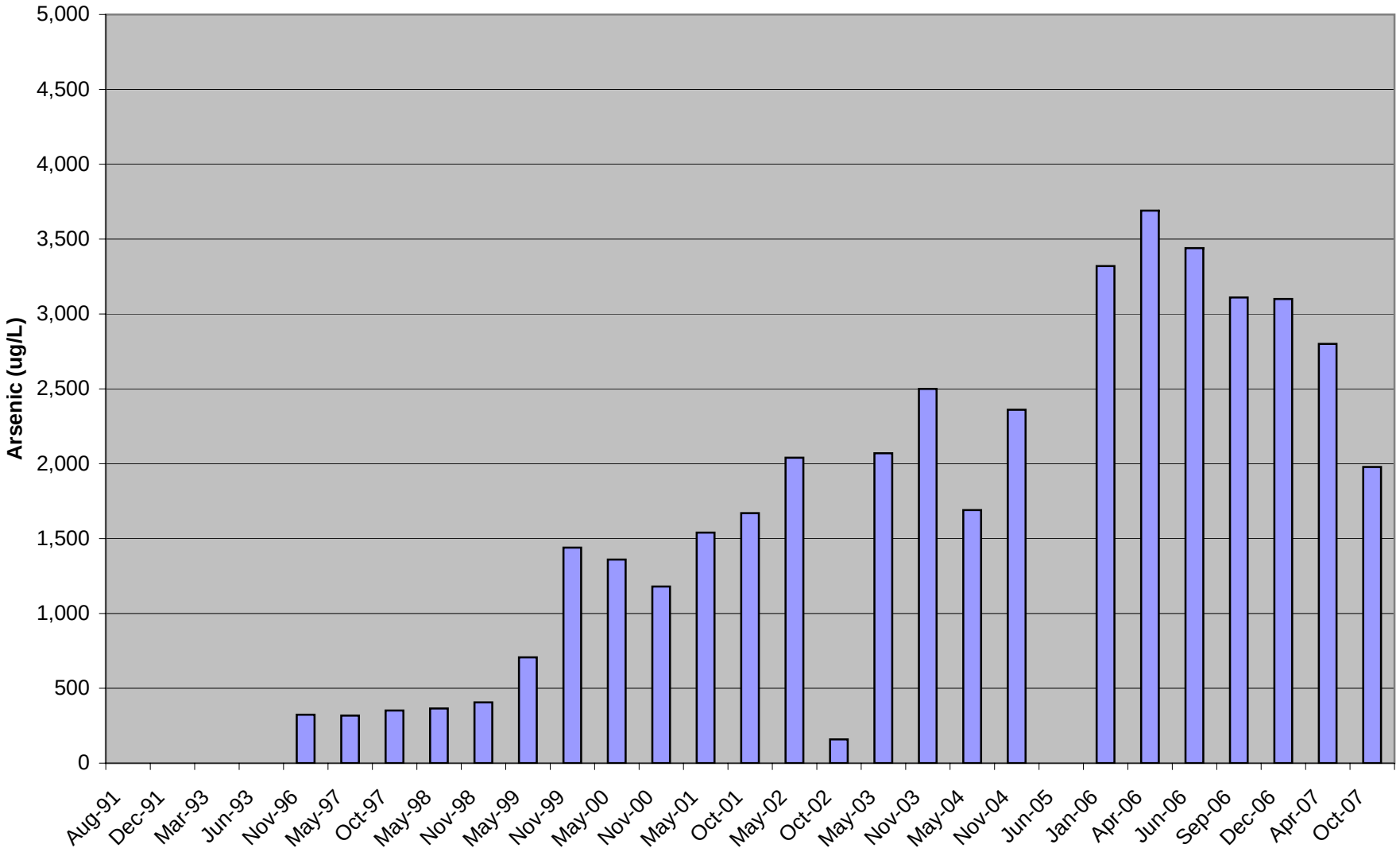
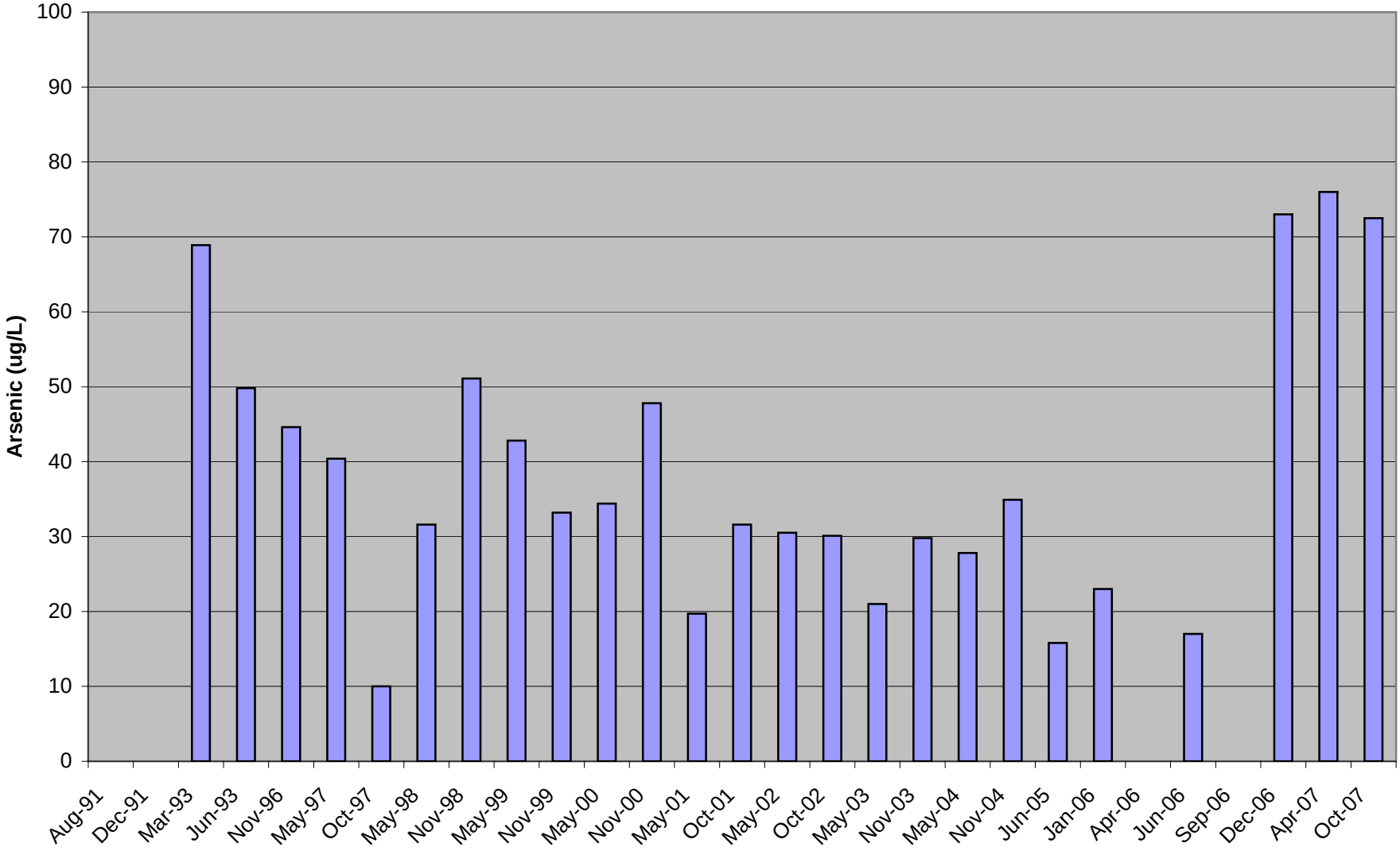
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07


SHM-93-22B
Arsenic (ug/L)
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

## SHM-93-22C


Arsenic (ug/L)
100
90
80
70
60
50
40
30
20
10
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
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Apr-06
Jun-06
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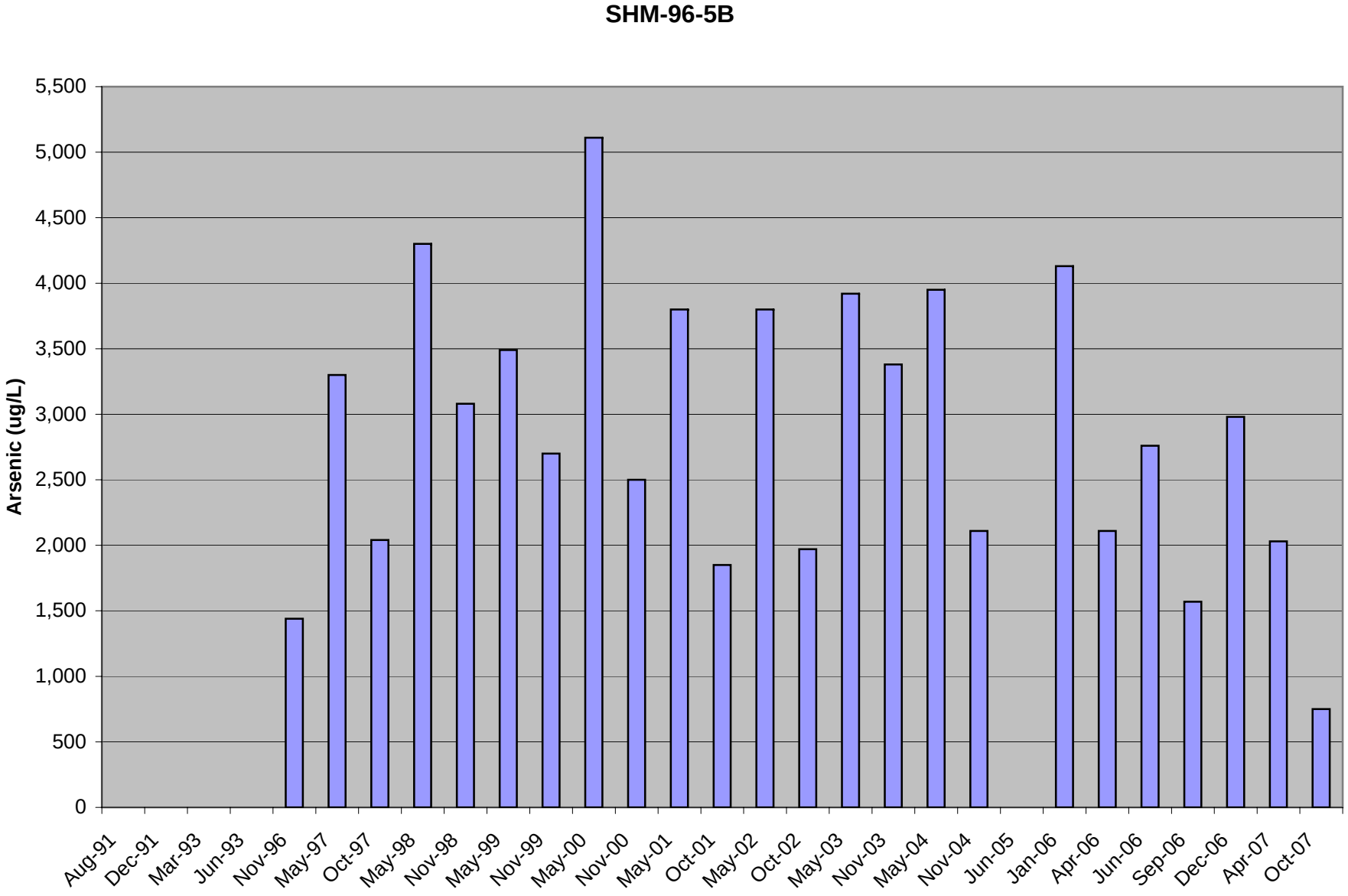
Dec-06
Apr-07
Oct-07


SHM-96-5B
Arsenic (ug/L)
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
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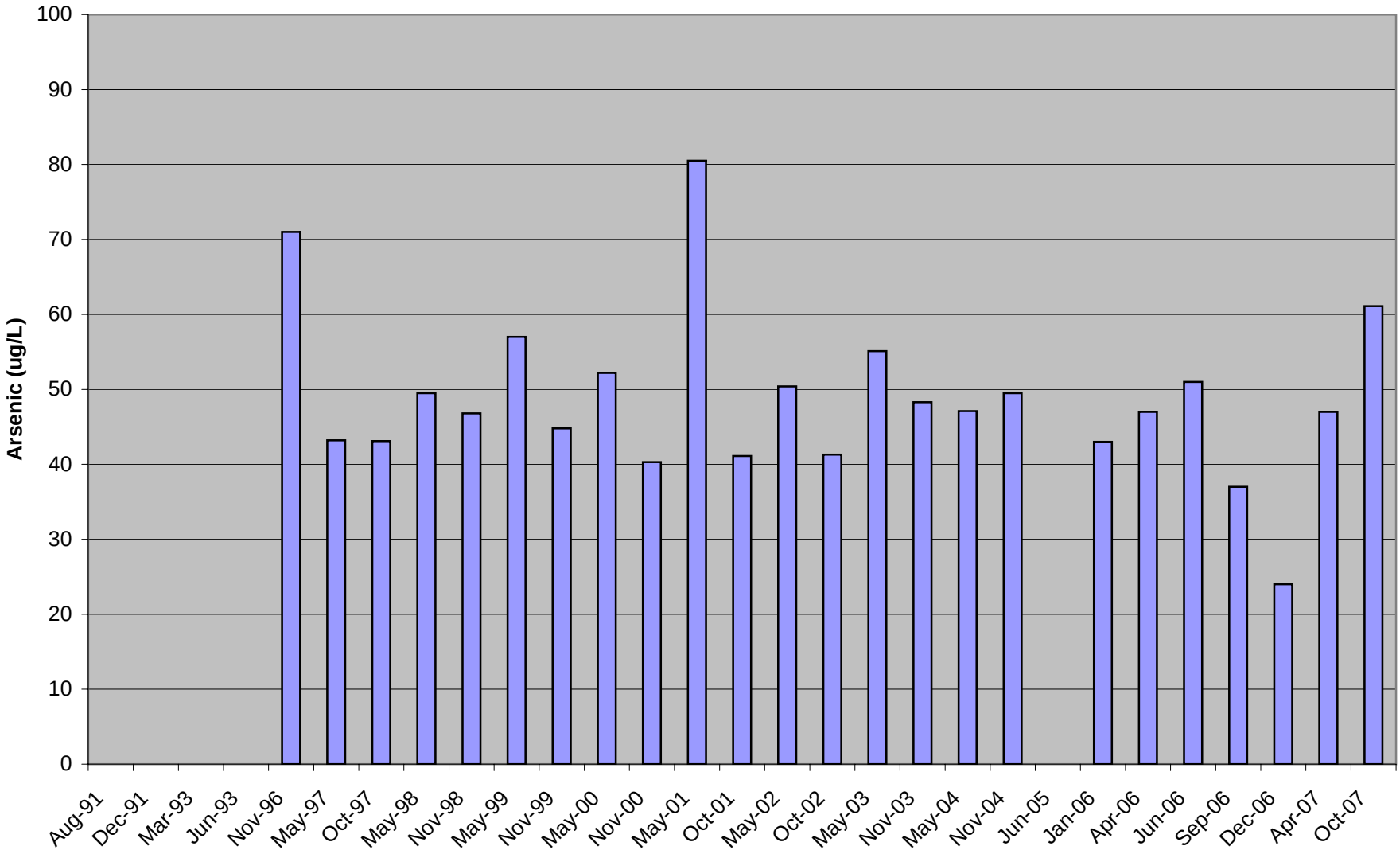
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07


SHM-96-5C
Arsenic (ug/L)
100
90
80
70
60
50
40
30
20
10
0
Aug-91
Dec-91
Mar-93
Jun-93
Nov-96
May-97
Oct-97
May-98
Nov-98
May-99
Nov-99
May-00
Nov-00
May-01
Oct-01
May-02
Oct-02
May-03
Nov-03
May-04
Nov-04
Jun-05
Jan-06
Apr-06
Jun-06
Sep-06
Dec-06
Apr-07
Oct-07

# Appendix G

# Agency Comment Letters and Army Responses

**Draft**
**Responses to EPA Comments on**
**2007 Annual Report**
**Shepley's Hill Landfill and Treatment Plant**
**Long Term Monitoring and O&M Services**
**Former Fort Devens, Massachusetts**
**May 2008**

**General Comments:**

1. The Contingency Remedy extraction system came on-line in August/September 2005 and maintained regular operation beginning in March 2006, at an extraction rate of 25 gpm. In July 2007, groundwater extraction was increased to 50 gpm. Analytical data collected between 8/2005 (the 'geochemical baseline' sampling round) and 10/2007 (the most recent long-term monitoring event) suggest that groundwater chemistry downgradient from the extraction system may be evolving in response to the pumping. For example, data from some of the downgradient wells along Molumco Rd. and in the wooded wetland north of the landfill show increasing arsenic concentrations. Monitoring well SHM-05-40X reported arsenic at 4070 ug/L in 12/2006 and 4445 ug/L in 10/2007, and arsenic in this well has increased systematically from a minimum of 3420 ug/L in June 2006. In SHM-05-41C, arsenic has increased from the baseline concentration of 573 ug/L (8/2005) to 685 ug/L (10/2007). In other wells, As has decreased, e.g. in monitoring well SHM-05-39B, from 634 ug/L in 6/2006 to 309 ug/L in 10/2007. Other geochemical indicator parameters are changing as well. Chloride has decreased consistently in monitoring wells SHP-99-31C and SHX-99-32X, while increases in Cl are seen in several other wells (e.g., SHM-05-40X, SHM-05-42B). It is not yet clear whether the observed changes in water chemistry are due to: (a) perturbations in the hydraulic field (e.g., shifting positions of flow lines) caused by pumping at the extraction wells; (b) seasonal (or longer, or even random) fluctuations; or (c) the continued long-term hydraulic response of the SHL system to capping. Nevertheless, these observations underscore the need to continue monitoring, to be alert to changes in downgradient groundwater compositions, and to reconcile the data with an internally consistent conceptual model.

**Response:** Comment acknowledged.

2. In future SHL annual reports, please include a section that discusses methane in influent groundwater and provides monitoring data. Is the methane concentration in influent groundwater monitored? If so, on what schedule? What are the influent concentrations for 2007? How is it removed in the treatment plant?

**Response:** Influent methane sampling was conducted on 10 January 2008. Methane and ethane concentrations in EW-01 were 5830 ppb and 0.539 ppb respectively, and EW-04 concentrations were 7590 ppb and 1.26 ppb. The treatment plant is not designed to remove methane. In March 2006, safety concerns resulting from methane/ethane were addressed by upgrades completed by CH2M Hill. The upgrades included changing potential exposed wiring to be explosion proof, venting tanks/sumps that may be susceptible to methane/ethane buildup in headspace to the

outside of the building, and the installation of methane and oxygen sensors at critical areas where methane could be released. Influent methane sampling results will be incorporated into future Annual Reports.

3. It is stated in the concluding paragraph of the Executive Summary and elsewhere in the report that "observed trends in arsenic concentrations and other geochemical indicator parameters should be projected into the future" in order "…to predict the geochemical response in the downgradient area," in particular, the time needed to reach target clean-up goals (i.e., MCLs). EPA concurs that this is an important assessment that must be done to demonstrate the effectiveness of the remedy. Data from monitoring wells SHM-93-22B and SHM-96-5B show significantly decreased As concentrations that are consistent with the operation of the extraction and treatment system. Thus, it should be reasonable to extrapolate with some confidence the time required to reach the target level at these locations. However, caution must be exercised in extending this extrapolation to the downgradient area, where the preliminary geochemical response to the extraction system is not as well defined or as well understood. Neither the As source(s) and distribution, nor the processes that control As mobility (e.g., factors that determine redox conditions at any particular point in the SHL system), are well understood. Because As does not behave conservatively, predicting its behavior downgradient from the extraction system requires careful data collection and interpretation.

**Response:** Given the complexity of the geochemical system there would be significant uncertainty associated with any predictions however where possible observed trends will be extrapolated to project remedy effectiveness.

4. The document reports results of quarterly and annual effluent monitoring at the treatment plant, but no influent groundwater data are included. There are references to influent groundwater composition, such as the statement on page 3-2 (Sec. 3.1.1) referring to quarterly monitoring of influent iron concentration, and the text on page 3-6 (Sec. 3.3.1) stating that "[A]verage influent arsenic concentrations remain high at greater than 3,000 parts per billion…" Please include influent monitoring results from the Arsenic Treatment Plant in all future annual reports.

**Response:** The discharge permit for the treatment plant does not require any influent sampling. The revised LTMMP requires annual influent VOC sampling, which was conducted in Oct 2007. In addition, influent inorganic concentrations (As, Fe, Mn) are monitored quarterly in order to ensure that iron concentrations are sufficient to attain acceptable arsenic removal. All 2007 influent data will be included in the Annual Report.

5. The staff gauge measurements near the treatment plant show a 1-ft change in the Plow Shop Pond water level between the two 2007 monitoring events (data in Table 4-2). From anecdotal reports, EPA understands that beaver activity supplemented the Plow Shop Pond outlet dam during 2007, and their efforts, as well as the subsequent breaching of their contribution in September or October, may have affected the pond level measurements. Please continue to record any observations of beaver activity in the vicinity of Plow Shop Pond, and include this information in future annual reports.

**Response:** Since January 2008, periodic monitoring of PSP-01 (staff gauge near outlet dam on Plow Shop Pond) has been conducted as a courtesy to the EPA. In addition, significant changes in the beaver activity can/will be noted. This data and observations will be included in future reports.

**Specific Comments:**

1. Page ES-2, Executive Summary. In the 5th paragraph of the Executive Summary, the text indicates that average arsenic concentrations in influent groundwater at the Arsenic Treatment Plant (ATP) were greater than 3000 ug/L. How often was the influent groundwater monitored, and for which parameters? If influent monitoring data are included in this report, please provide a pointer to the appropriate section or table; if these data are not reported in this document, please include them and ensure that they will be reported in future annual reports.

**Response:** See Response to General Comment #4

2. Page ES-2, Executive Summary, 6th paragraph. Monitoring well SHL-19 is listed among those reporting concentrations "greater than historical averages." Arsenic concentrations were 1790 ug/L, 142 ug/L, and 885 ug/L, in 6/2006/ 12/2006, and 10/2007, respectively. However, please note that turbidities accompanying these results were 702 NTU (6/2006) and 470 NTU (10/2007). Turbidity was not reported for the 12/2006 sampling round for this well. Please consider elevated turbidity readings when interpreting arsenic concentrations, as data as disparate as those from SHL-19 may be biased by suspended particulates.

**Response:** Comment noted. The text will be revised to note the high turbidity values associated with these data suggest they may not accurately reflect dissolved arsenic concentrations.

3. Page ES-2, Executive Summary, 6th paragraph. According to the text, reductions in arsenic concentrations are beginning to be observed in monitoring wells SHM-93-22B and SHM-96-5B "…based on the last sampling round only…" Please note that arsenic concentrations in these two wells have generally declined since the spring of 2006 (please see attached plots).

**Response:** Comment acknowledged. The text will be revised as follows: "The majority of geochemical data to date do not indicate significant changes in redox conditions and Arsenic concentrations. However it should be noted that Arsenic concentrations have been trending downward in nearfield monitoring wells SHM-93-22B and SHM-96-5B since system startup in Spring 2006 with the most significant declines to date in the latest sampling round."

4. Page 1-2, Section 1.2, 5-Year Review Status. The discussion of the 2005 5-Year Review should acknowledge that the Army and EPA deferred the protectiveness statement for the Shepley's Hill Landfill Operable Unit. This section should explain the follow-up action items and milestones that were identified in the 5-Year Review to resolve the deferral and explain the status of those actions.

**Response:** The section will be updated as follows: "In this review the Army and EPA deferred the protectiveness statement for the Shepley's Hill Landfill Operable Unit pending completion of Landfill Cap Maintenance and the CSA\CAAA (now referred to as the Supplemental Groundwater and Landfill Cap Assessment for Long-Term Monitoring and Maintenance). The Landfill Cap Maintenance will be completed in the fall of 2008. The Supplemental Groundwater and Landfill Cap Assessment for Long-Term Monitoring and Maintenance report is expected to be submitted before the end of 2008."

5. Page 1-3, Section 1.3, Regulatory Context, last paragraph. Change "Area of Concern" to "Area of Contamination". This term is defined in the FFA.

**Response:** Comment acknowledged. The text will be revised to replace the referenced phrase.

6. Page 1-4, Section 1.3, Regulatory Context. At the top of page 1-4, the 'working hypothesis' states that the distribution of arsenic in SHL groundwater is closely tied to reducing conditions, "…which generally decline with distance from the landfill and appear to be in dynamic equilibrium within the flow system." In previous discussions with the BCT, it has been noted that moderately reducing conditions prevail throughout the SHL footprint, with ORP values generally within the -200 to -100 mV range or higher. However, immediately downgradient from the landfill, more strongly reducing conditions have been encountered at depth. For example, ORPs as low as -461 mV were reported from the direct-push work conducted by CH2M Hill in preparation for construction of the extraction system (CH2M Hill memo to BCT, 12/17/2004). Similar low ORP values were reported in the drive-point profiles along Molumco Rd. (Fig. 3-21 in the SGI). Conditions become more oxidizing to the north, as seen in the profiles along W. Main Street, where the lowest observed ORPs are in the range -150 to -100 mV. These observations appear to contradict the statement regarding the decline in reducing conditions with distance from the landfill. Moreover, the "dynamic equilibrium within the flow system" to which this is attributed, requires further support. It is not known what controls ORP beyond the toe of the landfill, or what factors may influence arsenic mobility, in addition to ORP – for example, why is dissolved manganese strongly coupled to arsenic in downgradient groundwater from the wells along Molumco Road? Please clarify the statement at the top of page 1-4, and reconcile/support the 'working hypothesis' with available data.

**Response:** The text will be revised as follows: "The working hypothesis in these assessments is that the distribution of arsenic in groundwater is closely related to reducing conditions, which persist to the north of the landfill footprint to beyond W. Main St. and in groundwaters converging on Red Cove. With implementation of the Contingency Remedy…."

7. Page 2-1, Section 2.1, Maintenance. Typo in 3rd sentence? Should "loss" be "loess," referring to the sandy soil?

**Response:** The text will be corrected.

8. Page 2-1, Section 2.2, Inspection. The visual observations of the landfill cover include a description of "several settled areas where pooling is frequently observed." Please be aware

that EPA has recently received the results of a LiDAR survey, which have been distributed the BCT.

**Response:** Comment acknowledged.

9. Page 2-2, Section 2.2, Inspection. The site inspection revealed a number of locks on piezometers and monitoring wells that had been intentionally cut. As of May 2008, it appears that most, if not all, of these have been replaced. EPA endorses the recommendation (p. 2-3, Sec. 2.2.1) regarding the need for all parties who visit the landfill routinely to have access to keys.

**Response:** Comment acknowledged.

10. Page 2-3, Section 2.2.1, Recommendations. Recommendations need to be added here to address the deficiency identified under *Vegetative Growth* (page 2-2 notes that small trees should be removed) and *Landfill Gas Vents* (page 2-2 notes that vents should be re-painted). Please also add these to Section 6.2.

**Response:** A recommendation will be added to remove the small trees and paint the Gas Vents. It is planned these activities will be completed this Fall, prior to the October 2008 annual inspection activities.

11. Page 2-4, Section 2.3.1, Perimeter Gas Monitoring. Because the existing landfill gas probes do not monitor the entire thickness of the unsaturated zone, both the installation of additional gas wells (at both the southern and northern ends of the landfill), and more frequent perimeter gas monitoring are recommended. Please provide the rationale for the number and location of gas probes recommended here.

**Response:** The number of probes and their locations will be provided for review prior to installation, anticipated before the end of 2008.

12. Page 3-2, Section 3.1.1, System Description. Please include in this section a discussion of influent dissolved methane. What concentrations are observed? How is it removed?

**Response:** See Response to General Comment #2

13. Page 3-2, Section 3.1.1, System Description. The 3rd paragraph on this page states that influent iron concentrations are monitored quarterly. What other parameters are also monitored quarterly? On page 3-3 the text refers to combined inorganic concentrations (Fe, As, and Mn) in influent groundwater. On page 3-6, Section 3.3.1, average influent arsenic concentrations greater than 3000 ug/L are reported. Is the analyte list for the influent sampling the same as that shown in Table 3-5 (Quarterly Effluent Sampling Results)? Please revise to include the influent analytical results.

**Response:** See Response to General Comment #4. All 2007 influent data will be included in the Annual Report.

14. Page 3-2, Section 3.1.1, System Description. This section explains how the flow rate was increased from 25 gpm to 50 gpm. Were any 'economies of scale' realized through the pumping rate increase? Or did chemical usage, energy usage, sludge production, etc. basically double under the new flowrate?

**Response:** No 'economies of scale' resulting from the pumping rate increase were observed. Essentially all costs doubled. One significant cost, the Filter-Bottom Rolloff pumpouts, increased by more than double. Although sludge flow going to the FBRO essentially doubled, the duration of decant time is actually significantly reduced, resulting in the rolloff being filled at greater than double the rate.

15. Page 3-3, Section 3.1.2, System Efficiency. This section discusses downtime realized during different maintenance activities. Will these downtimes effect containment?

**Response:** It is acknowledged that periodic downtime for routine maintenance may reduce containment effectiveness however steps have been taken to minimize downtime and the plant is operating at maximum capacity.

16. Page 3-4, Section 3.2.1, Microfilter Air Line Upgrade. Typo? Please change "steal" to "steel."

**Response:** The text will be corrected.

17. Page 3-7, Section 3.4.1, Water Heater Replacement. Please add a recommendation in Section 6.2 to address the follow-up regarding the new water heater and/or new CIP solution and method of recirculation.

**Response:** The current CIP method requires that the acid solution recirculate overnight and that the caustic solution recirculate for approximately 4 hours. This method has produced satisfactory results. The vendor suggests that using heated water may reduce the amount of recirculation time that is necessary to achieve satisfactory results. However, the CIP process is usually scheduled in conjunction with FBRO pumpouts, which require an overnight shutdown to allow the roll-off to drain. As a result of performing CIPs in conjunction with the roll-off pumpouts, recirculation time is not an issue. At this time water heater replacement is not necessary, but could be recommended in the future if it is no longer practical to perform the CIPs and roll-off pumpouts at the same time.

18. Page 4-1, Section 4.1, Groundwater Elevations, Table 4-2, and Figure 4-2. Please note that there is an apparent error in the water level reported for N5-P2 on April 8, 2007 (see also the field sheet in Appendix D). Continuous logging in the N5 piezometer pair suggests that the head in the deeper (bedrock) screen (P1) is typically higher than the shallow (overburden) screen (P2) under spring, high-water conditions, and that head differences are typically of the order of a few tenths of a foot, in contrast to the 3.62 ft difference (of opposite sign) reported here. A transducer in N5-P2 indicated an elevation of about 220.1 ft msl on April 8. The difference between P1 and P2 was about 0.5 ft (higher in the BR) about two weeks following

the gauging reported here (and following an exceptionally large rainfall event from April 15 to 17). Please indicate in the text that the reported water level for N5-P2 in April is suspect. The contouring shown in Figure 4-2 appears to use the deep (P1) result, which is likely closer to the true level of the water table, so the figure does not require correction.

**Response:** The text will be revised accordingly.

19. Page 4-3, Section 4.2.1.1, Arsenic Results. At the top of page 4-3, the elevated arsenic concentrations observed in monitoring well SHL-19 are discussed, and 'further assessment' is offered if these levels persist throughout 2008. Please be aware that the turbidity readings accompanying the anomalously high arsenic measurements are extremely high and likely reflect an association with suspended particulates rather than dissolved arsenic. If high levels of arsenic continue to be observed in this well, please consider taking both filtered (0.45-micron) and unfiltered samples. In addition, add a recommendation in Section 6.2 to address the further assessment at SHL-19.

**Response:** Comment acknowledged and the recommendations will be expanded to include collection of both filtered and unfiltered samples from SHL-19.

20. Page 4-3, Section 4.2.1.1, Arsenic Results, also Table 4-1. The last paragraph in this section indicates that monitoring well SHM-93-22B has a 30-foot well screen, consistent with the reported screened interval of 62.3 to 92.3 ft bgs in Table 4-1. EPA understands that this well screen length appears to be 30 feet as seen on Figure 3-12 in the Supplemental Groundwater Investigation (Harding ESE, 2003). However, according to the "as-built" log for this well (please see attached), the length of the well screen is 10 ft, not 30 ft, and the correct screened interval is 82-92 ft bgs. Please edit the text on page 4-3 and Table 4-1 accordingly.

**Response:** The table and text will be revised accordingly.

21. Page 4-3, Section 4.2.1.1, Arsenic Results. The last paragraph in this section suggests that a trough interpreted in the bedrock surface is "…expected to be a controlling factor for flow north of the landfill." Please elaborate on this statement. In an unconfined aquifer, basement topography should have little influence on the hydraulic gradient. For uniform hydraulic conductivity, there will be greater volume flow (e.g., per unit horizontal distance normal to the flow) through the thicker (i.e., valley) portion of the aquifer, of course. If the trough is associated with higher-conductivity material, it may also "channel" groundwater.

**Response:** As the comment suggests the text refers to "controlling flow" in the volumetric sense. The text will be revised as follows: "… near the eastern edge of a trough interpreted in the bedrock surface, through which the bulk of horizontal groundwater flow to the north presumably occurs. As such this well likely reflects transition zone conditions along the eastern edge of the plume."

22. Page 5-5, Section 5.2.3, Drawdown Assessment, and Figure 5-3. It is notable that some of the transducer records shown in Figure 5-3 (e.g., the six shown at the top of the plot, with water levels (presumably immersion depths) from 9 to 15 ft) are very smooth, while others

(e.g., the remainder, with water levels from 1 to 9 ft) show fluctuations strongly correlated with barometric pressure. Were vented transducers used in the former group of wells, implying that barometric effects were removed directly by the transducers? Presumably, the latter group of wells had transducers recording total head (i.e., water level above the transducer plus headspace air pressure), and the data shown are not compensated for the barometric pressure. If these inferences are correct, the text might note this difference between the two sets of transducers so that readers can understand the very different appearance of the records. Despite this difference, it is agreed that the second group (i.e., the uncompensated transducers) does not show discernible effects from the shutdown/restart, which would be superimposed on the barometrically influenced records (i.e., manifested in sharp changes such as those shown for the first group of wells).

**Response:** The transducers installed by ECC for this assessment were the vented type, whereas those previously installed by USEPA appear to be unvented based on the evident correspondence to barometric changes. The text will be modified to acknowledge this difference.

23. Page 5-6, Section 5.2.3, Drawdown Assessment. It might be noted that another reason that the modeled and observed water levels may differ in the nearfield of the pumping wells is that the finite difference grid cannot resolve heads local to the pumping wells with sufficient spatial accuracy. Nonetheless, the agreement over larger length scales between modeled and observed drawdowns is satisfactory (see, e.g., Figure 5-5)

**Response:** Comment acknowledged.

24. Page 5-8, Section 5.2.4, Comparisons to Numerical Model Results. It is agreed that the comparison of computed to observed water levels (Figure 5-6) is satisfactory, and that further calibration of the model should await the refined model currently being developed. It is noted that predicted water levels are generally lower than measured in the upgradient domain (where elevations are higher), and the modeled water levels are generally higher than observed in the downgradient area (where elevations are lower). On the scale of the entire model domain, then, the overall calculated gradient is somewhat lower than is the observed gradient. Assuming that the overall flux of water through the overburden is approximately correct (i.e., that the recharge is represented accurately), this might suggest that the modeled conductivity is a bit high. This should be considered in future model refinements.

**Response:** Comment acknowledged. Future model refinements will identify hydraulic conductivity values that optimize the correspondence to both steady-state water levels and calculated drawdowns.

25. Page 5-9, Section 5.5, Recommendations for Future System Performance Metrics. This section suggests that observed trends in arsenic concentrations and other geochemical parameters such as ORP can be extrapolated into the future to predict the time required to reach target MCLs. This approach can then be used to "…predict geochemical changes in the downgradient area…" thereby providing a measure of system performance. As noted in the General Comments (above), EPA concurs with the need for this assessment and continued geochemical monitoring to support it. However, EPA cautions that this will be a

challenge. The source(s) of arsenic within the SHL system and the processes controlling As mobility are not known. Arsenic may be sorbed onto oxyhydroxides of Fe (also Mn, and/or Al) in the overburden, and liberated by contact with reducing groundwater. Alternatively, any As present in discrete sulfide phases (e.g., in bedrock underlying SHL) may be mobilized by exposure to oxidizing groundwater infiltrating through fractures. Other mechanisms – for example, sorption onto carbonates in the overburden – are even less well-understood. It is likely that the observed arsenic concentrations are controlled by more than one mechanism, and different geochemical processes likely dominate in different portions of the SHL system.

**Response:** Comment acknowledged. It is agreed that quantitative predictions of remedial timeframes will be challenging due to the complexity and uncertainties in understanding Arsenic geochemistry at this site.

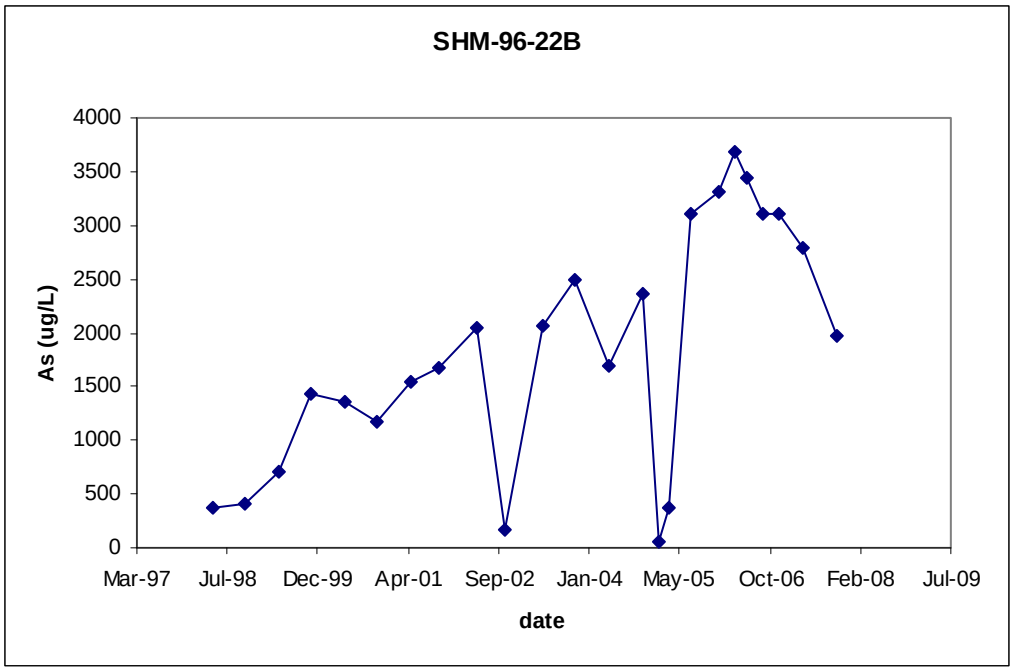
26. Table 4-3. In this table, there appear to be several discrepancies between what is shown for the October 2007 results for SHP-99-29X, and data that were transmitted to EPA electronically (October 2007 GW Results 11/28/07; sent by EPA 12/6/07). Please check and edit accordingly.

| Element | Table 4-3 (as shown) | Should be: |
|---|---|---|
| As | 11000 | 2953 |
| Ca | 44000 | 11000 |
| Fe | 990 | 44000 |
| Mg | 10400 | 990 |
| Mn | 530J | 10400 |
| K | 2600 | 530J |
| Na | 2953 | 2600 |

**Response:** The table will be corrected.

27. Page 6-3, Section 6.2, Recommendations, 3rd bullet. Please add a timeframe for the proposed evaluation of alternative filtration methods.

**Response:** Text will be added to indicate ECC is currently reviewing a pilot study proposal from Filtronics, Inc and will have a recommendation by September 2008.


SHM-96-22B
As (ug/L)
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3500
3000
2500
2000
1500
1000
500
0
Mar-97
Jul-98
Dec-99
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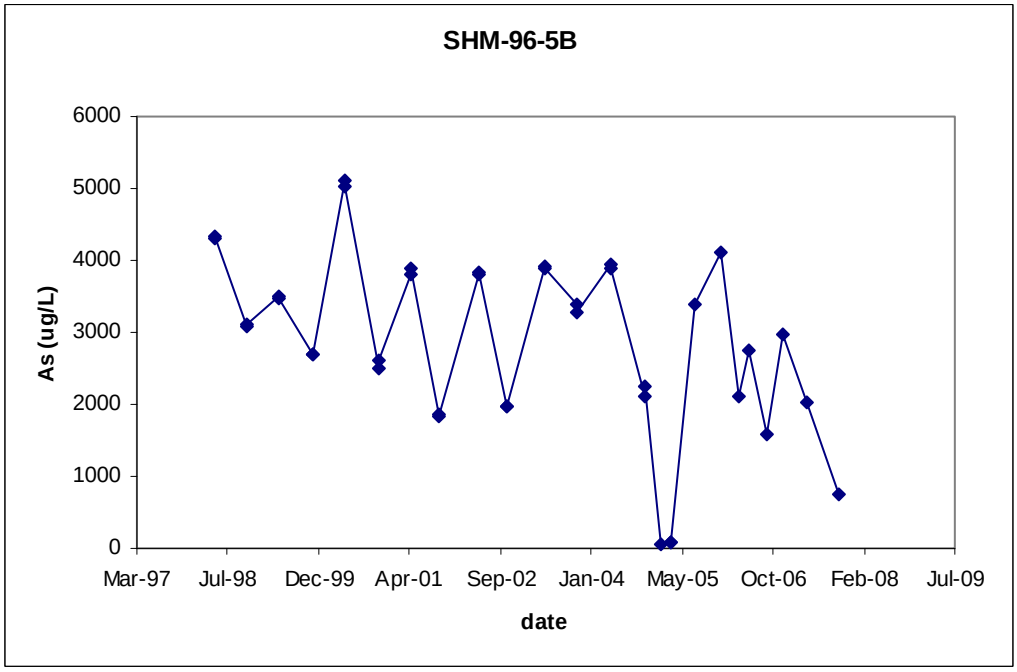
Jan-04
May-05
Oct-06
Feb-08
Jul-09
date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As (ug/L)
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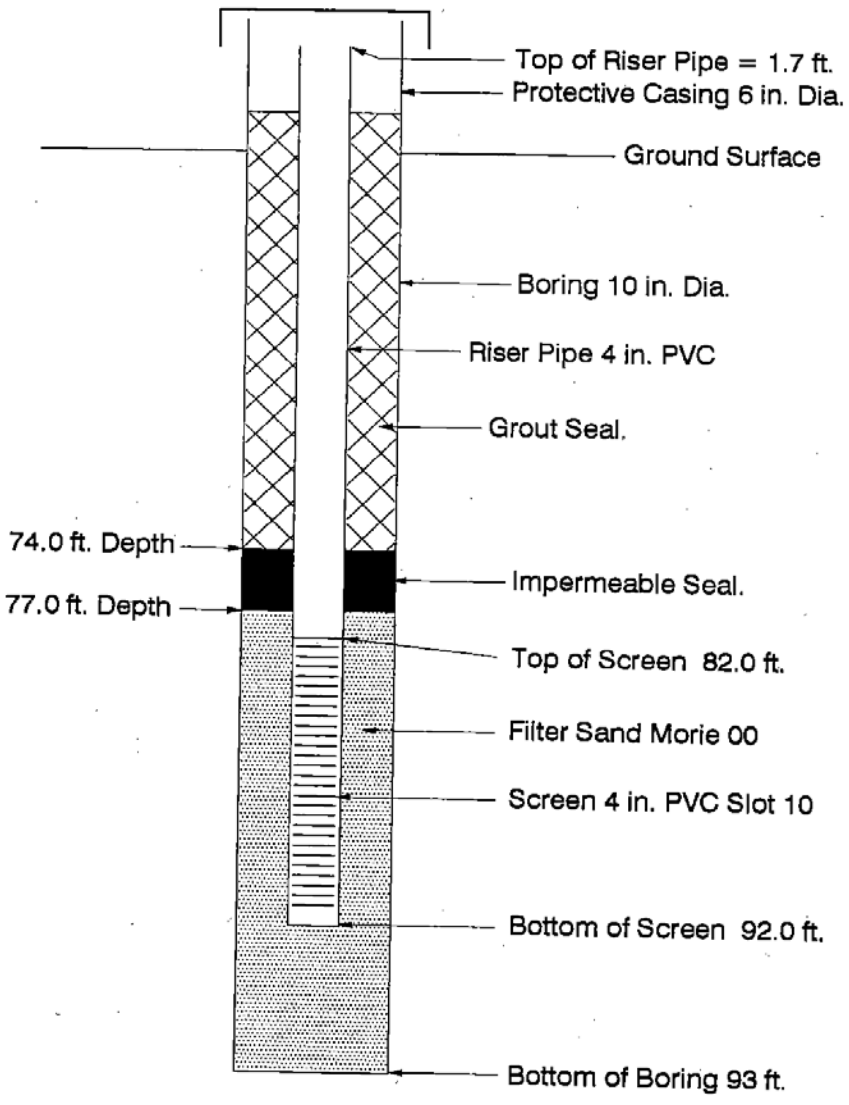
5000
4000
3000
2000
1000
0
Mar-97
Jul-98
Dec-99
Apr-01
Sep-02
Jan-04
May-05
Oct-06
Feb-08
Jul-09
date

# WELL NO. MW-SHM-96-22B
# AS-BUILT DRAWING




Well Completed 08/21/96
Drilled and constructed by Hydro Group

**Draft**
**Responses to MassDEP Comments on**
**2007 Annual Report**
**Shepley's Hill Landfill and Treatment Plant**
**Long Term Monitoring and O&M Services**
**Former Fort Devens, Massachusetts**
**May 2008**

**Comments:**

1. p1-4, under Section 1.3 of Regulatory Content, it stated that, "the working hypothesis…is that the distribution of arsenic in groundwater is loosely related to reducing conditions, which generally decline with distance from the landfill and …". Please provide further explanation.

**Response:** The text refers to the working conceptual model of Arsenic fate & transport and is described in several recent site documents including the Data Gaps Analysis Report (AMEC, 2006). Please also see response to EPA Specific Comment 6.

2. p2-2, under Landfill Gas Vents of Section 2.2, Inspection, it stated that, "…and no gas being vented could be visually detected." MassDEP requests that landfill gas flow, before and after the purging, be measured during the proposed quarterly sampling, to determine whether the passive gas venting system is actually venting.

**Response:** Landfill gas monitoring is conducted in accordance with the Revised LTMMP and standard operating procedures as defined in the *Landfill Technical Guidance Manual* (USEPA, 1997). Please see response to MassDEP comment 4.

3. p2-4, under Section 2.3.1 of Perimeter Gas Monitoring, it states that, "Results from Landfill Gas Probe (LGP) sampling indicated the presence of elevated levels of methane and percent lower explosive limit (LEL) in three LGPs on the southern end of the landfill that were inconsistent with historical data…, are considered to anomalous,…". MassDEP requests this conclusion be reevaluated after additional perimeter monitoring network is completed and resampled.

**Response:** Should additional detections occur at these locations the Army agrees to reevaluate this conclusion.

4. In addition, after carefully reviewing the landfill gas monitoring results attached at Appendix B, it seems the results indicate either the samplings were not conducted properly or the gas collection system was not operated in the optimal condition. The Municipal Solid Waste Landfills NSPS under Section 40 CFR 60.753 (c) of Operational standards for collection and control systems requires to "*Operate each interior wellhead in the collection system with a landfill gas temperature less than 55 ºC and with either a nitrogen level less than 20 percent or an oxygen level less than 5 percent. The owner or operator may establish a higher operating temperature, nitrogen, or oxygen value at a particular well. A higher operating value demonstration shall show supporting data that the elevated parameter does not cause fires or significantly inhibit anaerobic decomposition by killing methanogens*." Several vents located in the cells closed earlier showed low methane concentration with high oxygen concentration, but a couple of the vents located in the cells closed later showed relatively high methane concentration with significant oxygen concentrations. Please address.

**Response:** Higher methane concentrations are expected in younger waste cells and direct observation of this phenomenon is considered strong evidence that sampling was conducted properly and the gas venting system is operating properly.

5. In Figure 4-2, it seems water level at N-5 P-1 was used for the groundwater counter, instead of N-5 P-2. In addition, please explain the water level difference of more than three feet between these two wells.

**Response:** As noted the water level for N5-P1 was used in the interpretation as the N5-P2 value for the April round appears anomalous relative to previous and subsequent measurements. The text will be revised to indicate the value reported for April is suspect.

6. Arsenic concentration at SHP-99-29X recorded in Table 4-3 (11,000 ppb) is different from that shown in Figure 4-4 (2,953 ppb). Please address.

**Response:** This typographical error will be corrected in the text, tables and figures.

7. p4-4, under Section 4.2.2 of Field Parameters, it states that, "With the exception of ten samples, all which have arsenic concentrations exceeding 10 ug/L also have a corresponding negative ORP value. Notably, these exceptions occur in October, which may suggest there is seasonal influence on ORP values." MassDEP requests further explanation. It seems with the ten exceptions, only ORPs at SHM-96-5B were inconsistent during both sampling events. ORPs at three of the wells (SHL-5, SHL-8D and SHL-8S) were both positive for two sampling events, and ORPs at the rest of six wells were only available during October sampling event. Historically, ORPs at most wells (except SHL-5, SHL-8D and SHL-8S, in which arsenic concentrations had generally been below 10 ug/L) had been shown as negative.

**Response:** The text will be reworded as follows: "As previously noted, the majority of samples with arsenic above 10 ug/L also have negative ORP values. The few exceptions to this trend may reflect transition areas or seasonal influences."

8. p5-4, under Section 5.2.2 regarding Capture Zone Width Calculations, it indicates that, "despite this limitation, … the calculated capture zone width is considered sufficient to achieve full containment." Please explain the full containment. Is it only referring to northern plume?

**Response:** The analysis of capture zone width is one component of an assessment of effectiveness which includes a number of other lines of evidence. Figure 5-7 is provided to show the extraction system intercepts the vast majority of water passing under the landfill footprint.

9. In Figure 5-4, please explain why the hourly drawdown values recorded at EW-04 pilot and EW-01 pilot are significantly different.

**Response:** Most notably the screened interval for EW-01 is higher than that for EW-04 and therefore the accompanying pilot well screen is in closer proximity to the pumping stress. There also could be differences in the well completion and aquifer materials which influence the vertical communication of pumping stress at a local scale.

10. p5-6, under Section 5.2.2 of Drawdown assessment, it indicated that "the model over-predicts the magnitude in the near field area," which later attributes to vertical anisotropy in hydraulic conductivity of the aquifer. Please explain. Does the author mean multi-layer model may be necessary to account for those differences?

**Response:** The existing model represents the overburden aquifer as being vertically isotropic whereas glacial deposits are inherently stratified and therefore tend to transmit more water laterally than vertically. This may in part explain the observation of less drawdown in the shallow wells screens nearfield such as the EW pilot wells.

11. MassDEP agrees that the data as presented does not clearly demonstrate capture of the contaminant plume. The estimated width of the capture zone is 442 feet however, both the actual drawdown data (Figures 4-2, 4-3, and 5-5) and the modeled capture zone (Figures 5-7 and 5-8) are less than this estimate.

**Response:** The comment is noted however based on the cumulative assessment of multiple lines of evidence available to date "the extraction, treatment, and discharge system is interpreted to be operating as designed" as stated in Section 5.4.

12. The most important graphic to demonstrate capture is to plot the water level elevation under pumping conditions (on a monthly or quarterly basis) and plot the equipotential and groundwater flow lines. This should be done in cross-section and horizontally. Horizontal groundwater flow maps should be developed for different depth intervals.

**Response:** The lack of significant vertical head differences, relatively uniform overburden geology, and other hydrogeologic information suggest the overburden aquifer is "well connected" vertically (the inherent anisotropy not withstanding). In this circumstance the piezometric contour interpretations for shallow and deep portions of the aquifer are not expected to be significantly different and therefore multiple maps provide limited additional value. Similarly, with the exception of very close to the extraction system, vertical hydraulic gradients are negligible and therefore piezometric contours in cross section would be interpreted simply as vertical lines whose locations correspond to the plan view and therefore provide little insight into vertical flow patterns.

13. DEP also requests a reverse particle map with the particles starting in the extraction well. This will demonstrate the model predicted capture zone.

**Response:** Figure 5-7 is a reverse particle track map from the extraction wells.

14. To evaluate the usefulness of the vector analysis (Fig 5-1), provide supporting explanation.

**Response:** Gradient vectors calculated from adjacent well triplets provide a means of determining the direction of groundwater flow based solely on field data. These can then be compared to other interpretive tools (such as model-generated particle tracks) to gain further confidence in understanding of the flow system.