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September 2017
SAMPLING AND ANALYSIS PLAN
Coakley Landfill Superfund Site
North Hampton and Greenland
New Hampshire

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Project Type: Superfund Site
Project Number: 0431

Prepared For:
New Hampshire Department of Environmental Services
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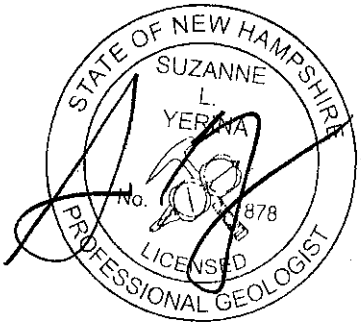

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SAMPLING AND ANALYSIS PLAN
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON AND GREENLAND, NEW HAMPSHIRE

PREPARED
FOR

THE COAKLEY LANDFILL GROUP
C/O CITY OF PORTSMOUTH
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SEPTEMBER 2017
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SAMPLING AND ANALYSIS PLAN APPROVAL PAGE

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TABLE OF CONTENTS

SAMPLING AND ANALYSIS PLAN APPROVAL PAGE I

TABLE OF CONTENTS II

LIST OF FIGURES III

LIST OF TABLES III

LIST OF APPENDICES IV

LIST OF ACRONYMS V

SECTION 1.0 | INTRODUCTION 1

1.1 Site Description and History 1
1.2 Remedial Overview and Recent Site History 2
1.3 Summary of the Site Geology and Hydrogeology 4
1.4 Summary of Groundwater Flow Pathways and Extent of Impacted Groundwater 5
1.5 Site Cleanup Levels 6
1.6 Data Quality Objectives 8

SECTION 2.0 | PROJECT ORGANIZATION AND RESPONSIBILITIES 9

SECTION 3.0 | MONITORING AND SAMPLING PROTOCOL 10

3.1 Groundwater Monitoring 10
3.1.1 Groundwater Level Monitoring 10
3.1.2 Groundwater Quality Monitoring 10
3.2 Water Supply Well Sampling 11
3.3 Surface Water and Leachate Seep Sampling 11
3.4 Sediment Sampling 11
3.5 Monitoring Well Inspection and Maintenance 12
3.6 Sampling Equipment Decontamination 12
3.7 Investigation Derived Wastes 12
3.8 Periodic Reviews of the Monitoring Program 13

SECTION 4.0 | QUALITY CONTROL AND QUALITY ASSURANCE (QA/QC) 13

4.1 Equipment Calibration and Maintenance 13
4.2 Field Quality Control 15
4.2.1 Blanks 18
4.2.1.1 Trip Blanks 18
4.2.1.2 Temperature Blanks 19
4.2.1.3 Equipment Blanks 19
4.2.1.4 Field Blank 19
4.2.2 Field Duplicates 20
4.2.3 Matrix Spike/Matrix Spike Duplicates 20
4.3 Data Validation and Verification 20
4.3.1 Data Qualifiers 22
4.3.2 Data Usability 23
4.3.2.1 Precision 23
4.3.2.2 Accuracy 24
4.3.2.3 Completeness 25
4.3.2.4 Representativeness 26
4.4 Quality Assurance Field Audits 27

SECTION 5.0 | SAMPLE HANDLING, TRACKING AND CUSTODY REQUIREMENTS 27

5.1 Sample Collection Documentation 27
5.1.1 Field Notes 27
5.1.2 Field Documentation Management System 27
5.2 Sample Handling and Tracking System 28
5.3 Sample Custody 28
5.4 Laboratory Sample Handling 28
5.4.1 Laboratory Document Control Procedures 29

SECTION 6.0 | REPORTING 29

6.1 Notification of Exceedance of Ambient Groundwater Quality Standards 29
6.2 Annual Reports 29
6.3 Semi-Annual Data Transmittal Reports 31

SECTION 7.0 | HEALTH AND SAFETY PROGRAM 31

SECTION 8.0 | REFERENCES 32

LIST OF FIGURES

Figure 1-1 Site Location Map
Figure 1-2 Groundwater Management Zone & Environmental Monitoring Network

LIST OF TABLES

Table 1-1 Groundwater Cleanup Levels
Table 2-1 Project Organization
Table 3-1 Analytical Methods, Sample Containers, Volumes, Preservatives, and Holding Times
Table 3-2 Site Analytes, Associated Regulatory Standards and Lab Criteria
Table 3-3 Monitoring Well Construction, Depth of Tubing Intakes and Historic Low Water Levels
Table 3-4 Groundwater Elevation Monitoring Well Network and Schedule
Table 3-5 OU-1 Monitoring Well Network Analytical Parameters, Sampling Methods and Schedule
Table 3-6 OU-2 Monitoring Well Network Analytical Parameters, Sampling Methods and Schedule
Table 3-7 Water Supply Well Monitoring Network, Analytical Parameter and Schedule
Table 3-8 Surface Water and Leachate Seep Monitoring Network, Analytical Parameters and Schedule
Table 3-9 Sediment Monitoring Network, Analytical Parameter, and Schedule
Table 4-1 Field Equipment - Preventative Maintenance Requirements
Table 4-2 Field Equipment - Calibration and Corrective Action Requirements
Table 4-3 Field Quality Control Requirements
Table 4-4 Summary of Quality Assurance Samples

LIST OF APPENDICES

A. Groundwater Management Permit

B. Boring Logs and Monitoring Well Construction Logs

C. Field Sampling Standard Operating Procedures (SOPs)

SOP-1	Water Level and Well Depth Measurements and Well Integrity Inspection
	Water Level and Well Depth Worksheet
	Well Integrity Inspection Worksheet
SOP-2	Calculation of Purge Volume
SOP-3	Sampling with a Bucket Type Bailer
	Bailer Sampling Worksheet
SOP-4	Low Flow Sampling Using a Peristaltic Pump
	Low Flow Equipment Setup Diagram - Peristaltic Pump
	Low Flow Sampling Worksheet
SOP-5	Surface Water, Leachate Seep and Sediment Sampling Procedures
	Surface Water, Leachate Seep and Sediment Worksheet
	Setup Diagram for Peristaltic Pump
SOP-6	Drinking Water Supply Well Sampling Procedure
	Drinking Water Setup Diagram for Water Quality Meters
	Drinking Water Quality Parameter Worksheet
SOP-7	Sampling Equipment Decontamination Procedure
SOP-8	Calibration of YSI and HACH Field Instruments
	Calibration Log
SOP-9	Chain-of-Custody, Sample Handling & Shipping Procedures
	Chain-of-Custody Sheet
SOP-10	Field Sampling Protocols for Sampling Per- & Poly-Fluorinated Alkyl Substances
SOP-11	Monitoring Well Development Protocol

LIST OF ACRONYMS

AGQS	Ambient Groundwater Quality Standard
COC	Chain-of-Custody
CES	CES, Inc.
CL	Cleanup Level
CLG	Coakley Landfill Group
DQO	Data Quality Objective
EMP	Environmental Monitoring Plan
ESD	Explanation of Significant Differences
GMP	Groundwater Management Permit
GMZ	Groundwater Management Zone
USEPA	United States Environmental Protection Agency
HA	Lifetime Health Advisory
HASP	Health and Safety Plan
HWRB	Hazardous Waste Remediation Bureau
HAZWOPER	Hazardous Waste Operation & Emergency Response
ICL	Interim Cleanup Level – Changed to Cleanup Level in August 2015
LCS	Laboratory Control Sample
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
NHDES	New Hampshire Department of Environmental Services
NFG	National Functional Guidelines
NPL	National Priorities List
OSHA	Occupational Safety and Health Administration
OU	Operating Unit
PAH	Polycyclic Aromatic Hydrocarbons
PFAS	Per- & Poly-Fluorinated Alkyl Substances
PFC	Perfluorinated Chemicals
PFOA	Perfluorooctanoic Acid
PFOS	Perfluorooctane Sulfonate
POP	Project Operations Plan
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RPD	Relative Percent Difference
QAPP	Quality Assurance Project Plan
QA/QC	Quality Assurance / Quality Control
QAO	Quality Assurance Officer
RDL	Reporting Detection Limit
SAP	Sampling and Analysis Plan
Site	Coakley Landfill Superfund Site
SOP	Standard Operation Procedure
SVOC	Semi-Volatile Organic Compound
VOC	Volatile Organic Compound

SAMPLING AND ANALYSIS PLAN
COAKLEY LANDFILL SUPERFUND SITE
NORTH HAMPTON AND GREENLAND, NEW HAMPSHIRE

SECTION 1.0 | INTRODUCTION

This Sampling and Analysis Plan (SAP) describes the procedures and guidelines for long-term environmental monitoring at the Coakley Landfill Superfund Site (Site) located in North Hampton and Greenland, New Hampshire (see **Figure 1-1**). CES, Inc. (CES) prepared this SAP on behalf of the Coakley Landfill Group (CLG). This SAP and its attachments will replace the agency approved September 2015 SAP.

This SAP was prepared based on and incorporates the requirements contained in the New Hampshire Department of Environmental Services (NHDES) and United States Environmental Protection Agency (USEPA) approved NHDES Hazardous Waste Remediation Bureau's Master Quality Assurance Project Plan (HWRB Master QAPP) Revision 4, dated March 2017 (http://des.nh.gov/organization/divisions/waste/hwrb/documents/hwrb_master_qapp.pdf).

Sampling activities at the Site will be performed in accordance with requirements contained in this SAP and the current Site QAPP. The Site QAPP was updated in July 2017 to be consistent with HWRB Master QAPP, which is updated on an annual basis. The Site QAPP and/or the current HWRB Master QAPP effective at the time of the sampling event will be used in conjunction with this SAP to complete environmental monitoring activities at the Site.

The purpose of the environmental monitoring program described in this SAP is to monitor the nature and extent of impacted groundwater and other potentially affected media (surface water and sediment), and to track the progress of the natural attenuation component of the site remedy. This document outlines the methods and procedures that will be used to collect and manage samples, assess analytical results, and evaluate conformance and compliance with USEPA-established Cleanup Levels (CLs, formerly known as Interim Cleanup Levels [ICLs] – see **Section 1.2**), USEPA Health Advisories (HA), and NHDES-established Ambient Groundwater Quality Standards (AGQS).

1.1 Site Description and History

The Coakley Landfill Superfund Site (Site) includes approximately 92 acres located within the towns of Greenland and North Hampton, Rockingham County, New Hampshire. The actual landfill covers approximately 27 acres. The Site is located about 400 to 800 feet west of Lafayette Road (U.S. Route 1), south of Breakfast Hill Road, and about 2.5 miles northeast of the center of the town of North Hampton. The landfill borders undeveloped woodlands and wetlands to the north and west and commercial and residential properties to the east and south.

A Groundwater Management Zone (GMZ) has been established by the NHDES for the Site and surrounding properties (refer to **Figure 1-2**), which extends beyond the approximately 92-acre property that contains the landfill; refer to **Section 1.2** for further discussion of the GMZ.

Landfill operations began in 1972, with the southern portion of the Site used for waste disposal. In March 1983, the New Hampshire Bureau of Solid Waste Management ordered the landfill closed to all waste except for combustion residue (ash) from a nearby incinerator. Landfill operations ceased in July 1985.

1.2 Remedial Overview and Recent Site History

In 1979, the New Hampshire Waste Management Division received a complaint concerning leachate breakouts around the landfill. A second complaint received in 1983 by the New Hampshire Water Supply and Pollution Control Commission concerned water quality from a nearby domestic drinking water supply well. Subsequent confirmatory sampling detected volatile organic compounds (VOCs) in groundwater samples to the south, southeast, and northeast of the Site. The Towns of North Hampton and Rye completed a water main extension to commercial and residential users in the vicinity of the Site.

In December 1983, the USEPA proposed listing the Site on the National Priorities List (NPL) and listed the Site in 1986. USEPA completed a Remedial Investigation/Feasibility Study (RI/FS) for Operating Unit 1 (OU-1, source control) on March 2, 1990 and an RI/FS for OU-2 (management of migration) on May 23, 1994. Both studies identified impacted groundwater beneath and outside the boundary of the landfill. VOCs detected at the site included; benzene, ethyl benzene, chloroethane, chlorobenzene, and xylene. Semi-volatile organic compounds (SVOCs) detected at the site included predominantly polycyclic aromatic hydrocarbons (PAHs) and dichlorinated benzenes. Inorganic compounds detected in groundwater and sediment samples included arsenic, barium, iron, lead, manganese, nickel, beryllium, selenium, and vanadium.

On June 28, 1990, USEPA issued a Record of Decision (ROD) for OU-1. The objective of the OU-1 ROD is to protect the drinking water aquifer by reducing further migration of contaminants to the groundwater and surface water and eliminating threats posed by direct contact with or ingestion of contaminated soils and wastes at the site. The CLG completed design of the OU-1 remedy and the USEPA approved the design on January 25, 1996. Construction began on September 24, 1996 with the relocation of trash from along the perimeter of the landfill to the top of the landfill. Wetland sediments were removed and placed on the landfill during 1997. The landfill cover and wetland construction/restoration activities were completed in the fall of 1998.

Monitoring of groundwater quality and water levels continued throughout the remedial design, construction, and post construction phases. USEPA evaluated that data and determined that the landfill cover was effective in reducing leachate generation such that the collection and treatment of contaminated groundwater at the edge of the landfill was no longer necessary. USEPA issued a September 29, 1999 Explanation of Significant Differences (ESD) which documented the decision to eliminate groundwater treatment from the remedy.

On September 30, 1994, EPA issued a ROD for OU-2 and the OU-2 Consent Decree was lodged on November 3, 1998. The objective of the OU-2 ROD is to manage the migration of contaminated groundwater outside the landfill boundaries. Investigations at the Site identified ingestion of groundwater as the primary threat to human health. The OU-2 ROD identified natural attenuation of groundwater, which had migrated from beneath the landfill to off-Site areas, together with long-term environmental monitoring and institutional controls as the selected remedy. The Consent Decree for the implementation of the management of migration remedy became effective on January 11, 1999.

The CLG submitted an environmental monitoring plan for the OU-2 remedy which USEPA approved on March 10, 1999 (Aries, 1999). The monitoring plan objective was to **1)** assess OU-1 Remedial Action impacts on site sediment, surface water and groundwater; and **2)** monitor natural attenuation of constituents in the OU-2 area, sediment, surface water and groundwater. To attain this objective, the monitoring plan required sediment, surface water and groundwater sampling and analysis in April, August, and November of 1999. The monitoring plan also specified that sampled media be analyzed for VOCs, SVOCs, metals, natural attenuation indicator parameters and water quality indicator parameters. In May 1998 and April 1999, groundwater samples were submitted for analysis of SVOCs and no exceedances of cleanup standards were reported; therefore, SVOCs were removed from the long-term monitoring plan (Aries, 1999).

Minor changes in the sampling program have been implemented since the beginning of the long-term monitoring plan, including the standardization of the VOC analyte list to NHDES requirements and addition of 1,4-dioxane to the monitoring program. Annual monitoring of groundwater, surface water and sediments continues today and data assessment reports are provided to the USEPA and NHDES. This SAP addresses the environmental monitoring and data quality assurance requirements that are applicable to the Site at this time.

As part of Institutional Controls for the Site, NHDES issued a Groundwater Management Permit (GMP) GWP-198712001-N-001 for the Coakley Landfill site for a five-year term on June 19, 2008. The GMP included requirements for long-term environmental monitoring activities and created a GMZ that requires recording notice of the permit on all deeds within the GMZ. The NHDES GMP requires that the GMZ boundary conditions be monitored and results compared to NHDES Ambient Groundwater Quality Standards (AGQSs).

The June 19, 2008 GMP expired in 2013 and as part of the GMP renewal application process a Groundwater Management Zone Boundary Evaluation (Summit 2013a) was prepared, which summarized trends in groundwater quality, the progress of the selected site remedy of monitored natural attenuation, and the appropriateness of the GMZ. The report concluded that long-term monitoring results for monitoring events prior to August 2013 indicate stable water quality was present at the majority of groundwater monitoring points. However, 1,4-dioxane, arsenic, and manganese concentrations at the northwestern boundary of the GMZ exceeded the AGQS and a GMZ expansion in this area was determined to be warranted. To support the delineation of an appropriate expanded GMZ boundary in the northwestern portion of the Site, 11 water supply wells located in Greenland, New Hampshire along Breakfast Hill Road were sampled and analyzed for the presence of 1,4-dioxane using a low-level detection limit methodology (Summit 2013b, 2013c). Following receipt of these data, and subsequent discussions with EPA/NHDES, the boundary of the GMZ expansion area was delineated and a GMP

Renewal Application was submitted on October 4, 2013. NHDES issued a new GMP (GWP-198712001-N-002) effective for a five-year term on January 7, 2014 which includes an expanded GMZ and a requirement to install two additional overburden/bedrock monitoring well couplets in the GMZ expansion area. The boundary of the GMZ established by the GMPs issued in 2008 and 2014 are shown on **Figure 1-2**.

Concurrent with the preparation of the GMP Renewal Application, a revised environmental monitoring plan, the July 2013 Addendum to the Environmental Monitoring Plan (EMP) (Summit 2013d), was developed to include additional water supply well monitoring points, updated standard operating procedures (SOPs), and to provide a framework for collecting interval samples from bedrock monitoring wells that have screened intervals longer than 10 feet such that the appropriate depth of tubing intakes could be established for subsequent sampling events.

This September 2017 SAP revision incorporates revisions to the sampling and analysis requirements contained in the conclusions and recommendations of the 2015 and 2016 Annual Reports, as well as recommendations contained in EPA's Fourth Five-Year Review Report and letters issued on December 16, 2016 and April 20, 2017 by the EPA. This SAP has been revised to include the following:

- Incorporate the FPC-3 series wells into the sampling program;
- Increase sampling of site monitoring wells from one to two sampling rounds (Spring and Fall) per year for 2017 and 2018;
- Sample 19 additional off-site water supply wells (4, 9, 10, 16, 19, and 21 Stone Meadow Way; 5, 9, and 15 Berry Farm Lane; 4 and 10 Red Oak Drive; 7 and 8 Woodknoll Drive, 340 and 463 Breakfast Hill Road; 67 Ridge Crest Drive, 25 Falls Way, 27 Birch Road, and 178A Lafayatte Road) for site-related contaminants twice a year for 2017 and 2018;
- Install four additional monitoring wells (two overburden/bedrock monitoring well couplets, MW-20 and MW-21) within the GMZ to the north/northwest of the landfill;
- Decommission and replace the damaged well FPC-5A; and
- Sample five additional surface water and sediment locations (SW-LR/SED-LR, SW-BB1/SED-BB1, SW-BB2/SED-BB2, SW-110/SED-110, upgradient from the culvert at Berry's Brook crossing of Breakfast Hill Road, (NHDES sample ID CLK_SW-10), and SW-111/SED-111, upgradient from the culvert at Berry's Brook crossing at Route 1, (NHDES sample ID CLK_SW-14)) for contaminants of concern.

1.3 Summary of the Site Geology and Hydrogeology

The surficial and bedrock geology and hydrogeological setting at the Coakley Landfill Site is described in detail in the various Remedial Investigation (RI) reports for the Site (CDM 1994; Golder 1993; Weston 1988). A compendium of the information, including descriptions and figures discussing the geology and hydrogeology of the Site is presented in the Management of Migration Remedial Investigation and Feasibility Study Report (CDM, 1994). In addition, the Groundwater Management Zone Boundary Evaluation (Summit 2013a) presents a summary of the RI information in the context of long-term monitoring results for the Site, up to and including data from August 2012 sampling event. A brief summary of the Site geology and hydrogeology is provided below.

The bedrock geology of the Coakley Site is characterized by upper metavolcanic-metasedimentary rocks of the Rye Formation and a foliated granite that forms an elongated lenticular-shape body that is oriented parallel the northeast trending regional foliation of the Rye Formation. The Rye Formation is a portion of a regional northeast/southwest trending highly deformed sedimentary basin bedrock sequence that underlies much of coastal New Hampshire and southern Maine. In the vicinity of the Coakley Landfill, the Rye Formation is described in boring logs as being composed of phyllite, metagraywake and quartzite with a steep northwest dipping foliation. Bedrock of the Rye Formation have been variably metamorphosed to a quartz-rich schist and feldspathic amphibolite in proximity to the granite body. The granite body is typically described in drilling logs as consisting of fine to medium grained foliated granite or gneiss containing trace amounts of pyroxene, biotite, muscovite and garnet. Trace pyrite and iron-straining was observed on many fracture faces in the granite body and the Rye Formation according to boring logs in the RI report.

Bedrock surface topography at the Coakley Site is characterized by a bedrock ridge situated beneath the landfill area and extending to the topographic high to the north of the landfill area. Bedrock topography slopes radially away from the landfill area, with slopes predominantly to the east and west (CDM 1994).

Overburden encountered in the vicinity of the Coakley Site consists of glacial deposits and recent swamp and alluvial deposits from current depositional environments. The glacial deposits can be separated into glacial till, glaciomarine (marine) and glacial outwash sediments. The till is present at most locations and was observed to be deposited directly onto the bedrock surface at all locations where it is present. Descriptions of the till unit indicate that it is generally dense and ranges in texture from fine to coarse gravel, fine to coarse sand and silt. Till unit thicknesses range from less than 1 foot in areas at topographic highs to 60 feet in the bedrock topographic low west of the landfill.

Marine deposits encountered in the study area were observed to be deposited on glacial till, or directly onto bedrock where the till unit was not present. Thicknesses of the marine unit varied from approximately 5 to 50 feet and textures within the unit varied from soft to very soft sandy to silty clay. The fringes of the marine deposits interfinger with glacial outwash (or reworked till) coevally/ simultaneously deposited in areas proximal to bedrock topographic highs.

Glacial outwash deposits generally overlie the marine sediment, but directly overly bedrock or till in areas where marine deposits are absent. Outwash deposits range in thickness from 5 to 15 feet and are composed of dense fine to coarse sand with varying amounts of silt and gravel.

1.4 Summary of Groundwater Flow Pathways and Extent of Impacted Groundwater

Groundwater movement within glacial till, marine deposits and sand and gravel outwash defines the overburden hydrogeology in the vicinity of the Coakley Site. The sand and gravel outwash is the most permeable of the three materials, followed by the till and marine deposits. The marine clay layer exhibits significantly lower permeability than other overburden units and in many places, forms an aquitard that hydraulically isolates the uppermost outwash layers from the lower till unit, except for areas proximal to bedrock highs, where inter-fingering of outwash and marine deposits may serve as possible flow pathways.

Bedrock in the vicinity of the Site consists of two different rock types, including a northeast/southwest narrow belt of foliated granitic rocks and pegmatite, roughly centered on the site, surrounded by metamorphic sedimentary rocks. A relatively thin (maximum 30-feet thick) weathered bedrock fracture system is present through the area according to boring logs and interpretations contained in the RI. A localized deeper fracture system in the Berry's Brook / Little River valley to the west of the Coakley Landfill was interpreted to be present by a photolineament and fracture trace analysis (Weston, 1988). The deeper fracture system trends roughly north-north east and parallel to the strike of regional foliation in bedrock and is parallel to the trend of the Berry's Brook / Little River valley located to the west of the Coakley Landfill.

Prior to landfill capping in Fall 1998, water level elevations indicated that general groundwater flow directions in overburden and bedrock were similar, with radial flow away from a ridge that runs roughly between the Coakley and Rye landfills (CDM, 1994); note that bedrock groundwater elevations supported only westward flow from the landfill, while overburden groundwater elevations supported a more radial flow from beneath the Coakley landfill. After construction of the Coakley Landfill cap system in Fall 1998, overburden groundwater elevations in the vicinity of the landfill dropped significantly and the dominant direction of groundwater flow in overburden underlying the landfill was interpreted to be primarily westerly toward Berry's Brook and Little River, while the direction of groundwater flow in bedrock continued to be interpreted as westerly. Water level elevations in shallow outwash wells MW-4 and OP-5 indicate an east/west shallow overburden flow divide is likely present proximal to the eastern boundary of the landfill.

Upward and downward hydraulic gradients are observed at many of the well couplets monitored at the Site. However, the likelihood that the gradients lead to a significant component of vertical flow within the hydrogeological units is dependent on the hydrogeological conditions present at each location and may vary on a seasonal basis.

Areas west of the landfill comprise the principal direction where groundwater quality impacts attributable to the landfill are present. Groundwater contour maps for overburden and bedrock groundwater (Summit 2014) show that areas west of the landfill are hydraulically downgradient of the landfill. Groundwater flowing beyond the western margin of the landfill encounters a flow divide located in a broad topographic saddle to the west of the landfill, which results in the bifurcation of groundwater flow into two distinct flow pathways along a prominent northeast/southwest trending valley (Summit 2013a). The northeastern flow pathway is situated within the watershed of Berry's Brook, which drains to the northeast across Breakfast Hill Road. The southwestern flow pathway is situated within the watershed of the Little River, which drains to the south-southeast across North Road.

Groundwater quality impacts along the northeastern and southwestern flow pathway are principally confined to a southwest/northeast trending bedrock fracture system in the valley to the west of the landfill.

1.5 Site Cleanup Levels

Contaminants of Concern with associated USEPA Cleanup Levels (CLs,) USEPA Health Advisories (HAs), and NHDES AGQSs are summarized in **Table 1-1**.

Table 1-1: Groundwater Cleanup Levels

Parameter	Chemical Abstract Service Registry Number	NHDES Ambient Groundwater Quality Standard (AGQSs)*	USEPA Record of Decision Cleanup Levels [2] (CLs)*
Benzene	71-43-2	5	5
Chlorobenzene (Monochlorobenzene)	108-90-7	100	100
Tetrachloroethene (PCE, Tetrachloroethylene)	127-18-4	5	3.5
Tetrahydrofuran (THF)	109-99-9	600	154
1,2-Dichloropropane	78-87-5	5	5
2-Butanone (MEK, Methyl Ethyl Ketone)	78-93-3	4,000	200
Diethyl phthalate [3]	84-66-2	--	2,800
Trans-1,2-dichloroethene (trans-DCE)	156-60-5	100	100
Phenol [3]	108-95-2	4,000	280
1,4-dioxane [2]	123-91-1	3	3
ertiary butyl alcohol (TBA, tert-butyl alcohol)	75-65-0	40	--
Antimony	7440-36-0	6	6
Arsenic	7440-38-2	10	10
Beryllium	7440-41-7	4	4
Chromium	7440-47-3	100	50
Lead	7439-92-1	15	15
Manganese	7439-96-5	840	300
Nickel	7440-02-0	100	100
Vanadium	7440-62-2	--	260
Perfluorooctanoic acid (PFOA)	335-67-1	70**	-- [1]
Perfluorooctane sulfonate (PFOS)	1763-23-1	70**	-- [1]
PFOA and PFOS Combined	--	70**	-- [1]

* units in micrograms per liter (ug/L, parts per billion)

** units in nanograms per liter (ng/L, parts per trillion)

(1) On May 31, 2016 EPA established a lifetime Health Advisory for PFOA, PFOS and combined PFOA/PFOS of 70 ng/L

(2) Interim Cleanup Levels (ICLs) for contaminants of concern were established in the ROD for groundwater and subsequently modified in several ESDs. The Fifth ESD issued in August 2015 formally changed the ICLs to Cleanup Levels (CLs) and established a CL for 1,4-dioxane.

(3) In May 1998 and April 1999, groundwater samples were submitted for analysis of SVOCs and no exceedances of applicable standards were reported; therefore, SVOCs (the requirement to analyze for diethyl phthalate and phenol) were removed from the long-term monitoring plan.

A summary of the status of the contaminants of concern is provided in annual reports presenting the results of sampling activities.

In accordance with the ROD, groundwater CLs must be met at the completion of the remedial action. Data generated will be reviewed by EPA at least once every five years to ensure that results are indicating that the remedy selected for the Site continues to be protective of human health and the environment.

There are no CLs established for surface water or sediment. Surface water data results will be compared to NHDES Surface Water Quality Regulations (Env-Wq 1700, see **Table 3.2**). Sediment laboratory analytical data will be compared with historical analytical data relative to long-term trends in sediment quality in addition to published, peer-reviewed screening level contaminant lists included in the NHDES Draft Evaluation of Sediment Quality Guidance Document, dated April 2005, that includes the National Oceanic and Atmospheric Administration Screening Quick Reference Tables (NOAA SQuiRT Tables). Current SQuiRT Tables are located on the NOAA website (http://www.response.restoration.noaa.gov/sites/default/files/SQuiRTs.pdf). TEC is Threshold Effect Concentration, which is consensus-based and incorporates the Ontario Ministry of the Environment lowest-observed effect levels (LELs). Sediment samples will also be compared against the EPA site-specific screening levels (SLs) for PFOA, PFOS, and PFBS.

1.6 Data Quality Objectives

Project Data Quality Objectives (DQOs) are qualitative and quantitative statements that specify the quality and quantity of data needed to support decisions during site assessments. DQOs are developed by considering the purpose of collecting the data and the intended use of the data. Data collected during environmental monitoring activities conducted under this SAP must be suitable for the following intended data uses:

- Prevent ingestion of groundwater containing contamination in excess of federal and state drinking water standards or criteria, or that poses a threat to public health and the environment.
- Prevent the public from direct contact with contaminated soils, sediments, solid waste and surface water which may present a health risk.
- Eliminate or minimize the migration of contaminants from the soil into groundwater.
- Prevent the off-site migration of contaminants above levels protective of public health and the environment.
- Restoration of groundwater, surface water, soils and sediments to be protective of public health and the environment.
- Ensure that the remedy does not negatively impact the wetlands and facilitates the restoration of the wetland environment.

Performance acceptance criteria for all new data generated for this project will be based on principal *Data Quality Indicators* including precision, bias, representativeness, completeness, comparability, and sensitivity. For data generated by Eastern Analytical Inc. (analytical laboratory used for the project), the RDLs and the acceptance limits for accuracy and precision have been accepted for use on this project. **Table 3-2** includes a summary of the test methods being performed by the laboratory and the associated reporting detection limits (RDLs) and method detection limits (MDLs).

Comparability is the extent to which data from one data set can be compared directly to similar or related data sets and/or decision-making criteria. Data comparability will be achieved by continuity of laboratory practices, method analysis, sample collection procedures and sample handling. Completeness is considered to be the percentage of data collected that is sufficient for the intended use following data validation.

The ability to meet the project DQOs will be achieved through the use of prescribed sampling procedures, analytical data quality levels, and measurement performance criteria (MPC) described in this SAP.

SECTION 2.0 | PROJECT ORGANIZATION AND RESPONSIBILITIES

Key personnel during implementation of the environmental monitoring program (shown in **Table 2-1**): include USEPA Remedial Project Manager, NHDES Project Manager, Group Project Coordinator, Sampling and Reporting Contractor and the Analytical Laboratory Project Manager.

USEPA Remedial Project Manager
The USEPA Remedial Project Manager for the Site is identified in **Table 2-1**. The primary responsibilities of the USEPA Remedial Project Manager include administration of USEPA responsibilities and oversight of the activities conducted under the Consent Decree.

NHDES Project Manager
The NHDES Project Manager for the Site is identified in **Table 2-1**. The primary responsibilities of the NHDES Project Manager include administration of NHDES responsibilities and oversight of the activities conducted under the Consent Decree and the GMP.

Group Project Coordinator
The Coakley Landfill Group (CLG) maintains ultimate responsibility for project completion. The CLG Project Coordinator serves as the main point of contact between USEPA/NHDES and the Sampling and Reporting Contractor.

Sampling and Reporting Contractor
The Sampling and Reporting Contractor is responsible for performing environmental monitoring under this SAP. Members of the Sampling and Reporting Contractor team include:

> **Sampling and Reporting Manager:** The Sampling and Reporting Manager will determine the technical staff involved with sampling, technical review, project management and QA/QC activities.
>
> **Quality Assurance Officer:** The Quality Assurance Officer's (QAO's) responsibilities include overseeing adherence to applicable procedures and assessing the general usability of the data generated.
>
> **Project Staff:** Project Staff will be selected by the Sampling and Reporting Manager to perform the tasks described in this SAP.

Analytical Laboratory Project Manager
The Analytical Laboratory Project Manager is responsible for providing analytical services and ensuring that quality assurance and quality control practices are maintained for analytical services.

SECTION 3.0 | MONITORING AND SAMPLING PROTOCOL

The following subsections discuss general methodology for performing sampling and analysis as part of the overall field activities including specific sampling procedures and data management requirements that will be implemented during the monitoring program.

Environmental monitoring activities to be conducted at the Site include: groundwater quality and groundwater level monitoring, surface water quality monitoring, leachate quality monitoring, sediment quality monitoring, and water supply well monitoring. Landfill gas monitoring is conducted under the Methane Monitoring Plan included in the POP. Monitoring point locations are shown on **Figure 1-2**. **Appendix A** includes a copy of the Site GMP issued by NHDES on January 7, 2014.

Analytical methods, laboratory RDLs, sample containers, volumes, preservative and holding times for all matrices are list in **Table 3-1**. Site Contaminants of Concern, Contaminants of Interest and associated regulatory standards and lab criteria are summarized in **Table 3-2**.

Field activities will be conducted in accordance with this SAP, unless Site conditions require temporary modifications. Any modifications shall be documented in field notes and described in the Annual Monitoring Report. Permanent modifications to field activities must be approved by EPA and NHDES.

Procedures for the collection of groundwater, water supply well (untreated drinking water), surface water, leachate seep, and sediment samples are described below and in the associated SOPs in **Appendix C**.

3.1 Groundwater Monitoring

Groundwater monitoring activities include measurement of groundwater levels and conversion to elevation data, as well as groundwater quality monitoring. Monitoring well locations are shown on **Figure 1-2**. Monitoring wells currently included in the environmental monitoring network and other associated information used for sampling activities are listed in **Table 3-3**. Boring and well completion logs for wells included in this long-term monitoring program are included in **Appendix B**.

3.1.1 Groundwater Level Monitoring

Monitoring wells currently included in the groundwater level measurement/elevation network are listed in **Table 3-4**. The Sampling and Reporting Contractor will perform groundwater level monitoring in conjunction with the scheduled groundwater sampling events. The Sampling and Reporting Contractor will perform the synoptic groundwater level monitoring in accordance with the SOP in **Appendix C**. The depth to the bottom of the monitoring well shall be confirmed in each well, at a minimum once every five years in the year prior to the USEPA Five Year Review, or as required.

3.1.2 Groundwater Quality Monitoring

Groundwater quality will be assessed through the collection, management, and analysis of groundwater samples from specified monitoring wells. Monitoring well locations are shown on **Figure 1-2**. The groundwater sampling schedule and analytical requirements are presented in **Table 3-5 (OU-1)** and **Table 3-6 (OU-2)**.

The Sampling and Reporting Contractor will collect groundwater samples using low-flow sampling, or a bottom-dispensing bailer sampling procedures as described in **Appendix C**. The sampling method utilized at each monitoring well location is identified on **Table 3-5 (OU-1)** and **Table 3-6 (OU-2)**. Field parameters will be measured at all monitoring points using portable field instrumentation calibrated in accordance with calibration procedures described in **Appendix C**.

Interval samples were collected at all open borehole wells and monitoring wells with screened intervals longer than 10 feet during sampling events 2010, 2013 and 2014. The depth of tubing intakes for low flow sampling activities along with background information regarding when the interval sampling occurred is provided in **Table 3-3**. For additional information regarding the data used to establish the depth of tubing intakes refer to the 2010, 2013 or 2014 Annual Report or a summary of the interval sampling history at the Site contained in the 2014 SAP (**Section 3.5**).

3.2 Water Supply Well Sampling

Groundwater quality at water supply wells will be assessed through the collection and analysis of untreated drinking water samples from specified water supply wells. The sampling schedule and analytical requirements for water supply wells included in the environmental monitoring network are listed in **Table 3-7**. Water supply well locations are shown on **Figure 1-2**.

The Sampling and Reporting Contractor will collect water supply well samples using the procedures described in **Appendix C**. Field parameters will be measured at all monitoring points using portable field instrumentation calibrated in accordance with calibration procedures described in **Appendix C**.

3.3 Surface Water and Leachate Seep Sampling

Surface water and leachate seep quality will be assessed by collecting samples from surface water and leachate seep sampling points included in the environmental monitoring network. The sampling schedule and analytical requirements for surface water sampling locations included in the environmental monitoring network are listed in **Table 3-8**. Sampling locations are shown in **Figure 1-2**.

The Sampling and Reporting Contractor will collect surface water samples and the leachate seep sample using the procedures described in **Appendix C**. Field parameters will be measured at all monitoring points using portable field instrumentation calibrated in accordance with calibration procedures described in **Appendix C**.

All field parameters, with the exception of turbidity are measured in-situ, by placing the probe of the water quality meter directly into the surface water or leachate seep sampling location and recording values.

3.4 Sediment Sampling

Sediment quality will be assessed by collecting samples from sediment sampling points included in the environmental monitoring network identified on **Figure 1-2**. The sediment sampling schedule and analytical requirements are listed in **Table 3-9**.

The Sampling and Reporting Contractor will collect sediment samples using the procedures described in **Appendix C**.

3.5 Monitoring Well Inspection and Maintenance

To ensure that the monitoring network provides representative data throughout the performance period, the Sampling and Reporting Contractor will complete periodic inspection and maintenance of monitoring wells during scheduled groundwater sampling events.

The Sampling and Reporting Contractor will, on an annual basis, visually inspect monitoring wells to observe signs of deterioration of the protective casing, surface seal, or interior casing and shall note whether the well is secure (locked). In addition, every five years in the year prior to the USEPA Five Year Review (2020, 2025, 2030, etc.), the Sampling and Reporting Contractor will measure the depth of the well to determine the presence of silt, sand, or other obstacles that may impede or compromise use of the well as a sampling location. The Sampling and Reporting Contractor will compare the measured depth of the well to the depth recorded at the time of installation and any differences will be discussed in the Annual Report.

Monitoring wells should be redeveloped if silt or sediment has accumulated to a depth of 1 foot, or if records indicate a significant change in yield and turbidity. If this is the case, the Sampling and Reporting Contractor will determine the nature of the material by lowering a clear bailer to the bottom of the well, withdrawing a sample, and observing the type of material retrieved. If the material is such that it can be removed using mechanical means, such as pumping or by air lift, the well will be cleared. In the event that the well cannot be cleared of foreign material, the CLG will discuss potential remedies including well replacement or abandonment, with USEPA and NHDES.

If a monitoring well is damaged at the surface, the Sampling and Reporting Contractor will notify the USEPA and NHDES of the damage and proposed repairs at least one week prior to performing the repairs necessary to render the well operational. If the inner casing is damaged, and it appears that it can be repaired without compromising the integrity of the well, the Sampling and Reporting Contractor will perform repairs as necessary to render the well operational. If significant damage is evident, the CLG will discuss potential remedies with the USEPA and NHDES including repair, replacement, and/or abandonment.

Previous Annual Reports recommend replacing monitoring well FPC-5A due to well integrity issues. It appears that FPC-5A is obstructed and the depth of the tubing is currently above the screened interval. The new replacement well was installed in close proximity to FPC-5B and will be referred to as FPC-5AR. Monitoring well FPC-5A was decommissioned shall no longer be sampled. Two additional overburden/bedrock monitoring well couplets (MW-20 and MW-21) will be installed in the GMZ expansion area as required in the new GMP. The approximate location of these monitoring well locations are shown on **Figure 1-2**.

3.6 Sampling Equipment Decontamination

The Sampling and Reporting Contractor will bring decontaminated sampling equipment to the Site and decontaminate equipment between sampling locations in accordance with the site-specific equipment decontamination procedures in **Appendix C**.

3.7 Investigation Derived Wastes

Decontamination procedures are described in **Appendix C**. Investigation derived waste will be managed as follows:

- Purged water will be discharged to the ground surface and allowed to infiltrate the soil adjacent to the well location. The purge water will not be allowed to runoff into surface water bodies. Care will be taken to prevent purge water from flowing back into road boxes (if applicable) or contaminating sampling equipment or supplies being used at that location.
- In the unlikely event that free product is encountered, purged water will be contained for off-site disposal.

3.8 Periodic Reviews of the Monitoring Program

The Sampling and Reporting Contractor will perform annual reviews of the monitoring program to ensure that monitoring meets project objectives and is cost-effective. The Sampling and Reporting Contractor will consider changes to monitoring frequency, the number and location of monitoring points and the types of analysis conducted as part of each review. Recommendations to modify the monitoring program will be provided in the Annual Report and will only be implemented with USEPA and NHDES approval. The SAP will be revised upon approval of any modifications.

It is important to note that the NHDES GMP identifies the monitoring frequency, the number and location of monitoring points, and types of analysis required at each monitoring point; therefore, any changes to the monitoring program may require that the NHDES GMP also be revised.

SECTION 4.0 | QUALITY CONTROL AND QUALITY ASSURANCE (QA/QC)

4.1 Equipment Calibration and Maintenance

Field equipment used during sampling activities may be rented from a rental equipment supplier. As such, the rental company will provide certified documentation indicating that the instruments are functioning within manufacturer specification when delivered to the Sampling and Reporting Contractor.

If the Sampling and Reporting Contractor owns the equipment used during monitoring activities at the Site, the Sampling and Reporting Contractor will be responsible to test and maintain the instruments according to manufacturer's specifications, and maintain documentation of such activities.

In general, all instrumentation necessary for field monitoring and health and safety purposes shall be maintained, tested, and inspected according to the manufacturer's instructions. Equipment calibration will be conducted in accordance with the equipment calibration SOP in **Appendix C**.

All field instruments shall be calibrated, and have a calibration check, in the office prior to the field event (within one week) to ensure that the equipment is working properly and meets the QA criteria.

Table 4-1 provides a summary of sampling equipment, maintenance and frequency of inspections.

Table 4-1
Field Equipment - Preventive Maintenance

INSTRUMENT	ACTIVITY	FREQUENCY
Multi-Parameter Water Quality Meters: YSI models 600XL/XLM or 6820	Calibration and Calibration Check – pre-sampling event	Once Prior to Sampling Event
	Battery check Calibration – beginning of day Calibration check – after morning calibration Calibration check – end of day	Daily
Hach 2100P or 2100Q Turbidity Meter	Calibration and Calibration Check – pre-sampling event	Once Prior to Sampling Event
	Battery check Calibration – beginning of day Calibration check – after morning calibration Calibration check – end of day	Daily
Solinst Electronic Water Level Indicator (or equivalent)	Battery Check	Daily

Table 4-2 provides a summary of the sampling equipment, calibration frequency, calibration standards, calibration acceptance criteria, and corrective action requirements.

Table 4-2
Field Equipment - Calibration and Corrective Action

Parameter	Calibration Standards	Acceptance Criteria for the Daily Calibration Checks[1]	Calibration Frequency	Corrective Action
Multi-parameter Meters: YSI models 600XL/XLM or 6820			Daily Calibration at the beginning of the day. Calibration Check at the beginning of the day after calibration. Calibration Check at the end of the day.	**Daily Calibration:** Recalibrate with the appropriate standards. If it is still outside the acceptance criteria, then replace with a different unit. **Calibration Checks:** If outside the criteria at the beginning of the day, recalibrate the instrument with new standards. If recalibration is unsuccessful, replace the unit. If outside the criteria at the end of the day, the data will be qualified by the Sampling and Reporting Contractor.
Dissolved Oxygen (DO) & Temperature	Calibrated to 100% Water Saturated Air Use 0 mg/L DO solution to check	0-0.5 mg/l for the Zero (0) mg/l solution		
Oxidation Reduction Potential (ORP)	Zobell Solution is used to calibrate and check	± 5%		
Specific Conductance	718 µS/cm to Calibrate 1413 µS/cm as a check	± 5%		
pH	7, 4, 10 units Use pH 7 to check	± 5%		
Hach 2100 P or 2100Q Turbidity Meter	Calibrate to <0.1, 10, 20, 100, and 800 NTUs as appropriate for each meter. [2] Use 20 NTUs to check 2100P and the 10 NTU to check the 2100Q.	± 5% for 2100P ± 10% for 2100Q		

Notes:
1. The Checks are a check of the instrument against the calibration standards and are performed in the "measurement or run" mode. This is not recalibration, but rather a check.
2. Use StablCal® Formazin Primary Turbidity Standards

Calibration solutions will be stored in a cooler when not in use such that they are not exposed to temperature extremes so that the integrity of calibration solutions is maintained. The calibration solutions required for field equipment calibration are specified in **Table 4-2** above and in the calibration SOP in **Appendix C**.

4.2 Field Quality Control

In accordance with the Site QAPP and HWRB Master QAPP requirements, field quality control samples are collected as part of environmental monitoring activities to evaluate representativeness of data and the effectiveness of field activities to limit extraneous contamination. Field quality control will be monitored through field QC checks, which consist of controlled samples that are introduced to the laboratory from the field and/or maintained with sampling containers from the beginning to the completion of activities. The following quality control samples are required for routine environmental monitoring activities: temperature blank, trip blank, duplicate sample, equipment blank and field blank.

In addition, matrix spike (MS) and matrix spike duplicate (MSD) samples are collected to assess the analytical method precision for aqueous sample matrices (e.g., surface water, groundwater, leachate seep).

Tables 4-3 and **4-4** summarize the quality control samples, frequency, measurement performance criteria (MPC, acceptance criteria) and corrective actions. The Sampling and Reporting Contractor is responsible for providing the sampling team with a clear and concise summary of the where QC samples will be collected and how many QC samples are required.

Table 4-3
Field Quality Control Requirements

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Trip Blanks (1 trip blank = 2 VOA vials)	1 per cooler containing VOC samples 1 per cooler containing 1,4-dioxane samples **NOTE:** Separate trip blanks are required for VOCs and 1,4-dioxane, as each has different preservative requirements.	No contaminants are detected	Flag in project report. Qualify affected analyses in accordance with data validation requirements specified in the SAP
Field Blank	One per sampling event. See **Table 4-4** for analysis requirements	No contaminants are detected	
Equipment Blanks	If dedicated equipment is used, an initial equipment blank is required, thereafter no additional equipment blanks are required If non-dedicated equipment is used, one equipment blank per sampling event, per equipment type is required. See **Table 4-4** for analysis requirements	No contaminants are detected	
Duplicate	A minimum of 1 duplicate per batch 20 samples, or one duplicate per sampling trip for each media sampled if fewer samples are taken on that particular trip; per matrix; per parameter. A minimum of one duplicate for each sampling method (e.g. low flow sampling, sediment, surface water, leachate seep) shall be collected per matrix, per analysis.	Duplicate concentrations are within ± 30% for aqueous samples and ± 50% for solid samples	
Matrix Spike / Matrix Spike Duplicates (MS/MSD)	MS/MSD samples are collected in addition to the duplicate samples. A minimum of 1 MS/MSD per batch 20 samples, or one MS/MSD per sampling trip for each media sampled if fewer samples are taken on that particular trip; per matrix; per parameter.	Evaluated in accordance with the analytical method and the most recent National Functional Guidelines (NFG) MS/MSD criteria.	

Note: See **Table 4-4** for analysis requirements

4.2.1 Blanks

Field quality control blanks include temperature blanks, trip blanks, field blanks (source water used for equipment decontamination), and equipment rinse blanks. Blanks (excluding temperature blanks) generally measure the amount and type of contamination introduced at any point throughout the sampling and analysis process, including sample handling and transport. If contamination is identified in the blanks, corrective actions will be taken by the Sampling and Reporting Contractor to identify the cause of the contamination and prevent its reoccurrence. Corrective actions may include implementation of more aggressive decontamination procedures, replacement of equipment or modification of sampling procedures.

For this project, laboratory designated blank deionized water from the same source used for laboratory method blanks will be bottled at the laboratory and used by the analytical laboratory to prepare trip blanks and temperature blanks. When PFAS are to be sampled, PFC free water bottled at the laboratory will be used in place of deionized water. The Sampling and Reporting contractor will prepare equipment blanks and field blanks, and decontaminate equipment using laboratory-provided deionized water used by the laboratory to prepare method blanks.

4.2.1.1 Trip Blanks

Trip blank results are used as indicators of contamination originating from handling and management of sample containers during storage and transport. Trip blanks will only be prepared and analyzed for VOCs and/or for analysis of 1,4-dioxane using a low-level detection limit methodology. One trip blank consists of two sample containers (VOA vials) filled by the laboratory with the laboratory designated blank source water and if necessary the preservative associated with the analytical method (i.e., with hydrochloric acid). Typically, VOC trip blanks contain hydrochloric acid; whereas, low level 1,4-dioxane trip blanks do not contain a preservative. Separate trip blanks are required for VOCs 8260 method, VOCs 524 method and 1,4-dioxane low level detection limit methodology.

The Sampling and Reporting Contractor will request that the Laboratory provide **undated** trip blanks. The Sampling and Reporting Contractor will record the date and time the trip blanks were put into the cooler on the sample label and chain-of-custody (COC) form.

A trip blank will accompany sample containers to be analyzed for VOCs and/or 1,4-dioxane from the laboratory, to the field, and back to the laboratory without being opened until it is to be analyzed. There must be one trip blank in every cooler used to ship samples to the laboratory for VOC analysis and one trip blank in every cooler used to ship 1,4-dioxane samples to the laboratory.

The field sampling technicians will identify each trip blank separately on the label and on the COC to ensure that the proper trip blanks are analyzed for a sampling event. Each trip blank will be identified on the COC as “Trip Blank and the analysis’. Examples include; “Trip Blank – 8260”; “Trip Blank – 524”; “Trip Blank – 1,4-dioxane”. Each trip blank (2 VOC vials) will appear on a separate line on the COC form and will indicated the number of containers (2) per analysis type.

Coolers may include more than one type of trip blank. For example, if three coolers contain 8260 VOC and 1,4-dioxane samples, each cooler will contain a separate COC form with a uniquely identified trip blank for VOCs (Trip Blank – 8260), indicating two containers for that trip blank; and a separate uniquely identified trip blank for 1,4-dioxane (Trip Blank – 1,4-dioxane), indicating two containers for that trip blank.

4.2.1.2 Temperature Blanks

A temperature blank will consist of a water filled container provided by the laboratory that will accompany each cooler of samples submitted for laboratory analyses. During sample receipt, the sample custodian will measure the temperature in the blank to determine the status of sample preservation during shipment to the laboratory. The preservation goal for the samples is to maintain temperatures less than 6°C (without freezing). If the cooler temperature is outside this range (i.e., above 6 °C), the laboratory will contact the Sampling and Reporting Contractor for guidance as to whether to proceed with the analyses.

4.2.1.3 Equipment Blanks

An equipment blank is collected to ensure that the decontamination procedure is adequate. The potential for cross contamination, within or on sampling equipment that comes into contact with the sample, is assessed by collecting rinsate water from the sampling equipment following decontamination with the source water used for equipment decontamination. The equipment blanks will consist of rinsate water samples collected directly into the appropriate bottle for each parameter. They shall be handled like any other sample (i.e., preserved and labeled in the same manner as original field samples), and submitted with the other samples for analysis.

Equipment blanks will be collected at a frequency as indicated on **Table 4-3 (Field Quality Control Requirements)**. Equipment blanks will be identified on the COC form as "EB – followed by a description of the equipment". For example, an equipment blank collected on the water level meter would be "EB-Water Level". One equipment blank on sediment sampling equipment (rinsate from the bowl, spoons, etc.) would be designated as "EB – Sediment".

4.2.1.4 Field Blank

The field blank is a sample of the laboratory-provided analytic free deionized water used for equipment decontamination during the course of a sampling event. In the event that compounds are detected in equipment rinse blanks, field blanks are used to assess whether the source of contamination is the designated decontamination source water, an issue with equipment decontamination procedures, or potentially due to laboratory handling and analysis procedures.

A field blank is collected by filling the appropriate sample container(s) and labeling and handling the samples in the same manner used for field samples. A field blank will be collected at a frequency as indicated on **Table 4-3 (Field Quality Control Requirements)**. The field blank will be collected prior to initiation of sampling activities.

The field blank will be identified as the "FB – DI Water" on the COC form. A description of the source of the water may be provided in the comment section COC form.

4.2.2 Field Duplicates

Field duplicates provide a measure of the reproducibility (precision) of the sampling procedures and the representativeness of the samples. Two samples from a single sample location and depth interval are collected, handled, submitted to the laboratory and analyzed by the laboratory in an identical manner. Each sample is labeled with a unique sample number, and both are submitted to the laboratory for the appropriate analyses. Field duplicate samples will be collected at a frequency as indicated on **Table 4-3 (Field Quality Control Requirements)**.

The duplicates shall be collected at the same time, in the same manner as their corresponding routine samples, in accordance with the associated sampling SOPs in **Appendix C**. In other words, duplicate samples shall be collected by filling a separate container for each analysis immediately following the actual field sample collection (e.g., VOC sample, VOC duplicate sample; metals sample, metals duplicate sample, etc.). The field duplicate sample bottle(s) will be filled using the same procedures as the original sample.

Field duplicate samples will be identified as the original sample number with a final letter designation of "DUP". For example, a duplicate sample collected from the original location GW-MW-4 would be designated GW-MW-4-DUP.

4.2.3 Matrix Spike/Matrix Spike Duplicates

Matrix spike/matrix spike duplicate (MS/MSD) samples are quality control samples used by the laboratory as part of their quality assurance program to assess the precision and accuracy of the analytical methods and to identify potential matrix interferences for aqueous samples (e.g., surface water, groundwater, leachate seep). MS/MSD samples shall be collected by filling a separate container for each analysis immediately following the actual field sample collection (e.g., VOC sample, VOC MS sample, VOC MSD sample, etc.). If duplicates are also collected, the order is as follows: sample, duplicate sample, MS sample, MSD sample.

MS/MSD quality control samples will be identified on the COC for the analytical laboratory. MS/MSD samples will be collected at a frequency as indicated on **Table 4-3 (Field Quality Control Requirements)**.

MS/MSD samples will be identified as the original sample number with a final letter designation of "MS" or "MSD". For example, MS and MSD samples collected from the original location GW-MW-4 would be designated GW-MW-4-MS and GW-MW-4-MSD, respectively.

4.3 Data Validation and Verification

Validation of measurements is a systematic process of reviewing data to verify that the data are adequate for their intended use. Data validation is the process of reviewing data and accepting, qualifying, or rejecting them on the basis of established criteria.

A USEPA Region I Tier I Plus data validation will be performed for the data collected under this SAP. The Tier 1 Plus consists of two parts, Part A and Part B.

Part A (Tier 1) consists of a third-party data validation of the analytical laboratory report in accordance with the following USEPA National Functional Guidelines (NFG) guidelines (https://www.epa.gov/clp/contract-laboratory-program-national-functional-guidelines-data-review) and Superfund specific procedures (http://www.epa.gov/superfund/programs/clp/guidance.htm):

- USEPA Region I Environmental Data Review Supplement for Regional Data Review Elements and Superfund Specific Guidance/Procedures (USEPA, 2013);
- USEPA National Functional Guidelines for Superfund Inorganic Methods Data Review (USEPA, 2016a); and
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2016b).

If the USEPA publishes revisions superseding these guidelines, the superseding documents will be used for data validation.

Based upon the selected tier level selected for this Site (Tier I Plus), the following deliverables will be required from the analytical laboratory:

- Electronic Data Deliverable (EDD) of analytical results in Adobe Portable Document Format (PDF) and NHDES EMD format (or equivalent).
- Sample-related QC results and QC acceptance criteria (e.g., method blanks, deuterated monitoring compounds (DMC) recoveries, laboratory control sample (LCS)recoveries, duplicate analyses, MS and MSD recoveries, serial dilutions, post digestion spikes);
- Instrument-related QC results (e.g., initial calibration, continuing calibrations, instrument performance checks);
- Qualification of results based on the additional QC reviewed.

Part B, the “Plus” part of the Tier 1 Plus data validation consists of an evaluation of the field sampling data by the Quality Assurance Officer (QAO) of the Sampling and Reporting Contractor to ensure data have been recorded, transmitted, and processed correctly.

Field water quality data collected / measured will be reviewed in the field by Project Staff daily for all matrices. Review will generally consist of the following:

1) Review of calibration data and beginning and end of the day checks;
2) Review of raw data and field notes for outliers or inconsistencies that may indicate a problem with the equipment or sampling procedure;
3) Review of the COC forms for correctness and completeness; and
4) Review of the coolers to ensure that each cooler contains temperature blanks and the proper trip blanks for both VOCS and 1,4-Dioxane and to ensure that the correct sample handling protocols are followed
5) Review of field sampling worksheets to ensure that all field data and parameters were collected and documented correctly and accurately according to proper protocols.

The following criteria will be used to evaluate the field sampling data at the end of each sampling event:

- Audit of the daily QA review as described directly above;
- Review of the sampling procedures;
- Review of field quality control samples to ensure that no contaminants are detected in the field/equipment blanks and an evaluation of the data reproducibility by calculating the relative percent difference (RPD) for duplicate samples to ensure that the field duplicates are within the acceptance criteria described on **Table 4-3 (Field Quality Control Requirements)**.
- Review of field equipment calibration activities; Reviewing data for technical credibility versus the sample site setting;
- Auditing field sample data records and COC forms for completeness and to verify that the COC for each sample is continuous and that the laboratory analyzed the samples for the specified parameters; and
- Auditing of sample handling and preservation procedures.

If severe non-compliant QC issues are identified during the Tier I Plus review, a USEPA Region I Tier II data validation may be triggered and the laboratory, and QAO will be required to perform corrective actions.

The results of the evaluation will be included in the Annual Environmental Monitoring Report, and resulting impacts to the data will be discussed.

4.3.1 Data Qualifiers

Based on data validation results, qualifiers may be added to reported analyte concentrations to indicate uncertainty or potential bias or interferences. Specific data qualifiers which will be applied to inorganic and organic sample concentrations include the following:

U The analyte was not detected above the laboratory RDL.

J The reported analyte concentration is an estimated value. The analyte was positively identified and the associated numerical value is the approximate concentration (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the RDL).

J+ The associated numerical value is estimated; associated QC data indicate a positive bias.

J- The associated numerical value is estimated; associated QC data indicate a negative bias.

UJ The analyte was not detected above the RDL. However, due to quality control results that did not meet acceptance criteria, the quantitation limit is uncertain and may not accurately represent the actual limit.

R The reported analyte concentration is rejected due to serious deficiencies with associated quality control results. The presence or absence of the analyte cannot be confirmed.

EB, TB An analyte that was identified in an aqueous equipment blank (EB) or trip blank (TB) that was used to assess field contamination associated with samples.

4.3.2 Data Usability

The measurement performance criteria will depend on the stated DQOs and quality control results reported in accordance with the SAP and the Laboratory SOPs. Depending on the required data quality, any or all of the following considerations for precision, accuracy, and completeness may be evaluated.

To meet these requirements, quality control criteria are provided in the standard samples to assess precision; MSs, LCSs and calibration results to assess accuracy; blank samples to determine representativeness; and field duplicates to assess comparability. The amount (percentage) of valid data obtained from validation will be used to determine completeness. The results of the data usability evaluation will be included in reports, and impacts and/or limitations on the use of the data will be discussed.

Data usability reporting should include an evaluation and summary of data usability relative to the project objectives, and should include the following:

- Description of the project QA/QC activities and DQOs;
- Procedures used for reviewing and evaluating data, including acceptance criteria, the definition of data qualifiers, and the statistical methods of data analysis, if applicable;
- Tabular summary of data used and not used, including the rationale for the data not used;
- Narrative summary of the representativeness evaluation relative to the sampling design, data completeness, and matrix homogeneity; and,
- Discussion of the limitations or restrictions of the data use regarding bias, precision, accuracy and sensitivity.
- Field QA/QC activities that were conducted to verify that sample collection, handling, and storage methods are adequate to ensure sample integrity; and,
- Office QA/QC data evaluation activities that were conducted to assess whether the laboratory data are complete and representative of site conditions.

4.3.2.1 Precision

Precision is a measure of the mutual agreement between concentrations of samples (e.g., duplicates) collected at the same time from the same location. Precision is measured by performing duplicate measurements in the field or laboratory. Precision is expressed in terms of Relative Percent Difference (RPD) using the following equation:

$$\text{RPD} = 100 \times \frac{|A - B|}{[(A + B)/2]}$$

where:

RPD	=	relative percent difference between duplicate results
A	=	concentration reported for original sample
B	=	concentration reported for duplicate sample

Laboratory precision will be evaluated using USEPA Region I tier evaluation criteria. In the absence of USEPA guidelines, acceptance criteria for analytical precision will be based on the fixed based laboratory's QA/QC program.

Acceptable levels of precision will vary according to the sample matrix, the specific analytical methods, and the analyte concentration relative to the MDL. QA objectives for precision will be met through the use of written laboratory SOPs in which data acceptance criteria will be outlined.

Field precision will be evaluated according to the acceptance criteria found in **Table 4-3 (Field Quality Control Requirements)**. Duplicate concentrations shall be within ± 30% for aqueous samples and ± 50% for solid samples.

4.3.2.2 Accuracy

Accuracy is the degree of agreement of a measurement with an accepted reference or true value. The difference between the values is generally expressed as a percentage or ratio. Through quality control checks for accuracy, potential bias of reported sample concentrations is identified. Accuracy of field instrumentation is assured by daily initial calibration and calibration checks. The accuracy of laboratory analytical procedures is measured through a review of calibration, MS and LCS results.

Continuing calibration accuracy checks are assessed by comparing the true value against the reported concentration. The percent difference between the results is calculated as follows:

Accuracy may be expressed as a percent difference (%D) calculated by the following equation:

$$\%\mathrm{D} = 100 \times \frac{|Vt - Vm|}{[Vt]}$$

Where:

Vt = the true or real value expected.
Vm = the measured or observed value.

The degree of accuracy demonstrated for laboratory control and MS samples is expressed as a percent recovery. The percent recovery indicates the amount of known concentration of an analyte that has been detected by the associated instrumentation. The percent recovery (%R) is calculated as follows:

$$\%\mathrm{R} = 100 \times \frac{|SSR - SR|}{[SA]}$$

Where:

SSR = the spiked sample result.
SR = the unspiked sample result.
SA = the concentration of the spike added.

The objective for field measurement accuracy initially is to successfully calibrate the associated instrumentation to the specifications of the Calibration SOP found in **Appendix C** in the SAP and to then check the amount of deviation from the calibrated values after the morning calibration and again at the end of day according to **Table 4-2 (Field Equipment - Calibration and Corrective Action)** and the Calibration SOP in **Appendix C**.

In addition, the low flow sampling procedure considers a well ready for sample collection once the water level and the indicator parameters have stabilized and the purge volume requirement has been met. Stabilization is considered to be achieved when three consecutive readings at five-minute (or greater) intervals are within certain accuracy criteria as specified in the Low Flow SOP in **Appendix C** (e.g.; specific conductivity =/< 3% uS/cm).

The objective for accuracy of laboratory determinations is to demonstrate that the analytical instrumentation provides consistent measurements, which are within USEPA and statistically-derived method-specific accuracy criteria. Laboratory data quality objectives for accuracy as measured by %R are provided in Laboratory Standard Operation Procedures located in **Appendix D**.

4.3.2.3 Completeness

Completeness is a measure (percentage) of the amount of valid data obtained from a measurement system relative to the amount that would be expected to be obtained under correct, normal conditions. Data qualified as "R" (rejected/unusable) is considered to be not valid; data with other qualifiers are considered valid.

Completeness is expressed as an acceptance percentage (%A) calculated by the following equation:

$$A\% = 100 \times \frac{\#\text{ of valid values reported for a parameter}}{\#\text{ of samples collected for analysis for that particular parameter}}$$

A% = Acceptance Percentage

The QA objective for completeness will be optimized by employing and evaluating frequent quality control checks throughout the analytical process so that sample data can be assessed for validity of results and to allow for reanalysis within the hold time when problems are indicated by the QC results.

A completeness of at least 85% is acceptable. The USEPA document 'Data Quality Objectives for Remedial Response Activities' states that Contract Laboratory Program data have been found to be historically 80-85% complete. Note that completeness will be evaluated only for those samples that are successfully collected. For example, dry wells and dry surface water sampling locations will not be considered in the final completeness calculations.

Completeness is considered to be the percentage of planned data collection that has to be complete in order to be considered sufficient for the intended use. A separate measurement of completeness for data collected for all field activities shall also be included. This shall include samples and other field data that was planned but not collected.

4.3.2.4 Representativeness

Sample representativeness will be assessed through an analysis of the blank results. The detection and concentration of target analytes in blanks will provide an indication of data representativeness. For organic samples, all blank sample results should be evaluated manually for contamination in accordance with the most recent NFG blank criteria. Note that this represents a change from previous USEPA Region I data validation guidance which included the application of a "5x or 10x" rule in accepting, qualifying or rejecting sample results based on blank contamination.

For organic sample results, apply the NFG criteria and actions based on the highest blank contamination associated with the samples, as follows:

- In determining the highest blank contamination, evaluate all blanks including method, instrument, trip and equipment rinsate blanks.
- If the blank action for an analyte is determined using the concentration from an equipment or trip, then the positive values in the equipment or trip should be reported unqualified on the Data Summary Tables. However, if the blank action is determined from a laboratory blank (e.g., method, clean-up, storage, or instrument blank), then the positive values in the equipment or trip blanks should be qualified.
- For aqueous equipment and trip blanks, if an analyte is present in the non-aqueous sample and is also present in the associated aqueous equipment blank and trip blank, then flag that sample result as EB or TB, respectively, to indicate to the end user that an indeterminate amount of sampling error has potentially impacted the sample results.

For inorganic sample results, all blank sample results should be evaluated manually for contamination in accordance with the most recent NFG blank criteria. Note that this represents a change from previous USEPA NE data validation guidance which recommended the application of a 5x rule in accepting, qualifying or rejecting sample results based on blank contamination.

Apply the NFG criteria and actions based on the highest blank contamination associated with each sample, as follows:

- In determining the highest blank contamination, evaluate all blanks including preparation/method, calibration/instrument, and equipment blanks.
- Initial and continuing calibration blank contamination within an analytical sequence applies to all samples analyzed in that sequence. Use professional judgment to apply contamination only to a specific subset of samples.
- If the blank action for an analyte is determined using the concentration in an equipment blank, then the positive values in the equipment blank should be reported unqualified on the Data Summary Tables. However, if the blank action is determined from a laboratory blank (e.g., preparation or calibration blank), then the positive values in the equipment should be qualified.
- For aqueous equipment blanks, if an analyte is present in the non-aqueous sample and is also present in the associated aqueous equipment blank, then flag that sample result as EB to indicate to the end user that an indeterminate amount of sampling error has potentially impacted the sample results.

Sample representativeness/usability will also be assessed through an evaluation of the sample results with the sampling design (locations and conceptual site model) to determine if the results are representative of the environment from which the samples were collected.

4.4 Quality Assurance Field Audits

The Sampling and Reporting Contractor shall perform internal field audits during the sampling events as part of the pro-active approach to ensure that the project objectives are met. Additionally, the Sampling and Reporting Contractor may request that a laboratory audit be performed during the course of the analytical program as part of the pro-active approach to ensure that the project objectives are met. Audits during the program may be performed at a frequency to satisfy the QAO that the sampling and analysis is progressing within QA/QC limits set forth in this SAP and the defined methods. Internal field and laboratory audits will be performed at a frequency determined by the Sampling and Reporting Contractor.

A completed QA notice will be prepared to close out the audit when corrective action is required. The QA notice will identify the specific nonconformance noted, the corrective action taken, a follow-up review to assure that the corrective action was effective, and final recommendations concerning continued operation.

SECTION 5.0 | SAMPLE HANDLING, TRACKING AND CUSTODY REQUIREMENTS

This section presents information related to sample collection field documentation, the field documentation management system, sample handling and tracking, and sample custody.

5.1 Sample Collection Documentation

This section describes the documentation and management system to be used as part of the environmental monitoring program at the Site.

5.1.1 Field Notes

The Sampling and Reporting Contractor will record field data on field worksheets included with the sampling SOPs included in **Appendix C**.

Field notes related to field observations and other data not included on the worksheets, such as the details of any deviation from the field operations plan or SOPs, including who authorized the deviation, and the collection of quality assurance samples (equipment/field blanks), will be documented in a field notebook. At a minimum, the sample designation, sampling time, associated equipment, decontamination water source, and brand/type of decontamination soap/solvent (if applicable) must be recorded.

In addition, field notes describing unanticipated conditions (e.g., well integrity issue) will be documented in a field notebook or field forms. Information in other site documentation (e.g., sampling worksheets) will not be repeated in logbooks except in summary form.

5.1.2 Field Documentation Management System

The Sampling and Reporting Contractor will maintain field documentation in project files. The Sampling and Reporting Contractor will transfer copies of completed field notes and worksheets, COC forms, and packing lists to a central file for storage. The CLG is responsible for maintaining the central file.

5.2 Sample Handling and Tracking System

The Sampling and Reporting Contractor will identify each sample by sample labels and a unique sample identifier. This coding system will uniquely identify a sample and provide a tracking procedure for sample retrieval. Each primary sample identification number will be composed of three components:

Sampled Media - Sampling Point Identification

Example: GW-MW-4

Where:

GW - Groundwater
MW-4 - Sampling Point Identification

Sampled media type – other sampled media will be identified using the following system:

S - Sediment
L - Leachate Seep
SW - Surface Water
DW - Drinking Water

The Sampling and Reporting Contractor will write the code for each sample on the sample label and the COC form. If interval sampling is performed, then the sample designation must also be reported on the field sampling form.

Quality control sample designations are discussed in **Section 4.2**.

5.3 Sample Custody

To maintain a record of sample collection, transfer between personnel, shipment, laboratory courier service, and receipt by the laboratory, each sample within a given shipping container that is shipped to the laboratory will be documented using COC procedures described in **Appendix C**. Each time the samples are transferred to another custodian, signatures of the persons relinquishing and receiving the samples, the time, and date will be completed on the COC Form.

Under this definition, the team member actually performing the sampling is personally responsible for the care and custody of the collected samples until the samples are transferred or dispatched properly.

The sampling team leader is responsible for reviewing the COC forms at the end of each day and ensuring that proper custody procedures were followed during the field work.

Samples and unused sample containers shall remain in the sample collector's view at all times, unless locked in a vehicle or other secure place in accordance with the SOP.

5.4 Laboratory Sample Handling

The Laboratory Sample Custodian will receive, unpack, and inspect the samples for the following:

- Temperature;
- Broken or leaking bottles;

- Presence of all samples listed on field COC form;
- Bottle labels match field COC form; and
- Number of coolers received matches number shown on shipping documentation.

The sample custodian will fill out a Shipment Condition Inspection Report or equivalent laboratory form. If problems or discrepancies are noted, they will be documented on the Inspection Report and the Sampling and Reporting Contractor will be contacted. The Laboratory will document discrepancies in the number of samples received or sample bottle labels on the field COC form. The sample custodian will then sign and date the field COC form.

After accepting custody of the samples, the sample custodian will log in the samples. Each sample will be assigned a unique sequential laboratory number which will be used for tracking the sample through the laboratory. After log-in, samples will be placed in storage pending analysis. The COC form, inspection report, and shipping documentation will then be forwarded to the Analytical Laboratory Project Manager.

The Analytical Laboratory Project Manager or designee will inspect the paperwork and, if all is in order, will direct the laboratory sections to begin analysis. Laboratory personnel will comply with all internal laboratory COC procedures. Additional custody procedures will be performed as described in the analytical laboratory Quality Assurance Program in **Appendix D**.

5.4.1 Laboratory Document Control Procedures

The final project file will consist of laboratory data packages (for example, summary and raw data from the analysis of QC samples and investigative samples, chromatograms, mass spectra, calibration data, worksheets, sample preparation logs, and/or COC records), logs, field log-books, pictures and subcontractor reports. The Sampling and Reporting Contractor will retain documents for a minimum of 10 years beyond the completion of the activity. The final files will reside with the CLG, or its designee.

SECTION 6.0 | REPORTING

The Sampling and Reporting Contractor, with the approval of the CLG, will submit Annual Reports and Semi-Annual Reports as Drafts until they are approved. Submittal of all draft documents to NHDES OneStop must have “DRAFT” in the title.

6.1 Notification of Exceedance of Ambient Groundwater Quality Standards

In accordance with GMP Standard Condition 11, upon receipt of the analytical data package, the Sampling and Reporting Contractor will review and validate the data package in a timely manner, identify any new exceedances of a CL/AGQS at or beyond the GMZ boundary, and notify the CLG immediately. The CLG is required to notify the USEPA/NHDES within 30 days of the discovery.

6.2 Annual Reports

Once analytical data from annual or semiannual sampling events are collected and validated, the data will be evaluated to identify spatial and temporal trends and compare observed data with USEPA established CLs and NHDES established Standards.

The Sampling and Reporting Contractor, with the approval of the CLG, will submit Annual Reports to the USEPA Remedial Project Manager and the NHDES Project Manager by the last day in February (in the year after sampling was completed - per GMP Standard Condition 7).

The Annual Report submittal will include the following:

- A summary of sampling activities;
- A copy of the complete laboratory report(s), including the COC forms and data validation report;
- A copy of calibration information including the calibration log(s) which contain the standards used, lot numbers, expiration dates, calibration checks, etc.;
- Copies of field sampling worksheets and other associated field notes not already recorded on field worksheets;
- A table summarizing the results of the monitoring event, including VOCs detected, metals analyzed and field parameter measurements. A separate table summarizing the detected contaminants of concern since the start of the remedy (September 29, 1999) at each monitoring point (if available); if the contaminant of concern has not been detected for the applicable matrix in the last 10 years, then it is acceptable to provide a table note regarding the status of the contaminant of concern. Both tables must have: 1) the applicable standards identified and exceedances of standards in bold font or otherwise highlighted; 2) data qualifiers identified for the affected samples/analyses and 3) the detected concentration or the laboratory RDL. In addition, laboratory detection limits that exceed the applicable standards shall be identified in the table notes;
- Time series plots for each monitoring point for contaminants of concern that exceeded an CLs/AGQS during the sampling event, or for contaminants of concern that have exceeded the CLs/AGQS;
- Statistical trend analysis for contaminants of concern at monitoring points where CLs/AGQS were exceeded during the sampling event. If insufficient data are available for statistical analysis, then a visual trend analysis will be completed if more than two data points are available;
- Isoconcentration contour figures illustrating the contaminant concentrations for which CLs/AGQS exceedance that were reported during the sampling event;
- A water level and elevation table showing historical data;
- A Site Plan showing all sampling monitoring points and overburden groundwater and bedrock groundwater potentiometric surface contour maps;
- A Quality Assurance/Quality Control (QA/QC) Section summarizing data validation procedures, analytical data where data qualification was warranted, summary of MS/MSD and duplicate comparison results. QA/QC issues will be listed and corrective actions will be identified if required. A discussion of any QA/QC issues that affect the quality, completeness or usability of the data;
- The results of the well integrity inspection including any corrective actions taken in the field, or any corrective action(s) that need to be undertaken;
- All information contained in Data Transmittal Reports during the year;
- A discussion of temporal trends in contaminants of concern in the context of the progress of the natural attenuation remedy for the restoration of groundwater, surface water and sediment quality; and
- Recommendations for any remedial actions, for future modifications to the current monitoring program and/or for implementation of corrective actions to address issues noted during the sampling events during the calendar year.

6.3 Semi-Annual Data Transmittal Reports

The Sampling and Reporting Contractor will make sure that an independent validator will review and validate the analytical data package for semi-annual water supply well sampling events, identify any exceedances of an CL/AGQS, and notify the CLG immediately. The CLG is required to notify the USEPA/NHDES immediately of any new exceedances of drinking water standards.

The Sampling and Reporting Contractor will submit Semi-Annual Data Transmittal Reports to the USEPA Remedial Project Manager and the NHDES Project Manager within 15 days after the completion of data validation. The Semi-Annual Data Transmittal Reports will include the following:

- Transmittal cover letter;
- A copy of the complete laboratory report(s), including the COC forms and data validation report;
- A copy of the sampling worksheet(s), calibration form(s) and a table summarizing analytical results; and
- A brief summary of data validation procedures, analytical data where data qualification was warranted and duplicate comparison results. QA/QC issues will be listed and corrective actions will be identified if required. A discussion of any QA/QC issues that affect the quality, completeness or usability of the data.

SECTION 7.0 | HEALTH AND SAFETY PROGRAM

The Hazardous Waste Operations and Emergency Response (HAZWOPER) regulations contained in 29 CFR 1910.120 require that a Health and Safety Program (HASP) be implemented at the Site to protect individuals and the environment.

A site-specific HASP is included in the POP. The HASP provides details related to worker health and safety for the environmental monitoring activities conducted at the Site. Sampling and Reporting Contractor personnel involved in field work on this site will conform and comply with the HASP. Each individual must regard and conduct him/herself as a member of the safety team and adhere to the prescribed HASP to ensure his/her own safety, as well as that of fellow field team members and the general public.

All contractors working at the Site must supply their own Site-specific HASP in accordance with Occupational Safety and Health Administration (OSHA) regulations.

SECTION 8.0 | REFERENCES

Aries (1999), Sediment, Surface Water and Groundwater Monitoring Plan, Coakley Landfill OU-1 and OU-2 Study Area, North Hampton, New Hampshire. Prepared by Aries Engineering, Inc. for the Coakley Landfill Group.

CDM (1994), Coakley Landfill Management of Migration Remedial Investigation and Feasibility Study Report. Prepared by CDM Federal Programs Corporation, for the US Environmental Protection Agency, May 1994.

Golder (2010), Projects Operations Plan, Coakley Landfill Superfund Site, North Hampton and Greenland, New Hampshire, Revision 1.0. (Includes Environmental Monitoring Plan as Attachment I). Prepared by Golder Associates Inc. for The Coakley Landfill Group.

Golder (1993), OU-2 Groundwater Quality Data Review and Evaluation, Coakley Landfill, New Hampshire (December 1993). Prepared by Golder Associates Inc. for The Coakley Landfill Group

NHDES (2015), Hazardous Waste Remediation Bureau Master Quality Assurance Project Plan (HWRB Master QAPP) Revision 4, dated March 2017, (http://des.nh.gov/organization/divisions/waste/hwrb/documents/hwrb_master_qapp.pdf).

Summit (2014), 2013 Annual Summary Report, Coakley Landfill, Breakfast Hill Road, North Hampton, NH. Prepared by Summit Environmental Consultants (a CES, Inc. company) for the Coakley Landfill Group, January 17, 2014; revised August 2014.

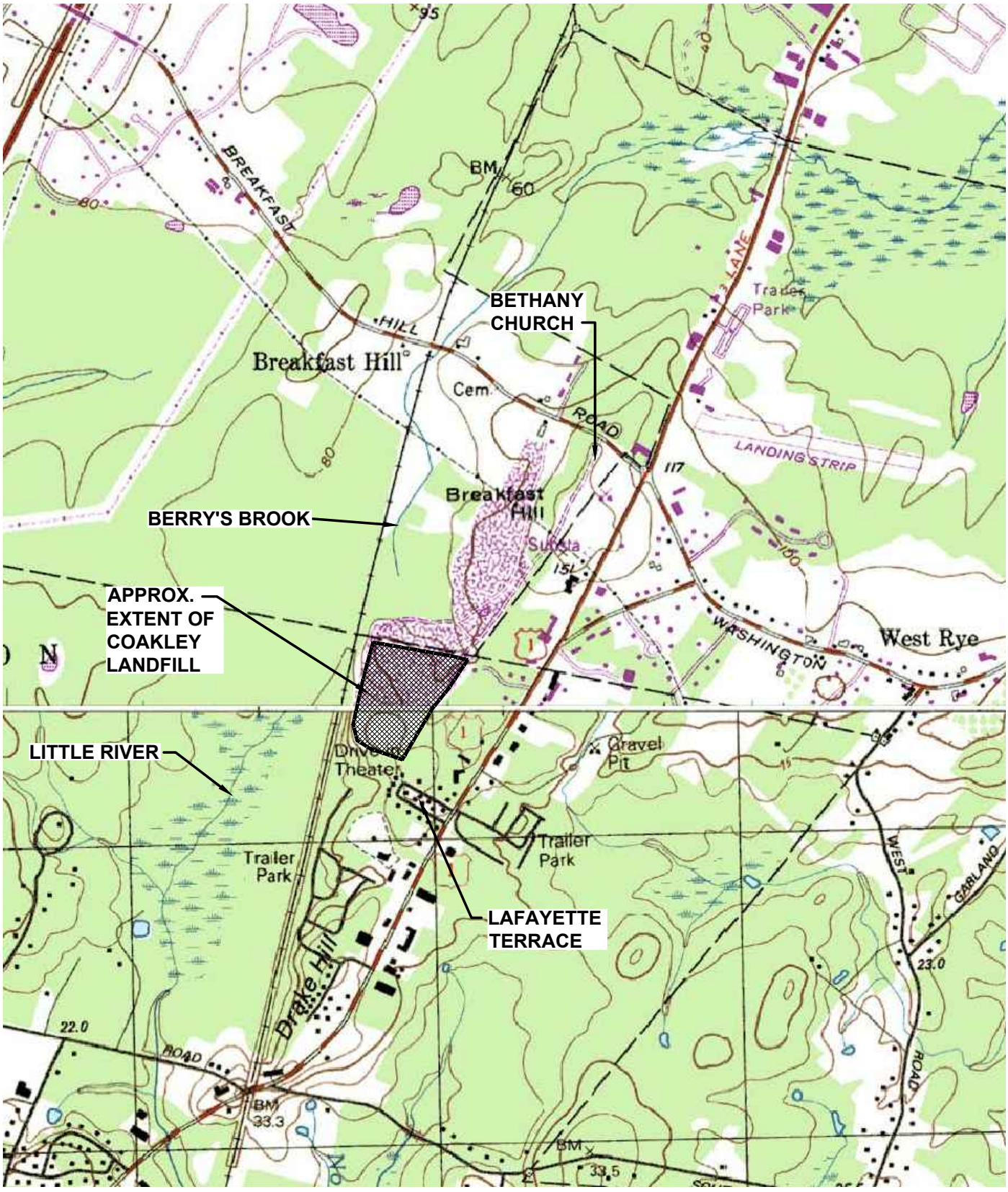
USEPA (2013), Environmental Data Review Supplement for Regional Date Review Elements and Superfund Specific Guidance/Procedures. U.S. Environmental Protection Agency New England (Region I) Quality Assurance Unit, Office of Environmental Measurement and Evaluation, EQADR-Supplement0, Final Version #0, April 22, 2013.

USEPA (2016a), National Functional Guidelines for Organic Superfund Data Review. U.S. Environmental Protection Agency, Office of Superfund Remediation and Technology Innovation, OSWER 9355.0-134, EPA-540-R-2016-002, September 2016.

USEPA (2016b), National Functional Guidelines for Inorganic Superfund Data Review. Office of Superfund Remediation and Technology Innovation, OSWER 9355.0-133, EPA-540-R-2016-001, September 2016.

Weston (1988), Remedial Investigation Coakley Landfill North Hampton, New Hampshire. Prepared by Roy F. Weston, Inc. and Goldberg-Zoino and Associates, Inc. for the State of New Hampshire Department of Environmental Services Waste Management Division.

FIGURES



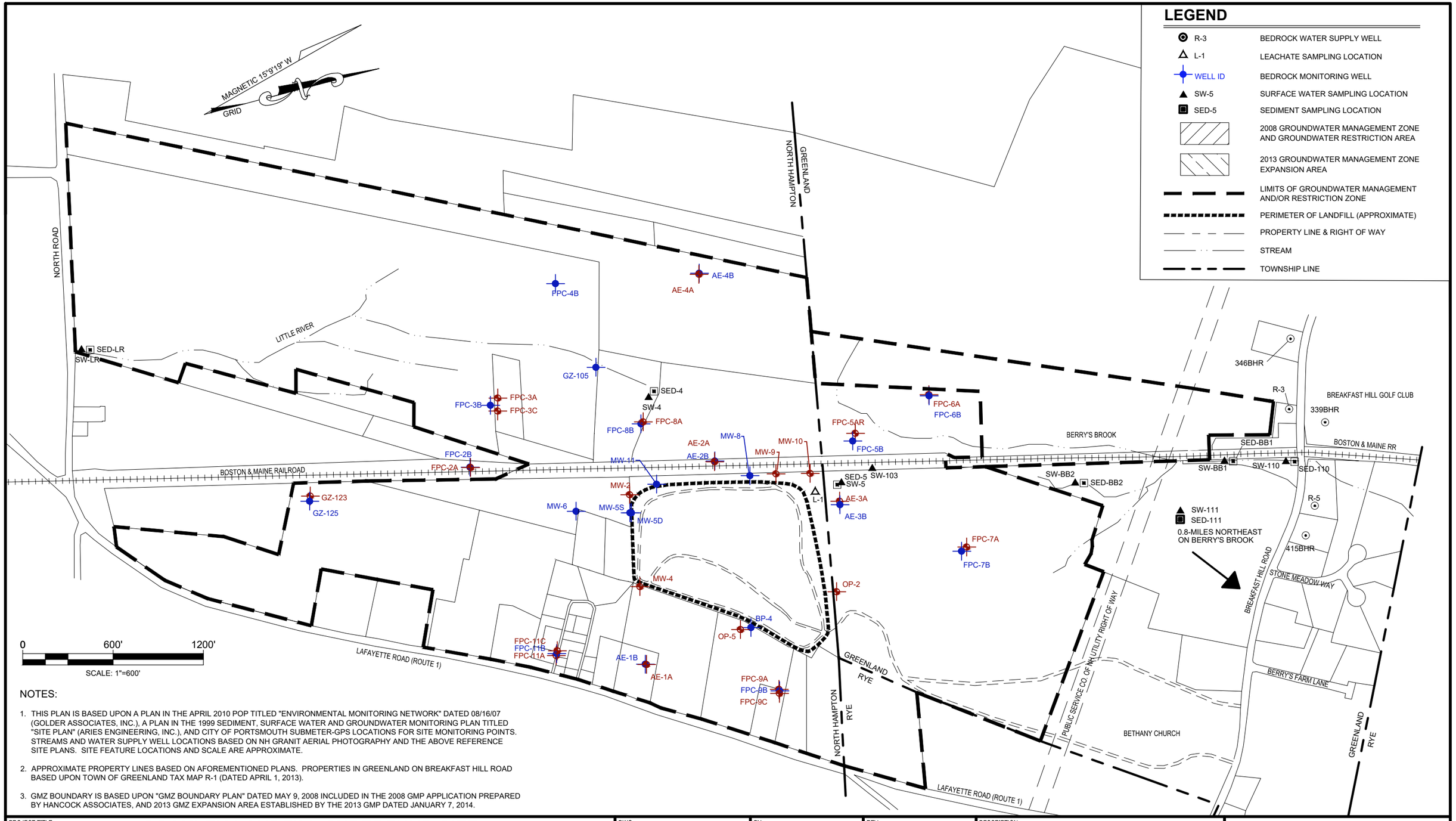
SOURCE:
U.S.G.S. TOPOGRAPHIC QUADRANGLE
PORTSMOUTH
SCALE: 1"=1500'

CES INC

COAKLEY LANDFILL
NORTH HAMPTON, NH
LOCATION MAP

2014-09-08
10424.002

FIGURE 1-1



LEGEND

R-3	BEDROCK WATER SUPPLY WELL
L-1	LEACHATE SAMPLING LOCATION
WELL ID	BEDROCK MONITORING WELL
SW-5	SURFACE WATER SAMPLING LOCATION
SED-5	SEDIMENT SAMPLING LOCATION
	2008 GROUNDWATER MANAGEMENT ZONE AND GROUNDWATER RESTRICTION AREA
	2013 GROUNDWATER MANAGEMENT ZONE EXPANSION AREA
	LIMITS OF GROUNDWATER MANAGEMENT AND/OR RESTRICTION ZONE
	PERIMETER OF LANDFILL (APPROXIMATE)
	PROPERTY LINE & RIGHT OF WAY
	STREAM
	TOWNSHIP LINE

NOTES:

1. THIS PLAN IS BASED UPON A PLAN IN THE APRIL 2010 POP TITLED "ENVIRONMENTAL MONITORING NETWORK" DATED 08/16/07 (GOLDER ASSOCIATES, INC.), A PLAN IN THE 1999 SEDIMENT, SURFACE WATER AND GROUNDWATER MONITORING PLAN TITLED "SITE PLAN" (ARIES ENGINEERING, INC.), AND CITY OF PORTSMOUTH SUBMETER-GPS LOCATIONS FOR SITE MONITORING POINTS. STREAMS AND WATER SUPPLY WELL LOCATIONS BASED ON NH GRANIT AERIAL PHOTOGRAPHY AND THE ABOVE REFERENCE SITE PLANS. SITE FEATURE LOCATIONS AND SCALE ARE APPROXIMATE.
2. APPROXIMATE PROPERTY LINES BASED ON AFOREMENTIONED PLANS. PROPERTIES IN GREENLAND ON BREAKFAST HILL ROAD BASED UPON TOWN OF GREENLAND TAX MAP R-1 (DATED APRIL 1, 2013).
3. GMZ BOUNDARY IS BASED UPON "GMZ BOUNDARY PLAN" DATED MAY 9, 2008 INCLUDED IN THE 2008 GMP APPLICATION PREPARED BY HANCOCK ASSOCIATES, AND 2013 GMZ EXPANSION AREA ESTABLISHED BY THE 2013 GMP DATED JANUARY 7, 2014.

PROJECT TITLE: **COAKLEY LANDFILL SUPERFUND SITE NORTH HAMPTON & GREENLAND, NEW HAMPSHIRE**	DWG:	BY: BLQ	REV:	DESCRIPTION:	CES INC Engineers • Environmental Scientists • Surveyors
		DATE: 2017-06-14	REV DATE:		
SHEET TITLE: **SITE PLAN**	JN: 10424.008	APPROVED BY: SLY	ISSUE:	DESCRIPTION:	
	SCALE: 1"=600'	CHECKED BY: SLY	ISSUE DATE:		

TABLES

TABLE 2-1
COAKLEY LANDFILL SUPERFUND SITE
PROJECT ORGANIZATION

Individual	Title	Organization	Telephone Number
Gerardo Millan-Ramos	USEPA Remedial Project Manager	USEPA New England (Region 1)	(617) 918-1377
Andrew Hoffman	NHDES Project Manager	NHDES	(603) 271-6778
Sharon Perkins	NHDES Quality Assurance Coordinator	NHDES	(603) 271-6805
Peter Britz	Project Coordinator	The Coakley Landfill Group	(603) 610-7215
Suzanne Yerina	Sampling and Reporting Manager	CES, Inc.	(207) 795-6009
Wes Harden	Sampling Staff	CES, Inc.	(207) 404-1657
Michael Deyling	Quality Assurance Officer	CES, Inc.	(207) 795-6009
Jennifer Laramie	Analytical Laboratory Project Manager	Eastern Analytical, Inc.	(800) 287-0525
Gloria Switalski	Data Validation	Data Check	(603) 859-8979

TABLE 3-1
COAKLEY LANDFILL SUPERFUND SITE
ANALYTICAL METHODS, SAMPLING CONTAINERS, VOLUMES, PRESERVATIVES AND HOLDING TIMES

Analytes	Analytical Method	Containers (Type and Size)	Preservation Requirements	Maximum Holding Time
Groundwater Samples				
Volatile Organic Compounds (VOCs)	EPA Method 8260B NHDES VOC Full List	2-40 mL VOA[1]	HCL (pH <2) 4° C ± 2° C	14 days
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	2-40 mL VOA[3]	None, 4° C ± 2° C	14 days
Per- & Poly-Fluorinated Alkyl Substances (PFAS)[2]	EPA Method 537 (Modified)	2-125 ml HDPE	None, 4° C ± 2° C	14 days
Hexivalent Chromium	EPA Method SW846 7196A	500 ml HDPE	None, 4° C ± 2° C	24 Hours
Metals (Total, unfiltered)[4]	EPA Method 200.8	1-125 mL HDPE	HNO_3 (pH <2)	180 days
Metals (Dissolved, filtered)[4]	EPA Method 200.8	1-125 mL HDPE, field filtered	HNO_3 (pH <2)	180 days
Surface Water Samples				
VOCs	EPA Method 8260B NHDES VOC Full List	2-40 mL VOA[1]	HCL (pH <2) 4° C ± 2° C	14 days
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	2-40 mL VOA[3]	None, 4° C ± 2° C	14 days
Per- & Poly-Fluorinated Alkyl Substances (PFAS)[2]	EPA Method 537 (Modified)	2-125 ml HDPE	None, 4° C ± 2° C	14 days
TAL Metals (Dissolved, filtered)[5]	EPA Method 200.8	1-125 mL HDPE, field filtered	HNO_3 (pH <2)	180 days, except 28 days for mercury
Ammonia	SM 4500 NH3 D	1-125 mL HDPE	H_2SO_4 (pH <2) 4° C ± 2° C	28 days
Leachate				
Volatile Organic Compounds (VOCs)	EPA Method 8260B NHDES VOC Full List	2-40 mL VOA[1]	HCL (pH <2) 4° C ± 2° C	14 days
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	2-40 mL VOA[3]	None, 4° C ± 2° C	14 days
Per- & Poly-Fluorinated Alkyl Substances (PFAS)[2]	EPA Method 537 (Modified)	2-125 ml HDPE	None, 4° C ± 2° C	14 days
TAL Metals (Dissolved, filtered)[5]	EPA Method 200.8	1-125 mL HDPE, field filtered	HNO_3 (pH <2)	180 days, except 28 days for mercury
Chemical Oxygen Demand	HACH 8000	1-125 mL HDPE	H_2SO_4 (pH <2) 4° C ± 2° C	28 days
Ammonia	SM 4500 NH3 D			
Sediment Sampling				
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	1-20 mL VOA[3] with 5ml of MeOH.[7]	None, 4° C ± 2° C	14 days
Per- & Poly-Fluorinated Alkyl Substances (PFAS)[2]	EPA Method 537 (Modified)	1 - 4 oz amber glass	None, 4° C ± 2° C	28 days
TAL Metals[4] and % Solids	EPA Method 6020A	125 mL Clear Glass	None, 4° C ± 2° C	180 days, except 28 days for mercury
Drinking Water Sampling (raw water - non-chlorinated)				
Volatile Organic Compounds (VOCs)	EPA Method 524.2 NHDES VOC Full List	2-40 mL VOA[1]	HCL (pH <2) 4° C ± 2° C	14 days
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	2-40 mL VOA[3]	None, 4° C ± 2° C	14 days
Per- & Poly-Fluorinated Alkyl Substances (PFAS)[2]	EPA Method 537 (Modified)	2-125 ml HDPE	Trizma, 4° C ± 2° C	14 days
Low Level 1,4-Dioxane	EPA Method 8260B SIM Heated Purge & Trap	2-40 mL VOA[3]	None, 4° C ± 2° C	14 days
Total Arsenic, Total Manganese	EPA Method 200.8	1-125 mL HDPE	HNO_3 (pH <2)	180 days
Field Parameters for Water Quality Sampling				
Temperature, Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), specific conductivity, and pH[6]	YSI 600 XL Multi-Parameter Water Quality Meter	N/A	N/A	N/A
Turbidity	Hach 2100P or 2100Q Turbidity Meter	N/A	N/A	N/A

NOTES:

1. VOC Trip Blanks will be included in each cooler containing VOC samples. Trip Blanks will be prepared by the laboratory using designated blank water and preserved according to the applicable method.
2. Per- & Poly-Fluorinated Alkyl Substances include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS). Samples must be chilled during shipment andmust not exceed 10° C during the first 48 hours after collection. Sample temperature must be confirmed to be at or below 10° C when the samples are received at the laboratory.
3. 1,4-dioxane (low level) Trip Blanks will be included in each cooler containing 1,4-dioxane samples. Trip Blanks will be prepared by the
4. Metals include antimony, arsenic, barium, beryllium, calcium, chromium, iron, lead, magnesium, manganese, nickel, potassium, sodium
5. TAL Metals include aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium,
6. The field parameters measurements for temperature, ORP, DO, specific conductivity, and pH for surface water and leachate will be
7. Additional syringeto be filled with sediment to accompany the container for dry weight.

TABLE 3-2
COAKLEY LANDFILL SUPERFUND SITE
SITE ANALYTES, ASSOCIATED REGULATORY STANDARDS AND LAB CRITERIA

GROUNDWATER				
Test Methods/Analytes	**ROD Interim Concentration Levels (ICLs) in ug/L**	**NHDES Ambient Groundwater Quality Standard (Env-Or 600) in ug/L**	**Method Detection Limits (MDLs)**	**Lab Reporting Detection Limits (RDLs)**
Volatile Organic Compounds NHDES Full List by 8260B in ug/L [1]				
Benzene	5	5	0.069	1
Chlorobenzene (Monochlorobenzene)	100	100	0.0355	2
Tetrachloroethene (PCE, Tetrachloroethylene)	3.5	5	0.056	2
Tetrahydrofuran (THF)	154	154	0.871	10
1,2-Dichloropropane	5	5	0.0558	2
2-Butanone (MEK, Methyl Ethyl Ketone)	200	4,000	1	10
Trans-1,2-dichloroethene (trans-DCE)	100	100	0.0526	2
Tertiary butyl alcohol (TBA, tert-butyl alcohol)	---	40	5.259	30
Per- & Poly-Fluorinated Alkyl Substances by 537 (modified) in ng/L				
Perfluorooctanoic Acid (PFOA)	---	70	1.11	15
Perfluorooctanesulfonic Acid (PFOS)	---	70	1.01	15
Perfluoroheptanoic Acid (PFHpA)	---	---	2.5	15
Perfluorononanoic Acid (PFNA)	---	---	2.02	15
Perfluorobutanesulfonic Acid (PFBS)	---	---	2.12	15
Perfluorohexanesulfonic Acid (PFHxS)	---	---	1.13	15
1,4-Dioxane by EPA Method 8260B SIM in ug/L				
1,4-dioxane	---	3	0.084	0.25
Metals by EPA Method 200.8 in mg/L				
Antimony	0.006	0.006	0.0000224	0.0005
Arsenic	0.01	0.01	0.0000699	0.0005
Barium	---	2	0.0000128	0.0005
Beryllium	0.004	0.004	0.0000255	0.0005
Calcium	---	---	0.0059167	0.05
Chromium	0.05	0.1	0.0000689	0.0005
Iron	---	---	0.003262	0.05
Lead	0.015	0.015	0.0000056	0.0005
Magnesium	---	---	0.0009632	0.05
Manganese	0.3	0.84	0.0000818	0.0005
Nickel	0.1	0.1	0.0000213	0.0005
Potassium	---	---	0.0042703	0.05
Sodium	---	---	0.0023336	0.1
Vanadium	0.26	---	0.0001823	0.0005

NOTES:

1. VOCs list is limited to VOC contaminants of concern, as listed in Table 1-1
2. NHDES Ambient Groundwater Quality Standards (AGQSs) are listed in Env-Or 600 Table 600-1.
3. The ROD identified two SVOCs (diethyl phthalate and phenol) as Contaminants of Concern. However, in May 1998 and April 1999, groundwater samples were submitted for analysis of SVOCs and no exceedances were reported; therefore, SVOCs (the requirement to analyze for diethyl phthalate and phenol) were removed from the long-term monitoring plan. The ROD has not been amended to remove diethyl phthalate and phenol as contaminants of concern at the Site.
4. Analytical services provide by Eastern Analytical, Inc. of Concord, New Hampshire

TABLE 3-2
COAKLEY LANDFILL SUPERFUND SITE
SITE ANALYTES, ASSOCIATED REGULATORY STANDARDS AND LAB CRITERIA

SURFACE WATER AND LEACHATE				
Test Methods/Analytes	**NHDES Surface Water Standard (Env Wq 1700) in ug/L**		**Method Detection Limits (MDLs)**	**Lab Reporting Detection Limits (RDLs)**
	Acute	**Chronic**		
Volatile Organic Compounds NHDES Full List by EPA Method 8260B (in ug/L) [1]				
Benzene	5,300	---	0.069	1
Chlorobenzene (Monochlorobenzene)	250	50	0.0355	2
Tetrachloroethene (PCE, Tetrachloroethylene)	5,280	840	0.056	2
Tetrahydrofuran (THF)	---	---	0.871	10
1,2-Dichloropropane	23,000	5,700	0.0558	2
2-Butanone (MEK, Methyl Ethyl Ketone)	---	---	1	10
Trans-1,2-dichloroethene (trans-DCE)	11,600	---	0.0526	2
Tertiary butyl alcohol (TBA, tert-butyl alcohol)	---	---	5.259	30
Per- & Poly-Fluorinated Alkyl Substances by 537 (modified) in ng/L				
Perfluorooctanoic Acid (PFOA)	---	70	1.11	15
Perfluorooctanesulfonic Acid (PFOS)	---	70	1.01	15
1,4-Dioxane by EPA Method 8260B SIM in ug/L				
1,4-dioxane	---	3	0.084	0.25
TAL Metals by EPA Method 200.8 in mg/L				
Aluminum	0.75	0.087	0.00092321	0.05
Antimony	9.0	1.6	0.0000224	0.0005
Arsenic*	0.34	0.15	0.0000699	0.0005
Barium	---	---	0.0000128	0.0005
Beryllium	0.13	0.0053	0.0000255	0.0005
Cadmium*	0.00095	0.0008	0.00000703	0.0005
Calcium	---	---	0.0059167	0.05
Chromium*	0.183 (Cr+3) 0.016 (Cr +6)	0.024 (Cr+3) 0.011 Cr+6)	0.0000689	0.0005
Cobalt	---	---	0.00000977	0.0005
Copper*	0.0036	0.0027	0.00001065	0.0005
Iron	---	1.0	0.003262	0.05
Lead*	0.014	0.00054	0.0000056	0.0005
Magnesium	---	---	0.0009632	0.05
Manganese	---	---	0.0000818	0.0005
Mercury*	0.0014	0.00077	0.00000551	0.0001
Nickel*	0.1449	0.016	0.0000213	0.0005
Potassium	---	---	0.0042703	0.05
Selenium	---	0.0005	0.00004651	0.0005
Silver*	0.00032	---	0.00005307	0.0005
Sodium	---	---	0.0023336	0.1
Thallium	1.4	0.040	0.00000382	0.0005
Vanadium	---	---	0.0001823	0.0005
Zinc*	0.0362	0.0365	0.00018015	0.005
Chemical Oxygen Demand by HACH 8000 in mg/L				
Chemical Oxygen Demand	---	---	3.079	10
Ammonia by EPA Method 350.3 in mg/L				
Ammonia **	pH Dependent	pH Dependent	0.022	0.05

NOTES:

1. VOCs list is limited to VOC contaminants of concern, as listed in Table 1-1
2. --- no standard has been established for the indicated parameter.
3. NHDES Surface Water Standards are listed in Env Wq 1700, Table 1703.1
4. There are no ROD ICLs established for surface water.
5. Analytical services provide by Eastern Analytical, Inc. of Concord, New Hampshire

* Acute and chronic standards based on "default" values listed in Env Wq 1700, Table 1703.1. Actual standards

** The freshwater and saltwater aquatic life criteria for ammonia are pH dependent. Refer to Env-Wq 1703.25

TABLE 3-2
COAKLEY LANDFILL SUPERFUND SITE
SITE ANALYTES, ASSOCIATED REGULATORY STANDARDS AND LAB CRITERIA

SEDIMENT				
Test Methods/Analytes	**SQuiRT TEC/[2] (Dry Weight)**		**Method Detection Limits (MDLs)**	**Lab Reporting Detection Limits (RDLs)**
Per- & Poly-Fluorinated Alkyl Substances by 537 (modified) in mg/kg.				
Perfluorooctanoic Acid (PFOA)	---	---	0.00112	0.0025
Perfluorooctanesulfonic Acid (PFOS)	---	---	0.00132	0.0025
Perfluoroheptanoic Acid (PFHpA)	---	---	0.00109	0.0025
Perfluorononanoic Acid (PFNA)	---	---	0.00135	0.0025
Perfluorobutanesulfonic Acid (PFBS)	---	---	0.00122	0.0025
Perfluorohexanesulfonic Acid (PFHxS)	---	---	0.00129	0.0025
1,4-Dioxane by EPA Method 8260B SIM in mg/kg				
1,4-dioxane	---	---	0.013	0.1
TAL Metals by EPA Method 6020 in mg/kg				
Aluminum	---		1.08	100
Antimony	---		0.078	0.5
Arsenic	9.79		0.046	0.5
Barium	---		0.025	0.5
Beryllium	---		0.013	0.5
Cadmium	0.99		0.009	0.5
Calcium	---		14.137	50
Chromium	43.4		0.028	0.5 (Total Only)
Cobalt	---		0.007	0.5
Copper	31.6		0.014	0.5
Iron	---		2.62	100
Lead	35.8		0.016	0.5
Magnesium	---		0.6	100
Manganese	---		0.215	0.5
Mercury (inorganic)	0.18		0.012	0.1
Nickel	22.7		0.017	0.5
Potassium	---		5.427	100
Selenium	---		0.093	0.5
Silver	---		0.084	0.5
Sodium	---		2.228	100
Thallium	---		0.006	0.5
Vanadium	---		0.246	5
Zinc	121		0.8	5

NOTES:

1. --- no standard has been established for the indicated parameter.
2. There are no ROD ICLs established for sediment.
3. Sediment laboratory analytical data will be compared with historical analytical data relative to long-term trends in sediment quality in addition to published, peer-reviewed screening level contaminant lists included in the NHDES Draft Evaluation of Sediment Quality Guidance Document, dated April 2005, that includes the National Oceanic and Atmospheric Administration Screening Quick Reference Tables (NOAA SQuiRT Tables). Current SQuiRT Tables are located on the NOAA website:
   http://archive.orr.noaa.gov/book_shelf/122_NEW-SQuiRTs.pdf
   TEC is Threshold Effect Concentration, which is consensus-based and incorporates the Ontario Ministry of the Environment lowest-observed effect levels (LELs).
4. Analytical services provide by Eastern Analytical, Inc. of Concord, New Hampshire

TABLE 3-3
COAKLEY LANDFILL SUPERFUND SITE
MONITORING WELL CONSTRUCTION, DEPTH OF TUBING INTAKES AND HISTORIC LOW WATER LEVELS

Well ID	Date Constructed	Monitored Zone - Unit	Well Diameter (inches)	Source Information (See Source Notes)	Measuring Point (Top of PVC or Top of Casing)	Measuring Point Elevation (ft NGVD)	Stickup (Feet Above Existing Grade)	Well Depth (ft bgs from Boring Logs)	Adjusted Well Depths Based on Well Depth and Stickup (ft from Measuring Point)	September 2015 Measured Well Depth from 2015 (in ft from Measuring Point)	Screen Length (in feet)	Screened Interval From Boring Logs (ft bgs)		Screened Interval (ft from Measuring Point)		Historic Maximum Depth to Water Level (ft from Measuring Point)	Depth of Tubing Intake (in ft from Measuring Point)
												Upper	Lower	Upper	Lower		
Operating Unit 1 Wells																	
BP-4	5/17/1993	Bedrock - Open Borehole	6	RDBA	Top of Casing	111.70	2.78	99	101.78	101.79	65.4	33.6	99.0	36.4	101.8	15.98	51.8
MW-2	6/10/1985	Bedrock - Shallow	1	Golder	Top of PVC	94.54	1.74	20	21.74	21.75	10	10	20	11.7	21.7	7.69	DTW Only
MW-4	6/14/1985	Overburden - Till	2	Golder	Top of PVC	129.12	2.12	38	40.12	39.22	10	28	38	30.1	40.1	32.95	NA
MW-5D	6/22/1993	Bedrock - Deeper	2	Note #1	Top of PVC	99.72	2.14	163.5	165.64	161.72	20	139	159	141.3	161.3	11.7	146.3
MW-5S	8/9/1993	Bedrock - Shallow	2	Note #1	Top of PVC	101.96	2.66	78	80.66	83.47	30	48	78	53.0	83.0	13.42	58.0
MW-6	6/19/1985	Bedrock - Open Borehole	6	Golder	Top of Casing	101.15	2.15	184	186.15	170.9	159	25	184	27.2	186.2	12.14	152.2
MW-8	4/25/1996	Bedrock - Shallow	2	Note #1	Top of PVC	85.02	2.59	65	67.59	67.58	20	44	64	47.5	67.5	9.36	57.0
MW-9	4/15/1996	Overburden - Outwash	2	RDBA	Top of PVC	82.60	3.00	10	13.00	12.46	5	5	10	8.0	13.0	9.34	10.5
MW-10	4/15/1996	Overburden - Outwash	2	Note #5	Top of PVC	80.60	2.67	10	12.67	12.07	5	5	10	7.7	12.7	6.61	10.2
MW-11	4/26/1996	Bedrock - Shallow	2	RDBA	Top of PVC	92.70	1.80	52	53.80	54.7	20	32	52	33.8	53.8	12.85	39.9
OP-2	5/7/1993	Overburden - Outwash	1.25	Note #1	Top of PVC	100.00	2.00	12	14.00	16.86	5	7	12	11.2	16.2	22.58	13.7
OP-5	6/11/1993	Overburden - Outwash	1.25	Golder	Top of PVC	112.68	2.84	23	25.84	25.74	10	13	23	15.8	25.8	16.64	20.8
Operating Unit 2 Wells																	
AE-1A	3/26/1999	Overburden - Till	2	RDBA	Top of PVC	127.00	2.00	65	67.00	66.14	10	54	64	56.0	66.0	31.11	NA
AE-1B	3/25/1999	Bedrock - Shallow	2	RDBA	Top of PVC	126.80	1.80	85.5	87.30	87.68	10	75	85	76.8	86.8	30.93	NA
AE-2A***	7/27/1999	Overburden - Till	2	RDBA***	Top of PVC	79.60	2.63	20	22.63	22.57	10	10	20	12.6	22.6	6.42	17.0
AE-2B***	7/27/1999	Bedrock - Shallow	2	RDBA***	Top of PVC	79.50	2.46	50	52.46	52.83	10	40	50	42.5	52.5	5.9	47.5
AE-3A*	3/24/1999	Overburden - Till	2	RDBA	Top of PVC	86.10	2.20	17.8	20.00	20.07	10*	??*	17.8*	??*	20*	9.8	15.0
AE-3B	3/23/1999	Bedrock - Shallow	2	RDBA	Top of PVC	87.30	3.40	40	43.40	43.1	12	28	40	31.4	43.4	10.44	41.0
AE-4A	9/15/2003	Overburden - Outwash	2	Note #3	Top of PVC	77.20	2.25	15	17.25	16.55	10	5	15	7.3	17.3	6.45	12.3
AE-4B	9/16/2003	Bedrock - Shallow	2	Note #3	Top of PVC	77.50	2.70	44	46.70	46.12	10	34	44	36.7	46.7	6.99	41.7
FPC-2A	4/3/1992	Overburden - Outwash	2	Golder	Top of PVC	78.40	2.80	16	18.80	18.82	10	6	16	8.8	18.8	2.99	DTW Only
FPC-2B	4/3/1992	Bedrock - Shallow	2	Golder	Top of PVC	77.98	2.58	37.8	40.38	40.31	15	22.5	37.5	25.1	40.1	3.04	DTW Only
FPC-3A	5/4/1992	Overburden - Till	2	Golder	Top of PVC	73.17	2.60	73	75.60	NA	10	62	72	64.6	74.6	2.26	70.6
FPC-3B	4/27/1992	Bedrock - Shallow	1.5	Golder	Top of PVC	72.22	1.65	95.5	97.15	NA	15	80.5	95.5	82.2	97.2	1.8	89.6
FPC-3C	5/5/1992	Overburden - Outwash	2	Golder	Top of PVC	72.36	2.38	28.5	30.88	NA	10	18.5	28.5	20.9	30.9	1.33	25.9
FPC-4B	6/3/1992	Bedrock - Shallow	2	Golder	Top of PVC	75.83	2.33	33.5	35.83	35.44	15	18	33	20.3	35.3	7.62	33.3
FPC-5B	5/14/1992	Bedrock - Shallow	2	Golder	Top of PVC	74.90	2.81	110.3	113.11	133.42	15	95	110	97.8	112.8	1.95	106.6
FPC-6A	8/1/2003	Overburden - Till	1.5	Note #2	Top of Casing	79.20	5.54	4.5	10.04	10.37	1	3.5	4.5	9.0	10.0	8.43	9.5
FPC-6B	3/24/1992	Bedrock - Shallow	2	Golder	Top of PVC	77.10	2.49	28.5	30.99	30.22	15	13	28	15.5	30.5	8.73	18.2
FPC-7A	5/11/1992	Overburden - Till	2	Golder	Top of PVC	82.08	2.08	22	24.08	24.02	5	16.7	21.7	18.8	23.8	2.05	21.3
FPC-7B	5/8/1992	Bedrock - Shallow	2	Golder	Top of PVC	82.33	2.43	45	47.43	46.95	15	29.8	44.8	32.2	47.2	2.9	39.9
FPC-8A	4/9/1992	Overburden - Till	2	Golder	Top of PVC	73.80	2.10	33	35.10	33.92	10	23	33	25.1	35.1	3.17	30.1
FPC-8B	4/8/1992	Bedrock - Shallow	2	Golder	Top of PVC	73.60	2.24	55.7	57.94	57.65	15	40	55	42.2	57.2	3.02	55.5
FPC-9A	5/28/1992	Overburden - Till	2	Golder	Top of PVC	117.57	2.37	68	70.37	68.43	10	58	68	60.4	70.4	22.09	65.4
FPC-9B	5/26/1992	Bedrock - Shallow	2	Golder	Top of PVC	117.87	2.47	87	89.47	89.45	15	72	87	74.5	89.5	22.73	DTW Only
FPC-9C	5/27/1992	Overburden - Outwash	2	Golder	Top of PVC	117.75	2.35	25	27.35	27.72	10	15	25	17.4	27.4	21.67	DTW Only
FPC-11A	6/23/1992	Overburden - Till	2	Golder	Top of PVC	117.95	-0.41	52	51.59	50.4	5	47	52	46.6	51.6	22.14	49.1
FPC-11B	6/19/1992	Bedrock - Shallow	2	Golder	Top of PVC	117.90	-0.55	73	72.45	71.3	15	58	73	57.5	72.5	22.36	TBD
FPC-11C	6/24/1992	Overburden - Outwash	2	Note #4	Top of PVC	118.10	-0.29	33	32.71	31.8	15	18	33	17.7	32.7	21.46	DTW Only
GZ-105	5/7/1987	Bedrock - Shallow	1.5	Note #6	Top of PVC	73.60	2.76	51	53.76	52.07	15	35	50	37.8	52.8	4.32	39.0
GZ-109	4/8/1987	Bedrock - Open Borehole	6	GZA	Top of Casing			252			149	103	252				
GZ-117	2/3/1987	Overburden - Till	2	GZA	Top of PVC	118.10		40.5			10	30	40				
GZ-123	2/25/1987	Overburden - Outwash	2	Golder	Top of PVC	87.49	1.39	16.5	17.89	17.35	5	11.5	16.5	12.9	17.9	10.58	DTW Only
GZ-125	4/13/1987	Bedrock - Open Borehole	6	Golder	Top of Casing	88.77	2.27	200	202.27	201.3	143	57	200	59.3	202.3	8.7	DTW Only

GENERAL TABLE NOTES

1. ft bgs = feet below ground surface
2. ft NGVD = feet National Geodetic Vertical Datum
3. Monitored Zone - Unit column identifies the hydrogeological unit within the screened/open interval. The hydrogeology of the site is comprised of four principle geological units include including bedrock, glacial till, marine sediments consisting of predominately of silt and clay and sandy outwash. Bedrock well screened intervals vary as follows: "Bedrock - Open Borehole" wells are standard 6-inch diameter wells with steel casing set in bedrock and open boreholes (no PVC screen in wells - typical water supply well construction). "Bedrock - Shallow" indicates the screen interval is the upper most section of bedrock. "Bedrock - Deeper" is used to differentiate a screened interval that is below the uppermost section of bedrock (i.e.; MW-5S versus MW-5D).
4. Maximum depth to water level from monitoring point based on data taken between August 2003 and August 2013, from 2013 Annual Report (Summit Env. Consultants). Water levels were not taken in every well at every event.
5. Well depths relative to measuring point measured in August 2012 and listed in 2012 Annual Report (Provan and Lorber)
6. NA= Not applicable

* AE-3A well screen interval not specifically listed on boring log (well construction log for AE-3A is the same as AE-3B). Assume 10 foot screen was installed to bottom of borehole (0.3 feet below top of bedrock).

*** AE-2A/2B stickups are based on field measurements in August 2014. Source (RDBA) measuring point (PVC) elevations appear accurate, however, existing grade elevation were not accurate. Field measurements of stickup added to total depth from boring log are consistent with total depth from top of PVC casing measured in August 2012.

DEPTH OF TUBING INTAKE NOTES:

1. TBD - depth of tubing intake for FPC-11B to be based on interval sampling results for 2014. Tubing intake depth used for subsequent sampling events to proposed in 2014 Annual Report and approved by NHDES/EPA prior the next sampling event.
2. Depth of tubing intake at wells BP-4 and MW-6 is based upon discrete interval sampling results reported in 2010 Annual Report; tubing intake depth used for low flow sampling at these wells beginnning in August 2013 are consistent with tubing intakes depths used in for discrete interval sample collection in the 2011 and 2012 long-term monitoring events. Tubing intake depths for MW-5D, MW-5S, MW-8, MW-11, AE-3B, FPC-4B, FPC-5B, FPC-6B, FPC-7B, FPC-8B, and GZ-105 established based on interval sampling results for August 2013 reported in the 2013 Annual Report.
3. DTW Only = Well not sampled, depth to water level monitored during annual monitoring events
4. NA = MW-4, AE-1A and AE-1B are sampled with a bailer. Depth of tubing intake is not applicable.

SOURCE NOTES:

GOLDER Table 31 in "Phase 1 Pre-Investigation Design Report" prepared by Golder Associates, Inc. (Jan. 1994).

RDBA "As Built Plat of the Coakley Landfill" prepared by Richard D. Bartlett and Associates, Inc. (September 1998).

1. MW-5S, MW-5D, MW-8 and OP-2: Summit determined that Reference Point Elevations for MW-5S, MW-5D, MW-8 and OP-2 were incorrect for data collected since 1999. Correct measuring point elevations were identified on an as built survey plan prepared by Richard D. Bartlett and Associates, Inc. dated September 1998. Surveyed "top of cap" elevations for MW-5S, MW-5D and MW-8 were adjusted to top of PVC using field measurements (significant settling is not likely at these wells as they are 2-inch diameter wells install in 6 inch diameter boreholes through 6-inch diameter metal casings. A PVC casing elevation was listed for OP-2. Screened interval and depth of tubing intakes updated based on revised survey elevations and boring log information. Stickups based on measurements on 2-27-2014 presented in August 2013 report (Summit Environmental Consultants).
2. FPC-6A: A replacement well (point) for FPC-6A was installed in August 2003, due to insufficient water for sampling for extended periods of time. However, the reference point elevation was not updated at that time. Therefore, groundwater elevations presented in previous monitoring reports for FPC-6A since August 2003 were incorrect. Summit surveyed the FPC-6A reference point elevation in December 2013 relative to the FPC-6B reference point elevation and determined that the measure point elevation for FPC-6A is 79.20 feet (not 77.00 feet, as identified in previous reports). The FPC-6A screened interval was updated based on well depth (9.97 feet), stickup (5.54 feet), and an assumed 1 foot screen interval (well construction log not available).
3. AE-4A/AE-4B: measuring point elevation based on elevations listed in 2004 Annual Report (Aries Engineering, Inc.) and stick up is based on field measurement in August 2013 (Summit Environmental Consultants).
4. FPC-11C: Well casing was modified during road box repairs on 1/10/2014 (Summit Environmental Consultants). Top of PVC casing was resurveyed relative to FPC-11A/B measuring points on 2/27/2014. Original measuring point elevation was 118.04 feet. New measuring point elevation is 118.10.
5. MW-10: Measuring Point elevation based on "As Built Plat of the Coakley Landfill" prepared by Richard D. Bartlett and Associates, Inc. (September 1998). Stickup based on field measurement in August 2013 (Summit Environmental Consultants).
6. GZ-105: Measuring Point elevation based on data in 1999 Annual Report. However, it is noted that the Golder (as noted above) lists the measuring point elevation as 68.56 and existing grade as 65.80.

TABLE 3-4
COAKLEY LANDFILL SUPERFUND SITE
GROUNDWATER ELEVATION MONITORING NETWORK AND SCHEDULE

Site ID	Monitored Zone - Unit	Well Diameter (inches)	Measuring Point (Top of PVC or Top of Casing)	Measuring Point Elevation (ft NGVD)	Monitoring Frequency
Operating Unit 1 Wells					
BP-4	Bedrock - Open Borehole	6	Top of Casing	111.7	Semi-Annual
MW-2	Bedrock - Shallow	1	Top of PVC	94.54	Semi-Annual
MW-4	Overburden - Till	2	Top of PVC	129.12	Semi-Annual
MW-5D	Bedrock - Deeper	2	Top of PVC	99.72	Semi-Annual
MW-5S	Bedrock - Shallow	2	Top of PVC	101.96	Semi-Annual
MW-6	Bedrock - Open Borehole	6	Top of Casing	101.15	Semi-Annual
MW-8	Bedrock - Shallow	2	Top of PVC	85.02	Semi-Annual
MW-9	Overburden - Outwash	2	Top of PVC	82.6	Semi-Annual
MW-10	Overburden - Outwash	2	Top of PVC	80.6	Semi-Annual
MW-11	Bedrock - Shallow	2	Top of PVC	92.7	Semi-Annual
OP-2	Overburden - Outwash	1.25	Top of PVC	100	Semi-Annual
OP-5	Overburden - Outwash	1.25	Top of PVC	112.68	Semi-Annual
Operating Unit 2 Wells					
AE-1A	Overburden - Till	2	Top of PVC	127	Semi-Annual
AE-1B	Bedrock - Shallow	2	Top of PVC	126.8	Semi-Annual
AE-2A	Overburden - Till	2	Top of PVC	79.6	Semi-Annual
AE-2B	Bedrock - Shallow	2	Top of PVC	79.5	Semi-Annual
AE-3A	Overburden - Till	2	Top of PVC	86.1	Semi-Annual
AE-3B	Bedrock - Shallow	2	Top of PVC	87.3	Semi-Annual
AE-4A	Overburden - Outwash	2	Top of PVC	77.2	Semi-Annual
AE-4B	Bedrock - Shallow	2	Top of PVC	77.5	Semi-Annual
FPC-2A	Overburden - Outwash	2	Top of PVC	78.4	Semi-Annual
FPC-2B	Bedrock - Shallow	2	Top of PVC	77.98	Semi-Annual
FPC-3A	Overburden - Till	2	Top of PVC	73.17	Semi-Annual
FPC-3B	Bedrock - Shallow	1.5	Top of PVC	72.22	Semi-Annual
FPC-3C	Overburden - Outwash	2	Top of PVC	72.36	Semi-Annual
FPC-4B	Bedrock - Shallow	2	Top of PVC	75.83	Semi-Annual
FPC-5B	Bedrock - Shallow	2	Top of PVC	74.9	Semi-Annual
FPC-6A	Overburden - Till	1.5	Top of Casing	79.2	Semi-Annual
FPC-6B	Bedrock - Shallow	2	Top of PVC	77.1	Semi-Annual
FPC-7A	Overburden - Till	2	Top of PVC	82.08	Semi-Annual
FPC-7B	Bedrock - Shallow	2	Top of PVC	82.33	Semi-Annual
FPC-8A	Overburden - Till	2	Top of PVC	73.8	Semi-Annual
FPC-8B	Bedrock - Shallow	2	Top of PVC	73.6	Semi-Annual
FPC-9A	Overburden - Till	2	Top of PVC	117.57	Semi-Annual
FPC-9B	Bedrock - Shallow	2	Top of PVC	117.87	Semi-Annual
FPC-9C	Overburden - Outwash	2	Top of PVC	117.75	Semi-Annual
FPC-11A	Overburden - Till	2	Top of PVC	117.95	Semi-Annual
FPC-11B	Bedrock - Shallow	2	Top of PVC	117.9	Semi-Annual
FPC-11C	Overburden - Outwash	2	Top of PVC	118.1	Semi-Annual
GZ-105	Bedrock - Shallow	1.5	Top of PVC	73.6	Semi-Annual
GZ-109	Bedrock - Open Borehole	6	Top of Casing	252	Semi-Annual
GZ-117	Overburden - Till	2	Top of PVC	40.5	Semi-Annual
GZ-123	Overburden - Outwash	2	Top of PVC	87.49	Semi-Annual
GZ-125	Bedrock - Open Borehole	6	Top of Casing	88.77	Semi-Annual

Notes

1. ft NGVD = feet National Geodetic Vertical Datum
2. Monitored Zone - Unit column identifies the hydrogeological unit within the screened/open interval. The hydrogeology of the site is comprised of four principle geological units include including bedrock, glacial till, marine sediments consisting of predominately of silt and clay and sandy outwash. Bedrock well screened intervals vary as follows: "Bedrock - Open Borehole" wells are standard 6-inch diameter wells with steel casing set in bedrock and open boreholes (no PVC screen in wells - typical water supply well construction). "Bedrock - Shallow" indicates the screen interval is the upper most section of bedrock. "Bedrock - Deeper" is used to differentiate a screened interval that is below the uppermost section of bedrock (i.e.; MW-5S versus MW-5D).
3. Wells will be sampled semi-annually in the Spring and Fall of 2017 and 2018.

TABLE 3-5
COAKLEY LANDFILL SUPERFUND SITE
OU-1 MONITORING WELL NETWORK
ANALYTICAL PARAMETERS, SAMPLING METHODS AND SCHEDULE

Sampling Point	BP-4	MW-4	MW-5S	MW-5D	MW-6	MW-8	MW-9	MW-10	MW-11	OP-2	OP-5
Field Parameters											
Static Water Level	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Turbidity	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Specific Conductance	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Temperature	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
pH	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Oxidation Reduction Potential	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Dissolved Oxygen	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Metals (List provided in Note #3)											
Total - unfiltered (See Note #4)	SA	-	SA	SA	SA	SA	-	-	SA	-	-
Dissolved - filtered (0.45-micron filter)	-	SA	-	-	-	-	SA	SA	-	SA	SA
Hexivalent Chromium	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Volatile Organic Compounds											
NHDES Full List (EPA Method 8260B)	-	-	SA	SA	SA	SA	-	-	SA	-	-
1,4-dioxane (EPA Method 8260B SIM)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Per- & Poly-Fluorinated Alkyl Substances (List provided in Note #5)											
PFAS (EPA Method 537 Modified)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Sampling Methodology											
Low Flow with Peristaltic Pump (SOP-4)	SA	-	SA	SA	SA	SA	SA	SA	SA	SA	SA
Bailer (Disposable) - (SOP-3)	-	SA	-	-	-	-	-	-	-	-	-

Notes:

1. SA = Semi-Annual Events - Spring and Fall 2017 and 2018 as requested by the EPA in the Fourth Five Year Report (2016).
2. - = Not Applicable / Not Analyzed
3. Metals include antimony, arsenic, barium, beryllium, calcium, chromium, iron, lead, magnesium, manganese, nickel, potassium, sodium and vanadium. Samples collected for dissolved metal analysis are field filter (0.45-micron filter) and acidified in the field after filtration. Analyzed via EPA Method 200.8. Hexivalent Chrmium samples analyzed via EPA Method SW846 7196A.
4. Metals sample for bedrock groundwater to be not field filtered unless turbidity is >100 NTU at the time of field parameter stabilization. If turbidity is >100 NTU then the sample will field filtered and acidified after filtration in the field.
5. Per- and Poly-Fluorinated Alkyl Substances include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS).

TABLE 3-6
COAKLEY LANDFILL SUPERFUND SITE
OU-2 MONITORING WELL NETWORK
ANALYTICAL PARAMETERS, SAMPLING METHODS AND SCHEDULE

Sampling Point	AE-1A	AE-1B	AE-2A	AE-2B	AE-3A	AE-3B	AE-4A	AE-4B	FPC-3A	FPC-3B	FPC-3C	FPC-4B	FPC-5AR	FPC-5B	FPC-6A	FPC-6B	FPC-7A	FPC-7B	FPC-8A	FPC -8B	FPC-9A	FPC-9B	FPC-11A	FPC-11B	GZ-105	GZ-109	GZ-117
Field Parameters																											
Static Water Level	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Turbidity	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Specific Conductance	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Temperature	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
pH	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Oxidation Reduction Potential	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Dissolved Oxygen	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Metals (List provided in Note #3)																											
Total - unfiltered (See Note #4)	-	SA	-	SA	-	SA	-	SA	SA	SA	SA	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	SA	SA	SA
Dissolved - filtered (0.45-micron filter)	SA	-	SA	-	SA	-	SA	-	-	-	-	-	SA	-	SA	-	SA	-	SA	-	SA	-	SA	-	-	-	-
Hexivalent Chromium	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Volatile Organic Compounds																											
NHDES Full List (EPA Method 8260B)	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	-	-	SA	SA	-	-	SA	SA	-	SA	-	-	SA	SA	SA
1,4-dioxane (EPA Method 8260B SIM)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Per- & Poly-Fluorinated Alkyl Substancess (List provided in Note #7).																											
PFAS (EPA Method 537 Modified)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Sampling Methodology																											
Low Flow with Peristaltic Pump (SOP-4)	-	-	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Bailer (Disposable) - (SOP-3)	SA	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

1. SA = Semi-Annual Events - Spring and FAll 2017 and 2018 as requested by the EPA in the Fourth Five Year Report (2016).
2. - = Not Applicable / Not Analyzed
3. Metals include antimony, arsenic, barium, beryllium, calcium, chromium, iron, lead, magnesium, manganese, nickel, potassium, sodium and vanadium. Samples collected for dissolved metal analysis are field filter (0.45-micron filter) and acidified in the field after filtration. Analyzed via EPA Method 200.8. Hexivalent Chromium samples analyzed via EPA Method SW846 7196A.
4. Metals sample for bedrock groundwater to be not field filtered unless turbidity is >100 NTU at the time of field parameter stabilization. If turbidity is >100 NTU then the sample will field filtered and acidified after filtration in the field.
5. Peristaltic Interval Sampling to be conducted at FPC-11B in Fall 2014 to determine the depth of the tubing intake to be used for subsequent sampling events (screen interval is greater than 10 feet long). Interval sampling in Fall 2014 to be conducted in accordance with the analytical parameters and depth of tubing intakes listed in Table 3-8. No field parameters, other than static water level, are collected with interval sampling.
6. Note that additional wells in the GMZ expansion area will be installed and sampled after the routine Fall 2014 sampling activities; A Field Services Plan will be provided under separate cover to govern new well installation activities.
7. Per- & Poly-Fluorinated Alkyl Substances include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS).

TABLE 3-7
COAKLEY LANDFILL SUPERFUND SITE
WATER SUPPLY WELL NETWORK, ANALYTICAL PARAMETER, AND SCHEDULE

Sampling Point	R-3	R-5	346BHR	339BHR	415BHR	340BHR	463BHR	4ROD	10ROD	25FW	67RCD	5BFL	9BFL	15BFL	4SMW	9SMW	10SMW	16SMW	19SMW	21SMW	27 BR	7 WKD	8 WKD	178A LR
Field Parameters																								
Turbidity	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Specific Conductance	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Temperature	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
pH	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Oxidation Reduction Potential	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Dissolved Oxygen	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Metals (unfiltered, total) - EPA Method 200.8																								
Total Arsenic	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Total Manganese	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Volatile Organic Compounds																								
NHDES Full List (EPA Method 524.2)	SA	SA	SA	SA	SA	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,4-dioxane (EPA Method 8260B SIM)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA
Per- & Poly-Fluorinated Alkyl SUbstances (List provided in Note #4).																								
PFAS (EPA Method 537 Modified)	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA	SA

Notes:

1. A = Annual (Fall Event) - August each year
2. SA = Semi-Annual Events - Spring and Fall for 2017 and 2018
3. - = Not Applicable / Not Analyzed
4. Per- & Poly-Fluorinated Alkyl Substances include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS).

Water Supply Well Sampling Point Descriptions:

1. R-3 serves a residence at 368 Breakfast Hill Road. Sample is collected from the exterior spigot behind bushes on east side (driveway) side of home.
2. R-5 serves a residence at 399 Breakfast Hill Road. The residence is condemned (as of February 2013) and the water system is out of service. R-5 was last sampled in 2009. Well will be sampled if possible.
3. 346BHR serves a residence at 346 Breakfast Hill Road. The sample is collected from the spigot on the pressure tank in the building basement.
4. 339BHR is a public well serving the Breakfast Hill Golf Club clubhouse located at 339 Breakfast Hill Road. The sample is collected from the sqigot on the pressure tank in the maintenance garage.
5. 415BHR serves a residence at 415 Breakfast Hill Road. Sample is collected from the exterior spigot located on the east side (driveway) side of home.
6. 340 BHR serves a residence at 340 Breakfast Hill Road. Sample is collected from an exterior spigot on the west side of the building.
7. 463BHR serves a multi-family residence at 463 Breakfast Hill Road. Sample is collected from the spigot prior to the pressure tank in the building basement.
8. 4ROD serves a residence at 4 Red Oak Drive. Sample is collected from the spigot on the pressure tank in the building basement.
9. 10ROD serves a residence at 10 Red Oak Drive. Sample is colelcted from the spigot on the preseure tank in the building basement.
10. 25FW serves a residence at 25 Falls Way. Sample is collected from the spigot on the pressure tank in the building basement.
11. 67RCD serves a residence at 67 Ridgecrest Drive. Sample is collected from an exterior spigot at the south corner of the building.
12. 5BFL serves a residential duplex at 3 and 5 Berry Farm Lane. Sample is collected from the spigot on the pressure tank in the the basement of 5 Berry Farm Lane.
13. 9BFL serves a residential duplex at 9 and 11 Berry Farm Lane. Sample is collected from an exterior spigot on the west side of 9 Berry Farm Lane.
14. 15BFL serves a residential duplex at 15 and 17 Berry Farm Lane. Sample is colleceted from an exterior spigot on the east side of 15 Berry Farm Lane.
15. 4SMW serves a residence at 4 Stone Meadow Way. Sample is collected from the spigot connected to the irrigation system on the east side of the building.
16. 9SMW serves a residence at 9 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.
17. 10SMW serves a residence at 10 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.
18. 16SMW serves a residence at 16 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.
19. 19SMW serves a residence at 19 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.
20. 21SMW serves a residence at 21 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.
21. 25SMW serves a residence at 25 Stone Meadow Way. Sample is collected from the spigot on the pressure tank in the building basement.

Confirmation of no treatment connected to exterior spigots is required prior to sampling.

TABLE 3-8
COAKLEY LANDFILL SUPERFUND SITE
SURFACE WATER AND LEACHATE MONITORING NETWORK
ANALYTICAL PARAMETERS AND SCHEDULE

	Surface Water								Leachate Seep
Sampling Point	**SW-4**	**SW-5**	**SW-103**	**SW-110**	**SW-111**	**SW-LR**	**SW-BB1**	**SW-BB2**	**L-1**
Field Parameters									
Turbidity	SA	SA	SA	SA	SA	SA	SA	SA	SA
Specific Conductance	SA	SA	SA	SA	SA	SA	SA	SA	SA
Temperature	SA	SA	SA	SA	SA	SA	SA	SA	SA
pH	SA	SA	SA	SA	SA	SA	SA	SA	SA
Oxidation Reduction Potential	SA	SA	SA	SA	SA	SA	SA	SA	SA
Dissolved Oxygen	SA	SA	SA	SA	SA	SA	SA	SA	SA
Inorganic Parameters									
Chemical Oxygen Demand	-	-	-	-	-	-	-	-	SA
Ammonia	SA	SA	SA	SA	SA	SA	SA	SA	SA
TAL Metals (List provided in Note #3)									
Dissolved - filtered (0.45-micron filter)	SA	SA	SA	SA	SA	SA	SA	SA	SA
Volatile Organic Compounds									
NHDES Full List (EPA Method 8260B)	SA	SA	SA	SA	SA	SA	SA	SA	SA
1,4-dioxane (EPA Method 8260B SIM)	SA	SA	SA	SA	SA	SA	SA	SA	SA
Per- & Poly-Fluorinated Alkyl Substances (List provided in Note #4).									
PFAS (EPA Method 537 Modified).	SA	SA	SA	SA	SA	SA	SA	SA	SA

Notes:

1. SA = Semi-Annual Events - Spring and Fall 2017 and 2018 as requested by the EPA in the Fourth Five Year Report (2016).
2. - = Not Applicable / Not Analyzed
3. TAL Metals include aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver,
4. Perfluorinated chemicals include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS).

TABLE 3-9
COAKLEY LANDFILL SUPERFUND SITE
SEDIMENT MONITORING NETWORK
ANALYTICAL PARAMETERS AND SCHEDULE

Sampling Point	SED-4	SED-5	SED-110	SED-111	SED-LR	SED-BB1	SED-BB2
TAL Metals (List provided in Note #2)							
Total Metals	SA	SA	SA	SA	SA	SA	SA
1,4-Dioxane							
1,4-dioxane (EPA Method 8260B SIM)	SA	SA	SA	SA	SA	SA	SA
Per- & Poly-Fluorinated Alkyl Substancess (List provided in Note #3).							
PFAS (EPA Method 537 Modified)	SA	SA	SA	SA	SA	SA	SA

Notes:

1. SA = Semi-Annual Events - Spring and Fall 2017 and 2018 as requested by the EPA in the Fourth Five Year Report (2016).
2. TAL Metals include aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium, thallium, zinc, cobalt, beryllium, manganese,
3. Per- & Poly-Fluorinated Alkyl Substances include perfluorobutanesulfonic acid (PFBS), perfluoroheptanoic acid (PFHpA), perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), perfluorononanoic acid (PFNA), and perfluorooctanesulfonic acid (PFOS).

APPENDICES

APPENDIX A

GROUNDWATER MANAGEMENT PERMIT

The State of New Hampshire
DEPARTMENT OF ENVIRONMENTAL SERVICES

Thomas S. Burack, Commissioner

January 7, 2014

Peter Britz
Environmental Planner
City of Portsmouth
1 Junkins Avenue
Portsmouth, NH 03801

Subject: **North Hampton** – Coakley Landfill Superfund Site, Groundwater Management Permit, DES #198712001, Project #431

Groundwater Management Permit Renewal Application, prepared by Summit Environmental Consultants, dated October 4, 2013

Dear Mr. Britz:

Please find enclosed Groundwater Management Permit Number **GWP-198712001-N-002**, approved by the Department of Environmental Services (Department). This permit is renewed and issued for a period of 5 years to monitor the effects of past discharges of contaminants of concern, as defined in Table 12 of the 1994 Site Record of Decision and subsequent decision documents.

All monitoring summaries and all required sampling results shall be submitted to the Groundwater Management Permits Coordinator at the address below. All correspondence must contain a cover letter that clearly shows the Department identification number for the site (DES #198712001). Please note that upon issuance of this permit, it is only necessary to submit monitoring results to the "Groundwater Management Permits Coordinator" and not to my attention.

The Groundwater Management Zone for this permit includes properties which are not owned by the permit holder and were not noticed or recorded with the original permit. Therefore, Condition #9 requires the permit holder to provide notice of the permit by certified mail, within 15 days of permit issuance, to those property owners of lots of record added to the Groundwater Management Zone since the original permit was issued. Documentation of the notification, in the form of a copy of the notice with return receipt(s), shall be submitted to the Department within 45 days of permit issuance.

Please note in future sampling & analysis plans and sampling activities the specific sampling methodologies for metals (e.g., total versus field filtered), as shown in the table under Standard Condition #7. In addition, sampling for metals (at minimum, arsenic and manganese) shall be conducted for all residential wells in the sampling program, as arsenic and manganese are above standards in certain GMZ compliance wells.

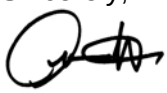
Also, please note that Condition #10 requires the permit holder to record "Notice" of the permit (not the permit), within 60 days of issuance, at the registry of deeds in the chain of title for each lot added to the Groundwater Management Zone since the original permit issuance. A separate Notice form for each newly added property within the Groundwater Management Zone shall be generated and recorded. The original notice on Lot 13 Map R1 should be amended to reflect the expanded GMZ within this lot.

An example Notice can be found on the Department's web page at the following link: http://des.nh.gov/organization/divisions/waste/hwrb/sss/grp/documents/example_notice_gmp.doc. A copy of each recorded Notice shall be submitted to the Department and, as appropriate, to the Towns of North Hampton, Greenland and Rye within 30 days of recordation.

Confirmation of the revised GMZ boundary for Map R1 Lot 13 is conditional upon analytical results from samples collected from four new compliance monitoring wells meeting established cleanup standards (see Special Condition 13), as discussed during a November 15, 2013 conference call.

Should you have any questions, please contact me at the Waste Management Division.

Sincerely,



Andrew Hoffman
Hazardous Waste Remediation Bureau
Tel: (603) 271-6778
Fax: (603) 271-2181
Email: Andrew.hoffman@des.nh.gov

ec: Stephen B. Marcotte, Summit Environmental
Greenland Health Officer
North Hampton Health Officer
Rye Health Officer
Gerardo Millan-Ramos, EPA

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

The

NEW HAMPSHIRE DEPARTMENT OF ENVIRONMENTAL SERVICES

hereby issues

GROUNDWATER MANAGEMENT PERMIT NO. GWP-198712001-N-002

to the permittee

COAKLEY LANDFILL GROUP

to monitor the past discharge of

Contaminants Of Concern
(as identified in Table 12 of the 1994 Record of Decision and subsequent decision documents)

at

COAKLEY LANDFILL
(480 Breakfast Hill Road)

in NORTH HAMPTON, N.H.

via the groundwater, surface water and sediment monitoring system comprised of

32 monitoring wells, 3 surface water, 2 sediment, and 1 leachate sampling locations and 5 residential drinking water supply wells

as depicted on the Site Plan and tables entitled

Environmental Monitoring Network (site plan);
OU-1 Groundwater Monitoring Wells and Water Supply Wells; and
OU-2 Groundwater Monitoring Wells

dated September 2013 (site plan) and July 2013 Revision 2.0 (tables), prepared by Summit Environmental Consultants

TO: COAKLEY LANDFILL GROUP
1 JUNKINS AVENUE
PORTSMOUTH, NEW HAMPSHIRE 03801

Date of Issuance: January 7, 2014
Date of Expiration: January 6, 2019

(continued)

Pursuant to authority in N.H. RSA 485-C:6-a, the New Hampshire Department of Environmental Services (Department), hereby grants this permit to monitor past discharges to the groundwater at the above described location for five years subject to the following conditions:

STANDARD MANAGEMENT PERMIT CONDITIONS

1. The permittee shall not violate Ambient Groundwater Quality Standards adopted by the Department (N.H. Admin. Rules Env-Or 600) in groundwater outside the boundaries of the Groundwater Management Zone, as shown on the referenced site plan and updated on the plot plan entitled "*Groundwater Monitoring Zone Plan"* prepared by Richard D. Bartlett & Associates, LLC., certified on December 11, 2013.

2. The permittee shall not cause groundwater degradation that results in a violation of surface water quality standards (N.H. Admin. Rules Env-Ws 1700) in any surface water body.

3. The permittee shall allow any authorized staff of the Department, or its agent, to enter the property covered by this permit for the purpose of collecting information, examining records, collecting samples, or undertaking other action associated with this permit.

4. The permittee shall apply for the renewal of this permit at least 90 days prior to its expiration date.

5. This permit is transferable only upon written request to, and approval of, the Department. Compliance with the existing Permit shall be established prior to permit transfer. Transfer requests shall include the name and address of the person to whom the permit transfer is requested, signature of the current and future permittee, and a summary of all monitoring results to date.

6. The Department reserves the right, under N.H. Admin. Rules Env-Or 600, to require additional hydrogeologic studies and/or remedial measures if the Department receives information indicating the need for such work.

7. The permittee shall maintain a water quality monitoring program and submit monitoring results to the Department's Waste Management Division no later than 45 days after sampling. Samples shall be taken from site monitoring wells, surface water and sediment sampling points as shown and labeled on the referenced site plan in accordance with the schedule outlined herein:

Monitoring Locations	**Sampling Frequency**	**Parameters**
FPC-4B, AE-4B	August each year	Bedrock well - field parameters, TAL metals (**total, unless highly turbid**), NHDES Waste Management Division full list of analytes for volatile organics (full list VOCs).
FPC-5A, MW-4, MW-9, OP-2	August each year	Overburden wells – field parameters, TAL metals (**dissolved**), 1,4-dioxane.
FPC-6B, FPC-8B, GZ-105, AE-2B, AE-3B, MW-5S, MW-5D, MW-6, MW-8, MW-11	August each year	Bedrock wells – field parameters, TAL metals (t**otal, unless highly turbid**), full list VOCs, 1,4-dioxane.
FPC-7A, FPC-9A, FPC-11A, AE-1A, MW-10, OP-5	August each year	Overburden wells – field parameters, TAL metals (**dissolved**)

- 3 -**Monitoring Locations**	**Sampling Frequency**	**Parameters**
FPC-5B, BP-4	August each year	Bedrock well – field parameters, TAL metals (**total, unless highly turbid**), 1,4-dioxane.
FPC-6A, FPC-8A, AE-2A, AE-3A	August each year	Overburden wells – field parameters, TAL metals (**dissolved**), full list VOCs, 1,4-dioxane.
AE-4A	August each year	Overburden well – field parameters, TAL metals (**dissolved**), full list VOCs.
FPC-7B, FPC-11B, AE-1B	August each year	Bedrock wells – field parameters, TAL metals (**total, unless highly turbid**).
Residential, Surface Water, Sediment & Leachate		
368BHR (R-3), 339BHR	August & February each year	Bedrock drinking water well – Field parameters, arsenic & manganese (**total**), VOCs full list (EPA Method 524), 1,4-dioxane.
399BHR (R-5), 346BHR, 415BHR	August each year	Field parameters, arsenic & manganese (**total**), NHDES full list (EPA Method 524), 1,4-dioxane.
SW-4, SW-5, SW-103	August each year	Field parameters, ammonia, TAL metals (**dissolved**), full list VOCs.
SED-4, SED-5	August each year	Metals (total).
L-1	August each year	Field parameters, COD, ammonia, TAL metals (**dissolved**).

Sampling shall be performed in accordance with the documents listed in Env-Or 610.02 (e) and the approved Environmental Monitoring Plan. Samples shall be analyzed by a laboratory certified by the U.S. Environmental Protection Agency or the New Hampshire Department of Environmental Services pursuant to Env-C 300. All overburden groundwater samples collected for metal analyses shall be analyzed for dissolved metals; and thus must be field filtered (with a 0.45-micron filter) and acidified after filtration in the field. Surface water samples and samples collected from bedrock or water supply wells shall be analyzed for total metals, and shall not be filtered. As referred to herein, the term "TAL Metals" refers to aluminum, arsenic, barium, cadmium, calcium, chromium, copper, iron, lead, magnesium, mercury, nickel, potassium, selenium, silver, sodium, thallium, zinc, cobalt, beryllium, manganese, antimony, and vanadium.

Summaries of water quality shall be submitted annually to the Department's Waste Management Division, in the month of February, using a format acceptable to the Department. The Summary Report shall include the information listed in Env-Or 607.04 (a), as applicable.

The Annual Summary Report shall be prepared and stamped by a professional engineer or professional geologist licensed in the State of New Hampshire.

8. Issuance of this permit is based on the Groundwater Management Permit Application dated October 3, 2013 and the historical documents found in the Department file DES #198712001. The Department may require additional hydrogeologic studies and/or remedial measures if invalid or inaccurate data are submitted.

9. Within 15 days of the date of Department approval of this Groundwater Management Permit, the permittee shall provide notice of the permit by certified mail, return receipt requested, to all owners of **newly added lots** of record (i.e., not noticed under original permit) within the Groundwater Management Zone (see shaded lots in Special Condition #12). The permittee shall submit documentation of this notification to the Department within 45 days of permit issuance.

10. Within 60 days of the date of Department approval of this Groundwater Management Permit, the permit holder shall record notice of the permit in the registry of deeds in the chain of title for each **newly added lot** within the Groundwater Management Zone (see shaded lots in Special Condition #12). The original notice on Lot 13 Map R1 shall be amended to reflect the expanded GMZ within this lot. **Recordation requires that the registry be provided with the name of current property owner and associated book and page numbers for the deed of each lot encumbered by this permit. Portions of State/Town/City roadways and associated right-of-way properties within the Groundwater Management Zone do not require recordation.** A copy of each recorded notice shall be submitted to the Department and to the governing body of each municipality in which the site or any lot within the GMZ is located within 30 days of recordation.

11. Within 30 days of discovery of a violation of an ambient groundwater quality standard at or beyond the Groundwater Management Zone boundary, the permittee shall notify the Department in writing. Within 60 days of discovery, the permittee shall submit recommendations to correct the violation. The Department shall approve the recommendations if the Department determines that they will correct the violation.

SPECIAL CONDITIONS FOR THIS PERMIT

12. Recorded property within the Groundwater Management Zone shall include the lots, or portions thereof, as listed and described in the following table:

Tax Map / Lot No.	Property Address	Owner	Deed Ref. (Book / Page)
6/37	365 Lafayette Road, Rye	SNS LLC	5238/2463
10/11	355 Lafayette Road, Rye	Malcolm E. Smith III	5079/0262
17/72	67 North Road, North Hampton	Joan M Nordstrom	2416/583
17/73	65 North Road, North Hampton	Joseph F and Yolanda Fitzgerald	3007/2807
17/82	160 Lafayette Road, North Hampton	Luck Enterprises, Inc.	2473/1659
17/86	180 Lafayette Road, North Hampton	Christopher C and Louis J Fucci	3319/952
17/87	186 Lafayette Road, North Hampton	Lori A Lessard Trustee	2760/2099
21/8	188 Lafayette Road, North Hampton	Joseph J and Helen M McKittrick	2641/2656
21/10	8A Lafayette Terrace, North Hampton	John J Sr and Dorleena Wylie	4030/2567
21/11	12A Lafayette Terrace, North Hampton	Seth McAlister	5044/102
21/12	16A Lafayette Terrace, North Hampton	William and Christine Adinolfo	2963/1721
21/14	20 Lafayette Terrace, North Hampton	Joseph Hanley	4682/1265
21/14-1	40-42 Lafayette Terrace, North Hampton	James A C Jones	4451/1104
21/15	44 Lafayette Terrace, North Hampton	Joseph B and Bridget S Conner	4183/1638
21/16	46 Lafayette Terrace, North Hampton	Rodney K Booker Trustee	5196/2724

Tax Map / Lot No.	Property Address	Owner	Deed Ref. (Book / Page)
21/17	1 Lafayette Terrace, North Hampton	Judith I and Bernard P Tracey	2450/687
21/18	3 Lafayette Terrace, North Hampton	Erin and Joshua Miller	5029/1768
21/19	5 Lafayette Terrace, North Hampton	Richard P and Kimberly M Bartlett	3824/2799
21/20	9 Lafayette Terrace, North Hampton	Alexis J Perron III	3088/1774
21/21	11 Lafayette Terrace, North Hampton	Kenneth and Tracey Margeson	3121/1606
21/22	15 Lafayette Terrace, North Hampton	Edward and Anita Gabree	3013/2221
21/23	Part of 11 Lafayette Terrace	Kenneth and Tracey Margeson	3121/1606
21/24	43 Lafayette Terrace, North Hampton	William Warman	4374/1365
21/25	45 Lafayette Terrace, North Hampton	ZCCMMXIIVOOOOOIIIII5INH LTD Partnership	2530/1863
21/26	198 Lafayette Road, North Hampton	Gozinta LLC	4275/904
21/27	206 Lafayette Road, North Hampton	206 Lafayette Road LLC	4785/379
21/27-1	200 Lafayette Road, North Hampton	Derek R Burt Trustee	5147/325
21/28	216 Lafayette Road, North Hampton	Stella A Ciborowski Trust	2414/729
21/28-1	216 Lafayette Road, North Hampton	Leo J Crotty Jr	2475/1278
21/29	212 Lafayette Road, North Hampton	S&L Realty Trust	3666/1199
21/31	224 Lafayette Road, North Hampton	SNS LLC	5238/2463
21/32	Coakley Landfill, North Hampton	Coakley Landfill LLC	3117/2934
21/33	Coakley Landfill, North Hampton	Coakley Landfill LLC	3117/2934
21/34	Lafayette Road Rear, North Hampton	James A C Jones	4451/1102
21/35	Lafayette Terrace Rear, North Hampton	James A C Jones	4451/1102
21/36	Lafayette Terrace Rear, North Hampton	James A C Jones	4451/1102
21/37	Lafayette Terrace Rear, North Hampton	Town of North Hampton	3415/1661
21/39	North Road Rear, North Hampton	Joan, Breen and Denise Grenier- Winther, Susan Sherr, and Caryn Blake	5142/2979
21/41	North Road Rear, North Hampton	Elmer M Sewall	1340/524
21/46	10 Lafayette Terrace / Part of 8A, North Hampton	John J Sr and Dorleena L Wylie	3219/2588

Tax Map / Lot No.	Property Address	Owner	Deed Ref. (Book / Page)
*R1/13	340 Breakfast Hill Road (Portion Only)	Elmer M Sewall Rev Trust 96	3159/928
R1/9B	560 Breakfast Hill Road	Town of Greenland	3454/1131

Shaded rows indicate newly added lots that require notice per Standard Permit Conditions #9 and #10. The original notice on Lot 13 Map R1 should be amended and recorded to reflect the expanded GMZ within this lot.

*An expanded portion of the Sewall parcel (Tax Map R1 Lot #13) is included within the GMZ, as shown on the updated plot plan entitled "*Groundwater Monitoring Zone Plan"* prepared by Richard D. Bartlett & Associates, LLC., certified on December 11, 2013, and described as follows:

Commencing at a point on the easterly line of land now or formerly of the Boston and Maine Corporation, said point being a distance of 600.93 feet as measured along a curve to the left, having a central angle of 01º54'46" and a radius of 18,000.00 feet, from a steel pin set on the southerly sideline of Breakfast Hill Road marking the northeasterly most corner of said Boston and Maine land identified on tax map R1 as lot 11, thence by a curve to the left, having a central angle of 00º33'15" and a radius of 18,000.00 feet, a distance of 174.06 feet to a point, thence by a curve to the left, having a central angle of 00º24'32" and a radius of 11,425.51 feet, a distance of 81.56 feet to a point; thence S13º08'30"W a distance of 1,419.54 feet to a point; thence, N76º51'30"W a distance of 99.00 feet to a point at land now or formerly of Elmer M. Sewall Revocable Trust 96, thence, along said Sewall land, N35º09'35"E a distance of 88.02 feet to a point; thence, continuing by said Sewall land, N13º08'30"E a distance of 163.21 feet to a point; thence N76º51'30"W a distance of 434.00 feet, through said Sewall land to a point; thence S17º29'30"W a distance of 1,097.80 feet to a point on the Greenland-North Hampton town line, said point being N79º55'00"W a distance of 18.99 feet from a concrete bound, on said town line, engraved "G" and "N-H", thence, along said town line, N79º55'00"W a distance of 345.00 feet to a point; thence N23º21'55"E a distance of 2,504.63 feet to a point; thence N25º28'15"E a distance of 551.47 feet to a point; thence S72º51'15"E a distance of 221.87 feet to a point; thence S15º37'10"W a distance of 441.43 feet to a point; thence S75º34'35"E a distance of 166.70 feet continuing through said Sewall land and said Boston and Maine land to the point of beginning.

Containing 1,306,532 square feet or 29.99 acres, of which 27.42 acres is the land of the Elmer M. Sewall Revocable Trust 96 and 2.57 acres is the land of the Boston and Maine Corporation.

13. INSTALLATION OF NEW GMZ COMPLIANCE WELLS

Two well couplets (overburden and bedrock) shall be installed near the revised GMZ boundary. Locations to be confirmed with EPA & DES prior to construction. Wells shall be installed and sampled as part of the regular scheduled 2014 sampling program.

14. UNDEVELOPED LOTS WITHIN THE GROUNDWATER MANAGEMENT ZONE:
Consistent with Env-Or 607.06(d), for each undeveloped lot, or portion thereof, which is within the Groundwater Management Zone and lacks access to a public water supply, the permittee shall contact the property owner annually to determine if a water supply well has been installed. The permittee shall include a report on this inquiry in the Annual Summary Report required in Standard Permit Condition #7. The results of these inquiries shall be documented in each Annual Summary Report.

Upon discovery of a new drinking water supply well within the Groundwater Management Zone, the permittee shall provide written notification to the Department and, to ensure compliance with Env-Or 607.06(a), submit a contingency plan to provide potable drinking water in the event the well is or becomes contaminated above the ambient groundwater quality standards. The potable water supply shall meet applicable federal and state water quality criteria. This plan shall be submitted to the Department for approval within 15 days of the date of discovery.

The permittee shall sample the new supply well within 30 days of discovery. The well shall be sampled for all the analytical parameters included in Standard Condition # 7, unless otherwise specified in writing by the Department. The permittee shall forward all analytical results to the Department's Waste Management Division, the Department's Environmental Health Program, and the owner of the drinking water supply well within 7 days of receipt of the results.

If the results for the new well meet the ambient groundwater quality standards, the permittee shall continue to sample the new wells annually as part of the permit. If the results for the new well indicate a violation of the ambient groundwater quality standards, the permittee shall notify the owner immediately and conduct confirmatory sampling within 14 days of receiving the original results.

Upon confirmation of a violation of the ambient groundwater quality standards in a new drinking water well, the permittee shall immediately implement the contingency plan to provide a potable drinking water supply that meets applicable federal and state water quality criteria.

15. All monitoring wells at the site shall be properly maintained and secured from unauthorized access or surface water infiltration.

16. The permittee shall update ownership information required by Env-Or 607.03(a)(20) for all properties within the Groundwater Management Zone prior to renewal of the permit or upon a recommendation for site closure.

Carl W. Baxter, P.E., Administrator
Hazardous Waste Remediation Bureau
Waste Management Division

Under RSA 21-0:14 and 21-0:9-V, any person aggrieved by any terms or conditions of this permit may appeal to the Waste Management Council in accordance with RSA 541-A and N.H. Admin. Rules, Env-WMC 200. Such appeal must be made to the Council within 30 days and must be addressed to the Chairman of the Waste Management Council, c/o Appeals Clerk, Department of Environmental Services Legal Unit, 29 Hazen Drive, P.O. Box 95, Concord, NH 03302-0095.

APPENDIX B

BORING LOGS AND MONITORING WELL CONSTRUCTION LOGS

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT Cookley / Remedial Design / NH WELL NO BP-4 SHEET 1 of 1

GA INSP. S. Nevshehirlian DRILLING METHOD 6" Dia Mud Rotary/Air Hammer GROUND ELEV. 108.8 WATER DEPTH 14.70

WEATHER N/A DRILLING COMPANY All Terrain Drilling/ R.E. Chapman COLLAR ELEV. 111.58 DATE/TIME 6/28/93

TEMP. N/A DRILL RIG Speedstar 30K DRILLER M. Hasselman STARTED 1400 5/17/93 (TIME / DATE) COMPLETED 1600 5/17/93 (TIME / DATE)

LOCATION / COORDINATES N. 183,528.9 E. 1,212,022.9

MATERIALS INVENTORY

WELL CASING 6" in. dia. 33.6 l.f. WELL SCREEN N/A in. dia. N/A l.f. BENTONITE SEAL N/A

CASING TYPE Steel SCREEN TYPE Open Hole INSTALLATION METHOD Gravity

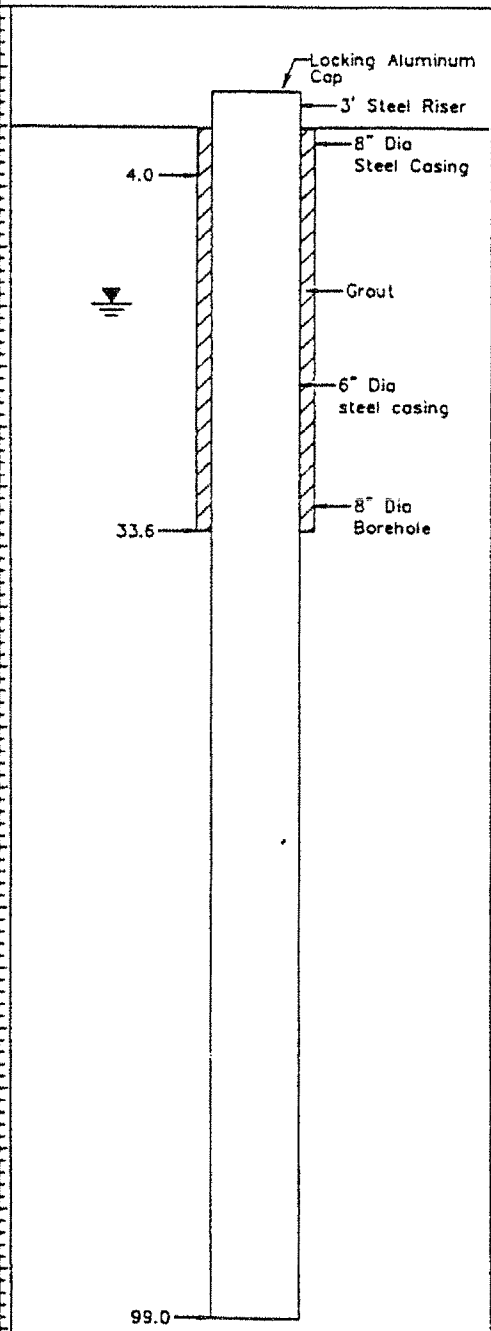
JOINT TYPE Welded SLOT SIZE N/A FILTER PACK QTY. N/A

GROUT QUANTITY 10 Bags CENTRALIZERS N/A FILTER PACK TYPE N/A

GROUT TYPE Cement DRILLING MUD TYPE Bentonite INSTALLATION METHOD N/A

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
0.00	GROUND SURFACE
0.0	0.0–30.6' OVERBURDEN
30.60	
	30.6'–99.0' BEDROCK See BPW-1 corehole log for descriptions.
99.00	
	End boring at 99.00'

WELL SKETCH



INSTALLATION NOTES

Drilled using mud rotary 8" bit to 33.6'

Set 6" dia. steel casing to 33.6' BGS. Then reamed hole to 99' BGS.

WELL DEVELOPMENT NOTES

Well developed using nitrogen pressure on 6/15/93

RECORD OF DRILLHOLE BPW-01

Log for BP-4

Sheet 1 of 4

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: NQ CORE
DRILLING DATE: 05/26/93
DRILL RIG: Star 30 k

DATUM: NGVD
COORDINATES N: 183512.3
AZIMUTH: 000

REFERENCE ELEV: 112.0
E: 1211973.9
INCLINATION: -90

ROCK TYPE

B-Bedding, BR-Broken, C-Curved, CA-Calcite, CH-Chloritic, CL-Chlorite, CO-Contact, F-Fresh, FA-Fault, FE-Iron, FR-Fracture, G-Ground, I-Irregular, J-Joint, K-Slickensided, IR-Iron, MN-Manganese, PL-Planar, QTZ-Quartz, R-Rough, SM-Smooth, SP-Stepped, ST-Stepped, UE-Uneven, W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
0			112.00									
	0.0-2.0ft Loose, light brown fine to medium sand.		0.00 / 110.00									The borehole was advanced from 0.0 to 35.7ft below ground surface using mud rotary drilling techniques. Lithologic descriptions for this interval are based on drill cuttings.
	2.0ft-13.0ft REFUSE.		2.00 / 99.00									
5												
10												
	13.0ft-33.0ft Light to medium grey fine to coarse SAND, some silt.		13.00 / 79.00									
15												
20												
25												
30												Run / Water loss
	Begin boring at 33.0 below ground surface. 33.0ft-35.7ft Weathered BEDROCK		33.00 / 76.30									
35	35.7ft-38.2ft Fresh to slightly weathered grey DIABASE, with light colored phenocrysts to 2mm in diameter, come iron staining on fractures.		35.70	1	3.3				J,ST J,PL,FE			1 / 25gals
	38.2ft-39.4ft Slightly to moderately weathered light grey to tan GRANITE, heavely Fe stained, many solution cavities throughout. Solutional cavities contain calcite.		38.20	2								2 / 20 gal
	39.4ft-43.2ft Fresh to slightly		39.40	3	4.0							
40	CONTINUED ON NEXT PAGE		40.00									

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: B. BARRASSA

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/27/93

Golder Associates

RECORD OF DRILLHOLE BPW-01

Sheet 2 of 4

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: NQ CORE
DRILLING DATE: 05/26/93
DRILL RIG: Star 30 k

DATUM: NGVD
COORDINATES N: 183512.3
AZIMUTH: 000

REFERENCE ELEV: 112.0
E: 1211973.9
INCLINATION: -90

B-Bedding, BR-Broken, C-Curved, CA-Calcite, CH-Chloritic
CL-Chlorite, CO-Contact, F-Fresh, FA-Fault, FE-Iron
FR-Fracture, G-Ground, I-Irregular, J-Joint, K-Slickensided
IR-Iron, MN-Manganese, PL-Planar, QTZ-Quartz, R-Rough
SM-Smooth, SP-Stepped, ST-Stepped, UE-Uneven, W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
40	CONTINUED FROM PREVIOUS PAGE											
	weathered grey DIABASE with light colored phenocrysts, some Fe staining and infilling at 43.2ft BGS.		40.00	3	4.0				J,PL,FE J,PL,FE J,PL J,SEALED			Run / Water loss 3 / 75 gal
45	43.2ft-50.5ft Fresh to slightly weathered, highly fractured, tan to light grey GNEISS-SCHIST, very foliated.		43.20	4	5.0				J,PL,FE			4 / 85 gals
50	50.5ft-52.3ft Fresh lightly fractured light gray to tan green GNEISSIC SCHIST. Very foliated no obvious accessory minerals.		50.50	5	5.0				J,ST/PL J,ST/C J,PL			100% water loss from run 4 to the end of boring. 5 / 75 gal
	52.3ft-53.4ft Fresh light tan GRANITE with black phenocrysts.		52.30						J,PL J,C			
55	53.4ft-56.1ft Fresh to slightly weathered grey green GNEISS some phenocrysts parallel foliation at 54.0ft, some Fe staining at 55.5'.		53.40	6	5.0				J,PL J,SM,FE J,ST,FE J,PL,FE FOW,CN J,PL,FE			6 / 75 gal
	56.1ft-58.4ft Slightly weathered, sligtly fractured, tan GRANITE PEGMATITE (phenocrysts 2-3cm in diameter throughout core) Fe staining throughout.		56.10						J,SM,FE,PL,C,P			
60	58.4ft-60.0ft Fresh tan GRANITE PEGMATITE with phenocrysts of mica and proxene or horneblende chlorite on fracture surfaces.		58.40 60.00	7	5.0				J,PL MANY LOW ANGLE FRACTURES			7 / 90 gal
	60.0ft-67.5ft Slightly weathered, inter fingered tan GRANITE PEGMATITE and grey green gneiss.								MANY LOW ANGLE FRAC			
65				8	5.0				J,ST J,ST,W J,ST J,ST,MF			8 / 70 gal
	67.5ft-74.5ft Fresh grey to black micaceous SCHIST.		67.50						J,SM			
70				9	4.5				J,PL J,PL,R			9 / 100 gal
									J,PL J,PL J,PL,SM			
75	74.5ft-81.0ft Slightly weathered inter fingered grey green SCHIST and tan GRANITE PEGMATITE. Both rock types very micaceous, Fe staining at 81.0ft some chlorite throughout zone.		74.50	10	5.0				J,PL/ST J,PL/R J,PL J,PL,SM J,PL			10 / 90 gal
				11	5.0				J,C			11 / 100 gal
80	CONTINUED ON NEXT PAGE		80.00									

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: B. BARRASSA

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/27/93

Golder Associates

RECORD OF DRILLHOLE BPW-01

Sheet 3 of 4

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: NQ CORE
DRILLING DATE: 05/26/93
DRILL RIG: Star 30 k

DATUM: NGVD
COORDINATES N: 183512.3
AZIMUTH: 000

REFERENCE ELEV: 112.0
E: 1211973.9
INCLINATION: -90

B-Bedding BR-Broken C-Curved CA-Calcite CH-Chloritic
CL-Chlorite CO-Contact F-Fresh FA-Fault FE-Iron
FR-Fracture G-Ground I-Irregular J-Joint K-Slickensided
IR-Iron MN-Manganese PL-Planar QTZ-Quartz R-Rough
SM-Smooth SP-Stepped ST-Stepped UE-Uneven W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	ROCK TYPE											
80	CONTINUED FROM PREVIOUS PAGE											
			80.00						J,PL,FE			Run / Water loss
	81.0ft-99.8ft Fresh dark grey SCHIST very pronounced foliation with quartz and feldspar banding along foliation.		81.00	11	5.0				J,PL			
85				12	4.9							12 / N/A
									J,PL,FR			
									J,PL,FR			
									J,PL			
90				13	5.0							13 / 100 gal
									J,PL,FO			
95				14	5.0				J,PL,R,FO			14 / 100 gal
									J,PL,R			
									J,W			
100	99.8ft-102.9ft Fresh tan GRANITE with black phenocrysts mixed with schist zones at 101.5ft-102.7ft.		99.80	15	5.0				J,PL,R			15 / 100 gal
									J,PL,SM			
	102.9ft-110.0 Fresh white to tan GRANITE, pregmatitic in small zones throughout, accessory minerals include garnet, mica, and pyroxene (or horneblende) no staining.		102.90									
105				16	5.0							16 / 90 gal
110	110.0ft-111.9 Fresh grey very micaceous SCHIST.		110.00	17	4.0							17 / 90 gal
	111.9ft-115.5ft Hole reamed past blockage.		111.90									N/A / N/A
115												
	115.5ft-122.5ft Grey very micareous SCHIST.		115.50	18	5.0							18 / 200 gal
120	CONTINUED ON NEXT PAGE		120.00									

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: B. BARRASSA

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/27/93

Golder Associates

RECORD OF DRILLHOLE BPW-01

Sheet 4 of 4

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: NQ CORE
DRILLING DATE: 05/26/93
DRILL RIG: Star 30 k

DATUM: NGVD
COORDINATES N: 183512.3
AZIMUTH: 000

REFERENCE ELEV: 112.0
E: 1211973.9
INCLINATION: -90

B-Bedding, BR-Broken, C-Curved, CA-Calcite, CH-Chloritic
CL-Chlorite, CO-Contact, F-Fresh, FA-Fault, FE-Iron
FR-Fracture, G-Ground, I-Irregular, J-Joint, K-Slickensided
IR-Iron, MN-Manganese, PL-Planar, QTZ-Quartz, R-Rough
SM-Smooth, SP-Stepped, ST-Stepped, UE-Uneven, W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
120	CONTINUED FROM PREVIOUS PAGE											
			120.00	18	5.0							Run / Water loss
				19	2							19 / 100 gal
	122.5ft-132.9ft Fresh to slightly weathered grey very miceous SCHIST.		122.50						J,PL,FO			
125				20	5.0				J,PL J,PL			20 / 240 gal
									J,PL J,PL,S?			
130				21	5.0				J,SM J,SM			21 / 240 gal
				22	.4				J,PL			22 / 130 gal
	BORING TERMINATED AT 132.9 BELOW GROUND SURFACE.		132.90									
135												
140												
145												
150												
155												
160												

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: B. BARRASSA

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/27/93

Golder Associates

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT COAKLEY / EMP WELLS / NH WELL NO. MW-10 SHEET 1 OF 1

GA INSP. M. ZARENSKI DRILLING METHOD Hollow Stem Auger 4 1/4" I.D GROUND ELEV. 77.6 WATER DEPTH 4.39 TOPVC

WEATHER SUNNY/CALM DRILLING COMPANY CAPITAL ENVIRONMENTAL COLLAR ELEV. 80.27 PVC DATE/TIME 5/23/96

TEMP 50° F DRILL RIG BOMBARDIER DAVY 10 DRILLER S. VOISINE STARTED 1245 4/15/96 (TIME / DATE) COMPLETED 1340 4/15/96 (TIME / DATE)

LOCATION / COORDINATES N 184168.6 E 1211131.9

MATERIALS INVENTORY

WELL CASING 2" in. dia. 8 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL BENTONITE PELLETS

CASING TYPE PVC SCREEN TYPE PVC INSTALLATION METHOD GRAVITY

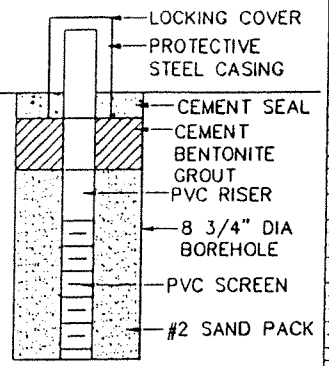
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" FILTER PACK QTY. 200 lbs

GROUT QUANTITY NONE CENTRALIZERS NONE FILTER PACK TYPE #2 SAND

GROUT TYPE N/A DRILLING MUD TYPE NONE INSTALLATION METHOD GRAVITY

ELEV / DEPTH	SOIL / ROCK DESCRIPTION
	GROUND SURFACE
0.0	0.0' – 3.0' Brown to black poorly sorted SANDY SILT AND LARGE COBBLES. (MH)
3.00	
-5	3.0' – 10.4' bgs Brown SAND AND GRAVEL consisting of angular rock fragments. Saturated @ 3' bgs.
-10 10.40	End boring at 10.4' bgs.
-15	
-20	
-25	
-30	
-35	
-40	
-45	
-50	
-55	

WELL SKETCH



INSTALLATION NOTES

Hole advanced to 10.4' bgs using hollow stem auger a few inches of sand placed in the bottom of the hole. screen set from 10' to 5' bgs. Sand pack added to 3' bgs Bentonite pellets added to 1' bgs. Protective casing set on top of pellets and cemented into place.

WELL DEVELOPMENT NOTES

LEGEND

- CEMENT SEAL
- BENTONITE CHIPS SEAL
- #2 MORIE SAND

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT COAKLEY / EMP WELLS / NH WELL NO. MW-11 SHEET 1 OF 1

GA INSP. M. ZARENSKI DRILLING METHOD AIR HAMMER 5 7/8" GROUND ELEV. 90.0 WATER DEPTH 3.52 TOPVC

WEATHER SUNNY/CALM DRILLING COMPANY CAPITAL ENVIRONMENTAL COLLAR ELEV. 92.57 PVC DATE/TIME 5/22/96

TEMP. 65° F DRILL RIG DRILL TECH D-25K DRILLER S. VOISINE STARTED 1530 4/25/96 (TIME / DATE) COMPLETED 1100 4/26/96 (TIME / DATE)

LOCATION / COORDINATES N 183163.4 E 1210941.6

MATERIALS INVENTORY

WELL CASING 2 in. dia. 35 l.f. WELL SCREEN 2 in. dia. 20 l.f. BENTONITE SEAL 3/8" HOLE PLUG CHIPS

CASING TYPE PVC SCREEN TYPE PVC INSTALLATION METHOD GRAVITY

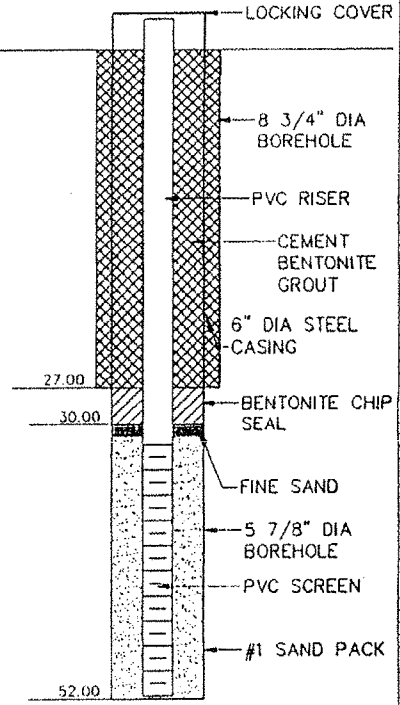
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" FILTER PACK QTY. 300 lbs

GROUT QUANTITY 35 - 40 Gal CENTRALIZERS NONE FILTER PACK TYPE #1 SAND

GROUT TYPE PORTLAND TYPE 1 BENTONITE DRILLING MUD TYPE BENTONITE POWDER/WATER INSTALLATION METHOD GRAVITY

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
GROUND SURFACE	
0.0	0.0' – 10.0' Brown CMF SAND (SP)
10.00	10.0' – 19.0'bgs Grey Gravelly CLAY (CH)
19.00	
22.00	19.0' – 22.0' bgs Angular COBBLES, likley fractured bedrock.
52.00	End boring at 52' bgs.

WELL SKETCH



INSTALLATION NOTES

Borehole advanced to 27'bgs using mud rotary drilling, steel casing then grouted in place. Borehole then advanced to 52' bgs using air rotary drilling. PVC then lowered into hole and sand pack added from 52'bgs to 30.5'bgs 6" of fine sand placed on top to 30'bgs, bentonite chips seal then added to 27' bgs and the remainder of the borehole was grouted.

WELL DEVELOPMENT NOTES

LEGEND

- CEMENT BENTONITE GROUT
- BENTONITE CHIPS SEAL
- FINE FILTER SAND
- #1 MORIE SAND

NHWS & PCC BORING LOG

SITE

Coakley Landfill

North Hampton

Boring No: MW2

Sheet: 1 of: 1

Date: 6/6/85

Boring Company: Soils Engineering

Boring Location: SW corner of L.F.

Foreman: Myron Dominique

Ground/Casing Elevation:

Geologist/Engineer: M. S. Robinette

Starting Date: 6/6/85 Ending Date: 6/10/85

SAMPLER

Type nx core barrel

Hammer Wt.

Fall

Groundwater Readings

Date	Depth to Water	Ref. Pt.	Time/Stabiliza

SAMPLE

Depth	Casing Bl/ft.	No.	Depth	Pen/Rcvy	Blows/6"	LOG	Description
							sand fill, 1 1/2'; organic debris, sands, boulders
5							top of weathered bedrock
							pull off hole, move over 3" drive & wash to 11' - BX core
10							greenish, weathered, biotite cuttings
							- begin BX core
							11:12 > 10 min. 1 ft. 11:22 > 7.5 min. 1 ft. 11:30 > 16 min. 1 ft. 11:46 > 21 min. 1 ft. 12:08 > 11 min. 4 in. 12:19
15							total core 4'4" recovery 9" HNU in core hole =27 ppm Explosimeter in core-hole - neg.
							begin 2nd BX core
20							13:00 > 15 min. 1 ft. 13:15 > 23 min. 1 ft. 13:38 > 16.5 min. 1 ft. 13:54 > 20 min. 1 ft. 14:14 > 27 min. 9 in. 14:41
25							
30							

Locking Construc

cement

Bentonite

KEY:

Granular Bls/ft	Desc.	Cohesive Bls./ft	Desc.
0-4	v. loose	<2	v. soft
4-10	loose	2-4	soft
10-30	m. dense	4-8	medium
30-50	dense	8-15	stiff
>50	v. dense	15-30	v. stiff
		>30	hard

REMARKS:

total core 4'9"
recovery 9"
HNU in core hole 74 ppm

Location 1 - probe to 6'
Location 2 - probe to 5'
Location 3 - probe to 8'
2 hr. washtime before moving to MW3
6/11/85 - set 1" well, 10' screen, 14' riser; 10# sand, 5# bentonite, 1/2 hr. flushing time, 40# cemen

MW-4

NHWS & PCC BORING LOG

SITE

Coakley Landfill
North Hampton

Boring No: MW4
Sheet: 1 of: 2
Date: 6/14/35

Boring Company: Soils Engineering
Boring Location: SE corner
Foreman: Myron Dominique
Ground/Casing Elevation:
Geologist/Engineer: M. S. Robinette
Starting Date: 6/14/85 Ending Date:

SAMPLER
Type
Hammer Wt.
Fall

Groundwater Readings

Date	Depth to Water	Ref. Pt.	Time/Stabilization

Depth	Casing Bl/ft.	SAMPLE No.	SAMPLE Depth	Pen/Rcvy	Blows/6"	LOG	Description	Locking Cap Construction
							edge of landfill - plastic and stained landfill soil top 6' with ≈1' of sand cover	
5							dark brown medium sand, stained, w/plastic and wire	
10		1		16"/9"	8/20/60+		v. dense gravelly sand w/silt - dark greenish grey - no odor wet, very cobbley, rounded gravels	
15		2		14"/14"	24/41/ 60+		dry, dense silty sands, gravels - till/moist HNU ≈10 ppm	
20		3		24"/24"	30/32/ 24/27		very gravelly, sandy, dense, iron staining - dry till	
25		4		24"/0	83/52/ 42/40		garbage stuck in spoon - no recovery	
		5		18"/12"	28/30/33		homogeneous, med. sands-damp	28
30							alternating sands, dense gravels	

KEY:

Granular Bls/ft	Granular Desc.	Cohesive Bls./ft	Cohesive Desc.
0–4	v. loose	<2	v. soft
4–10	loose	2–4	soft
10–30	m. dense	4–8	medium
30–50	dense	8–15	stiff
>50	v. dense	15–30	v. stiff
		>30	hard

REMARKS:

MW-4

NHWS&PCC BORING LOG

SITE
Coakley Landfill
North Hampton

Boring No: MW4
Sheet: 2 of 2
Date: 6/17/85

Boring Company: Soils Engineering
Boring Location: SE corner
Foreman: Myron Dominique
Ground/Casing Elevation:
Geologist/Engineer: M. S. Robinette
Starting Date: 6/14/85 Ending Date:

SAMPLER
Type
Hammer Wt.
Fall

Groundwater Readings

Date	Depth to Water	Ref. Pt.	Time/Stabilization

Depth	Casing Bl/ft.	SAMPLE No.	SAMPLE Depth	Pen/Rcvy	Blows/6"	LOG	Description	Construction
30		6		6"/3"	182		dense sandy, gravel cobble prevented spoon advance HNU =25 ppm cobbles @ 33'-34'	Ottawa Sand
35		7		16"/16"	51/69/104+		v. dense sandy gravel dark green; sulfur smell- rounded gravels	
		8		11"/10"	142/150/			
					5"			
40							Begin NX core 14:00 @ 38' losing H_2O - no return 11" 35.30 min.	38
							=5" recovery - very broken iron stained gneiss - Rye Fm.	
45							Start NX core 14:55 @ 38' 11" - water return, lost circulation - 29'2", regained circulation at 39' 3" - some water loss, 8" in 46 min. stopped at 39' 7", recovery 8" - very broken, iron stained hard gneiss	
50							Start NX core 15:55 at 39'7" - losing H_2O, 55 gallons/=6"/30 min. 36 min. for 5" at 40'	
55							start 16:30, 40'6" - 26 min.	
60							filled corehole; set well	

KEY:

Granular Bls/ft	Granular Desc.	Cohesive Bls./ft	Cohesive Desc.
0–4	v. loose	<2	v. soft
4–10	loose	2–4	soft
10–30	m.dense	4–8	medium
30–50	dense	8–15	stiff
>50	v. dense	15–30	v. stiff
		>30	hard

REMARKS:

10' Sch. 40 2" screen
30' Sch. 40 2" riser
10# bentonite
40# sand
50# cement
locking cap
flush 1/2 hr.

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT Cookley / Remedial Design / NH WELL NO. MW-05D SHEET 1 of 1

GA INSP. M. Zarenski DRILLING METHOD Air Rotary GROUND ELEV. 96.9 WATER DEPTH N/A

WEATHER Sunny DRILLING COMPANY All Terrain Drilling COLLAR ELEV. 98.05 DATE/TIME N/A

TEMP. 80 DRILL RIG N/A DRILLER V. Prue STARTED 1015 6/21/93 (TIME / DATE) COMPLETED 1220 6/22/93 (TIME / DATE)

LOCATION / COORDINATES N. 182,949.8 E. 1,211,082.3

MATERIALS INVENTORY

WELL CASING 2" in. dia. 140.2 l.f. WELL SCREEN 2 in. dia. 20 l.f. BENTONITE SEAL Bentonite Pellets

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD Gravity

JOINT TYPE O-ring seal Flush Threaded SLOT SIZE 0.010" FILTER PACK QTY. 700 lbs

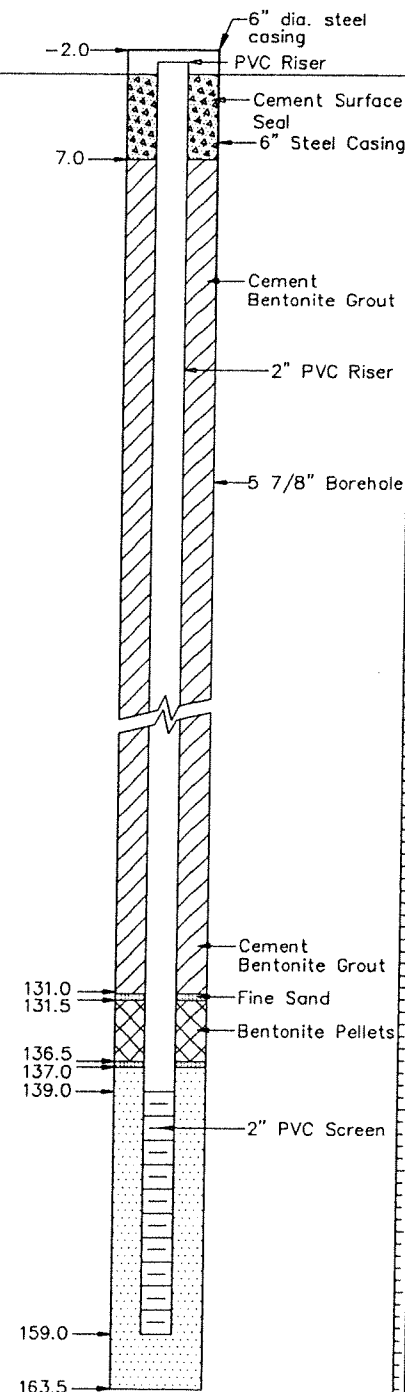
GROUT QUANTITY 250 gal CENTRALIZERS none FILTER PACK TYPE #1 Sand

GROUT TYPE Cement w/ 5% Bentonite DRILLING MUD TYPE N/A INSTALLATION METHOD Gravity

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.0	Borehole drilled during previous investigation. See borehole log MW-5 (NHWS + PCC) or borhole log for MW-5S.

Well casing extended after installation refer to SAP Table 3-1 for more information

WELL SKETCH



INSTALLATION NOTES

Well installed manually in previously existing borehole which had a field measured depth of 163.5' BGS. Sand placed from 163.5' BGS to 137' BGS. Screen set from 159' BGS to 139' BGS. Fine sand from 137' BGS to 136.5' BGS. Bentonite pellets placed from 136.5' BGS to to 131.5' BGS. Fine sand placed from 131.5' BGS to 131.0' BGS. Well grouted from 131' BGS to 7' BGS Then surface seal and casing was added. During well installation grout migrated into MW-05S borehole.

WELL DEVELOPMENT NOTES

Well developed with nitrogen pressure.

RECORD OF DRILLHOLE MW-05S

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: HQ Core
DRILLING DATE: 05/12/93
DRILL RIG: STAR 30K /CME45

DATUM: NGVD
COORDINATES N: 182960.1
AZIMUTH: 000

REFERENCE ELEV: 96.5
E: 1211084.0
INCLINATION: -90

B-Bedding BR-Broken C-Curved CA-Calcite CH-Chloritic
CL-Chlorite CO-Contact F-Fresh FA-Fault FE-Iron
FR-Fracture G-Ground I-Irregular J-Joint K-Slickensided
IR-Iron MN-Manganese PL-Planar QTZ-Quartz R-Rough
SM-Smooth SP-Stepped ST-Stepped UE-Uneven W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
0	0.0ft-12.0ft Brown fine to coarse SAND some gravel trace cobbles.		96.50 0.00									Boring advanced to 17.9 ft using mud rotary drilling methods. Lithologic descriptions from drill cuttings.
5												
10			84.50									
	12.0ft-17.9ft Weathered light grey GNEISS.		12.00									
15												Run / Water loss
	17.9ft-18.3ft Slightly weathered very light grey GNEISS.		78.60 18.30	1	.2							1 / 0 gal
	18.3ft-19.7ft Fresh to slightly weathered very light to light grey GNEISS. Abundant Fe staining on fracture surfaces Accessory minerals: muscovite, garnet, pyroxene.		76.80 19.70	2	1.4							2 / 60 gal
20				3	.9							3 / 0 gal
	19.7ft-25.0ft Fresh to slightly weathered light grey GNEISS, Fe staining on foliation/fracture surfaces. Fe staining from 24.0ft to 25.0ft BGS, resulting in pink discoloration. accessory minerals: muscovite, garnet, pyroxene.			4	4.4							4 / 120 gal
25			71.50									
	25.0ft-30.0ft Slightly weathered, slightly jointed, grey porpheritic GNEISS. Jointed parallel to foliation Fe staining of fracture surfaces, accessory minerals: muscovite, garnet.		25.00	5	5.0							5 / 150 gal
30			66.50									
	30.0ft-34.1ft Slightly weathered, slightly to moderately jointed porpheritic GNEISS. Fe staining on fracture surfaces. Resealed fractures from 33.0ft-34.0ft BGS.		30.00	6	4.5							6 / 120 gal
			62.40									
35	34.1ft-38.4ft Slightly to moderately weathered highly jointed black fine aphanitic DIABASE with feldspar phenocrystics. Fe staining on fracture surfaces. Trace pyrite or chalcopyrite on fractures.		34.10	7	5.1							7 / 500 gal
			58.10									
	38.4ft-49.0ft Slightly weathered, moderately jointed porpheritic GNEISS, iron staining on fractures.		38.40	8	.6							8 / N/A
40	CONTINUED ON NEXT PAGE											

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: D. HATCH

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/30/93

Golder Associates

RECORD OF DRILLHOLE MW-05S

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: HQ Core
DRILLING DATE: 05/12/93
DRILL RIG: STAR 30K /CME45

DATUM: NGVD
COORDINATES N: 182960.1
AZIMUTH: 000

REFERENCE ELEV: 96.5
E: 1211084.0
INCLINATION: -90

B-Bedding BR-Broken C-Curved CA-Calcite CH-Chloritic
CL-Chlorite CO-Contact F-Fresh FA-Fault FE-Iron
FR-Fracture G-Ground I-Irregular J-Joint K-Slickensided
IR-Iron MN-Manganese PL-Planar QTZ-Quartz R-Rough
SM-Smooth SP-Stepped ST-Stepped UE-Uneven W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DISCONTINUITY DATA: DIP wrt CORE AXIS	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
	CONTINUED FROM PREVIOUS PAGE											
40	Fractures generally parallel to foliation. Abundant healed fractures. Accessory mineral include muscovite pyroxene, garnet. (40.0ft BGS, quartz vein ~.1' wide)			8	.5							Run / Water loss
				9	.6							9 / N/A
				10	3.8							10 / 500 gal
45				11	2.8							11 / 275 gal
				12	2.1							12 / 200 gal
	49.0ft-49.8ft Moderately weathered, moderately jointed porpheritic GNEISS, Fe staining on fractures.		47.50 49.00 46.70									
50	49.8ft-63.5ft Fresh light grey to grey GNEISS, porpheritic, foliated, many resealed fractures. Accessory minerals include: pyroxene, muscovite, biotite, garnet.		49.80	13	5.1							13 / 250 gal
55				14	42							14 / 200 gal
60				15	4.5							15 / 430 gal
	63.5ft-68.9ft Fresh light grey to grey highly foliated GNEISS. Porpheritic resealed fractures, greater amounts of mica than in rock above. Accessory minerals include pyroxene, micas, and garnet.		33.00 63.50	16	4.1							16 / 445 gal
65			27.60									
	68.9ft-69.9ft Moderately weathered pink highly foliated GNEISS. Color due to alteration (staining) (C.L. from 70.2 to 70.5 BGS)		68.90 26.60 69.90	17	3.6							17 / 300 gal
70	69.9ft-74.9ft Fresh light grey to grey foliated porpheritic GNEISS with fractures parallel to foliation. 1.5" wide quartz vein parallel to foliation at 70.5 BGS.			18	.6							18 / 550 gal
				19	3.4							19 / 150 gal
75	74.9ft-80.4ft Pink to grey slightly to moderately fractured, moderately foliated GNEISS. Fe staining on fracture surfaces which are parellel to foliation. Accessory minerals include pyroxene, micas and garnet.		21.60 74.90	20	4.5							20 / 200 gal
80	CONTINUED ON NEXT PAGE											

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: D. HATCH

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/30/93

Golder Associates

RECORD OF DRILLHOLE MW-05S

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: MUD ROTARY/HQ C
DRILLING DATE: 05/12/93
DRILL RIG: STAR 30K /CME45

DATUM: NGVD
COORDINATES N: 182960.1
AZIMUTH: 000

REFERENCE ELEV: 96.5
E: 1211084.0
INCLINATION: -90

ROCK TYPE

B-Bedding CL-Chlorite FR-Fracture IR-Iron SM-Smooth
BR-Broken CO-Contact G-Ground MN-Manganese SP-Stepped
C-Curved F-Fresh I-Irregular PL-Planar ST-Stepped
CA-Calcite FA-Fault J-Joint QTZ-Quartz UE-Uneven
CH-Chloritic FE-Iron K-Slickensided R-Rough W-Wavy

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
80	CONTINUED FROM PREVIOUS PAGE											
	CORING TERMINATED AT 80.4FT Due to high water loss rates. 80.4ft-150ft Pink to light grey foliated GNEISS.		16.10 80.40	20 21	4.5							Boring was advanced to a total depth of 150 ft BGS using a 5 7/8" air hammer drill bit.
85												
90												
95												
100												
105												
110												
115												
120	CONTINUED ON NEXT PAGE		120.00									

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: D. HATCH

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/30/93

Golder Associates

RECORD OF DRILLHOLE MW-05S

PROJECT: COAKLEY/REMEDIAL DES./ NH
PROJECT NO: 923-6058
LOCATION: NORTH HAMPTON, NH

BORING METHOD: MUD ROTARY/HQ C
DRILLING DATE: 05/12/93
DRILL RIG: STAR 30K /CME45

DATUM: NGVD
COORDINATES N: 182960.1
AZIMUTH: 000

REFERENCE ELEV: 96.5
E: 1211084.0
INCLINATION: -90

B-Bedding CL-Chlorite FR-Fracture IR-Iron SM-Smooth
BR-Broken CO-Contact G-Ground MN-Manganese SP-Stepped
C-Curved F-Fresh I-Irregular PL-Planar ST-Stepped
CA-Calcite FA-Fault J-Joint QTZ-Quartz UE-Uneven
CH-Chloritic FE-Iron K-Slickensided R-Rough W-Wavy

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD 80 60 40 20	FRACTURES PER FOOT 2 4 6 8 10	DISCONTINUITY DATA: DIP wrt CORE AXIS 0 30 60 90	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	DISCONTINUITY DATA: GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
120	CONTINUED FROM PREVIOUS PAGE		120.00									
125												
130												
135												
140												
145												
150			-53.50 / 150.00									
155												
160												

DEPTH SCALE: 1 INCH = 5 FEET
DRILLING CONTRACTOR: ALL TERRAIN DRILLING
DRILLER: D. HATCH

LOGGED: M. ZARENSKI
CHECKED:
DATE: 8/30/93

Golder Associates

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT Coakley / Remedial Design / NH WELL NO. MW-5S SHEET 1 of 1

GA INSP. APTM DRILLING METHOD Core / Air Hammer GROUND ELEV. 96.5 WATER DEPTH 7.10 BGS

WEATHER Sunny DRILLING COMPANY Capital Drilling COLLAR ELEV. 96.71 DATE/TIME 8/23/93

TEMP. 80's DRILL RIG Mobile B-53 DRILLER M. Vosine STARTED 1045 8\9\93 (TIME / DATE) COMPLETED 1230 8/9/93 (TIME / DATE)

LOCATION / COORDINATES N. 182,960.1 E. 1,211,084.0

MATERIALS INVENTORY

WELL CASING 2 in. dia. 40 l.f. WELL SCREEN 2 in. dia. 30 l.f. BENTONITE SEAL Enviro-Plug Bentonite Chips

CASING TYPE SCH 40 PVC SCREEN TYPE Machine Slot PVC INSTALLATION METHOD Gravity

JOINT TYPE Flush Threaded SLOT SIZE 0.010" FILTER PACK QTY. 350 lbs

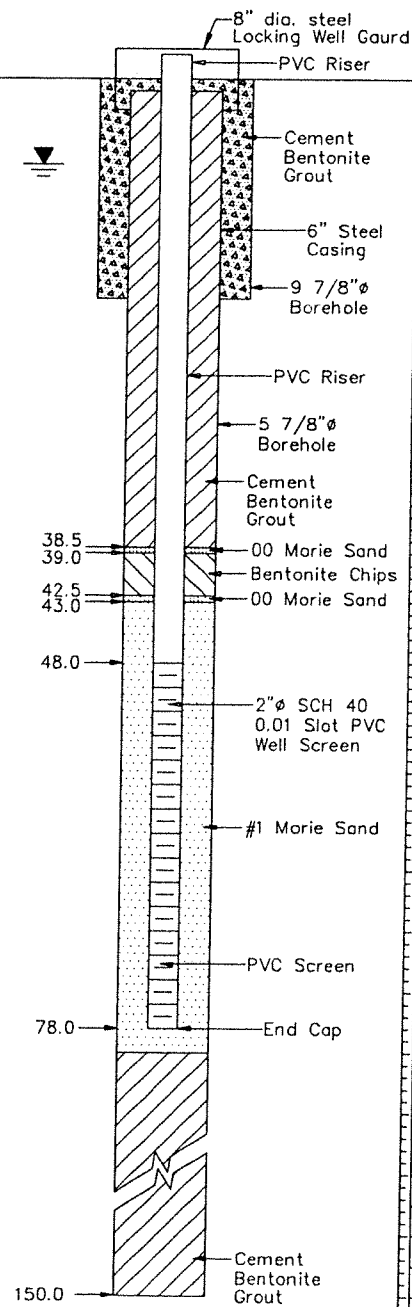
GROUT QUANTITY 65 gal CENTRALIZERS none FILTER PACK TYPE # 1 Morie Well Gravel

GROUT TYPE Cement(95%) Bentonite(5%) DRILLING MUD TYPE N/A INSTALLATION METHOD Gravity

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
0.00	GROUND SURFACE
0.0	0-12.0' Brown fine to coarse SAND, some gravel, trace cobbles.
12.00	12.0'-15.0' BEDROCK predominantly porpheritic gneiss. See corehole log for details.
150.00	End of boring 150.0'

Well casing extended after installation refer to SAP Table 3-1 for more information

WELL SKETCH



INSTALLATION NOTES

6' casing and borehole were bridged with bentonite chips prior to well installation. On 8/9/93 the borehole was reamed to a depth of 80 feet removing the bentonite plug.

WELL DEVELOPMENT NOTES

Well developed with 2" submersible pump on 8/23/93

MW-6

NHWS&PCC BEDROCK WELL LOG

SITE

Coakley Landfill
North Hampton

Boring No: MW6
Sheet: 1 of: 2
Date: 6/19/85

Drilling Company: Tasker Well Company
Foreman: Danny Tasker
Geologist/Engineer: M. S. Robinette

Boring Location: Granite Post Green
Ground/Casing Elevation:
Starting Date: 6/19/85 Ending Date: 6/19/85

SAMPLER
Type chips
air rotary - mudded
hole top 27 feet

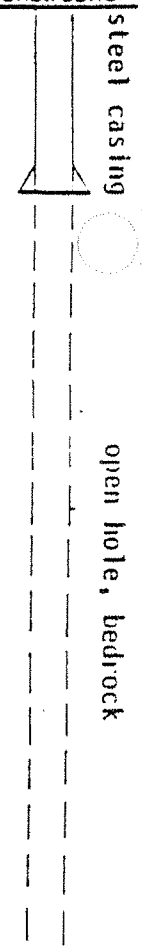
Groundwater Readings

Date	Depth to Water	Ref. Pt.	Time/Stabilization

SAMPLE

Depth	Advancement Time	No.	Depth	Fracture/Water Bearing?	LOG	Description
	11:44	1		Losing water		sandy overburden w/boulders
		2				weathered, fractured biotite gneiss - much iron staining
	12:00					
20	12:07	3				feldspar, bio-gneiss
	12:43	4				
	13:15					
		5				
40						
		6				biotite gneiss grading to pegmatite
60						
	13:42			fracture - 2 1/2		
	13:46	7		gpm		blow test - 7 1/2 gpm packer test - 10 1/2 gpm at 25 psi
80						
	13:57	8				
		9		fracture/ves		peg. zone/musc.
		10				
				fracture/ves		ironstained bio-gneiss
		11				
100	14:22			fracture/ves		pegmatite zone - qtz/feld/musc.
		12		fracture/ves		
120						

Locking Cap
Construction



REMARKS: 0-25 ft. 8 3/4" hole

Bedrock interpreted to be the Rye Fm.

NHWS&PCC BEDROCK WELL LOG

SITE

Coakley Landfill

North Hampton

Boring No: MW6

Sheet: 2 of: 2

Date: 6/19/85

Drilling Company: Tasker Well Company

Foreman: Danny Tasker

Geologist/Engineer: M. S. Robinette

Boring Location: Granite Post Green

Ground/Casing Elevation:

Starting Date: 6/19/85 Ending Date: 6/19/85

SAMPLER

Type chips

air rotary

Groundwater Readings

Date	Depth to Water	Ref. Pt.	Time/Stabilization

SAMPLE

Depth	Advancement Time	No.	Depth	Fracture/Water Bearing?	LOG	Description	Construction
120	15:40						
		13				very fractured - pegma-	
						tite zone - qtz., garnet	
						tr. biotite, chlorite	
						much iron staining	
140		14					
				fracture			
		15		fracture			
				fracture			
		16		fracture			
160	16:25						
		17		fracture			
180		18				Bottom of hole	
200							
220							
240							

REMARKS: Well tested (blow test) at 8 1/2+ gpm.
Set 27'6" of 6" casing with drive shoe.
Open hole, locking cap.
Packer test at 74' - 10 1/2 gpm at 25 psi.

MONITORING WELL INSTALLATION LOG

JOB NO 923-6058 PROJECT COAKLEY / EMP WELLS / NH WELL NO. MW-08 SHEET 1 OF 1

GA INSP M. ZARENSKI DRILLING METHOD AIR HAMMER 5 7/8" GROUND ELEV 81.5 WATER DEPTH 2.96 TOPVC

WEATHER SUNNY/CALM DRILLING COMPANY CAPITAL ENVIRONMENTAL COLLAR ELEV. 83.33 PVC DATE/TIME 5/23/96

TEMP 65° F DRILL RIG DRILL TECH D-25K DRILLER S. VOISINE STARTED 1100 4/25/96 (TIME / DATE) COMPLETED 1215 4/25/96 (TIME / DATE)

LOCATION / COORDINATES N 183778.3 E 1211044.8

MATERIALS INVENTORY

WELL CASING 2 in. dia. 48 LF WELL SCREEN 2 in. dia. 20 LF BENTONITE SEAL 3/8" HOLE PLUG CHIPS

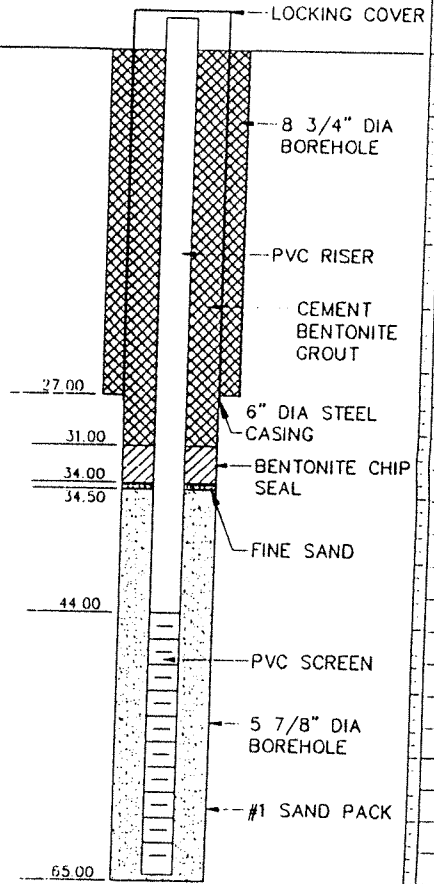
CASING TYPE PVC SCREEN TYPE PVC INSTALLATION METHOD GRAVITY

JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" FILTER PACK QTY. 450 lbs

GROUT QUANTITY 50 Gal CENTRALIZERS NONE FILTER PACK TYPE #1 SAND

GROUT TYPE PORTLAND TYPE 1 BENTONITE DRILLING MUD TYPE BENTONITE POWDER/WATER INSTALLATION METHOD GRAVITY

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
GROUND SURFACE	
0.0	0.0' – 12.0' Brown CMF SAND (SP)
12.00	12.0' – 21.0' bgs SILT AND GRAVEL, (ML)
21.00	21.0' – 65.0' bgs GRANITE Granite gneiss very micaceous to 27' bgs less mica more quartz with depth. Very fractured at 24' bgs.
65.00	End boring at 65' bgs.



INSTALLATION NOTES

BOREHOLE ADVANCED TO 27' bgs USING MUD ROTARY DRILLING AND 8 3/4" BIT. STEEL CASING WAS DRIVEN 6" INTO BEDROCK AND GROUTED IN PLACE, WITH BOTTOM AT 27' BGS THE REMAINDER OF THE BOREHOLE WAS ADVANCED WITH AIR ROTARY DRILLING TO 65' BGS. WELL INSTALLATION CONSISTED OF LOWERING PVC INTO THE HOLE WITH 20' OF SCREEN SET AT 64' BGS ADDING SAND PACK TO 34.5', 6" OF FINE SAND TO 34', ADDING A BENTONITE CHIP SEAL TO 31', AND GROUTING THE REMAINDER OF THE HOLE.

WELL DEVELOPMENT NOTES

LEGEND

- CEMENT BENTONITE GROUT
- BENTONITE CHIPS SEAL
- FINE FILTER SAND
- #1 MORIE SAND

Well casing extended after installation refer to SAP Table 3-1 for more information

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT COAKLEY / EMP WELLS / NH WELL NO. MW-09 SHEET 1 OF 1

GA INSP M. ZARENSKI DRILLING METHOD Hollow Stem Auger 4 1/4" I.D GROUND ELEV. 79.4 WATER DEPTH 4.49 TOPVC

WEATHER SUNNY/CALM DRILLING COMPANY CAPITAL ENVIRONMENTAL COLLAR ELEV. 82.62 PVC DATE/TIME 5/23/96

TEMP 50° F DRILL RIG BOMBARDIER DAVY 10 DRILLER S. VOISINE STARTED 1515 4/15/96 TIME / DATE COMPLETED 1615 4/15/96 TIME / DATE

LOCATION / COORDINATES N 183948.1 E 1211077.1

MATERIALS INVENTORY

WELL CASING 2 in. dia. 8 L.F. WELL SCREEN 2 in. dia. 5 L.F. BENTONITE SEAL BENTONITE PELLETS

CASING TYPE PVC SCREEN TYPE PVC INSTALLATION METHOD GRAVITY

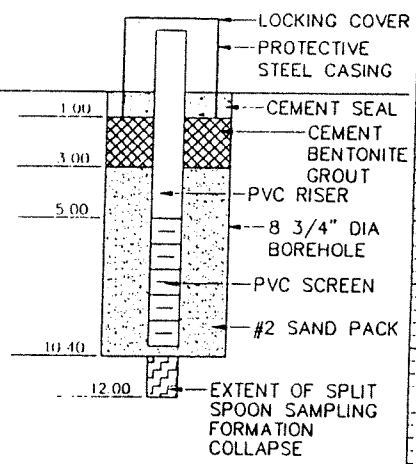
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" FILTER PACK QTY. 250 lbs

GROUT QUANTITY NONE CENTRALIZERS NONE FILTER PACK TYPE #2 SAND

GROUT TYPE N/A DRILLING MUD TYPE NONE INSTALLATION METHOD GRAVITY

LEV./DEPTH	SOIL/ROCK DESCRIPTION
GROUND SURFACE	
0.0	0.0' – 7.0' Loose Brown to grey fine SAND, little to some silt and gravel. (SP)
5	Saturated below 4'
7.00	
	7.0' – 10.4' bgs Brown to grey medium SAND some silt. Saturated
10 10.40	
12.00	10.4' – 12.0' bgs Very stiff grey CLAY (CH)
	End boring at 12' bgs.

WELL SKETCH



INSTALLATION NOTES

Hole advanced to 10' bgs using hollow stem auger and advanced to 12' bgs with the split spoon. split spoon hole did not remain open. A little sand placed in the bottom of the hole. Screen set at 10' to 5' bgs. Sand pack added to 3' bgs Bentonite pellets added to 1' bgs. Protective casing set on top of pellets and cemented into place.

WELL DEVELOPMENT NOTES

LEGEND

- CEMENT SEAL
- BENTONITE CHIPS SEAL
- #2 MORIE SAND
- CAVE IN

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6058 PROJECT COAKLEY/REMEDIAL DESIGN/NH WELL NO. OP-02 SHEET 1 of 1

CA INSP. S. Nevshehirlian DRILLING METHOD 4 1/4" I.D. HOLLOW STEM AUGER GROUND ELEV. 95.8 WATER DEPTH 3.5' BGS

WEATHER SUNNY DRILLING COMPANY ALL TERRAIN DRILLING COLLAR ELEV. 98.49 DATE/TIME 5/7/93

TEMP. 75° DRILL RIG MOBILE B-53 DRILLER Doug Hatch STARTED 1155 5/7/93 (TIME / DATE) COMPLETED 1715 5/7/93 (TIME / DATE)

LOCATION / COORDINATES N. 184,125.3 E. 1,211,942.9

MATERIALS INVENTORY

WELL CASING 1 1/4 in. dia. 10 l.f. WELL SCREEN 1 1/4 in. dia. 5 l.f. BENTONITE SEAL Pellets

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD Gravity

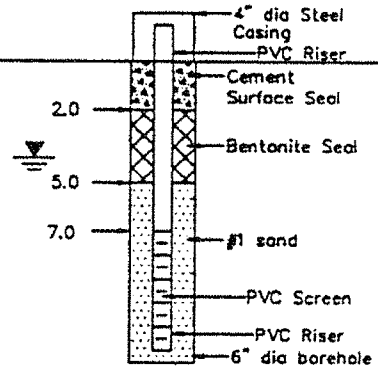
JOINT TYPE Flush Threading SLOT SIZE 0.010" FILTER PACK QTY. 200 lbs

GROUT QUANTITY N/A CENTRALIZERS none FILTER PACK TYPE #2 sand

GROUT TYPE N/A DRILLING MUD TYPE N/A INSTALLATION METHOD Gravity

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.0	0.0'–2.5' Loose light brown fine SAND.
2.50	2.5'–9.0' Light brown fine to medium SAND, trace fine gravel.
	3.5' BGS Hit water
9.00	9.0'–12.0' greenish gray clayey SILT, some sand.
12.00	12.0'–12.5' greenish gray silty CLAY, trace sand
12.50	Boring terminated at 12.5 BGS

WELL SKETCH



Well casing extended after installation refer to SAP Table 3-1 for more information

INSTALLATION NOTES

Borehole augered to 12.5 BGS. PVC screen set from 12.0' BGS to 7.0' BGS. No.1 sand pack poured through augers and ranged from 12.5' BGS to 5.0 BGS. Bentonite pellets placed on top of No.1 sand and allowed to hydrate. Bentonite seal ranged from 5.0 BGS to 2.0 BGS.

WELL DEVELOPMENT NOTES

Well developed with waterra foot valve on 6/15/93

MONITORING WELL INSTALLATION LOG

JOB NO. 923-6059 PROJECT COAKLEY/REMEDIAL DESIGN/NH WELL NO. OP-05 SHEET 1 of 1

GA INSP. S. Nevshehirlian DRILLING METHOD 4 1/4" I.D. HOLLOW STEM AUGER GROUND ELEV. 109.8 WATER DEPTH 14.88 BG

WEATHER Sunny DRILLING COMPANY ALL TERRAIN DRILLING COLLAR ELEV. 112.68 DATE/TIME 6/14/93

TEMP. 83° DRILL RIG CME 45 Skid Rig DRILLER Bob Barrasso STARTED 1515 6/10/93 (TIME / DATE) COMPLETED 1030 6/11/ (TIME / DATE)

LOCATION / COORDINATES N. 183,457.5 E. 1,212,015.9

MATERIALS INVENTORY

WELL CASING 1 1/4 in. dia. 16 l.f. WELL SCREEN 1 1/4 in. dia. 10 l.f. BENTONITE SEAL Pellets

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD Gravity

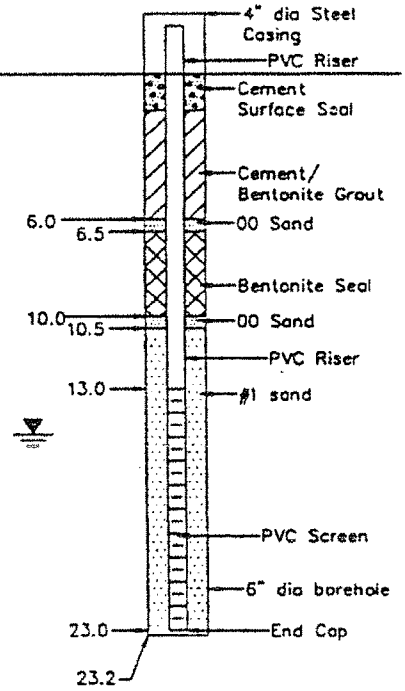
JOINT TYPE Flush Threading SLOT SIZE 0.010" FILTER PACK QTY. 200 lbs

GROUT QUANTITY 15 gallons CENTRALIZERS none FILTER PACK TYPE #1 sand

GROUT TYPE Cement Bentonite DRILLING MUD TYPE N/A INSTALLATION METHOD Gravity

ELEV./DEPTH	SOIL/ROCK DESCRIPTION
0.0	GROUND SURFACE
0.0	0.0–0.5 Medium brown organic TOPSOIL.
	0.5–5.5' Light orange brown fine to coarse SAND, some gravel, trace silt.
5.50	Loose light gray and light brown fine to coarse SAND AND GRAVEL.
12.50	
14.00	12.5–14.0 light gray fine to medium GRAVEL, some sand.
	14.0'–21.2' Saturated light gray medium to coarse SAND AND GRAVEL little silt and clay.
21.20	
23.20	21.2–23.2' Light olive green SILTY CLAY, little fine sand trace of gravel.
	Boring terminated at 23.2 BGS

WELL SKETCH



INSTALLATION NOTES

Borehole augered to 23.2' BGS. PVC screen set from 23.0' BGS to 13.0' BGS. No. 1 sand pack poured through augers and ranged from 23.2 BGS to 10.5 BGS. 00 sand poured on top of NO. 1 sand from 10.5' BGS to 10.0' BGS. Bentonite chips placed on top of 00 sand, hydrated and ranged from 10.0' BGS to 6.5 BGS. 00 sand placed on top of chips to 6.0' BGS. Bentonite/ cement grout tremied on top of 00 sand.

WELL DEVELOPMENT NOTES

Well developed using Waterra foot valve on 6/14/93

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

BORING NO. AE-1A
SHEET Page 1 of 2
FILE NO. 97070B

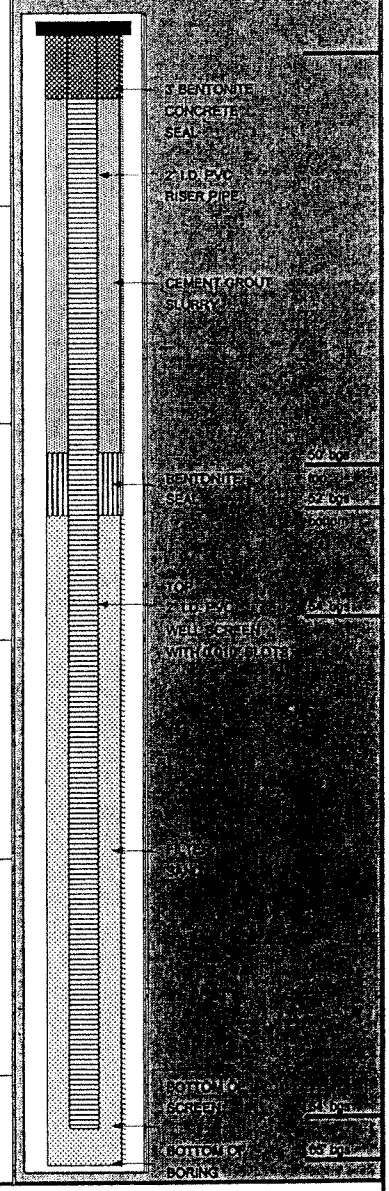
BORING CO.:	Great Works Test Boring - Truck Rig
FOREMAN:	Don
ARIES REP.:	Mike Towle
DATE:	03/26/99
PVC ELEVATION	100.81

DATE	TIME	DEPTH	CASING	STAB T.
3/26/99	12:00 PM	21.75	PVC	30min
3/26/99	13:30	29.06	PVC	2 hrs

	CASING	SAMPLER
TYPE	4" Steel	----
SIZE I.D.	4" Steel	----
HAMMER WT.	140 lbs.	----

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
5.0	S-1	2-1-1-4	0-2	24/10	ND	Gravely SAND, with little fine gravel, medium to fine Sand, loose, damp, brown, SW	Gr. SAND	
10.0	S-2	6-12-12-13	5-7	24/22	ND	Gravely SAND, some coarse to fine Gravel, fine to coarse Sand, medium dense, brown, SW	-9'- TILL	
15.0	S-3	29-26-35-50/1	10-11.5	19/14	ND	Till- Gravelly SAND, some coarse to fine Gravel coarse to fine SAND, trace Silt, very dense, moist, brown, SW		
20.0	S-4	14-23-21-16	15-17	24/12	ND	Boulder 11.5-12.5 feet Till- Sandy Gravel, some fine to coarse Gravel, coarse Sand, dense, saturated, brown, C.W.		
25.0	S-5	30-11-11-12	20-22	24/12	ND	Till: same as sample S-4 but medium dense, some cobbles		
30.0	S-6	9-7-8-10	25-27	24/6	ND	Till: Same as sample S-5 (sand washed out)		
35.0	S-7	10-7-7-6	30-32	34/3	ND	Till- finer material washed out, Gravel/Cobbles		
40.0	S-8	8-5-6-3	35-37	24/9	ND	TILL- Same as Sample S-5 but little Silt - gray, Saturated, medium, dense, GW.	-38- Silty CLAY	
45.0	S-9	4-6-5-7	40-42	24/8	ND	Silty CLAY, medium dense, some silty Clay, soft, saturated, CM		
50.0	S-10	Wolt/12 6-Apr	45-47	24/24		Silty CLAY, moderatelyplastic, Silty CLAY,medium soft, medium, soft, saturated, gray, CM		
	S-11	5-5-6-7	50-52	24/24	ND	Silty CLAY, moderate plasticity, little silty clay, soft saturated, gray, CL		

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



REMARKS

1. 2 bags of cement (94 lbs each)
2. 2 bags of grout (5 lbs each)
3. Type II Portland cement

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

BORING NO. AE-1A
SHEET Page 2 of 2
FILE NO. 97070B

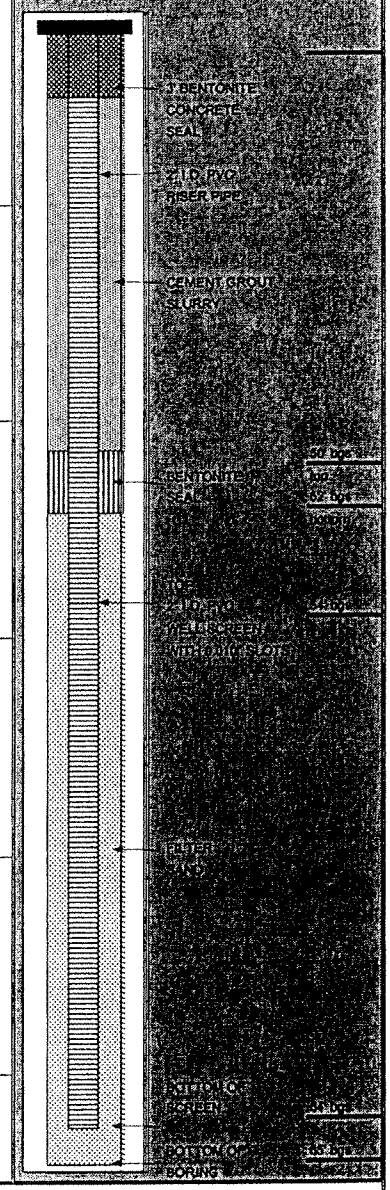
BORING CO.:	Great Works Test Boring - Truck Rig
FOREMAN:	Don
ARIES REP.:	Mike Towle
DATE:	03/26/99
PVC ELEVATION	100.81

DATE	TIME	DEPTH	CASING	STAB T.
3/26/99	12:00	21.75	PVC	30min
3/26/99	13:30	29.06	PVC	2 hrs

	CASING	SAMPLER
TYPE	4" Steel	
SIZE I.D.	4" Steel	
HAMMER WT.	140 lbs.	

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
55.0	S-12	5-5-4-4	55-57	24/24	ND	Same as Sample S-11	Silty Clay	
60.0	S-13	19-18-26 -34	60-62	24/24	ND	Silty Gravel, coarse to fine Gravel, little, coarse to fine Sand, some silty Sand, dense, gray, GW Till	TILL	
65.0	S-14	30-53-50	65-66	15/10	ND	Till - weathered Schist, black -gray, GW	Schist	
70.0								
55.0								
65.0								
75.0								

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



REMARKS

1. 2 bags of cement (94 lbs each)
2. 2 bags of grout (5 lbs each)
3. Type II Portland cement

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

BORING NO. AE-1B
SHEET Page 1 of 2
FILE NO. 97070B

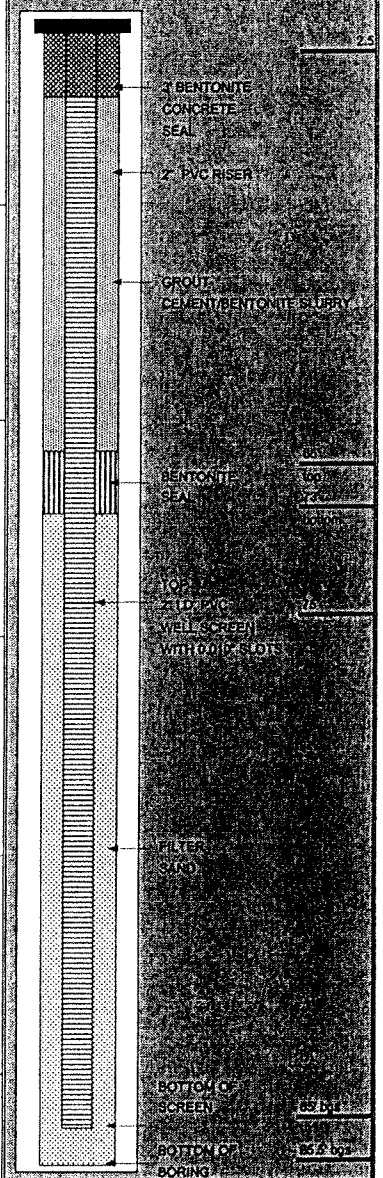
BORING CO.:	Great Works Test Boring - Bomb.
FOREMAN:	J. Lee
ARIES REP.:	Mike Towle
DATE:	03/25/99
PVC ELEVATION:	

DATE	TIME	DEPTH	CASING	STAB T.

	CASING	SAMPLER
TYPE	2" HAS	24" Split Spoon
SIZE I.D.	4" Casing	1-3/8"
HAMMER WT.	----	140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
	S-1	2-1-1-4	0-2	24/10	ND	Gravely SAND, with little fine gravel, medium to fine Sand, loose, damp, brown, SW	Gr. SAND	
5.0	S-2	6-12-12-13	5-7	24/22	ND	Gravely SAND, some coarse to fine Gravel, fine to coarse Sand, medium dense, brown, SW		
10.0	S-3	29-28-35-50/1	10-11.5	19/14	ND	Till- Gravelly SAND, some coarse to fine Gravel coarse to fine SAND, trace Silt, very dense, moist, brown, SW	-9'- TILL	
15.0	S-4	14-23-21-16	15-17	24/12	ND	Boulder 11.5-12.5 feet Till- Sandy Gravel, some fine to coarse Gravel, coarse Sand, dense, saturated, brown, C.W.		
20.0	S-5	30-11-11-12	20-22	24/12	ND	Till: same as sample S-4 but medium dense, some cobbles		
25.0	S-6	9-7-8-10	25-27	24/6	ND	Till: Same as sample S-5 (sand washed out)		
30.0	S-7	10-7-7-6	30-32	34/3	ND	Till- finer material washed out, Gravel/Cobbles		
35.0	S-8	8-5-6-3	35-37	24/9	ND	TILL- Same as Sample S-5 but little Silt - gray, Saturated, medium, dense, GW.	-38- Silty CLAY	
40.0	S-9	4-6-5-7	40-42	24/8	ND	Silty CLAY, medium dense, some silty Clay, soft, saturated, CM		
45.0	S-10	Wolf/12 6-Apr	45-47	24/24		Silty CLAY, moderatelyplastic, Silty CLAY,medium soft, medium, soft, saturated, gray, CM		
50.0	S-11	5-5-6-7	50-52	24/24	ND	Silty CLAY, moderate plasticity, little silty clay, soft saturated, gray, CL		
55.0								

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



REMARKS

1. Small diameter augers to 10' - won't stay open, switch to drive casing and wash
2. Roller bit through boulder 11.5-12.5' bgl. Another small boulder at 20'
3. Losing water throughout boring to loose till/gravel/cobbles Type II Portland cement
4. First time water in hole when rods inserted was 35'-37' bgl.

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

BORING NO. AE-1B
SHEET Page 2 of 2
FILE NO. 97070B

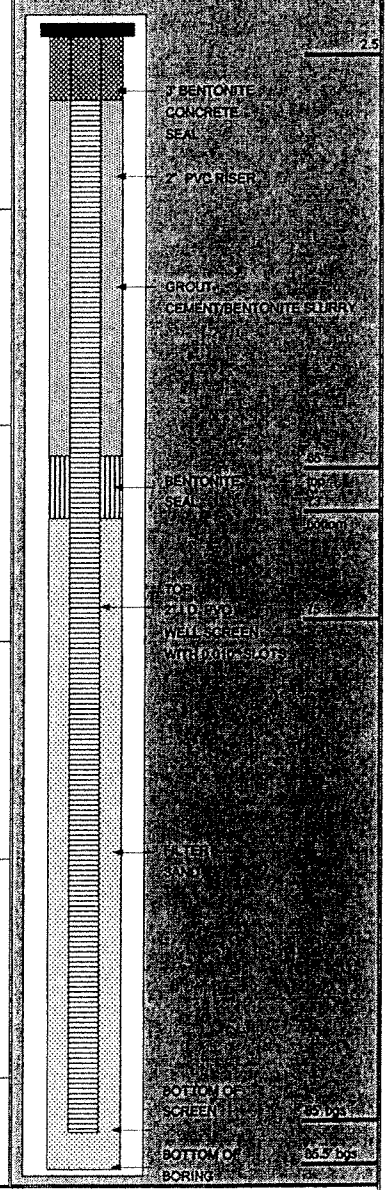
BORING CO.:	Great Works Test Boring - Bomb.
FOREMAN:	J. Lee
ARIES REP.:	Mike Towle
DATE:	03/25/99
PVC ELEVATION:	

DATE	TIME	DEPTH	CASING	STAB T.
3/26/99	12:00	30.33	PVC	30 min
3/26/99	13:30	28.87	PVC	2 hrs

	CASING	SAMPLER
TYPE	PVC	24" Split Spoon
SIZE I.D.	4" Casing	1-3/8"
HAMMER WT.		140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
	S-12	5-5-4-4	55-57	24/24	ND	Same as Sample S-11	58 TILL	
60.0	S-13	19-18-26-34	60-62	24/12	ND	Silty Gravel, coarse to fine Gravel, little, coarse to fine Sand, some silty Sand, dense, gray, GW Till		
65.0	S-14	30-53	65-66	15/10	ND	TILL- Weathered Rock (Schist - Black/ Grey) -Dry 66-70'		
70.0						Fracture Zone producing water at 71 feet		
75.0						Grey Schist - at 73 feet producing a lot of water		
80.0						Black/grey schist- 81 feet harder drilling some rust stain		
85.0						Bottom - 85.5'		

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



REMARKS

1. Small dean. Augers to 10' - won't stay open, switch to drive and wash casing
2. Roller bit through boulder 11.5-12.5' bgl. Another small boulder at 20'
3. Losing water throughout boring to loose till/gravel/cobbles Type II Portland cement
4. First time water in hole when rods inserted was 35'-37' bgl.

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION: North Hampton, New Hampshire

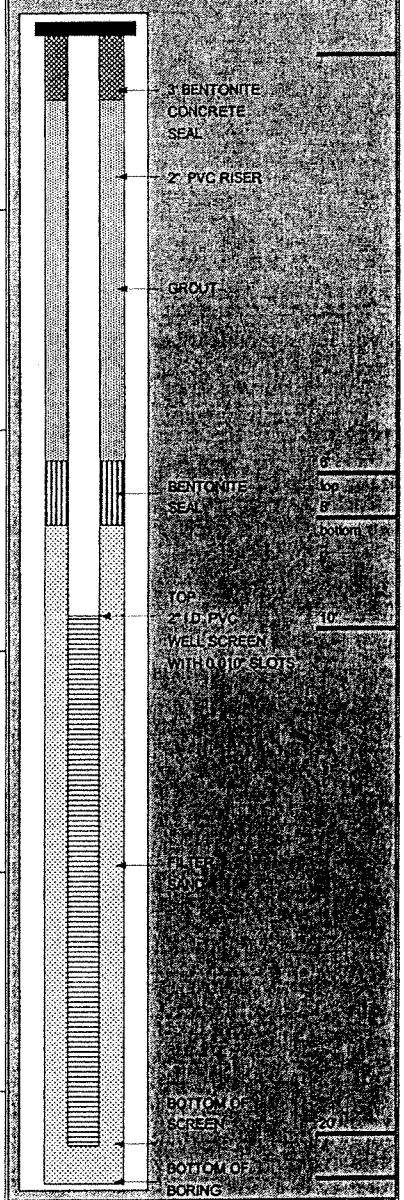
BORING NO. AE-2A
SHEET Page 1 of 1
FILE NO. 97070B

BORING CO.:	Great Works Test Boring					
FOREMAN:	J. Lee	DATE	TIME	DEPTH	CASING	STAB T.
ARIES REP.:	Dave Whelan	7/27/1999				
DATE:	07/27/99					
PVC ELEVATION:						

	CASING	SAMPLER
TYPE	PVC	24" Split Spoon
SIZE I.D.	4" Casing	1-3/8"
HAMMER WT.		140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
5.0						No Sampling See AE-2B Drive and Wash w/ Roller Bit		
10.0								
15.0								
20.0								
25.0						23' - 1" Bottom	_21'_ SAND -23'- BS	
30.0								
35.0								
40.0								
45.0								
50.0								
55.0								

EQUIPMENT INSTALLED
(DRAWING NOT-TO-SCALE)



REMARKS

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION: North Hampton, New Hampshire

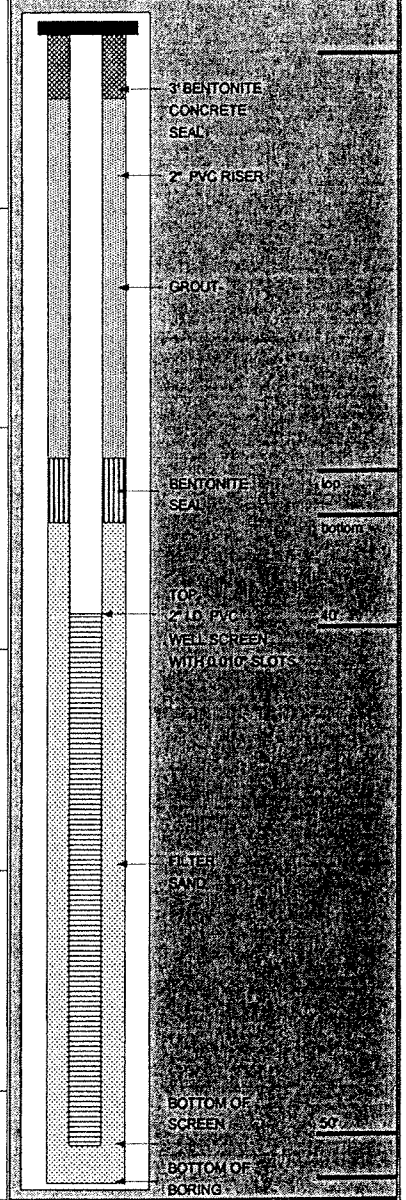
BORING NO. AE-2B
SHEET Page 1 of 1
FILE NO. 97070B

		DATE	TIME	DEPTH	CASING	STAB T.
BORING CO.:	Great Works Test Boring					
FOREMAN:	J. Lee					
ARIES REP.:	Dave Whelan	7/27/1999	9:30			
DATE:	07/27/99					
PVC ELEVATION:						

	CASING	SAMPLER
TYPE	PVC	24" Split Spoon
SIZE I.D.	4" Casing	1-3/8"
HAMMER WT.		140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
	S-1	2-3-4-6	0-2	23"	ND	SAND, wg., m/f SAND, loose, dry, bn SW.	Topsoil -7"- SAND	
5.0	S-2	4-9-13-21	5-7	18"	ND	SAND, wg., tr. Gravel, m/f, SAND, so silt, m. den, moist, grey, SW.	-7'- Silty SAND -8'-	
10.0	S-3	22-21-24 30	12-Oct	17"	ND	TILL- Weathered Rock TILL- silty Gravel, wg., so angular gravel, 1: f/m SAND 1: silty dense, sat, grey SM	TILL	
15.0	S-4	7100 for 5"	15-17	4"	ND	TILL- wg., angular gravel BOULDER Drive Casing Through BOULDER	-15'- BOULDER -16.5'-	
20.0	S-5	21-33-50 for 2"	20-22	14"	ND	Weathered Bedrock (schist Black/Grey) Casing Refusal @ 20 ft. Air Hammer 20'-50'	-22'- BEDROCK	
25.0								
30.0						Comp. Bedrock @ 30'	-30'- Comp. Br.	
35.0								
40.0								
45.0								
50.0								
55.0								

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



R	0-10	LOOSE
E	10-30	M. Dense
M	30-50	DENSE
A	50+	U Dense
R	100+	REFUSAL
K		
S	Proposed 33' 0 + 20' into rock 53'	
	8' TILL observed in wash casing set @ 20' - 0 " (BEDROCK)	

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

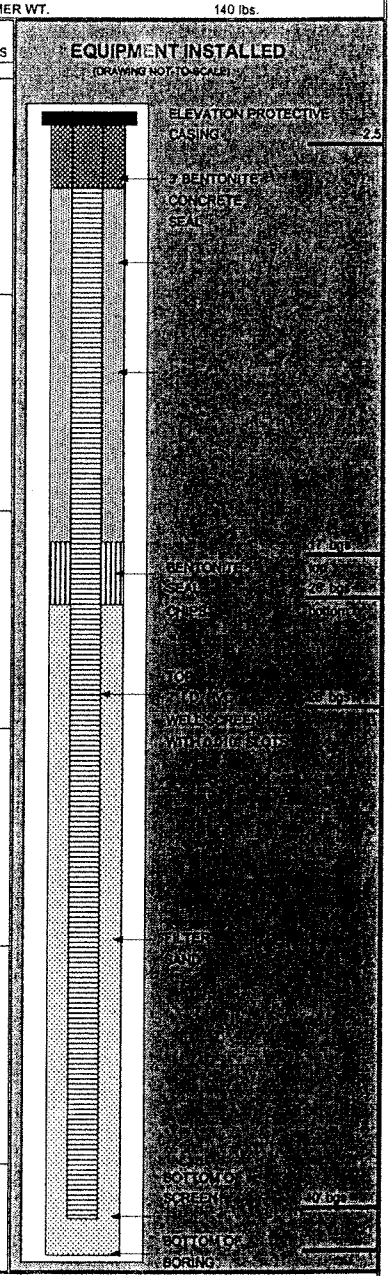
BORING NO. AE-3A
SHEET Page 1 of 1
FILE NO. 97070B

BORING CO.:	Great Works Test Boring - Bomb.					
FOREMAN:	J. Lee	DATE	TIME	DEPTH	CASING	STAB T.
ARIES REP.:	Mike Towle	3/26/99	12:00	30.33	PVC	30 min
DATE:	03/24/99	3/26/99	13:30	28.87	PVC	2 hrs
PVC ELEVATION:						

	CASING	SAMPLER
TYPE	PVC	24" Split Spoon
SIZE I.D.	4" Casing	1-3/8"
HAMMER WT.		140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
	S-1	11-17-18-14	0-2	24/12	ND	Sand Gravel, vg, so., Cobbles, so. C/f Gravel, c/f SAND, dense, dry, bn., CW		
5.0						-RIP-RAP Refusal @ 5 ft Drill w/ Air Hammer to 10'	FILL	
10.0	S-2	3-4-5-9	10-12	24/20	ND	Silty CLAY, mod. plastic, so. CLAY, silty, soft, sat,gr,CM	-9'- CLAY	
						Sand lens @11-11.5		
15.0	S-3	9-19-24-26	15-17	24/15	ND	TILL- Silty Gravel, wg, so. Angular gravel, C f/w sand, tr. Clay, dense, sat, gr, CM	-13 -	
						BEDROCK @ 17.5	-17.5 BEDROCK	
20.0	S-4		20		WD	Drilled 2" into BEDROCK		
25.0								
30.0								
35.0								
40.0								
45.0								
50.0								

EQUIPMENT INSTALLED
(DRAWING NOT TO SCALE)



REMARKS

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION North Hampton, New Hampshire

BORING NO. AE-3B
SHEET Page 1 of 1
FILE NO. 97070B

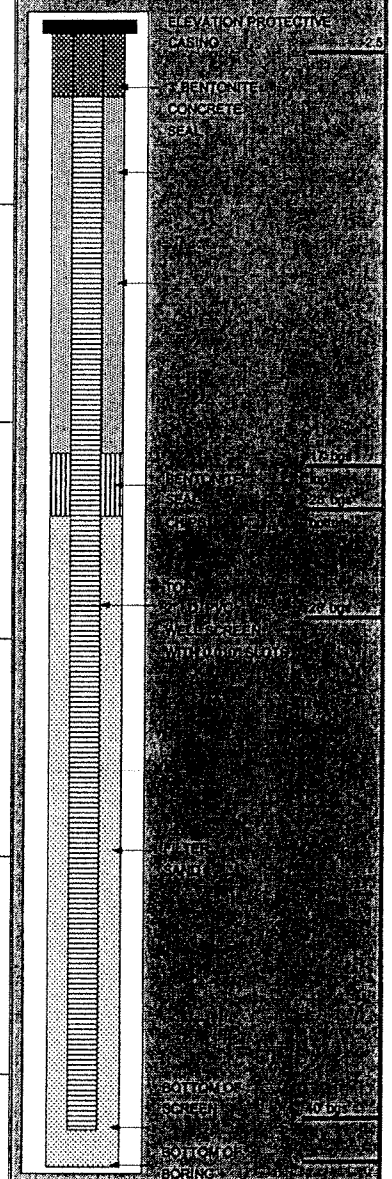
BORING CO.:	Great Works Test Boring - Bomb.
FOREMAN:	J. Lee
ARIES REP.:	Mike Towle
DATE:	03/23/99
PVC ELEVATION:	

DATE	TIME	DEPTH	CASING	STAB T.
3/24/99	10:00	8.61	PVC	15 min
		tot. dpth- 42.8	PVC	
3/24/99	11:49	8.69	42.8	2 hrs
3/24/99	13:30	8.45	42.8	4 hrs
3/25/99	12:30	8.51	42.7	1 day

	CASING	SAMPLER
TYPE	HsA/D+W	24" Split Spoon
SIZE I.D.	2"/4"	1-3/8"
	---	---
	---	---
HAMMER WT.	---	140 lbs.

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
	S-1	11-17-18-14	0-2	24/12	ND	Sandy Gravel, some Cobbles, some coarse to fine Gravel coarse to fine SAND, dense, dry, brown, CW	Gravel and Cobbles	
5.0						Rip-Rap refusal at 5 feet drilled with air hammer to 10 feet, to penetrate Rip-Rap	- 8 -	
10.0	S-2	3-4-5-9	10-12	24/20	ND	Silty CLAY, moderate plasticity, some CLAY, silt, soft, saturated, gray, CM also a Sand lens at 11-11.5 ft.	Silty CLAY	
15.0	S-3	9-19-24-26	15-17	24/15	ND	TILL-Silty Gravel, well graded, some angular gravel, coarse to fine wSAND, trace Clay, dense, saturated, gray, SM	- 16 - TILL - 18 -	
						Refusal with casing at 17 feet		
20.0	S-4		20		ND	BEDROCK- chips from air hammer		
25.0					ND	Air Hammer Bedrock- 17-40'	BEDROCK Schist	
30.0								
	S-5		32-40		ND	(Producing a lot of water with air hammer chips at 24 ft. Slight odor from water	Granite Pegmatite?	
35.0						Granite with biotite, some large white chips may be pegmatite.		
40.0						Fracture at 39 feet - rig jumped - rust colored water Bottom 40'		
45.0								
50.0								

EQUIPMENT INSTALLED
(NOT TO SCALE)



REMARKS

1. Lost a lot of grout to formation at 40' bgs.
2. Used combination grout/chips and surface
3. Start with small diameter augers to 5' refusal - switch to steel casing
   Use air hammer (if drive and wash would prbably lose a lot of water) to 10 feet. Drive a second section of pipe to 10' - drive and washto 15' - roller bit ajead (lost circulation at approx. 20') - switch to air ha

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION Greenland/Hampton, New Hampshire

BORING NO. AE-4A
SHEET Page 1 of 1
FILE NO. 97070 E

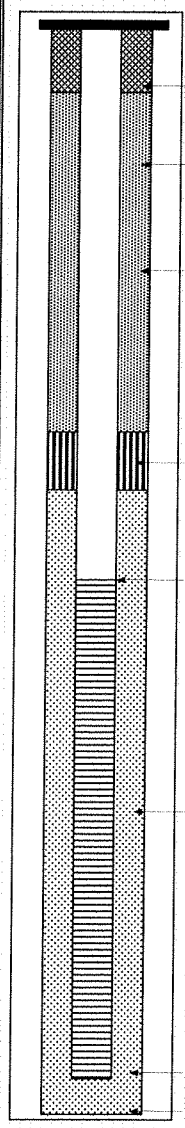
		DATE	TIME	DEPTH (ft. bgs)	CASING	STAB T.
BORING CO.:	Great Works Test Boring					
FOREMAN:	Peter M.					
ARIES REP.:	A. Piekarski					
DATE:	9/15/2003					
GROUND SURFACE ELEVATION (ft MSL):						

	CASING	SAMPLER
TYPE	H.S.A.	split spoon
SIZE O.D.	2"	
HAMMER WT.	140 lb	

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
2	S-1 (0-2')	1 1 10 18	24"	12/24	<1.0	Loam, organics, dark brown (0-4"); grades to f./c. SAND, some fractured rock, trace clay and silt, grey-brown, dry, SP.		
4						no split-spoon sample collected.	SAND	
6	S-2 (5-7')	21 29 32 35	24"	15/24	<1.0	f./c. SAND, some fractured rocks, trace clay, no silt, water approx. 6-feet, poorly graded, brown-grey, SP.		wet
8						no split-spoon sample collected.		
10	S-3 (10-12')	8 20 15 7	24"	12/24	<1.0	f./c. SAND and GRAVEL, some clay, few cobbles, wet, poorly graded, grey, GC.	SAND	
12						no split-spoon sample collected.		
14	S-4	41 2"/50	24"	6/24	<1.0	Fractured weathered bedrock, wet, grey.	Weathered Bedrock ?	
16						End of exploration at 15' bgs.		
18								
20								

EQUIPMENT INSTALLED

(DRAWING NOT-TO-SCALE)



ELEVATION PROTECTIVE CASING 0.0'
1.0 ft. CONCRETE SEAL
2" PVC RISER
FORMATION SOIL
2' bgs
BENTONITE SEAL top
4' bgs
bottom
TOP 2" I.D. PVC WELL SCREEN 5' bgs
WITH 0.010" SLOTS
FILTER
BOTTOM OF SCREEN 15' bgs
BOTTOM OF BORING 15' bgs

REMARKS

1. Great Works Test Boring set well at 15' bgs when auger chattering on possible weathered bedrock.

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION Greenland/Hampton, New Hampshire

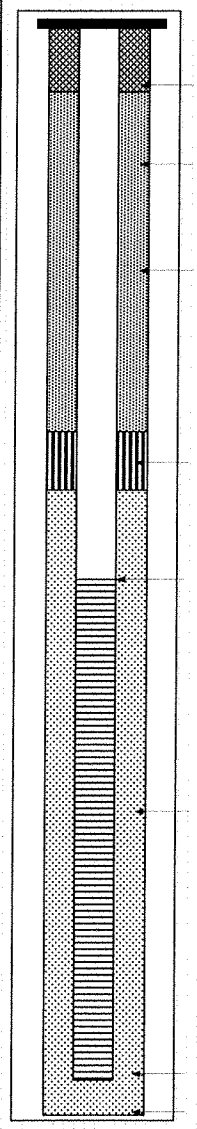
BORING NO. AE-4B
SHEET Page 1 of 3
FILE NO. 97070 E

		DATE	TIME	DEPTH (ft. bgs)	CASING	STAB T.
BORING CO.:	Great Works Test Boring					
FOREMAN:	Peter M.					
ARIES REP.:	A. Piekarski					
DATE:	9/16/2003					
GROUND SURFACE ELEVATION (ft MSL):						

	CASING	SAMPLER
TYPE	Roller Bit	None
SIZE O.D.	2"	
HAMMER WT.		

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
						No Sampling - See AE-4A for subsurface conditions.		
6								wet
14							Weathered Bedrock	
16						Fractured weathered bedrock, wet, grey.		

EQUIPMENT INSTALLED
(DRAWING NOT-TO-SCALE)



ELEVATION PROTECTIVE CASING 0.0'
1.0 ft. CONCRETE SEAL
2" PVC RISER
GROUT TO GROUND SURFACE
18' bgs top BENTONITE SEAL 32' bgs bottom
TOP 2" I.D. PVC WELL SCREEN 34' bgs WITH 0.010" SLOTS
FILTER
BOTTOM OF SCREEN 44' bgs
BOTTOM OF BORING 44' bgs

REMARKS

1. Great Works Test Boring used drive & wash techniques to 15' bgs. No sampling between 0-15' bgs. when auger chattering on possible weathered bedrock.

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION Greenland/Hampton, New Hampshire

BORING NO. AE-4B
SHEET Page 2 of 3
FILE NO. 97070 E

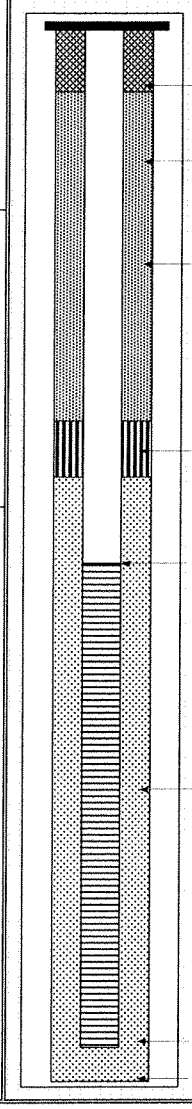
BORING CO.:	Great Works Test Boring
FOREMAN:	Peter M.
ARIES REP.:	A. Piekarski
DATE:	9/16/2003
GROUND SURFACE ELEVATION (ft MSL):	

DATE	TIME	DEPTH (ft. bgs)	CASING	STAB T.

	CASING	SAMPLER
TYPE	Roller Bit	None
SIZE O.D.		
HAMMER WT.		

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
22						No Sampling - Drive & Wash Drilling Through Bedrock		
24								
26							Bedrock	
28								
30								
32								
34								
36								
38								
40								

EQUIPMENT INSTALLED
(DRAWING NOT-TO-SCALE)



ELEVATION PROTECTIVE CASING 0.0'
1.0 ft. CONCRETE SEAL
2" PVC RISER
GROUT TO GROUND SURFACE
18' bgs
BENTONITE SEAL top
32' bgs bottom
TOP 2" I.D. PVC WELL SCREEN WITH 0.010" SLOTS
34' bgs
FILTER
BOTTOM OF SCREEN
44' bgs
BOTTOM OF BORING
44' bgs

REMARKS

1. Great Works Test Boring used roller bit drilling with drive and wash drilling techniques to set bedrock well at 44-feet bgs.

ARIES ENGINEERING, INC.
environmental engineers & hydrogeologists

PROJECT: Coakley Landfill
LOCATION Greenland/Hampton, New Hampshire

BORING NO. AE-4B
SHEET Page 3 of 3
FILE NO. 97070 E

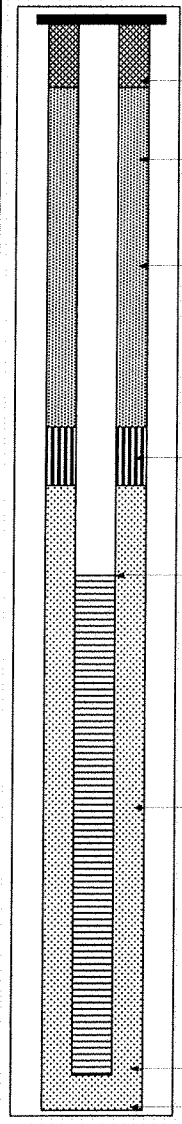
		DATE	TIME	DEPTH (ft. bgs)	CASING	STAB T.
BORING CO.:	Great Works Test Boring					
FOREMAN:	Peter M.					
ARIES REP.:	A. Piekarski					
DATE:	9/16/2003					
GROUND SURFACE ELEVATION (ft MSL):						

	CASING	SAMPLER
TYPE	Roller Bit	None
SIZE O.D.		
HAMMER WT.		

DEPTH FEET	SAMPLE NO.	S.P.T 6"	SAMPLE INTERVAL FEET	ADV./ RECOV INCHES	INSTRU READ PPM	SAMPLE DESCRIPTION	STRATA CHANGE	NOTES
42						No Sampling - Drive & Wash Drilling Through Bedrock	Bedrock	
44						End of boring at 44-feet bgs.		
46								wet
48								
50								
52								
54								
56								
58								
60								

EQUIPMENT INSTALLED

(DRAWING NOT-TO-SCALE)



REMARKS

1. Great Works Test Boring used roller bit drilling with drive and wash drilling techniques to set bedrock well at 44-feet bgs.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-2A

PROJECT NO.: 4710-15

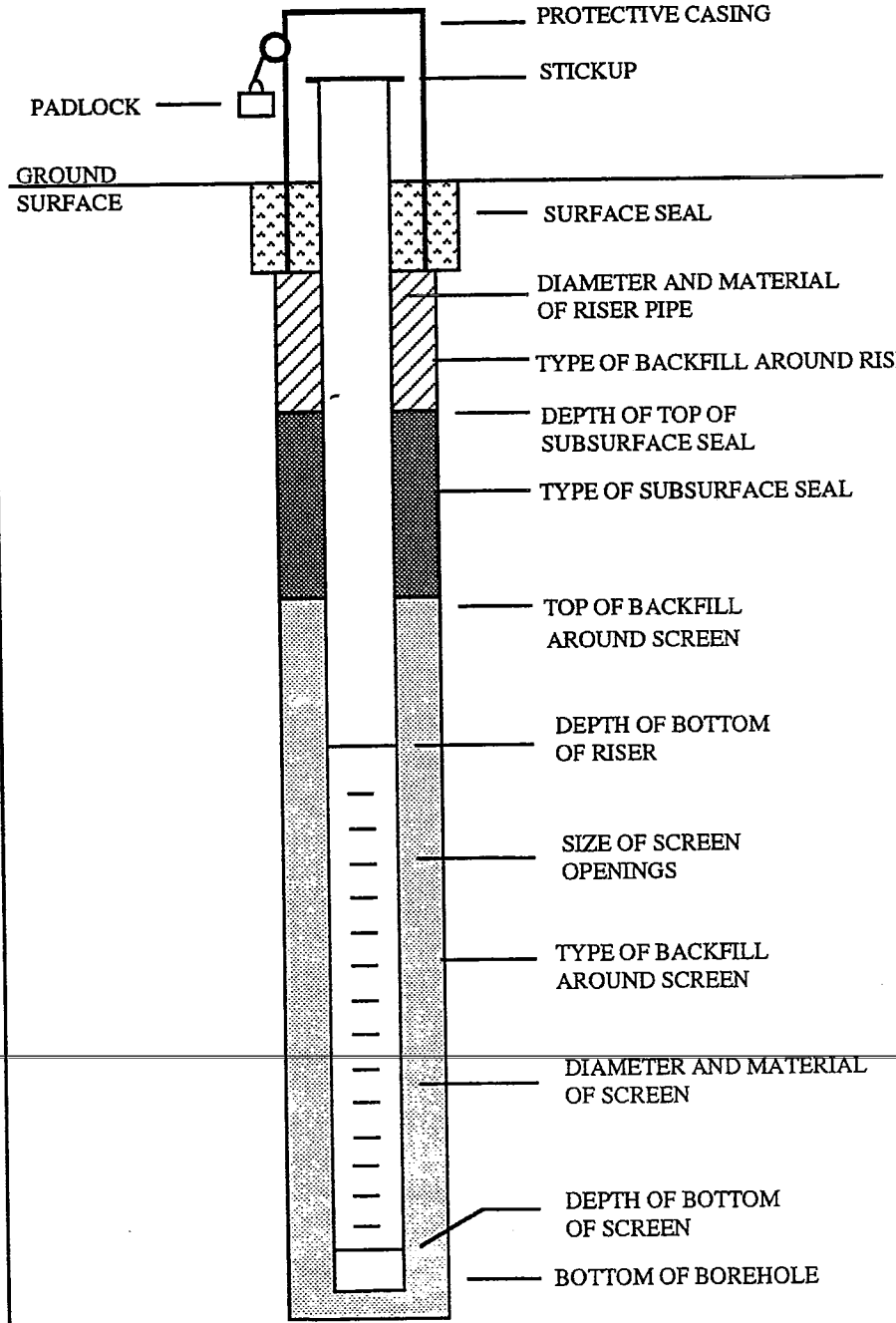
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 4-3-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



STICKUP	2.81 FT.
DIAMETER AND MATERIAL OF RISER PIPE	2 in. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	3 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	4 FT.
DEPTH OF BOTTOM OF RISER	6 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	16 FT.
BOTTOM OF BOREHOLE	16 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-2B

PROJECT NO.: 4710-15

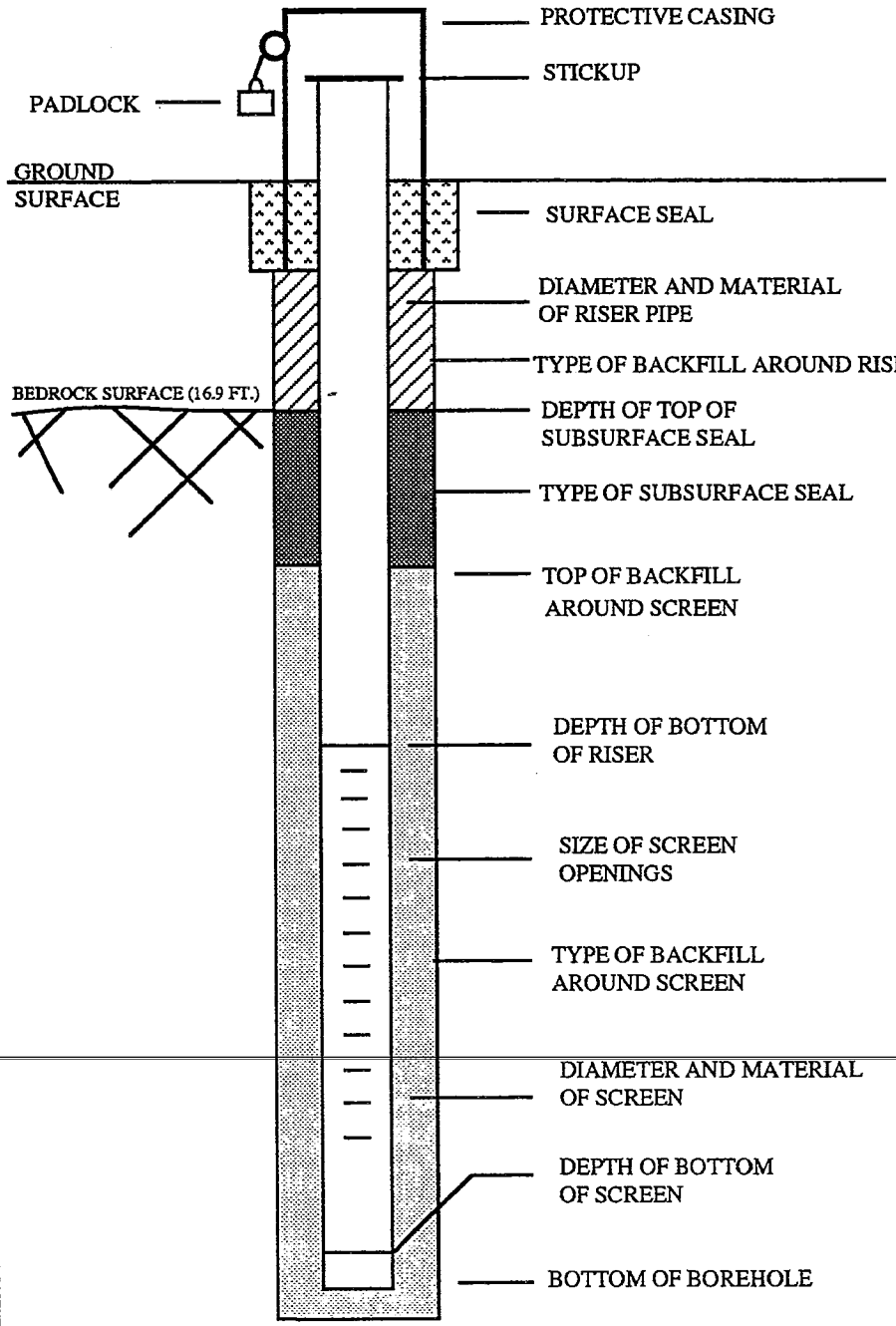
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 4-3-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.55 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	16.9 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	20 FT
DEPTH OF BOTTOM OF RISER	22.5 FT
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	37.5 FT.
BOTTOM OF BOREHOLE	37.8 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 4-3-92 Well No. FPC-2A Boring Co. Empire Top of Casing -- Screen Length 10 ft

Total Depth 16 ft Boring Method Used Hollow Stem Auger Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth +1.04

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
5						Auger to 16 ft, Construct Well		See Well Report
10								
15								

Remarks: No soil samples collected

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 4-28/5-4-92 Well No. FPC-3A Boring Co. Empire Top of Casing — Screen Length 10 ft

Total Depth 73 ft Boring Method Used Wash and Drive Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -0.47

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
55						Wash and Drive to 55 ft. (No samples collected. See FPC-3B)		See Well Report
	1	10-15-50/0.5'	55-57'	1.5/0.6				
60						55'-71' grey brown stoney glacial till; mixed sand, gravel, silt, very dense		
	2	110/0.5'	60-62'	0.5/0.4				
65								
	3	100/0.3'	65-67'	0.3/0.3				
	4	61-112/0.5'	67-69'	1/0.8				
70						71'-73' dark grey black silt, weathered rock fragments, some small pyrite crystals		
	5	75-100/0.25'	69-71'	0.75-0.5				
	6	100/0.4'	71-73'	0.4/0.4				
	7	110/0.5'	72.5-73'	0.5/0.5				

Remarks:

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-3A

PROJECT NO.: 4710-15

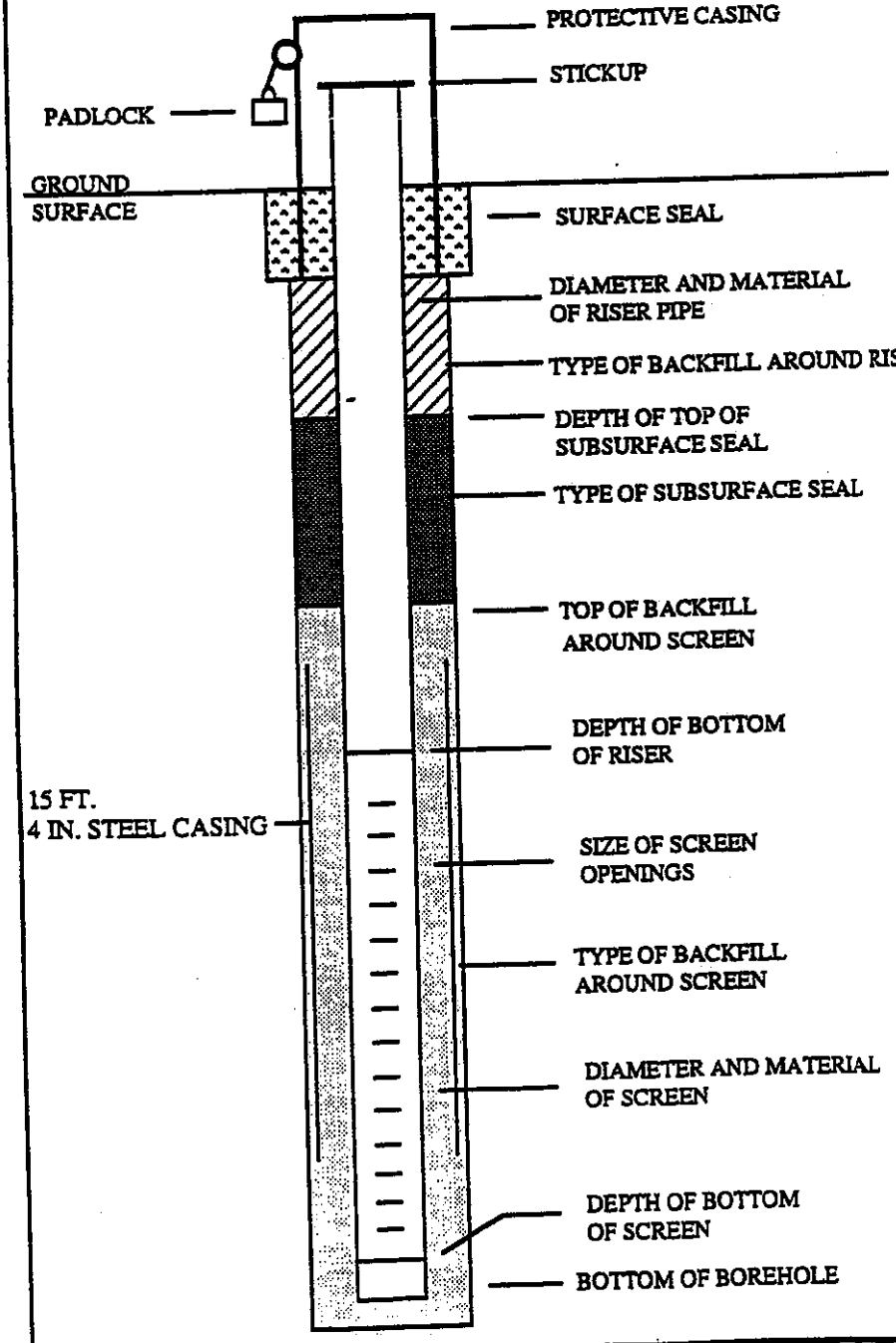
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-4-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING STICKUP	2.60 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	54 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	57 FT.
DEPTH OF BOTTOM OF RISER	62 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	72 FT.
BOTTOM OF BOREHOLE	73 FT.

AMP, DRESSER & McKEE, INC.
TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142

Soil Boring Log

Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 4-13/27-92 Well No. FPC-3B Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 95.5 ft Boring Method Used Wash and Drive/N-Core Piezometer Casing Size & Type 1.5 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -0.38

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
	1	WH-WH-1-1	0-2'	2/0.3		0'-3.5' grey to brown fine to medium sand, little silt		
	2	3-3-4-4	2-4'	2/1.3				
5								
	3	4-5-6-6	4-6'	2/1.6		3.5'-15' grey silty clay, occasional thin interlayer of fine sand		
	4	6-7-9-10	6-8'	2/1.5				
10	5	3-4-6-7	8-10'	2/1.6				
	6	6-8-9-8	10-12'	2/2				
	7	6-6-5-3	12-14'	2/1.5				
15								
	8	WH-3-9-4	14-16'	2/1		15'-20' grey brown fine to coarse sand and gravel, some silt		
	9	6-7-5-5	16-18'	2/0.8				
20	10	12-18-10-12	18-20'	2/1				
	11	7-12-15-10	20-22'	2/0.5				
	12	15-15-5-12	22-24'	2/0.4				
25								
	13	15-9-20-20	24-26'	2/0.6				
	14	33-17-7-14	26-28'	2/0.6				
30	15	18-15-17-20	28-30'	2/0.6				
	16	20-22-18-17	30-32'	2/0.7		20'-70' Grey brown stoney glacial till; mixed sand, gravel, silt, dense to very dense, occassional cobble or boulder		
	17	18-28-24-19	32-34'	2/0.4				
35								
	18	26-16-18-20	34-36'	2/0.3				
	19	24-45-100/ 0.4'	36-38'	2/1				
40	20	21-27-27-54	38-40'	2/0.8				
	21	100/0.4'	40-42'	0.4/0.3				
	22	31-23-19-22	42-44'	2/1.4				
45								
	23	21-33-33-30	44-46'	2/1.3				
	24	34-52-52-48	46-48'	2/0.8				
50	25	46-100/0.2'	48-50'	0.7/0.4				
	26	84-100/0.3'	50-52'	0.8/0.5				
55								

Remarks: WH = Weight of Hammer

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 4-13/27-92 Well No. FPC-3B Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 95.5 ft Boring Method Used Wash and Drive/N-Core Piezometer Casing Size & Type 1.5 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -0.38

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
65								See Well Report
70								
75	27	36-100/0.2'	70-72'	0.7/0.3		70'-75' dark grey weathered rock fragments		
80	28	200/0.3'	75-77'	0.3/0.2		77'-89.1' N-Core Bedrock Phyllite grey to dark grey, thin foliations dipping steeply, moderate to highly fractured, small pyrite crystals along fracture planes Run 1, 77.0'-80.4', Rec. 2.3', RQD 4"/40" Run 2, 80.4'-83.7', Rec. 2.0', RQD 8"/39" Run 3, 83.7'-85.1', Rec. 2.0', RQD Run 4, 85.1'-89.1', Rec. 2.5', RQD 0		
85								
90		C O R E				Roller bit from 89.1'-95'5		
95								

Remarks: Bit diamonds reportedly lost down hole; Switch to roller bit at 89.1'

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-3B

PROJECT NO.: 4710-15

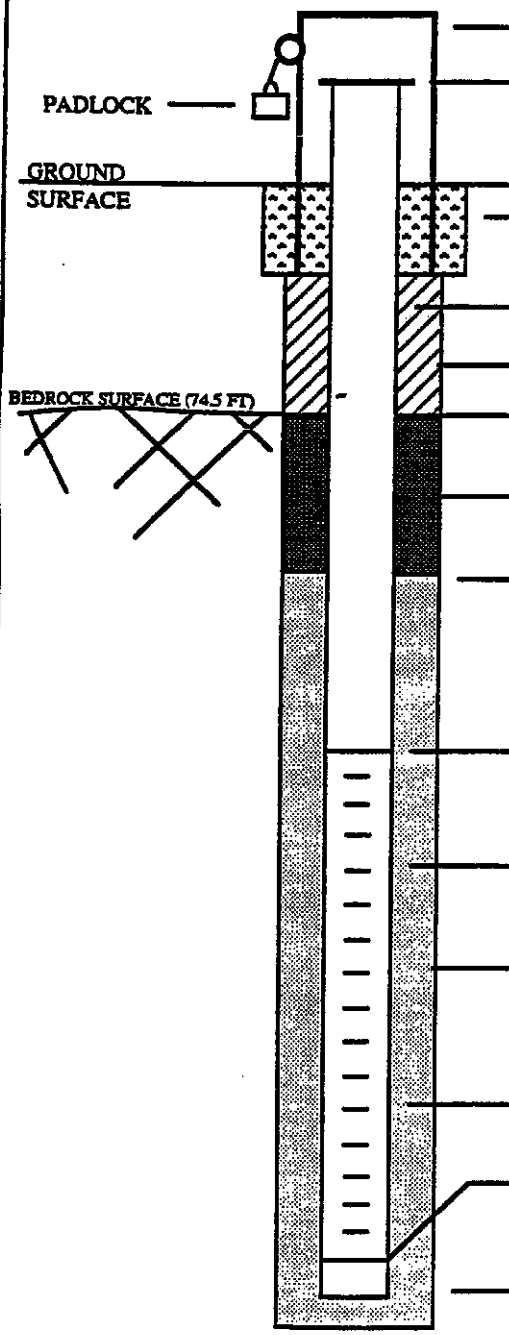
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 4-27-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	1.65 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	1.5 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	75 FT
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	78 FT
DEPTH OF BOTTOM OF RISER	80.5 FT
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	1.5 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	95.5 FT.
BOTTOM OF BOREHOLE	95.5 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-3C

PROJECT NO.: 4710-15

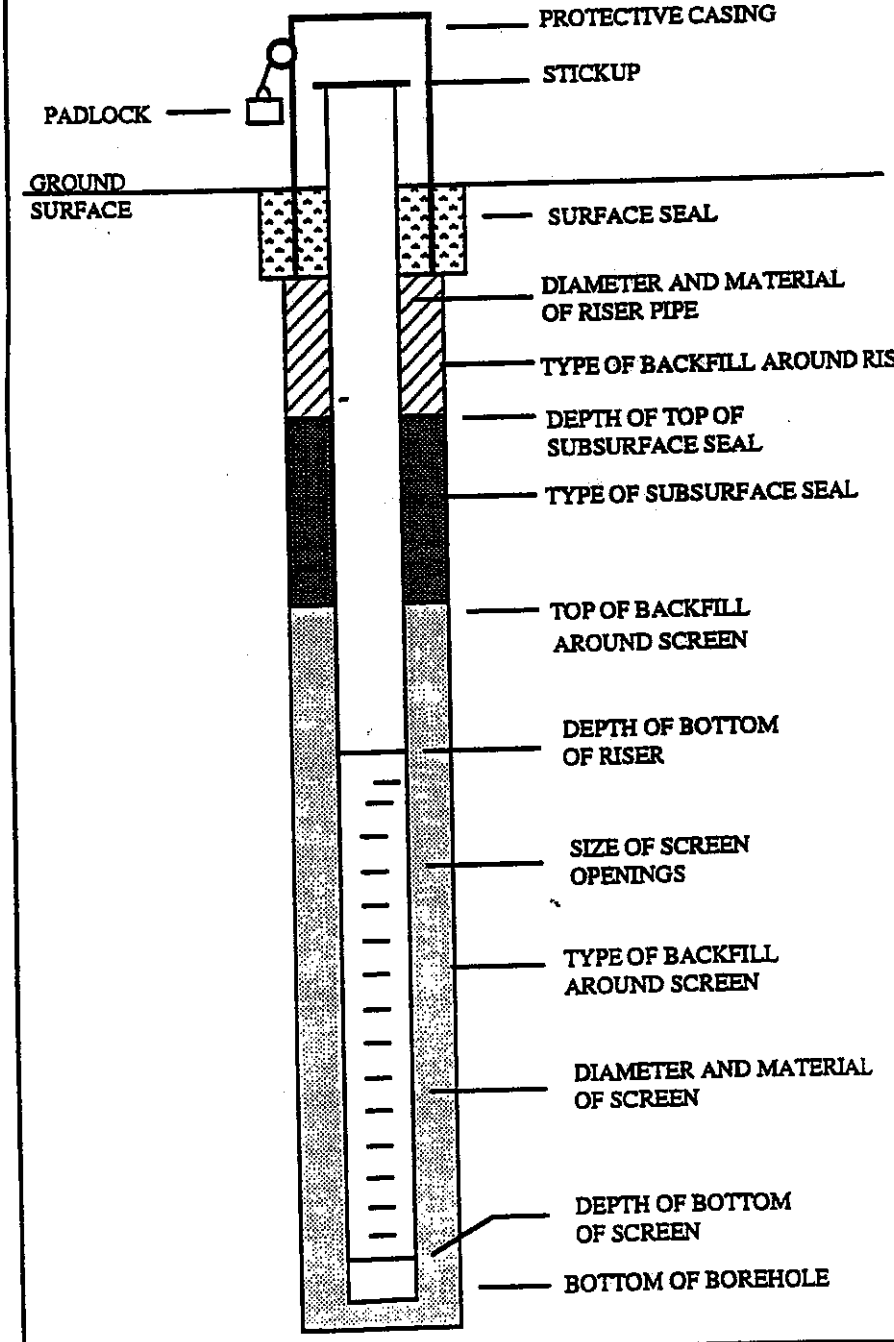
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-5-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE

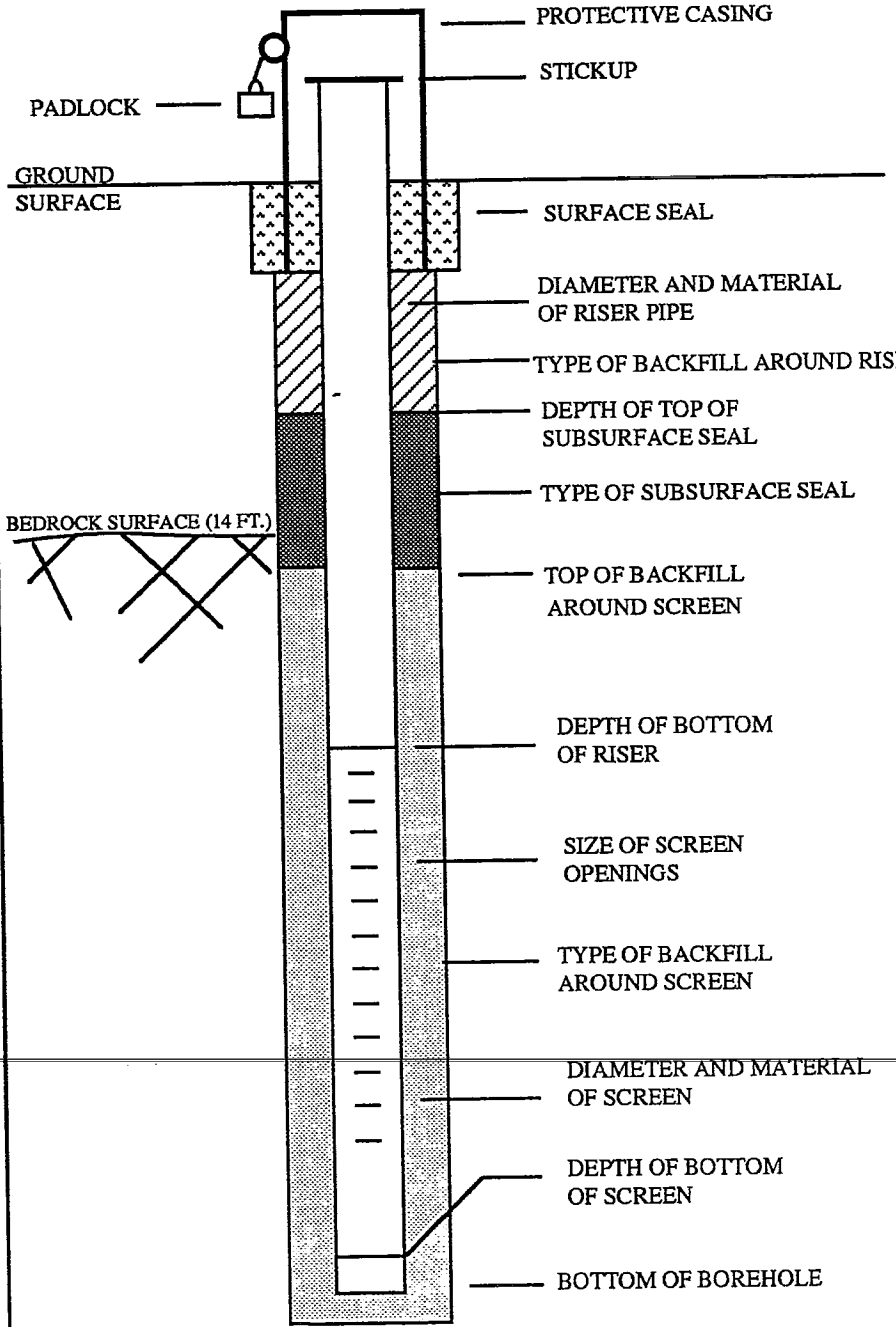


STICKUP	2.38 FT.
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	13 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	16 FT.
DEPTH OF BOTTOM OF RISER	18.5 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	28.5 FT.
BOTTOM OF BOREHOLE	28.5 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill
LOCATION: North Hampton, NH
WELL NO.: FPC-4B
PROJECT NO.: 4710-15
CONTRACTOR: Empire
DRILLER: Scott Breed
INSPECTOR: J.K.Kane
INSTALLATION DATE: 6-3-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



STICKUP	2.30 FT.
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	11 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	15 FT.
DEPTH OF BOTTOM OF RISER	18 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	33 FT.
BOTTOM OF BOREHOLE	33.5 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 6-2/3-92 Well No. FPC-4B Boring Co. Empire Top of Casing -- Screen Length 15 ft

Total Depth 33.5 ft Boring Method Used Wash and Drive/N-Core Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -2.92

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
0	1	WH-WH-1-6	0-2'	2/0.7		0'-6' Grey brown mottled silt, trace fine sand, trace clay		See Well Report
	2	7-10-11-13	2-4'	2/1.3				
5								
	3	6-9-13-20	4-6'	2/1.5		6'-12' brown fine sand, little to some fine to medium gravel, little silt		
	4	7-22-41-80	6-8'	2/1.7				
10	5	37-44-52-57	8-10'	2/1.7				
	6	50-20-20-100 /0.4'	10-12'	1.9/1.3				
15						14'-33.5' N-Core Bedrock Phyllite-grey, thin foliations dipping steeply, well fractured		
						Run 1, 14'-19', Rec. 5.0', RQD 16"/60"		
20						Run 2, 19'-20', Rec. 1.0', RQD 0 Run 3, 20-23.3', Rec. 3.3', RQD 4"/39"		
		C O R E				Run 4, 23.3'-27.5', Rec. 4.2', RQD 4"/50"		
25						Run 5, 27.5'-29.9', Rec. 2.2', RQD 0 Run 6, 29.9'-32.2', Rec. 2.3', RQD 0 Run 7, 32.2'-33.5', Rec. 1.7', RQD 4"/16"		
30								

Remarks: WH = Weight of Hammer

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-5A

PROJECT NO.: 4710-15

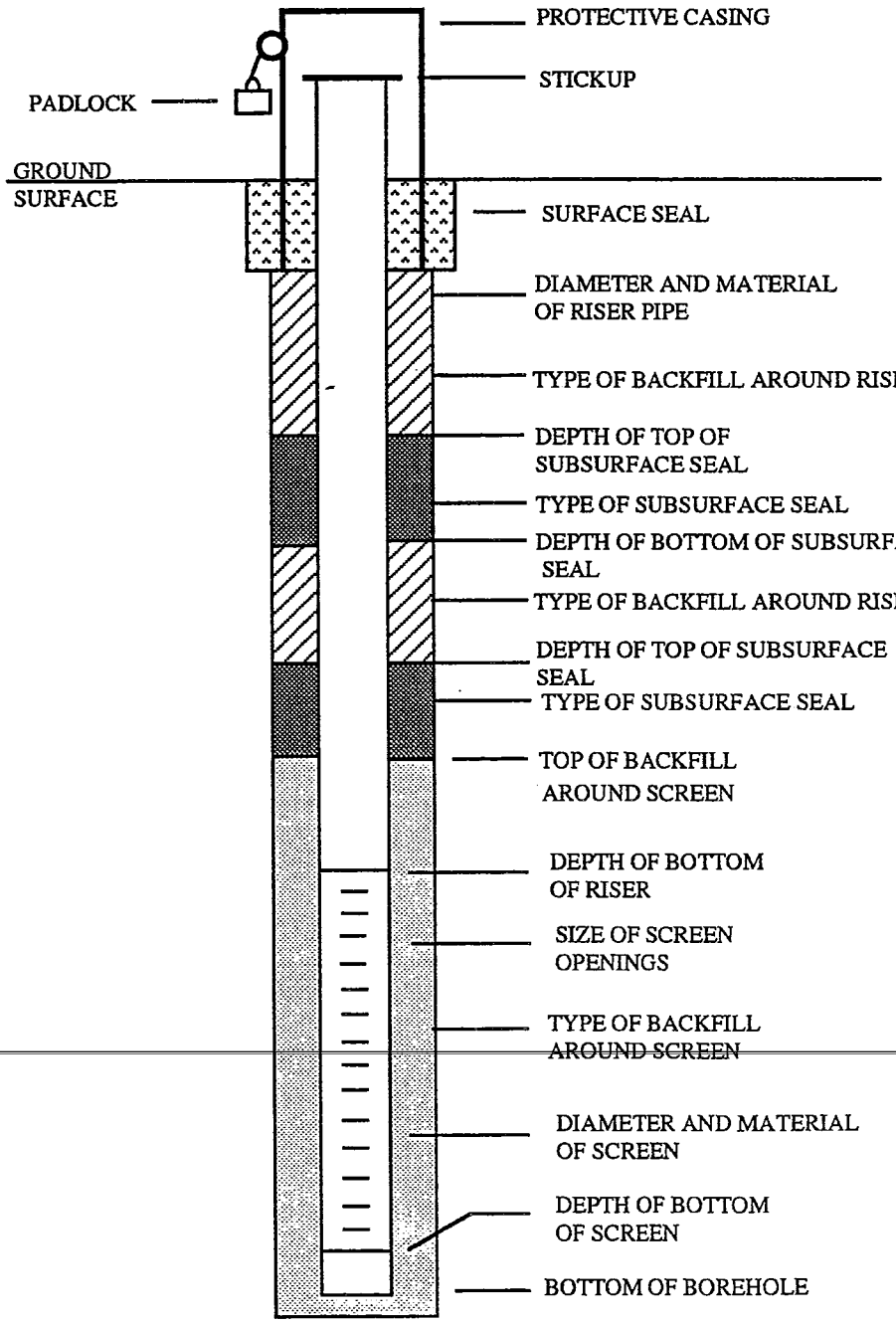
CONTRACTOR: Empire

DRILLER: Mike Lenigan

INSPECTOR: J.K.Kane

INSTALLATION DATE: 3-17-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.78 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	40 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
DEPTH OF BOTTOM OF SUBSURFACE SEAL	43 FT.
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	49 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	52 FT.
DEPTH OF BOTTOM OF RISER	54 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	64 FT.
BOTTOM OF BOREHOLE	70 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-5B

PROJECT NO.: 4710-15

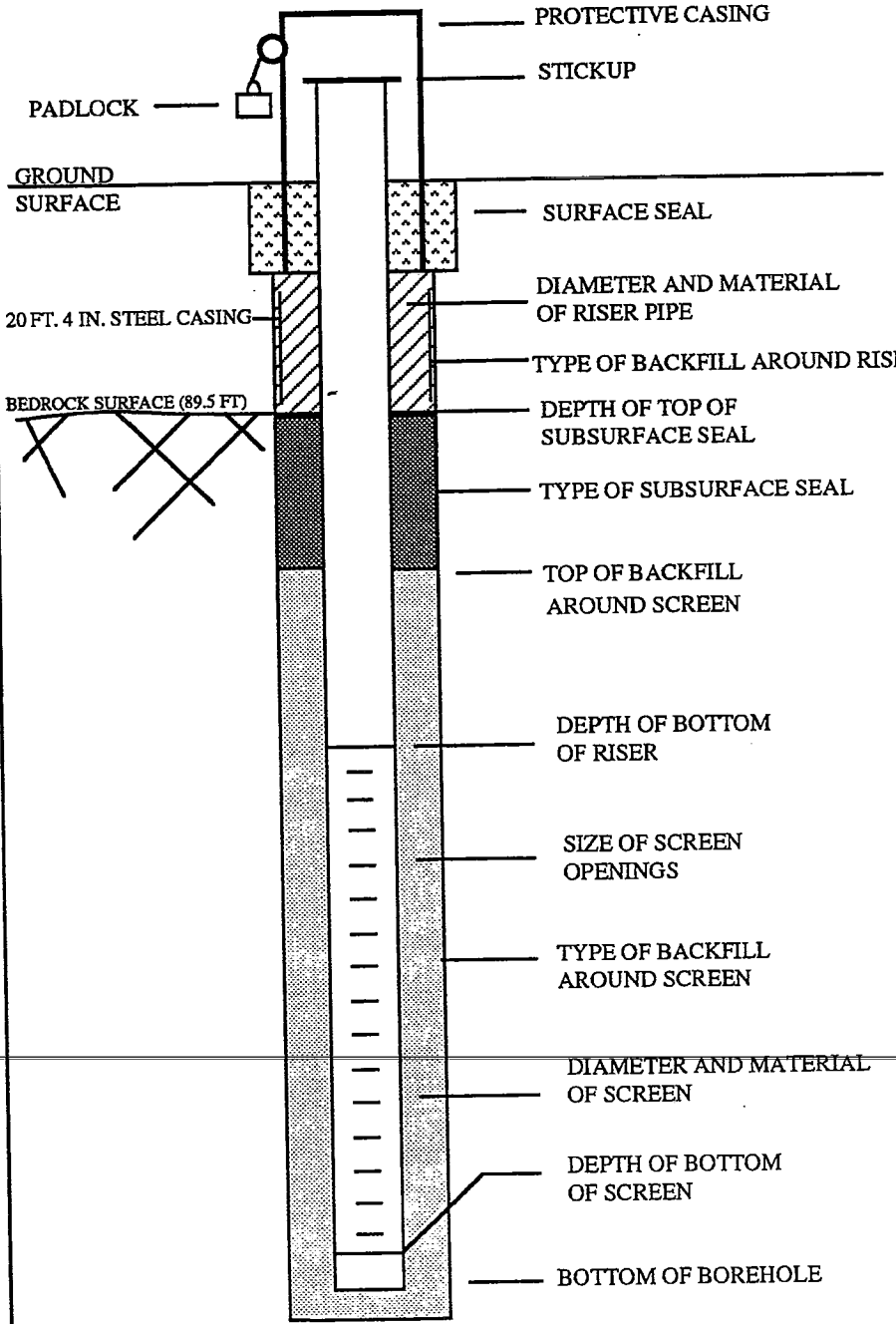
CONTRACTOR: Empire

DRILLER: Scott Breed

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-14-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING STICKUP	2.86 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	90 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	93 FT.
DEPTH OF BOTTOM OF RISER	95 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	110 FT.
BOTTOM OF BOREHOLE	110.3 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 3-3/17-92 Well No. FPC-5A Boring Co. Empire Top of Casing — Screen Length 10 ft

Total Depth 70 ft Boring Method Used Wash and Drive Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth +2.21 flows periodically

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
	1	1-WH-WH-3	0-2'	2/0.5		3" topsoil over grey fine sand, little silt grey to brown fine to medium sand, little silt, trace clay, slightly cohesive		See Well Report
5	2	2-2-3-3	2-4'	2/1.1				
	3	6-6-6-7	4-6'	2/1.5				
	4	12-12-12-15	6-8'	2/1.6				
10	5	8-8-9-14	8-10'	2/1.4				
	6	8-7-5-5	10-12'	2/2				
	7	6-8-8-9	12-14'	2/2		4'-22' grey silty clay		
15								
	8	5-6-6-5	14-16'	2/1.7				
	9	4-5-5-6	16-18'	2/2				
20	10	5-4-5-5	18-20'	2/2				
	11	5-5-6-5	20-22'	2/1.8				
	12	WH-WH-WH-1	22-24'	2/2				
25								
	13	WH-WH-WH-WH	24-26'	2/2				
	14	WR-WR-WR-WH	26-28'	2/2				
30	15	WH-WH-WH-WH	28-30'	2/2				
	16	WR-WR-WR-3	30-32'	2/2				
	17	1-WH-WH-WH	32-34'	2/2		22'-47' grey clay, soft		
35								
	18	WR-WR-WR-WR	34-36'	2/1.7				
	19	WR-WR-WR-WR	36-38'	2/2				
40	20	WH-1-WH-WH	38-40'	2/2				
	21	WH-WH-1-1	40-42'	2/2				
	22	WR-WR-WR-2	42-44'	2/2				
45								
	23	WR-WR-WH-WH	44-46'	2/2				
	24	1-56-62-16	46-48'	2/2				
50	25	31-20-19-16	48-50'	2/1.1				
	26	23-23-21-19	50-52'	2/1.5		47'-70' grey stoney glacial till, dense to very dense, some cobbles, occasional boulders		
	27	14-14-12-10	52-54'	2/0.8				
55								
	28	20-29-25-39	54-56'	2/1.5				
	29	25-56-52-41	56-58	2/2		58.5' boulder, cored		

Remarks: WH = Weight of Hammer; WR = Weight of Rods

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 4-23/27-92 Well No. FPC-5B(Abort) Boring Co. Empire Top of Casing — Screen Length — ft

Total Depth 80 ft Boring Method Used Wash and Drive Piezometer Casing Size & Type Abandoned

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth —

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
–	35	170-160-200/ 0.4'	70-72'	1.4/0.7		Auger to 70 ft. (No samples collected. See FPC-5A).		None
–	36	200/0.2'	72-74'	0.2/0.2				
75						70'-80' grey stoney glacial fill, mixed sand, gravel, silt, dense to very dense		
–	37	146-122-93-98	74-76'	2/1.5				
–	38	143-200/0.5'	76-78'	1/0.8				
80	39	153-147-200/ 0.2'	78-80'	1.2/1.2				

Remarks: Refusal of 4in. casing at 75 ft.
Abandon borehole and grout to surface

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-6A

PROJECT NO.: 4710-15

CONTRACTOR: Empire

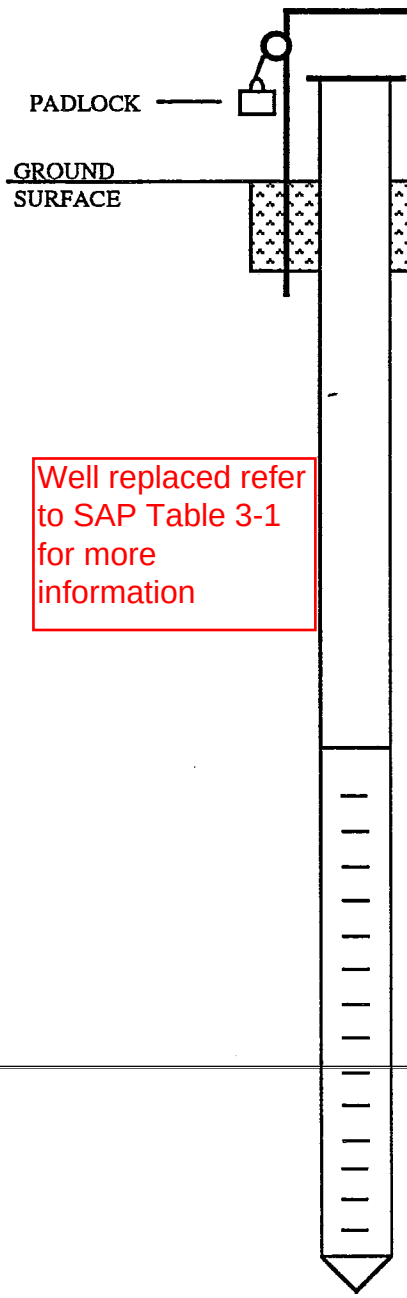
DRILLER: Well Point Installed by J.K. Kane

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-19-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE

NOTE: Well Point installed due to shallow overburden depth.



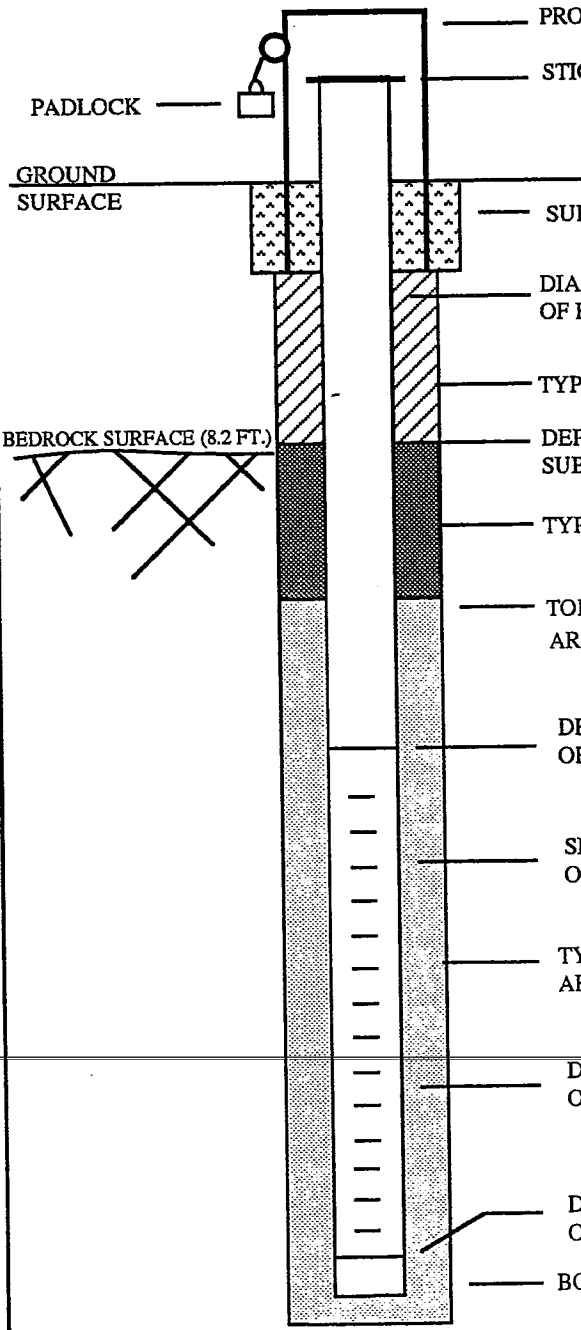
PROTECTIVE CASING	
STICKUP	3.28 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	
TYPE OF BACKFILL AROUND RISER	
DEPTH OF TOP OF SUBSURFACE SEAL	
TYPE OF SUBSURFACE SEAL	
TOP OF BACKFILL AROUND SCREEN	
DEPTH OF BOTTOM OF RISER	1.75 FT.
SIZE OF SCREEN OPENINGS	
TYPE OF BACKFILL AROUND SCREEN	
DIAMETER AND MATERIAL OF SCREEN	
DEPTH OF BOTTOM OF SCREEN	2.75 FT.
BOTTOM OF BOREHOLE	

Well replaced refer to SAP Table 3-1 for more information

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill
LOCATION: North Hampton, NH
WELL NO.: FPC-6B
PROJECT NO.: 4710-15
CONTRACTOR: Empire
DRILLER: Scott Breed
INSPECTOR: J.K.Kane
INSTALLATION DATE: 3-24-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING / STICKUP	2.75 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	8.2 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	10.5 FT.
DEPTH OF BOTTOM OF RISER	13 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	28.0 FT.
BOTTOM OF BOREHOLE	28.5 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 3-20/24-92 Well No. FPC-6B Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 28.5 ft Boring Method Used Wash and Drive/H-Core Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -2.10

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
				(ft)				
	1	1-4-5-6	0-2'	2/0.3		0'-6' brown fine to coarse sand and gravel, cobbles, little silt		See Well Report
	2	14-28-20-22	2-4'	2/1.8				
5								
	3	18-16-22-21	4-6'	2/1.3		6'-8' weathered bedrock fine gravel, rock fragments		
	4	50/0.2'	6-8'	0.2/0.2				
10	5	50/0.1'	8-10'	0.1/0.1				
						8.5'-28.5' H-Core Bedrock Phyllite-grey, moderately weathered, thin, steep dipping foliations, moderately fractured, quartz along foliations and fractures, little muscovite, little pyrite, quartz veinS at 16.5 ft and 21 ft.		
15								
		C O R E				Run 1, 8.5'-13.5', Rec. 5.0', RQD 9"/60"		
20						Run 2, 13.5'-18.5', Rec. 5.0', RQD 24"/60"		
						Run 3, 18.5'-23.3'. Rec. 4.8', RQD 19"/58"		
						Run 4, 23.3'-26.4', Rec. 3.1', RQD 6"/37"		
25						Run 5, 26.4'-28.5', Rec. 2.0', RQD 11"/25"		

Remarks:

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-7A

PROJECT NO.: 4710-15

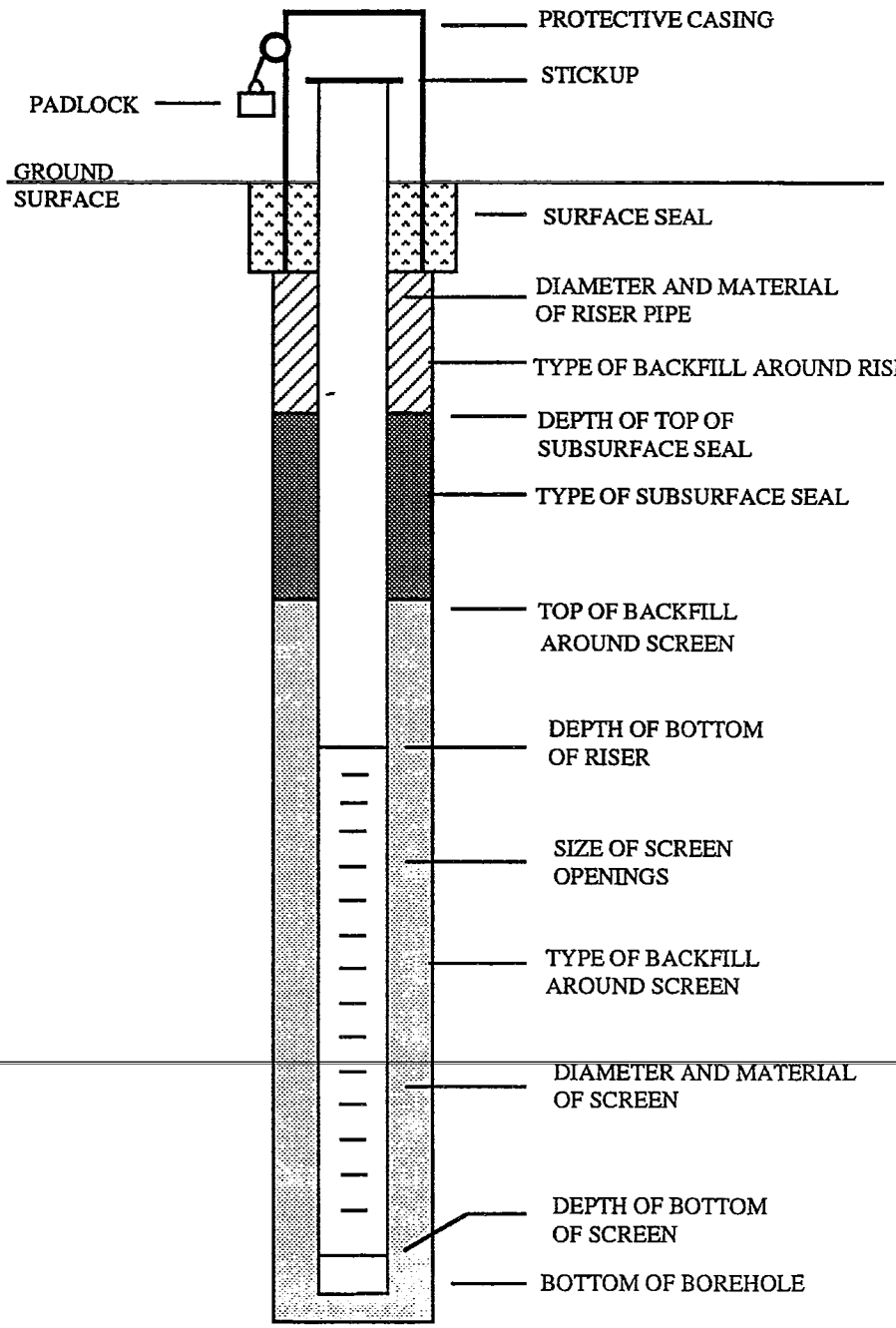
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-11-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.30 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	12 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	14 FT.
DEPTH OF BOTTOM OF RISER	16.7 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	21.7 FT.
BOTTOM OF BOREHOLE	22 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-7B

PROJECT NO.: 4710-15

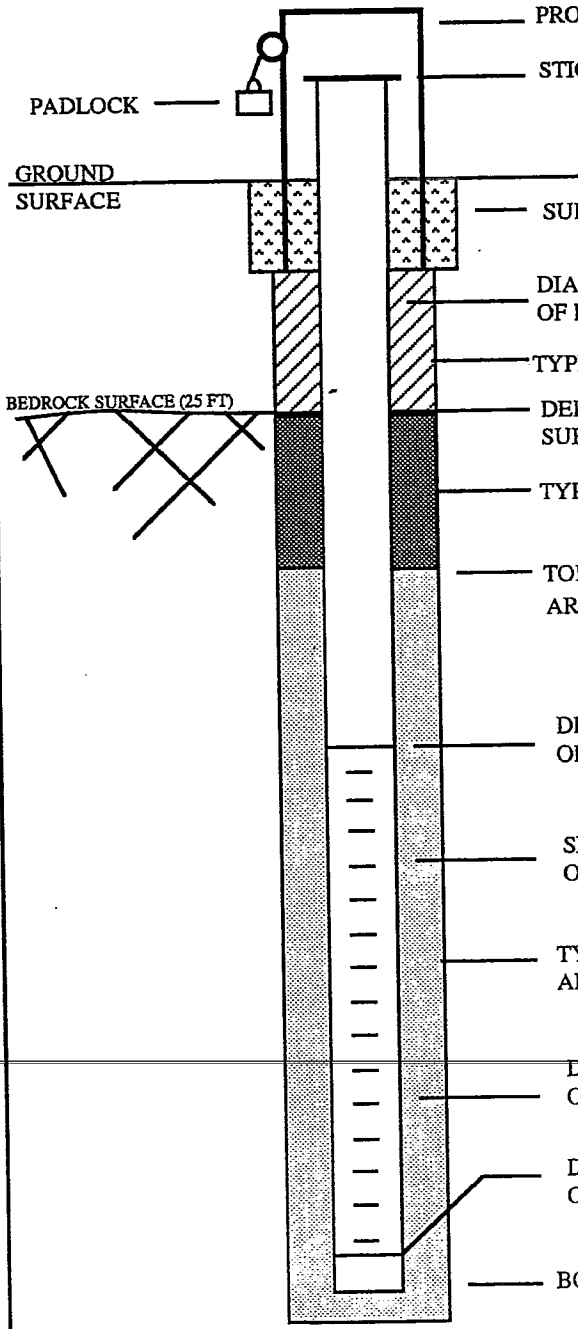
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-8-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.49 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	25 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	28 FT.
DEPTH OF BOTTOM OF RISER	29.8 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	44.8 FT.
BOTTOM OF BOREHOLE	45 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 5-6/8-92 Well No. FPC-7B Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 45 ft Boring Method Used Wash and Drive/H-Core Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -0.10

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
				(ft)				
	1	WH-1-4-4	0-2'	2/1.4		0'-4' grey brown fine sand		See Well Report
	2	4-4-4-4	2-4'	2/1.5				
5								
	3	1-2-4-5	4-6'	2/1.8				
	4	5-6-7-7	6-8'	2/2				
10	5	3-6-5-5	8-10'	2/0.3		4'-16' grey brown clayey silt to silty clay, trace fine sand		
	6	3-3-5-4	10-12'	2/2				
	7	4-6-5-5	12-14'	2/2				
15								
	8	3-2-2-3	14-16'	2/2		16-18' brown silty clay, trace fine sand, interlayered with brown fine sand		
	9	5-5-6-11	16-18'	2/2				
20	10	5-8-11-9	18-20'	2/1		18'-22' dark grey sand and fine gravel, some rock fragments		
	11	5-15-15-18	20-22'	2/1.4				
	12	20-68-100/ 0.2'	22-24'	1.2/1.2		22'-24' grey brown medium to coarse sand over grey weathered rock fragments		
25								
30						25'-45' H-Core Bedrock Phyllite-dark grey, moderately fractured, vague steep dipping foliations, some iron staining along fracture planes, trace pyrite		
35						Run 1, 26'-26', Rec. 0.8, RQD 0 Run 2, 26'-28.2', Rec. 2.0, RQD 5"/26"		
		C O R E				Run 3, 28.2'-29.7', Rec. 1.8', RQD 0 Run 4, 29.7'-34.2', Rec. 4.2', RQD 27"/54"		
40						RUN 5, 34.2'-35.2, REC. 1.0', RQD 4"/12"		
						Run 6, 35.2'-39.5, Rec. 3.8', RQD 13"/51"		
45						Run 7, 39.5'-40.7', Rec. 1.2', RQD 10"/14"		
						Run 8, 40.7'-45', Rec. 4.5', RQD 28"/51"		

Remarks: WH = Weight of Hammer

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-8A

PROJECT NO.: 4710-15

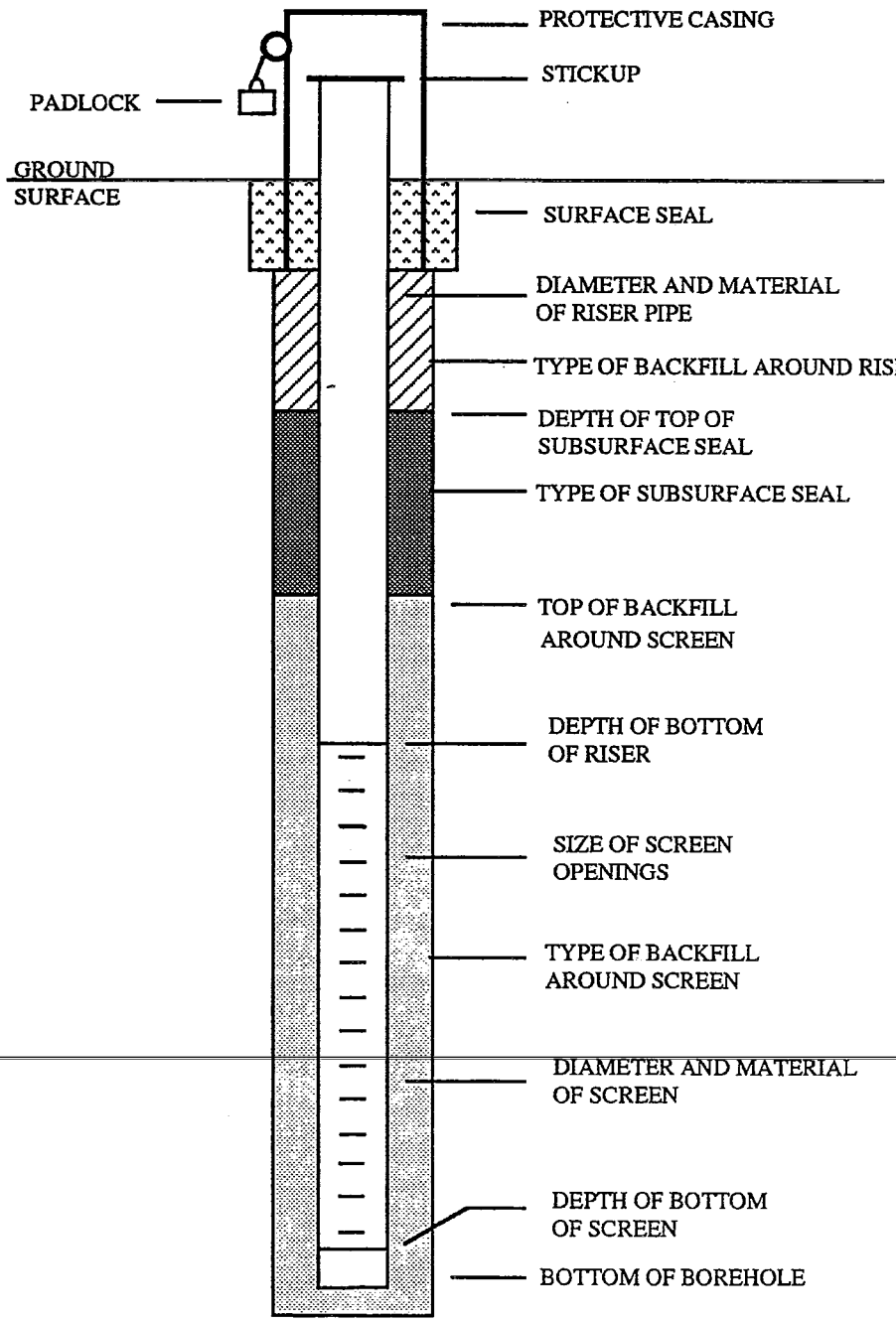
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 4-9-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.37 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	17 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	20 FT.
DEPTH OF BOTTOM OF RISER	23FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	33 FT.
BOTTOM OF BOREHOLE	33 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-8B

PROJECT NO.: 4710-15

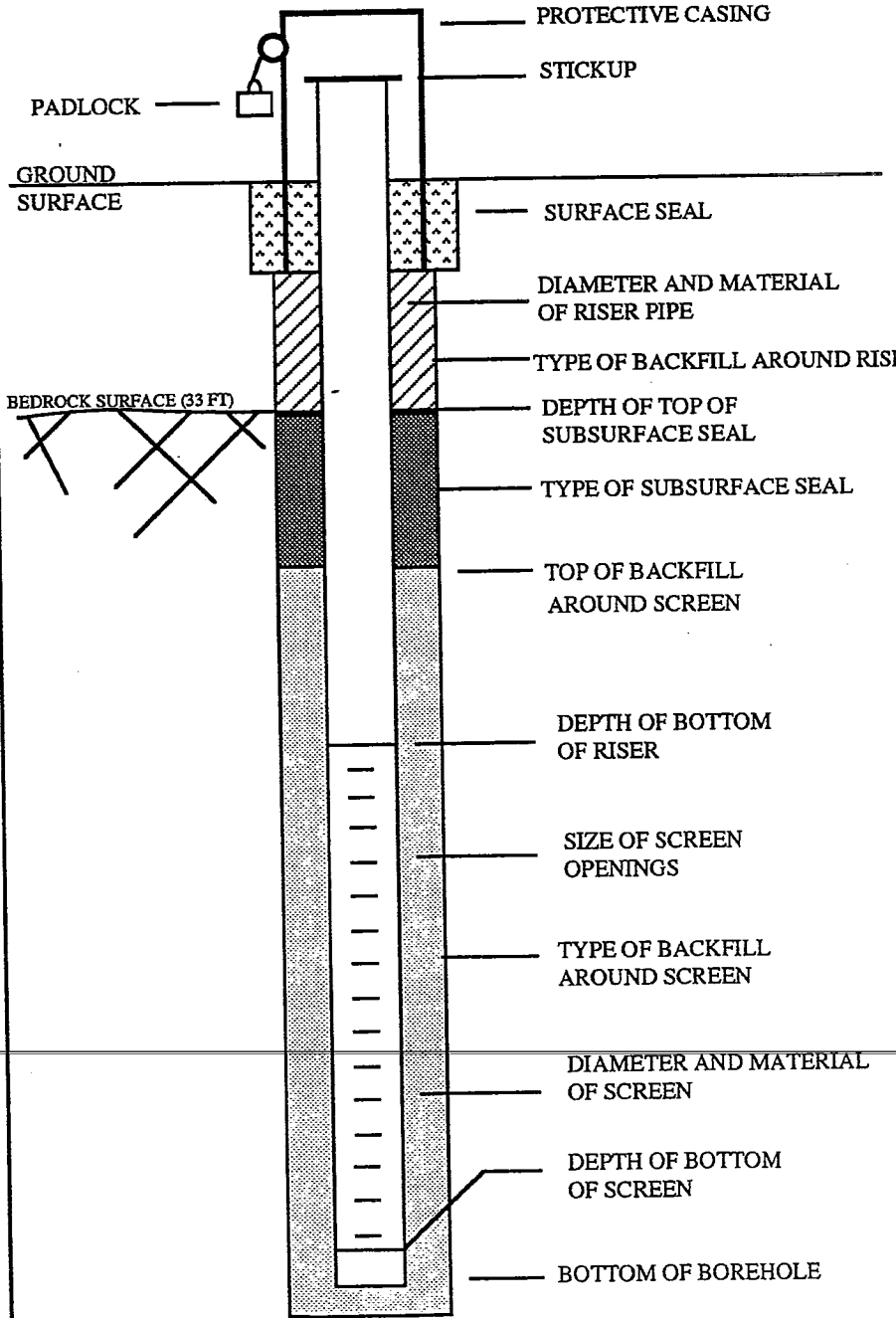
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 4-8-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.33 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	33.5 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	37 FT.
DEPTH OF BOTTOM OF RISER	40 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	55 FT.
BOTTOM OF BOREHOLE	55.7 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 4-6/9-92 Well No. FPC-8A Boring Co. Empire Top of Casing -- Screen Length 10 ft

Total Depth 33.9 ft Boring Method Used Hollow Stem Auger Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth +0.81

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
	1	1/1.0'-4-4	0'-2'	2/0.8		0'-3' 2 in. topsoil over grey brown fine to medium sand		See Well Report
	2	4-4-6-10	2'-4'	2/1.3				
5								
	3	6-7-8-8	4'-6'	2/1.8				
	4	10-11-11-11	6'-8'	2/2				
10	5	3-4-7-8	8'-10'	2/1.9		3'-26' grey brown silty clay, occasional thin fine sand interlayer		
	6	2-3-3-3	10'-12'	2/2				
	7	5-4-3-3	12'-14'	2/2				
15								
	8	1-1-2-2	14'-16'	2/2				
	9	1-2-3-2	16'-18'	2/2				
20	10	WH-WH-2-1	18'-20'	2/2		26'-30' grey to brown medium to very coarse sand, some fine to medium gravel		
	11	WR-WH-1-1	20'-22'	2/1.8				
	12	2-2-4-5	22'-24'	2/2				
25						30'-33' grey to brown stoney glacial till; mixed sand, gravel, silt dense to very dense		
	13	WH-WH-WH-6	24'-26'	2/NR				
	14	7-5-9-16	26'-28'	2/1.8				
30	15	96-100/0.1'	28'-30'	0.6/0.6				
	16	200/0.2'	30'-32'	0.2/0.2				
	17	200/0.3'	32'-34'	0.3/0.3				
35								
	18	100/0.2'	33.7'-33.9'	0.2/0.2		dark grey weathered rock fragments		

Remarks: WH = Weight of Hammer; WR = Weight of Rods; NR= No Recovery

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-9A

PROJECT NO.: 4710-15

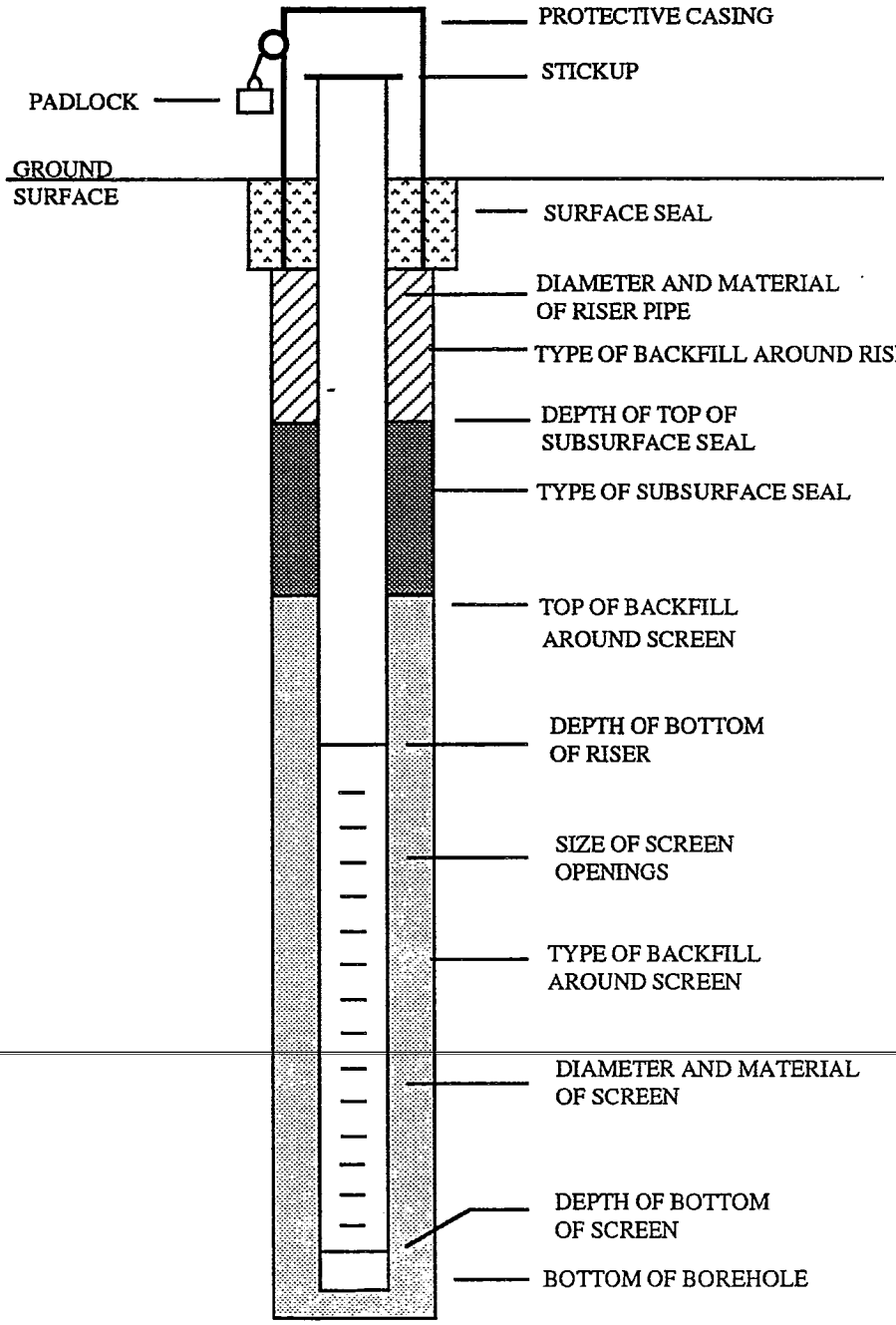
CONTRACTOR: Empire

DRILLER: Scott Breed

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-28-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE

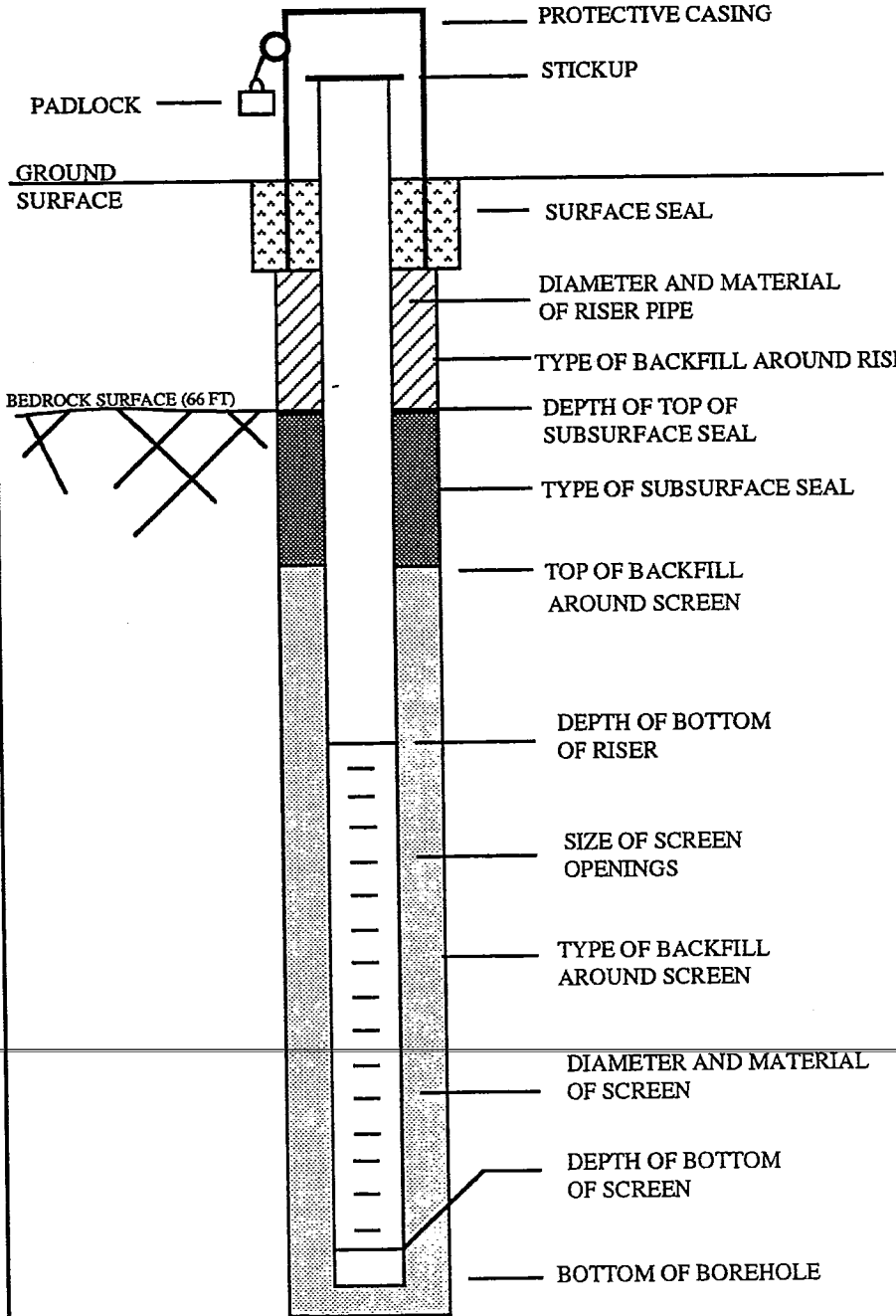


PROTECTIVE CASING	
STICKUP	2.29 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	54 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	56 FT.
DEPTH OF BOTTOM OF RISER	58 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	68 FT.
BOTTOM OF BOREHOLE	68 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill
LOCATION: North Hampton, NH
WELL NO.: FPC-9B
PROJECT NO.: 4710-15
CONTRACTOR: Empire
DRILLER: Scott Breed
INSPECTOR: J.K.Kane
INSTALLATION DATE: 5-27-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



STICKUP	2.47 FT.
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	67 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	70 FT.
DEPTH OF BOTTOM OF RISER	72 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	87 FT.
BOTTOM OF BOREHOLE	87 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-9C

PROJECT NO.: 4710-15

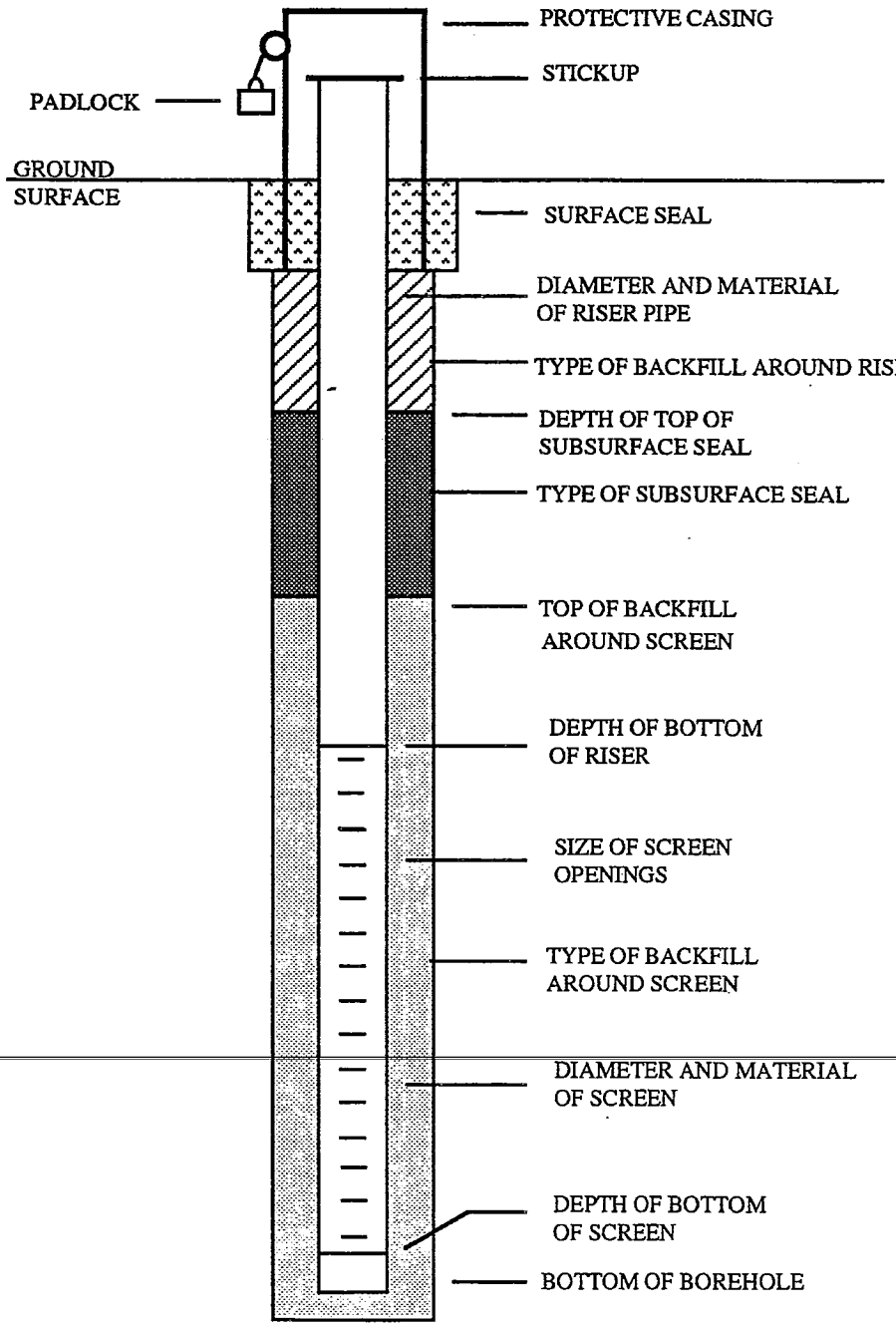
CONTRACTOR: Empire

DRILLER: Scott Breed

INSPECTOR: J.K.Kane

INSTALLATION DATE: 5-27-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



PROTECTIVE CASING	
STICKUP	2.38 FT.
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	10 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	13 FT.
DEPTH OF BOTTOM OF RISER	15 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	25 FT.
BOTTOM OF BOREHOLE	25 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 5-28-92 Well No. FPC-9A Boring Co. Empire Top of Casing — Screen Length 10 ft

Total Depth 68 ft Boring Method Used Hollow Stem Auger Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -18.86

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
10						Wash and Drive to 68 ft; Construct Well		See Well Report
20								
30								
40								
50								
60								
70								

Remarks: No soil samples collected

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 5-20/26-92 Well No. FPC-9B Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 87 ft Boring Method Used Wash and Drive/H-Core Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -18.87

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
	1	1-1-2-3	0'-2'	2/0.9				See Well Report
	2	2-3-3-5	2'-4'	2/NR				
5								
	3	14-20-18-20	4'-6'	2/1.4				
	4	100/0.3'	6'-8'	0.3/0.2		0'-25' brown medium to coarse sand, some fine to coarse subangular gravel		
10	5	10-15-16-18	8'-10'	2/1.2				
	6	10-15-18-21	10'-12'	2/1.5				
	7	23-18-17-20	12'-14'	2/1.3				
15								
	8	13-15-15-20	14'-16'	2/1.5				
	9	41-12-14-12	16'-18'	2/1.3				
20	10	17-12-12-9	18'-20'	2/1				
	11	6-7-8-9	20'-22'	2/1				
	12	9-5-5-5	22'-24'	2/0.8				
25								
	13	14-16-17-12	24'-26'	2/1.5		25'-32' grey silt, trace fine sand, cohesive		
	14	6-7-7-8	26'-28'	2/1.7				
30	15	7-5-5-5	28'-30'	2/1.8				
	16	1-2-2-4	30'-32'	2/2				
	17	4-6-6-14	32'-34'	2/1.3				
35						32'-38' grey silty fine sand		
	18	9-8-6-5	34'-36'	2/0.5				
	19	8-5-4-3	36'-38'	2/1.1				
40	20	WR-WH-3-2	38'-40'	2/2				
	21	2-3-3-3	40'-42'	2/2				
	22	WR/3.0'	42'-45'	3/2				
45						38'-56' grey silty clay		
	23	WR-WR	45'-46'	1/1				
	24	WR-WR-WR-WR	46'-48'	2/2				
50	25	WR-WR-WH-WH	48'-50'	2/NR				
	26	WR-WR-WR-WH	50'-52'	2/1.7				
	27	2-6-3-3	52'-54'	2/NR				
55								
	28	WR-WR-1/1'	54'-56'	2/1.6		56'-62' grey stoney glacial till; mixed sand, gravel, silt, dense		
	29	10-10-23-22	56'-58'	2/0.8				
	30	100/0.1'	58'-60'	0.1/NR				

Remarks: WH = Weight of Hammer; WR = Weight of Rods; NR = No Recovery

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground —

Date Drilled 5-27-92 Well No. FPC-9C Boring Co. Empire Top of Casing — Screen Length 10 ft

Total Depth 25 ft Boring Method Used Hollow Stem Auger Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -18.38

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
5								See Well Report
10						Auger to 25 ft; Construct well		
15								
20								
25								

Remarks: No soil samples collected

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-11A

PROJECT NO.: 4710-15

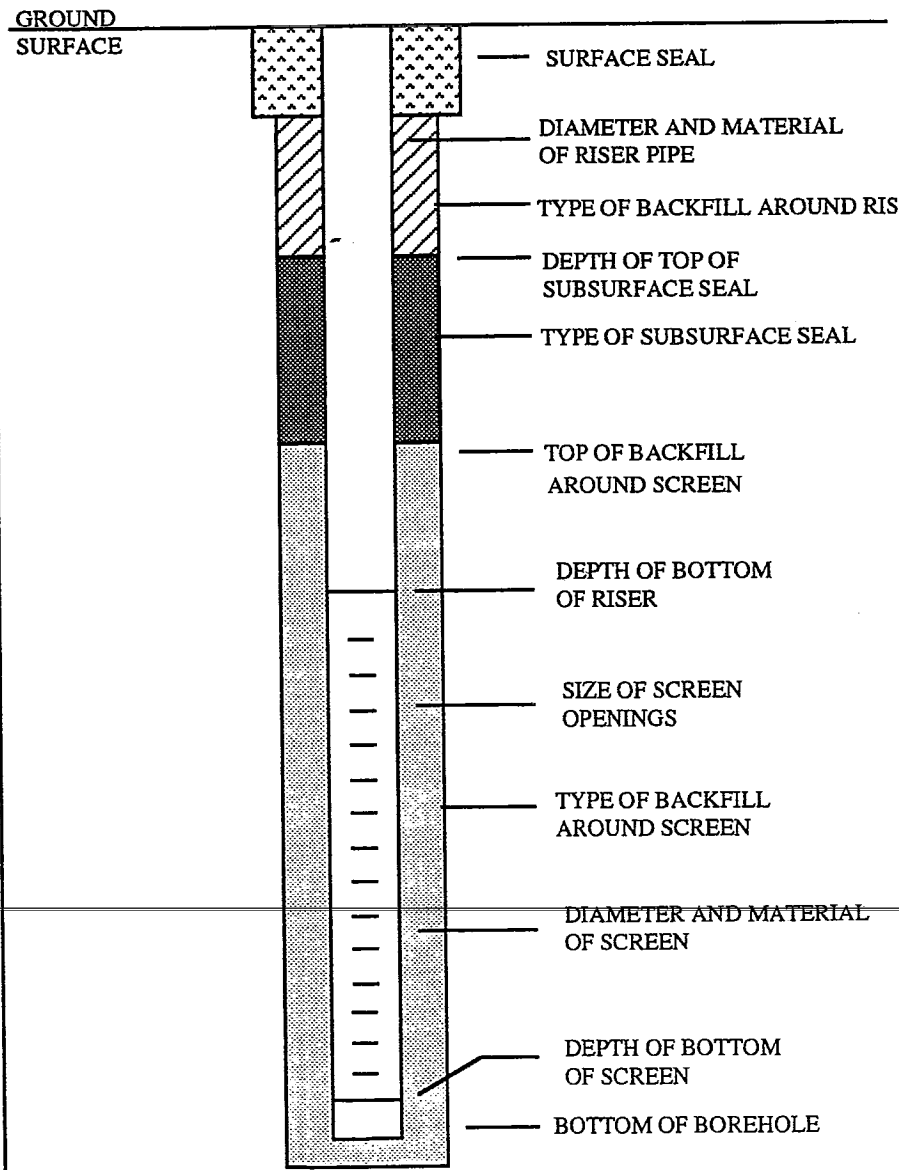
CONTRACTOR: Empire

DRILLER: John Smith

INSPECTOR: J.K.Kane

INSTALLATION DATE: 6-23-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



	-.35 FT. FLUSH MOUNT
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	41 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	44 FT.
DEPTH OF BOTTOM OF RISER	47 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	52 FT.
BOTTOM OF BOREHOLE	52 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-11B

PROJECT NO.: 4710-15

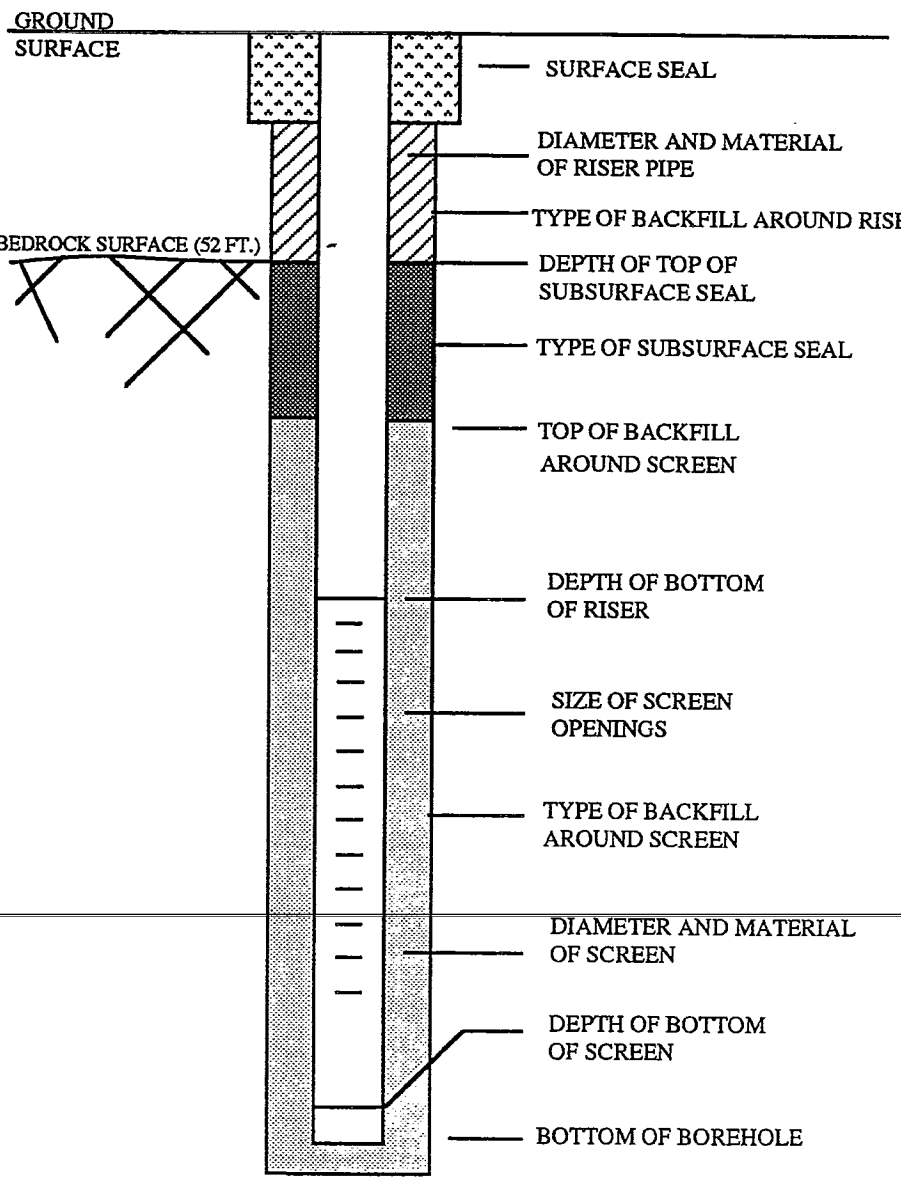
CONTRACTOR: Empire

DRILLER: Layne Pech

INSPECTOR: J.K.Kane

INSTALLATION DATE: 6-19-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE



	-.50 FT. FLUSH MOUNT
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	53 FT
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	56 FT
DEPTH OF BOTTOM OF RISER	58 FT
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - SLOTTED
DEPTH OF BOTTOM OF SCREEN	73 FT.
BOTTOM OF BOREHOLE	73 FT.

GROUNDWATER MONITORING WELL REPORT

SITE: Coakley Landfill

LOCATION: North Hampton, NH

WELL NO.: FPC-11C

PROJECT NO.: 4710-15

CONTRACTOR: Empire

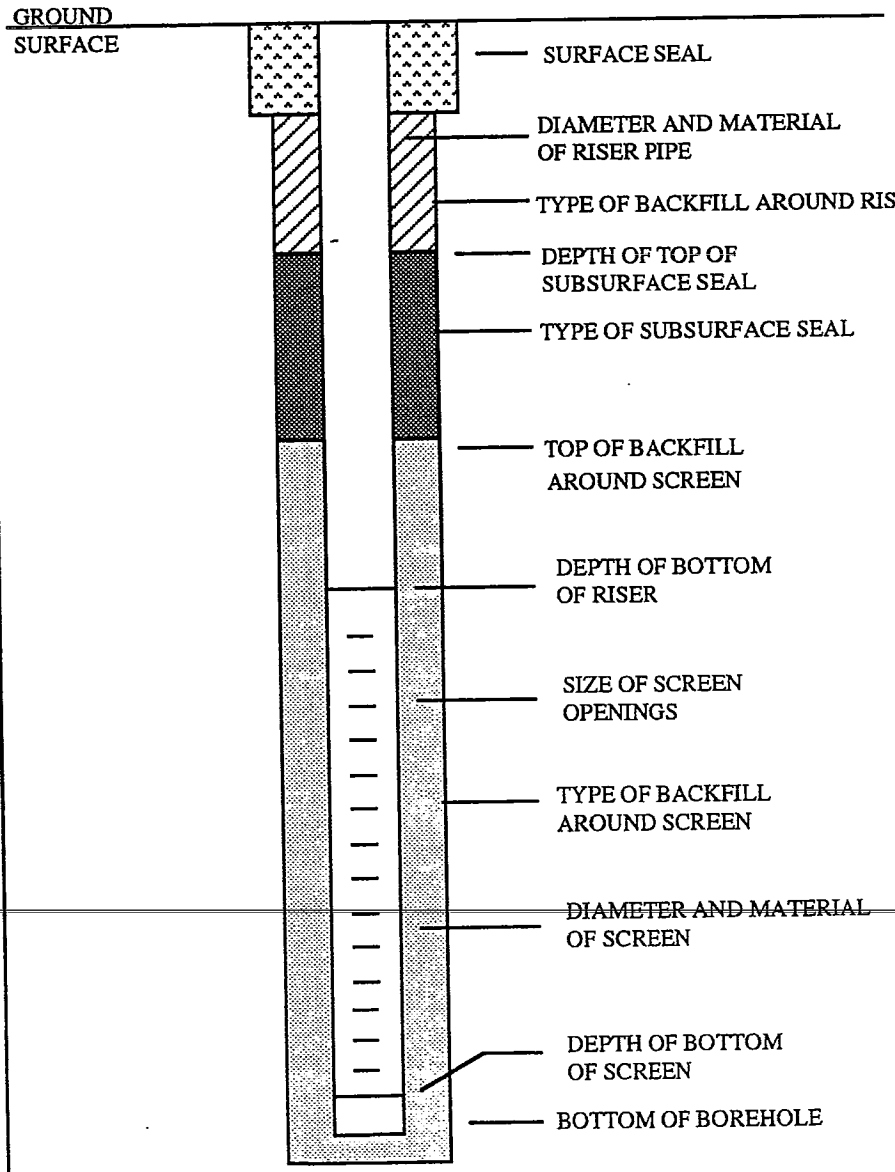
DRILLER: John Smith

INSPECTOR: J.K.Kane

INSTALLATION DATE: 6-24-92

ALL DEPTHS ARE IN FEET BELOW GROUND SURFACE

Well casing adjusted during road box repair activities. Refer to SAP Table 3-1 for more information



	- .32 FT. FLUSH MOUNT
SURFACE SEAL	
DIAMETER AND MATERIAL OF RISER PIPE	2 IN. PVC
TYPE OF BACKFILL AROUND RISER	GROUT
DEPTH OF TOP OF SUBSURFACE SEAL	13 FT.
TYPE OF SUBSURFACE SEAL	BENTONITE
TOP OF BACKFILL AROUND SCREEN	16 FT.
DEPTH OF BOTTOM OF RISER	18 FT.
SIZE OF SCREEN OPENINGS	.010 IN.
TYPE OF BACKFILL AROUND SCREEN	QUARTZ SAND
DIAMETER AND MATERIAL OF SCREEN	2 IN. PVC - WIRE WOUND
DEPTH OF BOTTOM OF SCREEN	33 FT.
BOTTOM OF BOREHOLE	33 FT.

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 6-15/19-92 Well No. FPC-11B Boring Co. Empire Top of Casing -- Screen Length 15 ft

Total Depth 73 ft Boring Method Used Wash and Drive/H-Core Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -21.20

Depth (feet)	Samp. No.	Blows per 6" 140 lbs.	Sample Interval	Adv./ Recov. (ft)	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
	1	10-8-7	0.5'-2'	1.5/0.3				See Well Report
	2	6-5-3-3	2'-4'	2/0.1				
5								
	3	14-9-14-16	4'-6'	2/0.4				
	4	21-20-24-41	6'-8'	2/2				
10	5	47-47-43-43	8'-10'	2/0.3				
	6	100/0.4'	10'-12'	0.4/NR		0'-32.5' Brown to grey brown coarse to very coarse sand and fine to medium gravel		
	7	100/0.4'	12'-14'	0.4/NR				
15								
	8	18-23-21-18	14'-16'	2/1.5				
	9	28-17-28-26	16'-18'	2/1.5				
20	10	23-21-29-30	18'-20'	2/1.3				
	11	30-33-31-26	20'-22'	2/1.2				
	12	19-15-22-22	22'-24'	2/1.5				
25								
	13	20-49-91-63	24'-26'	2/2		32.5'-38' Brown fine sand, compact, thin interlayer of grey brown silt		
	14	16-14-30-46	26'-28'	2/2				
30	15	7-16-25-55	28'-30'	2/2				
	16	9-11-14-18	30'-32'	2/0.3				
	17	20-22-17-25	32'-34'	2/1.5				
35								
	18	55-58-59-46	34'-36'	2/1.2		38'-43.75' grey silty clay, thin interlayer of grey fine sand		
	19	68-59-58-46	36'-38'	2/2				
40	20	14-12-14-12	38'-40'	2/2				
	21	21-12-14-15	40'-42'	2/2		43.75'-49' grey stoney glacial till; mixed medium to very coarse sand, fine to medium gravel, silt, dense		
	22	4-2-19-45	42'-44'	2/1.8				
45								
	23	100/0.4'	44'-46'	0.4/0.4				
	24	58-28-23-18	46'-48'	2/0.3				
50	25	14-11-20-30	48'-50'	2/1.3		49'-54' grey weathered micaceous rock fragments		
	26	44-80-80-85	50'-52'	2/1.4				
	27	100/0.2'	52'-54'	0.2/0.2				
55								

Remarks: NR = No Recovery

CAMP, DRESSER & McKEE, INC.
Soil Boring Log

TEN CAMBRIDGE CENTER, CAMBRIDGE, MA 02142
Well Installation and Completion Data

Client USEPA Site Coakley Landfill Job No. 4710-15 Surveyed Elevation: Ground --

Date Drilled 6-24-92 Well No. FPC-11C Boring Co. Empire Top of Casing — Screen Length 15 ft

Total Depth 33 ft Boring Method Used Hollow Stem Auger Piezometer Casing Size & Type 2 in. PVC

Field Geologist J.K. Kane Organic Vapor Instruments OVM Water Table Depth -21.08

Depth (feet)	Samp. No.	Blows per 6" lbs.	Sample Interval	Adv./ Recov.	Org. Vap. PPM	Sample Description	Strata. Change	Equipment Installed
5						Auger to 33.5 ft; Construct well		See Well Report
10								
15								
20								
25								
30								

Remarks: No soil samples collected

GZ-105

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Coakley Landfill, N. Hampton, NH

REPORT OF BORING NUMBER GZ-105
SHEET 1 OF 1
DATE 4/30/87 FILE 1-105

BORING CO. GZA Drilling Inc.
FOREMAN Charles Linley
GZA ENGINEER Doug Lansing

BORING LOCATION See Exploration Location Plan
GROUND ELEV. 70.9
DATE STARTED 4/30/87 DATE ENDED 5/7/87

CASING
SIZE: HW/NW Casing
HAMMER: 300 lb.
FALL: 30

SAMPLER
TYPE: 2" split spoon OTHER: NW Corebarrel
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
4/30	0	perched water	
5/1	1.0	5.0	18 hours

DEPTH	CAS. BL. /FT.	SAMPLE NO.	SAMPLE PEN./REC.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRTA CHG GEN. DESC	EQUIPMENT INSTALLED	FIELD TESTING	RMKS
	10	S-1	24/20	.5-2.5	W.O.R.-1-2-4	Very loose, dark brown SILT and fine Sand with organics.	0.5'	CONCRETE SURFACE SEAL		
	20					S-1: Loose, gray, fine SAND, little Silt.	1.5' FINE SAND	FORMATION MATERIAL		
	25						4'			
	28							4'		
5		S-2	24/4	5-7	6-6-11-15	Stiff gray, CLAY & SILT, of medium plasticity.			0.0	
	20									
	25									
	45									
10		S-3	24/2	10-12	4-12-10-10	Stiff, gray, Silty CLAY, of high plasticity.	CLAY & SILT		0.0	
								14' SCH 80 PVC RISER		
		S-4	22/20	15-16.9	5-33-41-100/5"	Stiff, gray, CLAY & SILT with Silt partings one inch apart and with fine to medium Gravel from 16.5' to 16.9'.			0.0	
15							16.5'			
								CEMENT/BENTONITE GROUT		
							VERY DENSE GRAVEL & CLAYEY SILT (TILL)			
20		S-5	20/14	20-21.7	22-30-90-100/2"	Very dense, gray-black, fine to coarse GRAVEL, some fine to coarse Sand, some Clayey SILT. (TILL)			0.0	2
25		S-6	12/8	25-26	38-100/5"	Very dense, gray-black, fine to coarse GRAVEL, some Silt & Clay.	26'		0.0	
		C-1	60/50	26-31	5 min.	C-1: Moderately hard, fresh, light to dark gray, fine grained, interbedded QUARTZITE and pelitic META-SILTSTONE; bedding plane dips 30° from horizontal, moderately fractured, fractures parallel to bedding.				
			ROD=35%		3 min.					
30					3 min.					
					4 min.					
					4 min.					
		C-2	36/34	31-34	4 min.		BEDROCK	32'		3
			ROD=40%		4 min.	C-2: Similar to above.				
					4 min.					
35		C-3	60/54	34-39	4 min.	C-3: Similar to above.		35'		
			ROD=40%		4 min.					
					3 min.					
					3 min.			FILTER SAND		
					3 min.					
40		C-4	24/24	39-41	3 min.	C-4: Similar to above.				
			ROD=35%		3 min.					4
		C-5	60/60	41-46	4 min.	C-5: Similar to above.				
			ROD=33%		5 min.			14' SCH 80 PVC WELL SCREEN		
45					6 min.					
					6 min.					
		C-6	60/58	46-51	6 min.	C-6: Similar to above, except less fractured.				
			ROD=62%		5 min.					
					5 min.					
					4 min.					
50					6 min.			50' ROCK CUTTINGS		

Bottom of boring at 51.0'.

REMARKS: 1. VOC screening of soil in jar samples was conducted using an Analytical Instruments Development, Inc. (AID) Model 580 Organic Vapor Meter; values indicate total VOC's in parts per million referenced to a butadiene in air standard. 2. Roller bit broke off drill rod while washing out 5" casing from 17 to 20 feet. Shoe had broken off in the very dense Gravel and Silt. Moved over 2 feet and advanced 3" casing to 20 feet. 3,4 Lost circulation in bedrock at 32 feet and 42 feet while coring. 5. Monitoring well with 5' x 5" ID protective steel casing with locking cap installed at completion of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE

JOB No: D-6683

AIR ROTARY WELL LOG

JOB NAME: Coakley Landfill	WELL	GZ-109	DATE: 4/8/87 TO
LOCATION: North Hampton, NH	TOTAL DEPTH:	252 feet	DRILLING CONTRACTOR: Yankee Drilling
	TOTAL CASING:	103 feet	FORMAN: Bruce Champney
	DIAM:	6-inch	
	TOTAL YIELD:	6.5 GPM	GZA REPRESENTATIVE: Mike Nardone

FT	CALIPER LOG DIAMETER, INCHES 6 7 8 9	LITHOLOGY	GPM	COMMENTS
5		0'-41' SAND and GRAVEL		Drilled through 91 feet of overburden using rotary mud techniques and 8" roller bit.
10				
15				
20				
25				
30				
35				
40		41' - 91' Silty CLAY		
45				
50				
55				
60				
65				
70				
75				Drilled with roller bit into bedrock from 91' to 103'. Set 6"-diameter casing from 0' to 103', and pressure grouted in place.
80				
85				
90		Top of bedrock at 91'.		
95				Used 6"-diameter air-hammer from 103' to 252'.
100		Casing to 103'.		
105		91' - 252' Moderately-hard to hard, interbedded Meta-sedimentary sequence of MICA-SCHIST and QUARTZITE.		
110			0.5	111'
115				
120				
125				
130				128' - 129' 1.0 min/ft drill rate
135				
140				
145				
150				153' - 154' 1.0 min/ft drill rate
155				

JOB No: D-6683 | AIR ROTARY WELL LOG | PAGE 2 OF 2

JOB NAME: Coakley Landfill
LOCATION: North Hampton, NH

WELL: GZ-109
TOTAL DEPTH: 252 feet
TOTAL CASING: 103 feet
DIAM: 6-inch
TOTAL YIELD: 6.5 GPM

DATE: 4/8/87 TO
DRILLING CONTRACTOR: Yankee Drilling
FORMAN: Bruce Champney
GZA REPRESENTATIVE: Mike Nardone

FT	CALIPER LOG DIAMETER, INCHES 6 7 8 9	LITHOLOGY	GPM	COMMENTS
160				162' OVM=0.1
165				
170				173' - 174' 1.0 min/ft drill rate
175				
180				
185				
190				191' soft rock
195				193'-194' 1.0 min/ft drill rate 195' Pyrite observed in sample
200				
205				
210				
215				216' OVM=0.0
220				
225				228'-229' 0.9 min/ft drill rate
230				
235				
240				
245				
250			6.5	OVM=0.0
255		Bottom of boring at 252'.		
260				

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Coakley Landfill RI, N. Hampton, NH

REPORT OF BORING NUMBER GZA-117
SHEET 1 OF
DATE 1/26/87 FILE 0-6607

BORING CO. GZA Drilling, Inc.
FOREMAN Arthur Johnson
GZA ENGINEER George Draper

BORING LOCATION See Subsurface Exploration Plan
GROUND ELEV. 116.1
DATE STARTED 1/26/87 DATE ENDED 2/3/87

CASING
SIZE: 3-3/4" I.D. HSA/NW Casing
HAMMER: lb.
FALL:

SAMPLER
TYPE: 24" Split Spoon OTHER: NW Corebarrel
HAMMER: 140 lb
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME
2/2	26.7	90'	2 days

DEPTH	CAS. BL. /FT.	SAMPLE NO.	PEN./REC.	DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG.	GEN. DESC.	EQUIPMENT INSTALLED	FIELD TESTING	RMKS.
						No sample: Frost.			CONCRETE SURFACE SEAL FORMATION MATERIAL		1.
5		S-1	24/14	5-7	30-43-57-56	Very dense, brown, medium SAND and coarse Gravel, trace Silt. Rock fragment in nose of spoon.		SAND AND GRAVEL	5' BENTONITE SEAL 8'	0.0	
10		S-2	24/17	10-12	22-26-24-25	Dense, brown, fine to coarse SAND, trace fine Gravel, trace Silt.	9'		FORMATION MATERIAL	0.0	
15		S-3	24/15	15-17	18-43-21-24	Very dense, brown, fine to coarse SAND, trace coarse Gravel, trace Silt.		SAND	2" SCH 80 PVC RISER	0.0	
20		S-4	24/12	20-22	13-19-25-38	Dense, brown, fine to medium SAND, trace fine Gravel, trace Silt. Wet.				0.0	
25		S-5	18/18	25-26.5	17-21-68	Dense, brown, fine to medium SAND, trace fine Gravel, trace Silt. Wet.				0.0	
							29'		26.5'		
30		S-6	24/22	30-34	10-10-32-50	Dense, brown, fine to coarse SAND, some fine to coarse Gravel, trace Silt. (Fines may have washed out of spoon).		GRAVELLY SAND	30.5' 2" SCH 80 PVC WELL SCREEN	0.0	
							34'				
35		S-7	24/8	35-37	2-13-24-48	Dense, brown, fine to medium SAND, trace fine Gravel, trace Silt.		SAND	FILTER SAND	0.0	
40		S-8A	12/10	40-41	13-16	Medium dense, brown, fine SAND, trace gray, Silty CLAY.	41'		40.5'	0.0	
		S-8B	12/12	41-42	23-40	S-8B: Very stiff, gray, Silty CLAY, trace fine Sand. Few fine Sand layers.			41.5'	0.0	
45		S-9	24/15	45-47	5-7-8-9	Stiff, gray, Silty CLAY.		SILTY CLAY	CEMENT/BENTONITE GROUT	0.0	
50											

REMARKS:
1. VOC screening of soil in jar samples was conducted using an Analytical Instruments Development, Inc. (AID) Model 580 Organic Vapor Meter; values indicate total VOC's in parts per million referenced to a butadiene standard.
2. Monitoring well with 5' x 5" I. D. protective steel casing with locking cap installed at completion of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Coakley Landfill NT, N. Hampton, NH

REPORT OF BORING NUMBER G-11
SHEET 1 OF 1
DATE 1/28/87 FILE G-2880

BORING CO. GZA Drilling, Inc.
FOREMAN Arthur Johnson
GZA ENGINEER George Draper

BORING LOCATION See Subsurface Exploration Plan
GROUND ELEV 116.1
DATE STARTED 1/26/87 DATE ENDED 2/3/87

CASING
SIZE: 3-3/4" I.D. HSA/NW Casing
HAMMER: ____ lb.
FALL: ____

SAMPLER
TYPE: 2" Split Spoon OTHER: NW Corebarrel
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	SAMPLE PEN./REC.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRTA CHG AND GEN. DESC.	EQUIPMENT INSTALLED	FIELD TESTING	RMKS.
		S-10	24/24	50-52	4-4-4-6	Medium stiff, gray, Clayey SILT, trace fine Sand.	CLAYEY SILT		0.0	
55		S-11A	24/24	55-57	21-25-20-12	Hard, gray, Silty CLAY. 1/2" to 3" layers.	TO		0.0 0.0	
		S-11B				Dense, gray, fine SAND, little Silt. 1" to 5" layers.				
60		S-12	24/0	60-62		Recovery insufficient for classification. Traces of Clay and Sand.				
65		S-13	24/24	65-67	1/W.O.R. 5-5	Soft, gray, SILT & CLAY, trace fine Sand.	SILTY CLAY		0.0	3
70		S-14	24/1	70-72	14-12-65-10	Recovery insufficient for classification. Small amount of SILT & CLAY, Rock fragments.	WITH SAND LAYERS	CEMENT/BENTONITE GROUT	0.0	
75		S-15	24/21	75-77	9-1-0-7	Very soft, gray, Silty CLAY, trace fine Sand. 8" layer of fine Sand and Silt at top of spoon. 1" Sand layer in Silty CLAY.			0.0	
80		S-16	24/16	80-82	4-5-1-9	Medium stiff, gray, Silty CLAY, trace fine Sand. 1.5" layer of fine Sand and Silt in middle of sample.			0.0	
85		S-17	6/5	85-85.5	112/6"	Very dense, gray, fine SAND, little Silt. 1/4" Clayey SILT layer.			0.0	
90		S-18	28/24	90-92.3	WOR/1'11" 12/4"	Gray, Silty CLAY, trace fine Sand.	91.5' WEATHERED BEDROCK		0.0	
95		C-1	60/34	96-101		Moderately hard, fresh, lustrous gray, fine grained, pelitic SCHIST; highly angled foliation, highly fractured, fractures parallel to foliation.	96 BEDROCK			
			RQD=24%							
100						Bottom of boring at 101.0'.				

3. Weight of rods pushed spoon 1 foot.
4. Drilled with roller bit from 93.5 to 96 feet.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

GZ-123

GOLDBERG-ZOINO & ASSOCIATES, INC.
GEOTECHNICAL/GEOHYDROLOGICAL CONSULTANTS

PROJECT: Coakley Landfill RI, N. Hampton, NH

REPORT OF BORING NUMBER GZ-123
SHEET 1 OF
DATE 2/25/87 FILE

BORING CO. GZA Drilling, Inc.
FOREMAN Arthur Johnson
GZA ENGINEER George Draper

BORING LOCATION See Subsurface Exploration Plan
GROUND ELEV. 86.2
DATE STARTED 2/25/87 DATE ENDED 2/25/87

CASING
SIZE: 3-1/4" I.D. HSA
HAMMER: lb
FALL:

SAMPLER
TYPE: 24" Split Spoon OTHER:
HAMMER: 140 lb.
FALL: 30"

GROUNDWATER READINGS

DATE	DEPTH	CASING AT	STABILIZATION TIME

DEPTH	CAS. BL. /FT.	SAMPLE NO.	SAMPLE PEN./REC.	SAMPLE DEPTH	SAMPLE BLOWS/6"	SAMPLE DESCRIPTION	STRTA. CHG AND GEN. DESC.	EQUIPMENT INSTALLED	FIELD TESTING	RMKS.
						No sample taken. Refer to log of boring GZ-123A.	GRAVELLY SAND (FILL)	CONCRETE SURFACE SEAL		
								FORMATION MATERIAL		
5								2" SCH 80 PVC RISER		
								6.5'		
							7.5' ORGANIC 9' SILT	BENTONITE SEAL		
10								9.5'		
							SAND	11.5'		
								2" SCH 80 PVC WELL SCREEN		
15								FILTER SAND		
							16.5'	16.5'		
						Bottom of boring @ 16.5'.				
20										

REMARKS: 1. GZ-123 is located 3 feet west of GZ-123A and was for the purpose of installing a monitoring well in the upper sand.
2. Monitoring well with 5' x 5" I.D. Protective steel casing with locking cap installed at completion of boring.

NOTES: 1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL. 2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORINGS LOGS. FLUCTUATIONS IN THE LEVEL OF GROUNDWATER MAY OCCUR DUE TO FACTORS NOT ACCOUNTED FOR AT THE TIME MEASUREMENTS WERE MADE.

JOB No: 0-6683

AIR ROTARY WELL LOG

JOB NAME: Coakley Landfill

LOCATION: North Hampton, NH

WELL: GZ-125

TOTAL DEPTH: 200 feet

TOTAL CASING: 58 feet

DIAM: 6-inch

TOTAL YIELD: 3 GPM

DATE: 4/10/87 TO 4/13/87

DRILLING CONTRACTOR: Yankee Drilling

FORMAN: Bruce Champney

GZA REPRESENTATIVE: Mike Nardone, Doug Lansing 4/10

FT	CALIPER LOG DIAMETER, INCHES 6 7 8 9	LITHOLOGY	GPM	COMMENTS
5		0' - 9' SAND and GRAVEL. (FILL)		Drilled through 47 feet of overburden using rotary mud techniques and 8" roller bit.
10		9' - 18' SAND.		Encountered stump (wood) at approximately 8'.
15				
20		18' - 47' CLAY and SILT.		Drilled into bedrock from 47' to 57' with rollerbit.
25				
30				Set 6"-diameter casing from 0' to 57' and pressure grouted in place.
35				
40				
45				
50		Top of bedrock at 47'.		Used 6"-diameter air hammer from 57' to 200' (weight of rods downpressure).
55		Casing to 57 feet.		
60		57' - 135' Dark gray, moderately-hard to hard, fine-grained PHYLLITE, with thin, foliation-parallel Quartz veins.		
65				
70				
75				
80				
85				85'-105' 1.4 min/ft drill rate 88'-89' 1.6 min/ft drill rate
90				
95				
100				
105			2	103', Yield test 105'-125' 0.8 min/ft drill rate
110				
115				
120				
125				125'-145' 0.7 min/ft drill rate
130				130'-137' Soft rock 136' Fracture
135		135' - 140' Moderately-hard, dark gray, fine-grained PHYLLITE to gray MICA-SCHIST.		
140				
145		140' - 150' Hard, dark gray, well foliated, Micaceous QUARTZITE, with foliation parallel Quartz vein.		145'-165' 1.2 min/ft drill rate 150' Observed orange color in drill water (iron staining)
150				
155		150'-155' Iron-stained, quartz-feldspathic SCHIST to granite GNEISS.		

JOB No: D-6682

AIR ROTARY WELL LOG

JOB NAME: Coakley Landfill	WELL	GZ-125	DATE: 4/10/87 TO 4/13/87
LOCATION: North Hampton, NH	TOTAL DEPTH:	200 feet	DRILLING CONTRACTOR: Yankee Drilling
	TOTAL CASING:	58 feet	FORMAN: Bruce Champney
	DIAM:	6-inch	
	TOTAL YIELD:	3 GPM	GZA REPRESENTATIVE: Mike Nardone

FT	CALIPER LOG DIAMETER, INCHES 6 7 8 9	LITHOLOGY	GPM	COMMENTS
160		155' - 170' Hard, well foliated, Micaceous QUARTZITE, with foliation - parallel quartz veins.		
165				165'-185' 1.0 min/ft drill rate
170		170'-175' Quartz-feldspathic SCHIST to Granitic GNEISS.		
175		175' - 200' Well foliated Micaceous QUARTZITE, with foliation-parallel quartz veins.		177' Observed orange color in drilling water; possible fracture zone.
180				
185				
190				189' observed orange coloring in drill water. 191' observed orange coloring in drill water.
195				
200			3	200' OVM=0.1
205		Bottom of boring at 200'.		
210				
215				
220				
225				
230				
235				
240				

APPENDIX C

FIELD SAMPLING STANDARD OPERATING PROCEDURES (SOPS)

WATER LEVEL, WELL DEPTH MEASUREMENTS AND WELL INTEGRITY INSPECTION

PURPOSE

This Standard Operating Procedure (SOP) *Water Level, Well Depth Measurements and Well Integrity Inspections* is to set guidelines for the manual determination of the depth to water in monitoring wells at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire.

In general, water-level measurements are used to construct water table or potentiometric surface maps and to determine flow direction as well as other aquifer characteristics. Therefore, a synoptic water level measurement round should be performed in the shortest possible time (preferably within a 24-hour period) before any purging and sampling activities begin.

Well integrity inspections are completed on an annual basis to ensure that the monitoring wells are in suitable condition to meet the project data quality objectives (i.e., well are not damaged and are maintained secure).

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

EQUIPMENT AND MATERIALS

- An approved Health & Safety Plan and appropriate personal protective clothing and gear.
- Site-specific Sampling and Analysis Plan (SAP)
- Boring logs (included in the SAP)
- Field book.
- Water Level and Well Depth Worksheet (see attached).
- Well Integrity Inspection Worksheet (see attached)
- Photoionization detector (PID), if required.
- Electronic water level meter of appropriate length (e.g., 100 ft, 200 ft, and 300 ft, and measures in increments of 0.01 feet).
- Gate keys / well keys and other applicable field equipment to open wells.
- Indelible black-ink pen (Sharpie).
- Decontamination supplies in accordance with the Decontamination SOP in the SAP.

GENERAL INFORMATION

All monitoring wells should be locked at all times, or within a secure locked area, to ensure the integrity of the well. Completion of the well integrity worksheet ensures that maintenance issues are identified in a timely manner and that corrective actions are completed when required.

If water level measurements are being completed for the first time following well installation (or if it does not already exist), a survey mark/physical notch should be placed on the top of the riser or casing as a reference point for future groundwater level measurements. If the top of the riser or casing is not flat, make the reference point the highest point. The measurement reference point should be documented in the site logbook. Refer to the SAP and the attached Water Level Worksheet for correct reference points.

All field personnel must be made aware of the measurement reference point, top of casing (TOC) or top of PVC pipe (TOPVC) being used in order to ensure the collection of comparable data.

Before measurements are made, water levels in monitoring wells should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low yield situations, recovery of water levels to equilibrium may take longer. All measurements should be made to an accuracy of 0.01 feet.

Water levels should be collected from the least contaminated to the most contaminated wells if possible and where it's applicable.

All equipment shall be decontaminated in accordance with the decontamination SOP and checked (e.g. batteries) prior to use to ensure that they are in proper working condition.

WATER LEVEL MEASUREMENT PROCEDURES

Care should be taken to minimize water column disturbance. Use the following procedures to collect water level measurements:

1. Open the well and monitor the headspace with the appropriate air monitoring instrument to determine the presence of volatile organic compounds (if applicable).

2. Note if the lock was damaged or missing and any physical changes to well condition, such as erosion or cracks in protective concrete pad, road box, standpipe, etc., in field book/field sheet.

3. Turn the meter on and adjust the sensitivity control.

4. Lower the electronic water level meter probe and measuring tape into the well from the reference point until the water surface is reached as indicated by a tone and/or the light display.

5. Read and record measurement (to 0.01 feet) along with the date, time on the attached Water Level Worksheet. In addition, note the reference point used (top of PVC riser or casing) if

different from the reference point on the worksheet. Note any changes in the conditions of the well and surroundings, including missing locks.

6. The depth to the bottom of the monitoring well shall be confirmed in each well and recorded on the Water Level Worksheet at least once every five years, during the sampling event just prior to the 5-year review, unless otherwise requested. Highlight any significant deviations in the depth to the bottom from the reported depth to bottom.

7. Remove all downhole equipment used for the water level measurement, and replace well cap and locking steel caps and secure.

8. Thoroughly decontaminate the tape and probe in accordance with the Decontamination SOP. The decontamination procedure for water level meters and oil/interface probes shall include the probes and, at a minimum, the length of tape used in that well.

9. Complete Well Integrity Inspection Worksheet.

QUALITY ASSURANCE/ QUALITY CONTROL (QA/QC)

An equipment blank on the water level shall be collected after use in the most contaminated well and decontamination, to ensure that the equipment has been properly decontaminated and the decontamination procedures are adequate. The equipment blank shall include rinsate from the water level probe and, at a minimum, the length of tape used in that well. Refer to the SAP tables for specific location and analysis.

If well integrity issues are identified, the Coakley Group, NHDES and EPA should be notified as soon as possible, and corrected actions should discussed and documented in the field notes.

REFERENCES

Water Level Measurement Procedure included in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

ATTACHMENTS

Water Level and Depth Worksheet
Well Integrity Inspection Worksheet

WATER LEVEL AND WELL DEPTH MEASUREMENT WORKSHEET
COAKLEY LANDFILL SUPERFUND SITE

	Data from SAP Table 3-1				Field Personnel Measurements / Observations						
Well ID	**Well Diameter (inches)**	**Measuring Point (MP)**	**Adjusted Well Depths Based on Well Depth and Stickup (ft from MP)**	**Measured Well Depth from 2015 (ft from MP)**	**Well Depth (ft from MP) *if required* [1]**	**Deviation in Well Depth Measurement (ft difference) [2]**	**Depth to Static Water Level (ft from MP) [2]**	**Date of Measurement**	**Time of Measurement (24 hr clock)**	**Initials of Personnel**	**Comments**
BP-4	6	Top of Casing	101.78	101.79							
MW-10	2	Top of PVC	12.67	12.07							
MW-11	2	Top of PVC	53.8	54.70							
MW-2	1	Top of PVC	21.74	21.75							
MW-4	2	Top of PVC	40.12	39.22							
MW-5D	2	Top of PVC	165.64	161.72							
MW-5S	2	Top of PVC	80.66	83.47							
MW-6	6	Top of Casing	186.15	170.90							
MW-8	2	Top of PVC	67.59	67.58							
MW-9	2	Top of PVC	13	12.46							
OP-2	1.25	Top of PVC	14	16.86							
OP-5	1.25	Top of PVC	25.84	25.74							
AE-1A	2	Top of PVC	67	66.14							
AE-1B	2	Top of PVC	87.3	87.68							
AE-2A	2	Top of PVC	22.63	22.57							
AE-2B	2	Top of PVC	52.46	52.83							
AE-3A	2	Top of PVC	20	20.07							
AE-3B	2	Top of PVC	43.4	43.1							
AE-4A	2	Top of PVC	17.25	16.55							
AE-4B	2	Top of PVC	46.7	46.12							
FPC-2A	2	Top of PVC	18.8	18.82							
FPC-2B	2	Top of PVC	40.38	40.31							

WATER LEVEL AND WELL DEPTH MEASUREMENT WORKSHEET
COAKLEY LANDFILL SUPERFUND SITE

	Data from SAP Table 3-1				Field Personnel Measurements / Observations						
Well ID	**Well Diameter (inches)**	**Measuring Point (MP)**	**Adjusted Well Depths Based on Well Depth and Stickup (ft from MP)**	**Measured Well Depth from 2015 (ft from MP)**	**Well Depth (ft from MP) *if required* (1)**	**Deviation in Well Depth Measurement (ft difference) (2)**	**Depth to Static Water Level (ft from MP) (2)**	**Date of Measurement**	**Time of Measurement (24 hr clock)**	**Initials of Personnel**	**Comments**
FPC-3A	2	Top of PVC	74.6	Not Measured							
FPC-3B	1.5	Top of PVC	97.15	Not Measured							
FPC-3C	2	Top of PVC	30.88	Not Measured							
FPC-4B	2	Top of PVC	35.83	35.44							
FPC-5A	2	Top of PVC	72.84	Not Measured	NM	NM	NM	NM	NM		well needs to be replaced
FPC-5AX	2	Top of PVC		Not Measured							
FPC-5B	2	Top of PVC	113.11	113.42							
FPC-6A	1.5	Top of Casing	10.04	10.37							
FPC-6B	2	Top of PVC	30.99	30.22							
FPC-7A	2	Top of PVC	24.08	24.02							
FPC-7B	2	Top of PVC	47.43	46.95							
FPC-8A	2	Top of PVC	35.1	33.92							
FPC-8B	2	Top of PVC	57.94	57.65							
FPC-9A	2	Top of PVC	70.37	68.43							
FPC-9B	2	Top of PVC	89.47	89.45							
FPC-9C	2	Top of PVC	27.35	27.72							
FPC-11A	2	Top of PVC	51.59	50.40							
FPC-11B	2	Top of PVC	72.45	71.30							
FPC-11C	2	Top of PVC	32.71	31.80							
GZ-105	1.5	Top of PVC	53.76	52.07							
GZ-109	6	Top of Casing		Not Measured							
GZ-117	2	Top of PVC		Not Measured							
GZ-123	2	Top of PVC	17.89	17.35							
GZ-125	6	Top of Casing	202.27	201.30							
MW-20O	2	Top of PVC		Not Measured							
MW-20B	2	Top of PVC		Not Measured							
MW-21O	2	Top of PVC		Not Measured							
MW-21B	2	Top of PVC		Not Measured							

Notes

1. Well depth are measured every five years, in the year prior to the Five-Year Review (i.e., 2020 etc.), or on an as-needed basis to evaluate corrective actions.
   If well depth measurement is not required, then write NM or Not Measured
2. Well depth measurement must be corrected based on the distance from the bottom of the probe to the bottom of the pin. All well depths and static water levels measure to the hundredth of a foot (0.01)

WELL INTEGRITY INSPECTION WORKSHEET
COAKLEY LANDFILL SUPERFUND SITE

Well ID	Measuring Point (MP)	Is MP Location Identified [1] (circle one)	Is Well Label Legible? (circle one)	Is surface seal intact? (circle one)	Is Well Locked? (circle one)	Is lock in good Condition? (circle one)	Is protective casing in good Condition? (circle one)	Is there any other damage to well? (circle one)	Date of Inspection	Initials of Personnel	Comments
BP-4	Top of Casing	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-10	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-11	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-2	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-4	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-5D	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-5S	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-6	Top of Casing	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-8	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-9	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
OP-2	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
OP-5	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-1A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-1B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-2A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-2B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-3A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-3B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-4A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
AE-4B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-2A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-2B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			

WELL INTEGRITY INSPECTION WORKSHEET
COAKLEY LANDFILL SUPERFUND SITE

Well ID	Measuring Point (MP)	Is MP Location Identified [1] (circle one)	Is Well Label Legible? (circle one)	Is surface seal intact? (circle one)	Is Well Locked? (circle one)	Is lock in good Condition? (circle one)	Is protective casing in good Condition? (circle one)	Is there any other damage to well? (circle one)	Date of Inspection	Initials of Personnel	Comments
FPC-3A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-3B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-3C	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-4B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-5AX	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-5B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-6A	Top of Casing	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-6B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-7A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-7B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-8A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-8B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-9A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-9B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-9C	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-11A	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-11B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
FPC-11C	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
GZ-105	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
GZ-109	Top of Casing	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
GZ-117	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
GZ-123	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
GZ-125	Top of Casing	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			

WELL INTEGRITY INSPECTION WORKSHEET
COAKLEY LANDFILL SUPERFUND SITE

Well ID	Measuring Point (MP)	Is MP Location Identified [1] (circle one)	Is Well Label Legible? (circle one)	Is surface seal intact? (circle one)	Is Well Locked? (circle one)	Is lock in good Condition? (circle one)	Is protective casing in good Condition? (circle one)	Is there any other damage to well? (circle one)	Date of Inspection	Initials of Personnel	Comments
MW-20O	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-20B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-21O	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			
MW-21B	Top of PVC	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N	Y or N			

Notes

1. The measuring point on the Top of PVC Casing or Top of Metal Casing should be clearly identified with a permanent black marker.

CALCULATION OF PURGE VOLUME

PURPOSE

This Standard Operating Procedure (SOP) *Calculation of Purge Volume* is to set guidelines for the determination of purge volumes to be collected at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire.

PROCEDURES

1. Determine the water level in the well.
2. If well depth (or the depth of the tubing intake point) is not already known from well history, measure the depth from the same reference point used to collect the water level data.
3. Measure the well (or tubing) inside diameter in inches.
4. Calculate one purge volume using the following equation, multiplying by number of purge volumes needed (3-5) or use conversion charts shown below and on the next page.

One Purge Volume (Gallons) = h x 3.14(r/12)^2 x 7.48 gal/ft^3

Volume = h x π x r^2

π = 3.14 (a constant)

r = radius = diameter (in inches)/12
r/12 converts radius to feet

h = height(in feet of water) = depth of well - depth of water level.

7.48 = gallons in 1 cubic foot (ft) of water

CALCULATION OF PURGE VOLUME FOR TUBING

The purge volume is equal to h x 3.14(r/12)^2 x 7.48 gal/ft^3

One purge volume is equal to (h) x (f) where:

h = length of tubing

f = the volume in gal/foot

Then convert gallons to milliliters (1 gallon = 3785 mL) so that the purge volume can be accurately measured using a graduated cylinder.

Below are the factors for some typical tubing sizes.

Tubing ID (Inside Diameter) In inches	1/8 (0.125)	11/64 (0.17)	1/4 (0.25)	3/8 (0.375)	1/2 (0.50)	5/8 (0.625)
Volume (gal/foot)	0.00064	0.0012	0.00255	0.00573	0.01019	0.01593
Volume (mL/foot)	2.42	4.50	9.65	21.69	38.57	60.30

CALCULATION OF PURGE VOLUME FOR WELLS

Purge Volume = h x $3.14(r/12)^2$ x 7.48 gal/ft^3;

One Purge Volume = height of water x gallons/foot

h = height (in feet) = depth of well - depth of water level.

Casing Diameter (Inches)	Gallons Per Foot	Gallons Per Foot X 3 Volumes	Gallons Per Foot X 5 Volumes	Height Of Water (Feet)	Purge Amount (Gallons)
1.00"	**0.04**	**0.12**	**0.20**		
1.25"	**0.06**	**0.18**	**0.30**		
1.50"	**0.09**	**0.27**	**0.45**		
1.75"	**0.12**	**0.36**	**0.60**		
2.00"	**0.16**	**0.48**	**0.80**		
2.25"	**0.21**	**0.63**	**1.05**		
2.50"	**0.25**	**0.75**	**1.25**		
3.00"	**0.37**	**1.11**	**1.85**		
3.50"	**0.50**	**1.50**	**2.50**		
4.00"	**0.65**	**1.95**	**3.25**		
6.00"	**1.47**	**4.41**	**7.35**		

REFERENCES

Calculation of Purge Volume Procedure included in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

GROUNDWATER WELL SAMPLING - BAILERS

PURPOSE

This Standard Operating Procedure (SOP) *Groundwater Well Sampling - Bailers* is designed to provide general reference information on purging and sampling of groundwater wells using a bucket type bailer at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire. Every effort must be made to ensure that the sample is representative of the particular zone of groundwater being sampled.

Bottom dispensing bailers are required for samples volatile organic compounds (VOCs). This procedure is designed for use with a bottom dispensing bailer.

Bucket type bailers are tall narrow buckets equipped with a check valve on the bottom. This valve allows water to enter from the bottom as the bailer is lowered, then prevents its release as the bailer is raised. Bailers are typically made of stainless steel, polyethylene or Teflon. Teflon bailers will not be used due to the potential cross contamination for per- and poly-fluorinated alkyl substances (PFAS).

This device is particularly useful when samples must be recovered from depths greater than the range (or capability) of suction lift pumps, or when well casing diameters are too narrow to accept submersible pumps. Samples can be recovered with a minimum of aeration if care is taken to gradually lower the bailer until it contacts the water surface and is then allowed to sink as it fills.

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

EQUIPMENT AND MATERIALS

The following is a list of equipment and material commonly used for the collection of groundwater samples:

- Appropriate health and safety gear and an approved site-specific Health and Safety Plan.
- Site specific Sampling and Analysis Plan (SAP). Current HWRB Master QAPP. Bailer Sampling Worksheet.
- Electronic water level meter of appropriate length (e.g., 100 ft., 200 ft., and 300 ft.) and measures in increments of 0.01 feet.
- Clean, portable or dedicated, bottom filling/bottom dispensing bailer of appropriate size and construction material (e.g. stainless steel or polyethylene) with a sample dispensing device (e.g., slow dispensing VOC tip).
- Bailing twine made of appropriate material (e.g., Nylon).
- Gate keys / well keys and other applicable field equipment to open wells.

- Toolbox to include at least: sharp knife (locking blade), bolt cutters, spare well locks, screwdrivers, pliers, hacksaw, hammer, flashlight, adjustable wrench, socket set, and duct tape.
- Plastic sheeting.
- Graduated five gallon bucket for collecting purge water.
- Logbook, pencil/pen/sharpies, and calculator.
- Sample labels, chain-of-custody records and custody seals.
- Sample containers including spare containers, preserved as necessary by the laboratory and re-sealable plastic bags.
- Loose ice and a sample cooler.
- Trash bags to containerize solid waste.
- Laboratory-grade deionized (DI) water.
- Decontamination equipment and supplies in accordance with the Decontamination SOP in the SAP for the water level.

PROCEDURE FOR USING A BOTTOM DISPENSING BAILER:

1. To prevent cross contamination using non-dedicated equipment (i.e., water level meter), sample the least contaminated wells first and the more contaminated wells last. If the degree of contamination is unknown, sample the upgradient wells first and the downgradient wells last.
2. Lay out a sheet of clean polyethylene to place the sampling equipment on.
3. Determine the water level in the well.

   Before collecting a groundwater sample, a water level measurement must be obtained. Care should be taken to minimize water column disturbance. Use the following procedures to collect water level measurements:

   a) If possible, and when applicable, start at those wells that are least contaminated and proceed to those wells that are most contaminated.

   b) Lower water level meter and graduated measuring tape/cable into the well to the water surface.

   c) Record the distance from the water surface (to 0.01 feet), as determined by the audio signal or tone, to the reference measuring point (i.e., top of PVC riser or casing) and record in the field book/field sheet. In addition, note the reference point used (top of PVC riser or casing).

   d) Record the distance to the bottom of the well (to 0.01 feet) once every 5 years, during the sampling event just prior to the 5-year review or as specified in the SAP.

e) In field book/field sheet, note any physical changes to well condition, such as erosion or cracks in protective concrete pad, road box, standpipe, variation in total depth of well, etc.

4. Using the water level and well construction information included in the SAP, determine the midpoint of the saturated screen (sample location) and record on worksheet.

5. Calculate the purge volume. Refer to Calculating Purge Volume section below.

6. Attach a pre-cleaned or disposable bailer to a dedicated unused line for lowering.

7. Slowly lower the bailer to the sampling location, being careful not to drop the bailer into the water, causing turbulence and possible loss of VOCs. Allow the bailer to fill and then slowly and gently retrieve the bailer from the well avoiding contact with the casing, so as not to knock flakes of rust or other foreign materials into the bailer. When pulling the bailer out, ensure that the line either falls onto a clean area of plastic sheeting or never touches the ground.

8. Discharge the water from the top of the bailer into a graduated five gallon bucket.

9. Repeat filling and discharging until the 3 times the standing water volume in the well has been purged from the well (3 well volumes).

10. Record final volume purged in logbook.

11. Discharge final purge water to the ground (ensure that water does not flow back into road box).

12. To collect a groundwater sample slowly lower and retrieve the bailer as described above, discharging the groundwater into the appropriate sample containers as follows:

    a) Refer to the SAP for specific samples to be collected. Samples shall be collected in the following order, as applicable:

        1) VOCs

        2) 1,4 Dioxane

        3) PFAS – (Refer to SOP-10 for specific sampling procedures related to PFAS sampling)

        4) Metals

        5) Other

    b) Remove the cap from the appropriate sample container and place it on the plastic sheet or in a location where it won't become contaminated.

    c) Slowly lower and retrieve the bailer as described above.

    d) Attach the sample dispensing device to the bottom of the bailer.

    e) Begin slowly discharging from the bottom of the bailer, using the dispensing device, into the appropriate containers. All sample containers should be filled by allowing the discharge to flow gently down the inside of the container with minimal

turbulence. The priority order in which the samples should be collected from each well is described above.

f) Cap sample containers securely after filling each bottle. Sample containers should be wiped dry. Place samples in re-sealable plastic bags and then in loose ice within the cooler. Metals samples do not require cooling.

g) Continue to remove water from the well until sufficient volume has been obtained to fill all sample containers according to the priority order identified above.

h) If a field duplicate sample and/or a field matrix spike/matrix spike duplicate (MS/MSD) samples are required, the samples should be collected by filling a separate container for each analysis immediately following the actual field sample collection and should be in the same priority order as indicated above. Duplicate samples are not intended to be blind duplicate samples. They should be designated with a "DUP" after the well designation (i.e., CKL_M-2 DUP) as indicated in the SAP. Refer to the SAP for specific QC sampling requirements and appropriate COC notations required for MS/MSD samples.

13. If the bailer is dedicated and will remain in the well, it should be suspended as close to the top of the well as possible and above the water column if possible.

14. Replace the well cap and secure the well.

15. Log all samples in the field book and on the chain of custody. Ensure all samples are appropriately labeled.

16. Package samples and complete necessary paperwork.

17. Decontaminate the water level in accordance with the Decontamination SOP in the SAP.

CALCULATING PURGE VOLUME

Calculate one purge volume using the following equation, multiplying by number of purge volumes needed (3-5) or use conversion chart shown below.

$$\text{One Purge Volume (Gallons)} = h \times 3.14(r/12)^2 \times 7.48 \text{ gal/ft}^3$$

$\text{Volume} = h \times \pi \times r^2$ $\pi = 3.14$ (a constant)

r = radius = diameter (in inches)/~~1~~2 r/12 converts radius to feet

h = height(in feet of water) = depth of well - depth of water level.

7.48 = gallons in 1 cubic foot (ft) of water

Conversion Chart

One Purge Volume = height of water x gallons/foot
h = height (in feet) = depth of well - depth of water level.

Casing Diameter (Inches)	Gallons Per Foot	**Gallons Per Foot X 3 Volumes**	Gallons Per Foot X 5 Volumes	Height Of Water (Feet)	Purge Amount (Gallons)
1.00"	0.04	**0.12**	0.20		

1.25"	0.06	**0.18**	0.30		
1.50"	0.09	**0.27**	0.45		
1.75"	0.12	**0.36**	0.60		
2.00"	0.16	**0.48**	0.80		
2.25"	0.21	**0.63**	1.05		
2.50"	0.25	**0.75**	1.25		
3.00"	0.37	**1.11**	1.85		
3.50"	0.50	**1.50**	2.50		
4.00"	0.65	**1.95**	3.25		
6.00"	1.47	**4.41**	7.35		

DECONTAMINATION

Decontaminate water level meter following the Decontamination SOP included in the SAP before reuse. Disposable sampling equipment (bailer and bailing twine) shall be discarded after completing the sampling task and not reused. Dedicated bailers shall remain in the well.

REFERENCES

Bailer Sampling Procedure included in current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

Calculating Purge Volume Procedure included in current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

BAILER SAMPLING WORKSHEET

Project: Coakley Landfill Superfund Site

Well ID	
Date	
Sampler Name	
Inner Casing Diameter	inches
Depth of Well (from top of casing)	feet
Static Water Level (from top of casing)	feet
Volume of Standing Water	gallons
Min. Purge Volume (3x Volume of Standing Water)	gallons
Max. Purge Volume (5x Volume of Standing Water)	gallons
Actual Purge Volume	gallons

Lab Analyses Requested	**QA/QC Samples**

CALCULATION OF PURGE VOLUME FOR WELLS

Purge Volume = h x $3.14(r/12)^2$ x 7.48 gal/ft^3;

One Purge Volume = height of water x gallons/foot

Inner Casing Diameter (Inches)	Gallons Per Foot	Gallons Per Foot X 3 Volumes	Gallons Per Foot X 5 Volumes
1.00"	0.04	0.12	0.2
1.25"	0.06	0.18	0.3
1.50"	0.09	0.27	0.45
1.75"	0.12	0.36	0.6
2.00"	0.16	0.48	0.8
2.25"	0.21	0.63	1.05
2.50"	0.25	0.75	1.25
3.00"	0.37	1.11	1.85
3.50"	0.5	1.5	2.5
4.00"	0.65	1.95	3.25
6.00"	1.47	4.41	7.35

Sampler Signature

LOW FLOW SAMPLING USING A PERISTALTIC PUMP

SCOPE AND APPLICATION

This Standard Operating Procedure (SOP) *Groundwater Sampling – Low flow Using A Peristaltic Pump*, provides a general framework for collecting groundwater samples at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire that are indicative of total mobile organic and inorganic loads (dissolved and colloidal sized fractions) transported through the subsurface under ambient flow conditions with minimal physical and chemical alterations from sampling operations. This is accomplished by: low pumping rates, negligible water level draw down and stabilization of water quality parameters; emphasizing the need to minimize hydraulic stress at the well-aquifer interface.

This SOP was developed using the "Low Flow Groundwater Purging and Sampling SOP" included in the current New Hampshire Department of Environmental Services (NHDES) Hazardous Waste Remediation Bureau Master Quality Assurance Project Plan (HWRB Master QAPP), EPA RFA #13027 and is considered to be generally consistent with EPA's "Groundwater Sampling EPA Region 1 "Low Stress (Low-flow) Purging and Sampling Procedure For the Collection of Ground Water Samples From Monitoring Wells," Revision 3, January 19, 2010. This SOP will help ensure that the project's data quality objectives (DQOs) are met under certain low-flow conditions.

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

This procedure is primarily designed for monitoring wells with a screen length or open interval ten feet or less and with a water level above the top of the screen or open interval (Hereafter, the "screen or open interval" will be referred to only as "screen interval").

In low permeability formations or poorly installed monitoring wells it may not be possible to collect groundwater samples using the standard low flow procedure. In such instances, refer to the "Monitoring Wells That Have Insufficient Recharge" section for instruction for sampling the well. If the low flow procedure has been attempted unsuccessfully at a well for two consecutive rounds, confer with the field team leader and proceed to the "Monitoring Wells That Have Insufficient Recharge" section without further attempt to use the standard low flow procedure. Wells where this occurs should be considered for replacement in the future.

Low flow indicator parameters include: pH, turbidity, specific conductance, temperature, dissolved oxygen (DO) and oxygen reducing potential (ORP). All measurements must be obtained using a "flow-through-cell", except for turbidity. Turbidity must be taken at a point before the flow-through-cell and measured with an instrument that is separate from the flow-through-cell apparatus (refer to the attached schematic). A three-way stop cock attached to the tubing before the flow-through-cell will be used for this purpose. Transparent flow-through-cells with a cell

capacity of 250 ml or less are required. The transparency allows field personnel to watch for air bubbles and particulate build-up within the cell, which may affect indicator field parameter values measured within the cell. The flow-through-cell must be designed in a way that prevents air bubble entrapment in the cell. Placing the flow-through-cell at a 45 degree angle with the port facing upward can help remove bubbles from the flow-through-cell (see attached Low-Flow Setup Diagram). All during the measurement process, the flow-through-cell must remain free of any gas bubbles. Otherwise, the monitoring probes may act erratically. When the pump is turned off, water in the cell must not drain out. Monitoring probes must be submerged in water at all times.

A small volume cell (250 ml or less) facilitates rapid turnover of water in the cell between measurements of the indicator field parameters. The pump's flow rate must be able to "turn over" at least one flow-through-cell volume between measurements (for a 250 mL flow-through-cell with a flow rate of 50 ml/min., the monitoring frequency would be every five minutes; for a 500 mL flow-through-cell at the same flow rate, it would be every ten minutes). If the cell volume cannot be replaced in the proper interval, (e.g. five minute for a 250 mL flow through cell) then the time between measurements must be increased accordingly. **Readings shall not be less than five minutes apart.**

USE OF TERMS

Field duplicates: Field duplicates are collected to determine precision of sampling procedure. For this procedure, collect a duplicate for each analyte group in consecutive order (volatile organic compound [VOC] original, VOC duplicate, perfluorinated chemical (PFC) original, PFC duplicate, SVOC original, SVOC duplicate, etc.).

Matrix Spike/Matrix Spike Duplicates: Used by the laboratory in its quality assurance program.

Trip blank (VOCs): Trip blank is a sample of analyte-free water taken to the sampling site along with the sample bottles, and returned to the laboratory to measure possible cross contamination of samples during shipping to and from the site. The trip blanks (one pair) are added to each sample cooler that contains VOC samples.

Temperature blank: A temperature blank is added to each sample cooler. The blank is measured prior to shipment and upon receipt at the laboratory to assess whether the samples were properly cooled during transit.

Equipment blank: The equipment blank shall include the water level meter. A sample of deionized (analyte free)

For the pump and the pump's tubing, if tubing is dedicated to the well, the equipment blank need only include the pump in subsequent sampling rounds. If the pump and tubing are dedicated to the well, the equipment blank is collected prior to its placement in the well. If the pump and tubing will be used to sample multiple wells, the equipment blank is normally collected after sampling from contaminated wells and not after background wells.

Potentiometric Surface: The level to which water rises in a well constructed in a confined aquifer. In an unconfined aquifer, the potentiometric surface is the water table.

Stabilization: A condition that is achieved when the drawdown rate and all the indicator field parameter measurements are sufficiently stable (as described in the "Well Purging and Sampling Procedure" section), thereby allowing sample collection to begin (as long as the minimum purge volume is met).

BACKGROUND FOR IMPLEMENTATION

Prior to conducting the low flow sampling event, information regarding well construction, development, and water level records for each well to be sampled should be obtained and reviewed to determine the appropriate pump to be used, the location of the intake, and the potential groundwater recharge rate of the well. If this information is not available, a reconnaissance should be made prior to the actual sampling event to determine well depth, water level, length of screen, etc., and performance of a pump test to determine the recharge rate of the well. Additionally, wells that have not been sampled should be redeveloped prior to conducting the actual sampling event, if possible.

It is expected that the monitoring well screen, or open interval has been properly located (both laterally and vertically) to intercept existing contaminant plume(s) or along flow paths of potential contaminant migration. Problems with inappropriate monitoring well placement or faulty/improper well installation cannot be overcome by even the best water sampling procedures. This SOP presumes that the analytes of interest are moving (or will potentially move) primarily through the more permeable zones intercepted by the screen interval.

Proper well construction, development, operation and maintenance cannot be overemphasized. The use of installation techniques that are appropriate to the hydrogeologic setting of the site often prevent "problem well" situations from occurring. During well development, or redevelopment, tests should be conducted to determine the hydraulic characteristics of the monitoring well. The data can then be used to set the purging/sampling rate, and provide a baseline for evaluating changes in well performance and the potential need for well rehabilitation. Note: if this installation data or well history (construction and sampling) is not available or discoverable, for all wells to be sampled, efforts to build a sampling history should commence with the next sampling event.

The pump/tubing intake should be located within the screen interval and at a depth that will remain under water at all times. It is recommended that the intake depth and pumping rate remain the same for all sampling events. The mid-point or the lowest historical midpoint of the saturated screen length is often used as the location of the pump intake.

Significant chemical or permeability contrast(s) within the screen may require additional field work (e.g. interval sampling and/or borehole geophysics) to determine the optimum vertical location(s) for the pump/tubing intake, and appropriate pumping rate(s) for purging and sampling more localized target zone(s). Primary flow zones (high(er) permeability and/or high(er) chemical

concentrations) should be identified in wells with screen lengths longer than 10 feet, or in wells with open boreholes in bedrock. Targeting these zones for water sampling will help ensure that the low stress procedure will not underestimate contaminant concentrations. (Refer to the tables in the SAP for well construction details and intake depths). Stabilization of indicator field parameters is used to indicate that conditions are suitable for sample collection. Achievement of turbidity levels of less than 5 NTU, and stable drawdown of less than 0.3 feet, while desirable, are not mandatory. Sample collection may still take place provided the indicator field parameter criteria in this procedure are met.

A goal of this procedure is to emphasize the need for consistency in deploying and operating equipment while purging and sampling monitoring wells during each sampling event. This will help minimize sampling variability.

Cold weather considerations must be factored into a low-flow sampling plan. It is recommended that low-flow sampling be conducted when the air temperature is above 32°F (0°C). If the procedure is used below 32°F, special precautions will need to be taken to prevent the groundwater from freezing in the equipment. Because sampling during freezing temperatures may adversely impact the data quality objectives, the need for water sample collection during months when these conditions are likely to occur should be evaluated during site planning and special sampling measures may need to be developed. Ice formation in the flow-through-cell will cause the monitoring probes to act erratically. A transparent flow-through-cell is required to observe if ice is forming in the cell. If ice starts to form on the other pieces of the sampling equipment, additional problems may occur.

The use of dedicated sampling equipment is recommended as it promotes consistency in the sampling; may reduce sampling bias by having the pump's intake at a constant depth; and can streamline sampling activities, significantly reducing the time needed to complete each sampling event, thereby reducing the overall field costs.

HEALTH & SAFETY

When working on-site, comply with all applicable OSHA requirements and the site's health/safety procedures. All proper personal protection clothing and equipment are to be worn. Some samples may contain biological and chemical hazards. These samples should be handled with suitable protection to skin, eyes, etc.

PRECAUTIONS

The following precautions needs to be considered when planning to collect groundwater samples when the below conditions occur.

If the groundwater degasses during purging of the monitoring well, dissolved gases and VOCs will be lost. When this happens, the groundwater data for dissolved gases (e.g., methane, ethene, ethane, dissolved oxygen, etc.) and VOCs will need to be qualified. Some conditions that can promote degassing are the use of a vacuum pump (e.g., peristaltic pumps), changes in aperture

along the sampling tubing, and squeezing/pinching the pump's tubing (e.g., constricting the flow) which results in a pressure change. The observation of bubbles in the tubing is indicative or groundwater degassing.

When collecting the samples for dissolved gases and VOCs analyses, avoid aerating the groundwater in the pump's tubing. This can cause loss of the dissolved gases and VOCs in the groundwater. Having the pump's tubing completely filled prior to sampling will avoid this problem.

Direct sun light and hot ambient air temperatures may cause the groundwater in the tubing and flow-through-cell to heat up. This may cause the groundwater to degas which will result in loss of VOCs and dissolved gases. When sampling under these conditions, shade the equipment from the sunlight (e.g., umbrella, tent, etc.). If possible, sampling on hot days, or during the hottest time of the day, should be avoided. The tubing exiting the monitoring well should be kept as short as possible to avoid the sun light or ambient air from heating up the groundwater in the tubing.

Condensation (fogging) of Turbidity Vial: Condensation may occur on the outside of the sample cell when measuring a cold sample in a warm, humid environment. Condensation interferes with turbidity measurement, so all moisture must be thoroughly wiped off the sample cell before measurement. If fogging recurs, let the sample warm slightly by standing at ambient temperature or immersing in a container of ambient temperature water for a short period. After warming, gently invert the sample cell to thoroughly mix the contents before measurement.

Thermal currents in the monitoring well may cause vertical mixing of water in the well bore. When the air temperature is colder than the groundwater temperature, it can cool the top of the water column. Colder water which is denser than warm water sinks to the bottom of the well and the warmer water at the bottom of the well rises, setting up a convection cell. "During low-flow sampling, the pumped water may be a mixture of convecting water from within the well casing and aquifer water moving inward through the screen. This mixing of water during low-flow sampling can substantially increase equilibration times, can cause false stabilization of indicator parameters, can give false indication of redox state, and can provide biological data that are not representative of the aquifer conditions" (Vroblesky 2007).

Interferences may result from using contaminated equipment, cleaning materials, sample containers, or uncontrolled ambient/surrounding air conditions (e.g., truck/vehicle exhaust nearby). Cross contamination problems can be eliminated or minimized through the use of dedicated sampling equipment and/or proper planning to avoid ambient air interferences. Clean and decontaminate all sampling equipment prior to use. All sampling equipment needs to be routinely inspected to be free from contaminants and equipment blanks collected to ensure that the equipment is free of contaminants. Check the previous equipment blank data for the site (if they exists) to determine if the previous cleaning procedure removed the contaminants. If contaminants were detected and they are a concern, then a more vigorous cleaning procedure will be required.

PERSONNEL QUALIFICATIONS

All field samplers working at sites containing hazardous waste must meet the requirements of the OSHA regulations. Federal regulations require the sampler to take the 40 hour OSHA health and safety training course and a yearly 8 hour refresher course prior to engaging in any field activities on Superfund Sites.

The field samplers must be trained prior to the use of the sampling equipment, field instruments, and procedures. Training is to be conducted by an experienced sampler before initiating any sampling procedure.

The entire sampling team needs to read, and be familiar with most recent versions, and all addendums to, the Coakley Landfill Superfund Site Health and Safety Plan, the SAP, all relevant SOPs, and the HWRB Master QAPP before going onsite for the sampling event. It is recommended that field sampling leader attest and document that they and the field team have read and understand these site documents.

EQUIPMENT AND MATERIALS

- Informational materials for sampling event: A copy of the current approved site-specific Health and Safety Plan, site-specific SAP and HWRB Master QAPP, monitoring well construction data, location map(s), field data from prior sampling events, manuals for sampling, diagram(s) to show how the equipment should be set up, and the monitoring instrument's operation and maintenance manuals, should be brought to the site.
- Appropriate health and safety gear.
- Site and well keys, spare locks, and bolt cutters.
- Electronic water level indicator capable of measuring to one-hundredth of a foot (0.01') accuracy.
- Adjustable rate Geotech Peristaltic Pump Series II Variable Speed pump 300 + 600 RPM with Easy Load Peristaltic Pump Heads (that allow 50 ml/minute) and a battery (marine, battery pack, etc)
- ¼" ID x 3/8" OD polyethylene tubing for down-hole installation: enough to dedicate to each well.
- Pharmaceutical or surgical grade silicon tubing for pump. <u>For sampling</u>: Thin walled tubing #16 (1/8" x ¼" x 1/16") and/or thin walled tubing #14 (1/16" x 3/16" x 1/16") if necessary to reduce flow to 50 ml/min. <u>For connections</u>: thick walled tubing #15 (3/16" x 3/8" x 3/32".
- YSI 600XL/XLM Multi-parameter unit with a 250 ml or less transparent flow cell, capable of measuring pH (units); ORP in mV; DO in milligrams per liter (mg/L), 100% saturation for calibration; specific conductance in µS/cm and temperature (˚C).
- Appropriate calibration solutions for the YSI meter including: 0 mg/L DO for DO; Zobell

solution for ORP; two different specific conductance standards to calibrate and check calibration (e.g. 718 and 1,413 µS/cm); and 4, 7, & 10 units pH. Extra DO membranes in case of breakage. Small wet sponge or paper towel for DO 100% saturation calibration.

- Hach 2100P or 2100Q Turbidity Meter.
- Calibration solutions the Hach Turbidity meter: <0.1, 10, 20, 100, 800 Nephelometric Turbidity Units (NTUs) standards as appropriate for each meter.
- One use only 0.45 micron in-line filters for dissolved metals, if required.
- A three way stop cock to divert sample flow (before the multi-parameter meter) to collect turbidity samples.
- Flow measurement supplies: graduated cylinder sized according to the flow rate (250 ml max), measured in 10 ml increments, stop watch, and 5 gallon graduated bucket for purge water.
- Logbook, pencil/pen/sharpies, sharp knife (locking blade), calculator.
- Field-data sheets, sample labels, and chain-of-custody records.
- Sample containers and spare containers, preserved as necessary, provided by the laboratory.
- Loose ice and a sample cooler/shipping containers, re-sealable plastic bags and packing materials.
- Clear tape – Place clear tape over sample container labels before sampling in the event the labels are not water proof labels. Alternative – use plastic water proof labels.
- Onsite Tools -- to include at least: bolt cutters, spare well locks, screwdrivers, pliers, hacksaw, duct tape, hammer, flashlight, adjustable wrench, socket set.
- Decontamination equipment and supplies in accordance with the Decontamination SOP in the SAP.
- Trash bags to containerize solid waste.
- Tap water / Deionized Water (DI) / distilled water, as necessary.
- Flagging/spray paint as needed to demark well locations, if needed.
- Equipment protection paraphernalia, including a tent/canopy, to:
    - Adequately shade equipment and tubing to prevent temperature variations in the readings, bubbles forming in the tubing, and to prevent the acid preservative in the sample containers from volatilizing;
    - Protect both personnel and equipment from other elements including rain, wind; etcetera.
    - Keep the sampling equipment from freezing in the winter.

- Equipment to keep monitoring and sampling equipment off the ground (e.g. table, bucket or polyethylene sheeting).

EQUIPMENT/INSTRUMENT CALIBRATION

1. In general, all instrumentation necessary for field monitoring and health and safety purposes shall be maintained, tested, and inspected according to the manufacturer's instructions prior to the sampling event. This will ensure that the equipment/instruments are working properly before they are used in the field. The manufacturer's instruction manuals for field equipment shall be on site during each sampling event.

2. **All field instruments shall be successfully calibrated, and have a successful calibration check, in the office prior to the field event (within one week) to ensure that the equipment is working properly and meets the QA criteria.**

3. *IMPORTANT – Refer to the Calibration SOP in the SAP for specific calibration information and procedures. All calibration and check values shall be documented on the calibration log maintained by each user.*

4. The instrument shall be calibrated at the beginning of each sampling day at the Site prior to sample collection using the appropriate solutions. The calibration will be checked in the run mode after the morning calibration has been completed to ensure that the calibration was successful. If the field measurement falls outside the calibration range, the instrument must be re-calibrated so that all measurements fall within the calibration range.

5. The calibration will be checked at the end of the day in the run mode to verify the accuracy of the instrument readings throughout the day. If a calibration check at the end of the day is not within the acceptable range for any parameter, the data collected that day for that parameter shall be qualified in its use. This qualification shall be documented on the calibration log and the field sheets/logs for the appropriate sampling locations. For example: pH measurements are collected as part of the low flow sampling procedure. If the afternoon pH calibration check was not within the acceptable range that day, the pH data collected by that instrument on that day would be qualified as useful only for determining stabilization and not as representative pH measurements of the water being sampled. That qualification would then be documented on the calibration log and the sampling sheet for each of those locations.

6. In addition, should any erratic or illogical readings occur during the field day and between calibrations, the instrument shall be recalibrated in order to ensure that representative measurements are obtained. Refer to the Calibration SOP in the SAP for specific calibration procedures.

7. If the field instruments are being used to monitor the natural attenuation parameters then a calibration check at mid-day is highly recommended to ensure that the instruments did not drift out of calibration.

8. Note: during the day, if the instrument reads zero or a negative number for dissolved oxygen, pH, specific conductance, or turbidity (negative value only); this indicates that the instrument drifted out of calibration or the instrument is malfunctioning. If this situation

occurs the data from this instrument will need to be qualified or rejected, and the instrument must be recalibrated before use.

9. Failure to calibrate or perform proper maintenance on the sampling equipment and measurement instruments (e.g., multi-parameter meter, etc.) can result in faulty data being collected.

PRELIMINARY PROCEDURES INCLUDING WATER LEVEL MEASUREMENTS

1. The dedicated tubing intake within each well should be located at the midpoint of the saturated well screen length based on historical groundwater low unless otherwise specified in the SAP.

   Great care must be taken during tubing installation and sampling to minimize the disturbance of particulates that can greatly extend the purge time by increasing turbidity.

2. Check well for security (damage, evidence of tampering, missing lock, etc.) and record pertinent observations (include photograph as warranted). Note any physical changes to well condition, such as erosion or cracks in protective concrete pad, road box or standpipe. If a lock is found to be damaged, replace with a new lock. Wells shall be locked at all times when not being sampled.

3. A synoptic water level measurement round should be performed (in the shortest possible time) before any purging and sampling activities begin. Refer to the Groundwater Elevation Monitoring SOP in the SAP. It is recommended that water levels (to 0.01 feet) be measured at least one day prior to well sampling activities, if possible, in order to allow for re-settlement of any particulates in the water column.

4. The depth to the bottom of the monitoring well should be confirmed in each well every five years during the sampling event just prior to the 5-year review.

   If measurement of total well depth is to be collected and is not made the day before, it should not be measured until after sampling of the well is complete.

5. Set up equipment according to the attached Low Flow Equipment Setup Diagram. Lay out sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, bucket, etc.). Be sure to tilt the low flow cell with the outflow connection facing upward to eliminate and prevent air bubbles.

6. Be sure all sampling equipment is properly protected from the weather.

WELL PURGING AND SAMPLING PROCEDURES

1. A water level indicator should be carefully lowered to the top of groundwater. Measure and record the water level (to 0.01 feet) before any disturbance to the well. Care should be taken to minimize suspension of any particulates attached to the sides.

2. Install and secure polyethylene sampling tubing if necessary. Each well will have dedicated sampling tubing for the event, which will be left in the well for future rounds. In general, the depth of the tubing intake will be the midpoint of the saturated screen length

in consideration of historic low water levels where there are 10 foot screens; however, that may not be appropriate for longer screened wells. Refer to SAP for the proper location of the tubing intake.

In general, the tubing intake needs to be kept at least one to two feet above the bottom of the well to avoid disturbing any sediment on the bottom. The exceptions to this include wells with 2-foot screen lengths and those wells that typically have less than 2 feet of saturated thickness and are not flowing under artesian conditions. For these wells, the intake will be adjusted during each sampling round to be the middle of the saturated screen based on the current water level, and needs to be at least ½-foot off the bottom of the well. If there is less than ½-foot of water, a sample will not be collected.

3. Lower the water level meter to the top of the water table and measure and record the water level again with the tubing in the well before starting the pump.

4. From the time the pump starts purging and until the time the samples are collected, the purged water is discharged into a graduated bucket to determine the total volume of groundwater purged. Record total volume purged on the Low Flow Sampling Worksheet.

5. If available, check flow rates, drawdown and pump setting information from previous sampling events for each well. Duplicate, to the extent practicable, the final settings and flow rates from previous events. For wells that are routinely sampled, refer to the ***prior Low Flow Sampling Worksheets*** to determine the initial settings to reach stabilization of the water level as quickly as possible. This is only a guide and the sampler will need to "fine tune" the operating conditions since the recharge rate of groundwater may vary.

   If changes are made in the settings used during previous sampling events, record new values on the sampling worksheet and explain reasons for the changes.

6. If no previous information is available, start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Check water level.

7. The water flow during sampling needs to be a laminar flow without air bubbles. If air bubbles are observed they can usually be removed by elevating the discharge tube and pump to allow the air to continue rising until discharged with the water.

   Prevent sample tubing from crimping and avoid the use of constriction devices on the tubing to decrease the flow rate because the constrictor will cause a pressure difference in the water column. This will cause the groundwater to degas and result in a loss of VOCs and dissolved gasses in the groundwater samples. All tubing needs to maintain open condition.

8. Adjust pump rates until there is little or no water level drawdown. The purge rate should be close to the well recharge rate so that the water level in the well doesn't decrease during purging. Pumping rates shall not be less than 50 ml/minute.

   If excessive turbidity or floc is anticipated or encountered with the pump startup, divert the water through the three way stopcock, as if you were taking a turbidity sample, until it clears in order to minimize particulate buildup in the cell (this is a judgment call made by the sampler). Make sure that the discharge water is going into the graduated bucket as part of the final purge volume.

Concentrate on the flow rate and water level stabilization in the beginning of the well purging effort. For new wells being sampled, in general, the water level is expected to be stabilized within the first fifteen minutes of purging.

9. Recording of the indicator parameters is not mandatory during this initial time period when attempts are being made to stabilize the water level; however make sure the purge water is still being collected in the graduated bucket as part of the total purge volume.

   Make a notation on the field worksheet "NR" for "no reading" at times when only partial data is being collected (i.e. water level only) during this initial stage of stabilizing the water level. Note that if you observe minimum fluctuation of the indicator parameters during this initial period go ahead and begin recording data as it may limit the total volume purged. Measure purge volume of a cycle with a 250 ml graduated cylinder or smaller size.

10. During pump start-up, drawdown may exceed the 0.3 feet target and then "recover" somewhat as pump flow adjustments are made. If the initial water level is above the top of the screen do not allow the water level to fall below the top of the well screen. If the drawdown has exceeded 0.3 feet and stabilizes, continue purging until the indicator parameters stabilize.

    Pumping rates should, if needed, be reduced to the minimum capabilities of the pump to avoid drawdown and to ensure stabilization of monitoring parameters. If the water level continues to drop with the pump settings at the lowest level or if the flow rate for a stabilized groundwater level is below 50 ml per minute, the well will be considered to have insufficient recharge for low flow sampling. Refer to the "*Monitoring Wells That Have Insufficient Recharge*" section below for instructions as to how to sample the well.

    If the water level drops to the top of the well screen or open interval, stop purging and refer to the "*Monitoring Wells That Have Insufficient Recharge*" section below for instruction as to how to sample the well.

11. Begin recording the water level, draw down, pumping rate, any adjustments, and the indicator field parameters (pH, turbidity, specific conductance, temperature, DO and ORP) every ten minutes until the well starts to stabilize. Once the well begins to stabilize record readings every five minutes until the well stabilizes or until the two hour time limit is up. **Readings shall not be less than five minutes apart.**

    Periodically check the probes and the top of the flow through cell for air bubbles and eliminate any that are found. Be sure to tilt the flow through cell with the outflow connection facing upward to eliminate and prevent air bubbles.

    Rinse the turbidity vial with DI water before collecting the first sample. Rinse with fresh purge water or DI water between readings to eliminate any sediment that may have collected on the bottom.

    Condensation (fogging) of Turbidity Vial: Condensation may occur on the outside of the sample cell when measuring a cold sample in a warm, humid environment. Condensation interferes with turbidity measurement, so all moisture must be thoroughly wiped off the sample cell before measurement. If fogging recurs, let the sample warm slightly by standing at ambient temperature or immersing in a container of ambient temperature water

for a short period. After warming, gently invert the sample cell to thoroughly mix the contents before measurement.

When recording pH and DO data, round off data to one decimal place (nearest tenth). When DO is less than 0.5 mg/L, data should be recorded as "< 0.5" or "less than 0.5". When recording specific conductance, temperature, turbidity, and ORP data, record only whole numbers (round off to the nearest whole number). When turbidity data is less than 5 NTU, data should be recorded as "< 5" or "less than 5".

12. The well is considered ready for sample collection once the water level and the indicator parameters have stabilized and the purge volume requirement has been met, or two hours of purge time has elapsed. Stabilization is considered to be achieved when three consecutive readings at five-minute intervals **(or greater)**, are within the following limits:

    - Temperature =/< 3%. Values are typically rounded to the nearest whole number.
    - Specific Conductivity =/< 3% (shall be reported in uS/cm). Values are typically rounded to the nearest whole number.
    - Dissolved Oxygen =/< 10% for values greater than 0.5 mg/L. If three consecutive DO values are less than 0.5 mg/L, consider the values as stabilized. Values are typically rounded to one decimal place.
    - pH =/< 0.1 unit. Values are typically rounded to one decimal place.
    - ORP =/< 10 millivolts **(10 millivolt units not 10 %)**. Values are typically rounded to the nearest whole number.
    - Turbidity =/< 10% for values greater than 5 NTU (rounded to a whole number, values between 5 and 10 will be considered stable within +/- 1 NTU). If three consecutive turbidity values are less than 5 NTU, consider the values as stabilized. Values less than 5 NTU are typically reported as <5.

13. The final purge volume must be greater than the stabilized drawdown volume plus the pump's tubing volume. If parameter stabilization has been achieved but the purge volume criteria has not been met, pumping must be continued until the combined volume (stabilized drawdown plus tubing volume) has been purged from the well or the two hour limit has been reached.

    Purge volume calculations should utilize stabilized drawdown value, not the initial drawdown. Calculate the volume of water between the initial water level and the stabilized water level. Add the volume of the water which occupies the pump's tubing to this calculation. This combined volume of water needs to be purged from the well before samples are collected. Purge volume calculations must be documented on the field worksheet

14. If all the indicator field parameters have not stabilized within 2 hours of purging, collect the samples and record the following information on the field worksheet: indicate that two-hour purge limit was reached, note the specific conditions that were not achieved, which parameters were not stabilized, the final set of readings, and the total purge volume.

    Samples for laboratory analyses must be collected before the flow cell and three way stop cock. This will be done by disconnecting the flow cell and three-way stop cock after reaching stabilization. The sample should be collected directly through the pump tubing.

15. Remove the cap from the sample container and place it on the plastic sheet or in a location where it won't become contaminated.

16. Refer to the SAP for specific samples to be collected. The order in which samples should be collected from each well includes:

    a. VOCs (see special notes), as applicable

    b. 1,4-Dioxane, as applicable

    c. PFAS, as applicable (Refer to SOP-10 for specific sampling procedures related to PFAS sampling)

    d. Total metals (Dissolved metals if required)

    e. Other parameters, as required

    For collecting VOC samples including 1,4-dioxane (using Methods 8260 SIM), carbon dioxide, and methane/ethane/ethane, refer to the Special Notes section at the end of this SOP.

    If dissolved metals are required, attach a onetime use only 0.45 micron in-line filter to the end of the tubing. Hold the filter upright until the purge water exits the top to allow the water to completely fill the filter. Allow a sufficient amount of purge water to discharge into the bucket to rinse the filter before collecting the sample. Discard the filter after use. When collecting a duplicate sample, a new filter must be used.

17. All sample containers should be filled by allowing the discharge to flow gently down the inside of the container with minimal turbulence. Cap sample containers securely after filling each bottle. Sample containers should be wiped dry.

18. Field duplicate and matrix spike, matrix spike duplicate (MS/MSD) samples should be collected by filling a separate container for each analysis immediately following the actual field sample collection and should be in the same priority order as indicated above. Refer to SAP for specific QC sampling requirements and appropriate COC notations required for MS/MSD samples.

19. Place samples in re-sealable plastic bags and then in loose ice within the cooler. Metals samples do not require cooling.

20. If the water level drops to, or below, the tubing intake during sample collection, then discontinue sampling at the location and return to collect the remaining samples once the well has sufficiently recharged.

21. Just prior to turning off the pump, measure and record the water level on the worksheet, then turn off the pump.

22. Record the total purged volume (contained within the graduated bucket) on the worksheet.

23. Disconnect equipment as needed. Tubing should be secured to the inside of the well.

24. Collect the well bottom depth information if required. Record depth to bottom measurement on the Low Flow Sampling Worksheet. Also note variation in total depth of

well compared to that previously recorded. Remove the water level meter tape and secure the well.

25. All non-dedicated equipment (water level meter) must be decontaminated following the Decontamination SOP in the SAP.

26. If an equipment blank is required, specific QC sampling requirements and appropriate COC notations are required for samples.

MONITORING WELLS THAT HAVE INSUFFICIENT RECHARGE

This procedure is to be used if the well has insufficient recharge and stabilized drawdown cannot be achieved. Well purging is not required prior to taking samples under these conditions.

If the low flow procedure was attempted unsuccessfully during the current monitoring round, or if the water level dropped below the top of the well screen or open interval, ensure that the well has recharged sufficiently and there is ample water to remove one tubing volume of water and collect all the samples before continuing with this procedure. When samples are being collected, the water level must not drop below the top of the screen or open interval. If the water does drop below the top of the screen, let the well recover until there is sufficient water to collect the remaining samples, unless otherwise directed by the Field Team Leader.

1. Measure the water level. Carefully lower a water level indicator to the top of groundwater, measure and record the water level (to 0.01 feet) before any disturbance to the well. Care should be taken to minimize suspension of any particulates attached to the sides.

2. Prior to sample collection, purge one discharge line volume.

   The purge volume is equal to h *3.14(r/12)^2 * 7.48 gal/ft^3

   One purge volume is equal to (h) * (f) where:
   h = length of tubing
   f = the volume in gal/foot

   Then convert gallons to milliliters (1 gallon = 3785 mL) so that the purge volume can be accurately measured using a graduated cylinder.

Tubing Diameter (inches)	¼ - inch (0.25) OD **(0.17 in ID)***	3/8 - inch (0.375) OD **(0.25 in ID)***	1/2 - inch (0.50) OD **(0.375 in ID)***	5/8 - inch (0.625) OD **(0.50 in ID)***
Volume (gal/foot)	0.0012	0.0026	0.0057	0.0102
Volume (ml/foot)	4.5	9.7	21.7	38.6

   Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs. Pump rate may be increased to sample at a rate of 50 ml/min.

3. Remove the cap from the sample container and place it on the plastic sheet or in a location where it won't become contaminated.

4. Following purging of the discharge line, immediately begin collecting groundwater samples with the following parameter priority:

a. VOCs (see special notes), as applicable
b. 1,4 Dioxane, as applicable
c. PFAS, as applicable (Refer to SOP-10 for specific sampling procedures related to PFAS sampling)
d. Total Metals, (then dissolved metals), as applicable
e. Other parameters, as required

For collecting VOC samples including carbon dioxide, and methane/ethane/ethane, refer to the Special Notes section at the end of this SOP.

5. All sample containers should be filled by allowing the discharge to flow gently down the inside of the container with minimal turbulence. Cap sample containers securely after filling each bottle.
6. Refer to the previous section for collecting duplicate and MS samples.
7. Place samples in re-sealable plastic bags and then in loose ice within the cooler. Metals samples do not require cooling.
8. Disconnect equipment as needed. Tubing should be secured to the inside of the well.
9. Secure the well with the locking cap.
10. All non-dedicated equipment (water level meter) must be decontaminated following the Decontamination SOP in the SAP.
11. Wells where this occurs will be considered for replacement in the future.

RECORDS AND DOCUMENTATION

A field log must be kept each time ground water monitoring activities are conducted in the field. The attached Low Flow Sampling Worksheet is the approved form for use by staff. Fill out the worksheet completely. The field log/sampling worksheet should document (at a minimum) the following in ink:

- Job name;
- Well identification, condition of well;
- Name of sample collector(s):
- Description of all the sampling/monitoring equipment used, including type of pump used, trade names, model number, instrument identification (serial) number, diameters, material composition, etc. (Some of this information may be located on the Calibration log, see SOP#8 Calibration of YSI Hach Field Instruments).
- Date;
- Well depth, in reference to measuring:

- Well screen interval from measuring point (if known);
- Static water level from measuring point;
- Pump serial numbers/identification numbers;
- Pump rate, or flow rate including units;
- Any adjustments made (including adjustments in flow rates, etc.);
- Time of all measurements;
- All measurement readings of indicator parameters;
- Water level at the specified pumping rate (water levels are measured from the measuring point, either top of PVC or top of metal casing, as specified in the SAP);
- Drawdown and cumulative drawdown, in feet;
- Total purge volume;
- Time of sample collection (start, and end);
- Sampler's signature;
- Laboratory analyses requested; and
- Notation of which indicator parameters did not stabilize after two hours of purging (if any).

Refer to the *Chain-of-Custody, Sample Packaging and Shipment Procedures* in the SAP for additional documentation requirements.

If a calibration check at the end of the day is not within the acceptable range for any parameter(s), the data collected that day for that parameter shall be qualified in its use. A note must be added to the worksheet to indicate the qualification and the values for that parameter highlighted. (Example note: "The afternoon calibration check for ORP was not within the acceptable range; therefore, these ORP values can only be used for determining stabilization and not as representative of actual ORP values of the water being sampled.")

SPECIAL NOTES

Special Considerations for Volatile Organic Compound Sampling

This consideration for VOC collection includes 1,4-dioxane samples analyzed by Method 8260 SIM.

The proper collection of a sample for volatile-organic compounds requires minimal disturbance of the sample to limit volatilization and therefore a minimal loss of volatiles from the sample. The following VOC procedures should be followed:

1. Open the vial, set cap in a protected place, and collect the sample by allowing the water to gently flow down the inside wall of the container for minimal turbulence. When collecting quality control samples (duplicate and MS/MSD samples) collect them immediately following the original sample (e.g., VOC sample, VOC duplicate sample, VOC MS/MSD sample).
2. Do not rinse the vial or excessively overflow it because it likely contains a specific volume or preservative that must not be diluted.
3. Do not collect the initial 10 ml (approximate) of sample in the discharge tubing, as the beginning of the sample has been in contact with air.
4. Be sure the sample flow is laminar and there are no air bubbles in the sample flow.
5. There should be a convex meniscus on the top of the vial. You can use the cap to create the convex meniscus for VOC samples, if needed.

   For methane/ethane/ethene and carbon dioxide, the laboratory requests that the sample bottle cap is not used to top off the sample vials. These vials should be filled in the shortest time possible and capped immediately. Do not uncap these vials and add more water. Small bubbles are considered normal for these pre-preserved containers; however, every effort should be made to collect the best sample possible.
6. Check that the cap has not been contaminated (splashed) and carefully cap the vial.
7. Place the cap directly over the top and screw down firmly. Do not over-tighten and break the cap.
8. Invert the vial and tap gently. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling the vial. If this has to be repeated more than twice, discard the sample and begin again with a new container and preservative. It is imperative that no entrapped air is in the sample vial.
9. Wipe the vial dry and immediately place the vial in a re-sealable plastic bag or the protective foam sleeve (if available) and then place into loose ice in the cooler.

REFERENCES

Low Flow Groundwater Purging and Sampling Procedure included in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA#13027, Revision 4, March 2017.

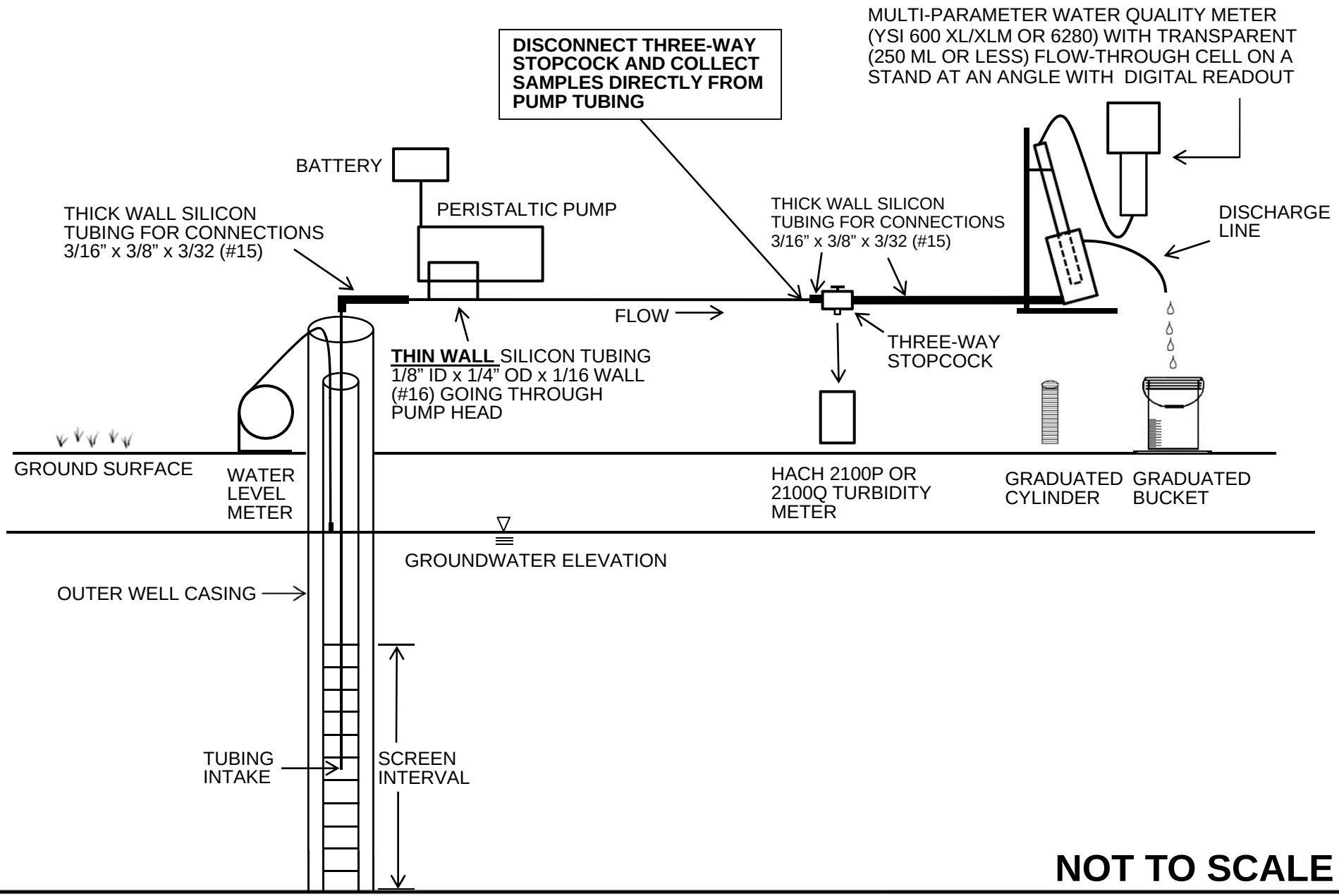
EPA's "Groundwater Sampling EPA Region 1 "Low Stress Purging and Sampling Procedure For the Collection of Ground Water Samples From Monitoring Wells", dated July 30, 1996, as revised January 19, 2010.

ATTACHMENTS

Low Flow Equipment Setup Diagram – Peristaltic Pump

Low Flow Sampling Worksheet

LOW FLOW SETUP DIAGRAM USING A PERISTALTIC PUMP



NOT TO SCALE

Coakley Landfill - Low Flow Sampling Worksheet for Peristaltic Pump

Date : _____ Well ID : _____

Weather Conditions : _____

Field Personnel: _____

Peristaltic Pump Serial #: _____

Reference Measuring Point (circle one): Top of PVC -or- Top of Casing (Refer to Table 3-1)

Screen Interval (ft, ref. to measuring point): _____ (Refer to Table 3-1)

Purging Start Time : _____ (24 hour cycle) Sample Time: _____ (24 hour cycle)

Well Depth (ft, ref. to measuring point): _____

Initial Water Level (ft, ref. to measuring point): _____

Tubing Intake (ft, ref. to measuring point): _____

Total Purge Volume (gallons): _____

Indicator Parameter Stabilization (circle one) ? : YES or NO

Two Hour Time Limit Reached (circle one) ?: YES or NO

Time at Sample Completion: _____ (24 hour cycle)

Clock Time (24 HR)	Water Level (ft below measuring point)	Drawdown (ft)	Cumulative Drawdown (ft)	Purge Rate (mL/min)	Temp +/- 3% (1) (ºC)	Spec. Cond. +/- 3% (1) (µS/cm)	pH +/- 0.1 (1) std units	ORP +/-10 mV (not %) (1) (mV)	DO +/- 10% if > 0.5 (1) (mg/L)	Turbidity +/- 10% if > 5 (1) (NTU)	Comments/Adjustments

Lab Analyses Requested	QA/QC Samples	Purge Volume Calculations

Notes: 1. When recording pH and DO data, only use one decimal place. When recording specific conductance, temperature, turbidity, and ORP data, record only whole numbers.
When turbidity data is less than 5 NTU, data should be recorded as "< 5". Turbidity values between 5 and 10 considered stable if within +/- 1 NTU; however, < 5, 5 and < 5 is not stablized.
When DO data is less than 0.5 mg/L, data should be recorded as "< 0.5"; three consecutive "<0.5" is stable, however, <0.5, 0.6, <0.5, is not stablized

2. When determining stablization, all values must be within the specificed stabilization criteria for the parameter (e.g. for ORP: 10, 20, 15 is stable but 10, 21, 15 is not)

3. "NR" indicates no reading taken.

Sampler's Signature: _____

SURFACE WATER, LEACHATE SEEP, SEDIMENT SAMPLING PROCEDURES

PURPOSE

The purpose of this standard operating procedure (SOP) is to obtain surface water, leachate seep, and sediment samples for analyses that are representative of environmental conditions at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire. The collection of these samples using the following sampling procedures will be carried out at the locations identified in the Coakley Landfill Sampling and Analysis Plan (SAP).

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

It is assumed that sampling can be conducted either from the shore, or by a sampler standing in the water wearing boots or waders.

SAFETY

This sampling procedure requires two field personnel.

If a sample cannot be obtained safely, the sample should not be taken at all and the conditions documented in the sampler's field book. Potential dangers include, but are not limited to, uneven and rocky terrain that may cause a fall or other personal injury. All necessary precautionary measures should be heeded when performing these sampling techniques.

GENERAL INFORMATION

1. Each of the regular sampling locations is permanently marked in the field so that sampling points are consistent for each round. All surface water and sediment samples shall be located using a global positioning system (GPS) unit.
2. Digital photographs shall be taken at each sampling location, upstream and downstream from the same position. Consistency should be maintained between sampling rounds.
3. Surface water, leachate seep, and sediment sampling will occur congruent to the groundwater sampling event. Based on weather reports, the sampling team will select the driest period during the Site sampling events to collect the samples**,** unless otherwise directed by the project manager.
4. When surface water and sediment sampling are both required at the same location; surface water samples are collected first, followed by sediment samples.
5. Additional information to be recorded on the Surface Water Sediment Worksheet includes the following:

- Past 7 days of local meteorological data showing a minimum of daily precipitation totals and barometric pressure;
- General physical description of the samples and sampling locations; and
- Descriptions/ID's of digital photographs

PART I – SURFACE WATER

This SOP specifically describes the procedures for collecting surface water samples; however, it also applies to the collection of leachate seep samples associated with the Coakley Landfill Superfund Site.

In general the surface water samples shall be collected using the dipping technique described below. If there is not enough water to collect the surface water samples using a wide-mouth glass transfer vessel, samples may be collected using tubing and a peristaltic pump. However; extra caution will be required if collecting a sediment sample at the same location so that the sediment is not disturbed or lost.

EQUIPMENT AND MATERIALS

- Informational materials for sampling event: A copy of the current approved site-specific Health and Safety Plan, site-specific SAP, HWRB Master QAPP, location map(s), field data from prior sampling events, manuals for sampling, and the monitoring instrument's operation and maintenance manuals, should be brought to the site.
- Appropriate personal protective equipment (PPE).
- Waders.
- Pole and strapping as necessary to collect samples from locations with limited access.
- New wide-mouth glass sample containers (jar) for each sampling location, plus extra, to use as transfer vessel to fill pre-preserved sampling containers; pre-cleaned by laboratory.
- Fifty (50) cc or larger syringes and 0.45 micron filters to fit over the end of the syringes for each sampling location to collect dissolved metals, as required. Have enough filters on hand to collect the volume required by the lab. Keep in mind that the turbidity of the water may clog the filters at an unknown rate. Use separate filters when collecting duplicate samples.
- Logbook, pencil/pen/sharpies, calculator.
- Appropriate sample containers, pre-preserved as necessary by the laboratory.
- Re-sealable plastic bags to protect and store samples.
- Cooler and loose ice.
- YSI 600XL or XLM Multiparameter Unit with a built in barometer with a probe guard to take

in-situ readings for pH, Specific Conductivity, Temperature, oxygen reduction potential (ORP) and dissolved oxygen (DO).

- Appropriate calibration solutions for the YSI meter including: 0 mg/L DO for DO check; Zobell solution for ORP; two different specific conductance standards to calibrate and check calibration (e.g. 718 and 1,413 µS/cm); and 4, 7, & 10 units pH. Extra DO membranes in case of breakage.
- Hach 2100P or 2100Q Turbidity Meter.
- Calibration solutions the Hach Turbidity meter: <0.1, 10, 20, 100, 800 Nephelometric Turbidity Units (NTUs) standards as appropriate for each meter.
- Field data from last sampling event if available.
- Field data sheets, sample labels, chain of custody forms.
- The manufactures instruction manuals for all equipment.
- Paper towels.
- Trash bags to containerize solid waste.
- Toolbox to include general items such as large and small wrenches, pliers, screw drivers, 25' measuring tape, hose connectors, sharp knife (locking blade), duct tape, at a minimum.
- Decontamination supplies as described in the Decontamination SOP included in the SAP.
- Digital camera.

If a peristaltic pump is used, the following additional equipment will be required:

- Adjustable rate Geotech Peristaltic Pump Series II Variable Speed pump 300 + 600 RPM with Easy Load Peristaltic Pump Heads (that allow 50 ml/minute) and a battery (marine, battery pack, etc)
- ¼" ID x 3/8" OD polyethylene tubing for sample collection – new tubing will be used at each sampling location and disposed.
- Pharmaceutical or surgical grade silicon tubing for pump. <u>For sampling</u>: Thin walled tubing #16 (1/8" x ¼" x 1/16") and/or thin walled tubing #14 (1/16" x 3/16" x 1/16") if necessary to reduce flow to 50 ml/min. <u>For connections</u>: thick walled tubing #15 (3/16" x 3/8" x 3/32" – new tubing will be used at each sampling location and disposed.
- A three way stop cock to divert sample flow (before the multi-parameter meter) to collect turbidity samples.
- A 250 ml or less transparent flow cell and a ring stand for the YSI 600XL/XLM Multi-parameter unit.
- Equipment to keep monitoring and sampling equipment off the ground (e.g. table, bucket or polyethylene sheeting).

- Possible slender stake/stainless steel rod and zip ties to hold tubing at the correct depth in the water.
- Single-use disposable 0.45 micron in-line filters for dissolved metals, if required (refer to SAP).

PRELIMINARY PROCEDURES

1. In general, all instrumentation necessary for field monitoring and health and safety purposes shall be maintained, tested, and inspected according to the manufacturer's instructions. The manufacturer's instruction manuals for field equipment shall be kept on-site with the equipment.
2. All instruments will be successfully calibrated once by the sampling team prior to the sampling event. Instruments will be calibrated and checked according to the Calibration SOP in the SAP.
3. Sampling occurs sequentially from downstream to upstream. Each sampling location is entered from downgradient side.
4. Prepare sampling equipment and bottles on shore.

A. PROCEDURE USING THE DIPPING TECHNIQUE

The following procedures shall be used to collect a surface water sample from each location:

1. Laboratory samples are collected first, followed by in-situ field screening parameters using the YSI meter and turbidity using the Hach meter. If there is a co-located sediment location, surface water samples are collected first, then in-situ field screening parameters, followed lastly by the sediment sample.
2. All surface water samples and field parameters are generally collected from the shore. Refer to the SAP for specific locations to be sampled.
3. In general, surface water will be collected using the dipping technique (except for dissolved metals) using a clean wide-mouth glass bottle (without preservatives); attached to a pole with strapping or tape, if necessary. Rinse each pre-cleaned sample container downstream of the sampling location once. The sample will be collected from just below the surface of the water (one to two inches). Make sure that the sample is free of floating debris and/or surface skim. Refer to the SAP for specific analysis.

   Remove the cap from the sample container and place it on the plastic sheet or in a location where it won't become contaminated.

   Surface water will be transferred to the containers by allowing the water to flow gently down the inside of the sample containers with minimal turbulence in the following order:

   - VOCs
   - 1,4-Dioxane, as applicable

- PFAS, (Refer to SOP-10 for specific sampling procedures related to PFAS sampling).
- Total metals (Dissolved metals, as required)
- Other parameters, as required

Note: If dissolved metals are required see special procedure below.

4. Field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples should be collected by filling a separate container for each analysis immediately following the actual field sample collection and should be in the same priority order as indicated above. Duplicate samples are not intended to be blind duplicate samples. They should be designated with a "DUP" after the well designation as indicated in the SAP. Refer to the SAP for specific QC sampling requirements and appropriate COC notations required for MS/MSD samples.
5. Cap sample containers securely after filling each bottle. Sample containers should be wiped dry.
6. Place samples in re-sealable plastic bags and then in loose ice within the cooler or store the sample in accordance with appropriate protocols. Metals samples do not require cooling.
7. With the probe guard on the YSI instrument, rinse the probes in the surface water downstream of the sampling location.
8. Immerse the probes into the water, immediately upstream of any disturbance caused by accessing the sample location, making sure it is deep enough to cover the probes and probe guard. It is important that there are no air bubbles on/in the electrode. To dislodge any bubbles, gently move the electrode through the water before recording the measurement. If the sample location is not accessible, a pole and strapping may be used to hold the probes in place for stabilization and readings.
9. Allow a minimum of two minutes for the readings to stabilize.
10. Once the readings have stabilized, record the pH (unit), Specific Conductivity (µS/cm), Temperature (°C), ORP (millivolts) and DO (mg/L) on the worksheet.
11. Rinse out a turbidity vial downstream of the sampling location.
12. Collect an aliquot of water for the Hach Turbidity Meter and analyze the sample for turbidity. Record the NTU value on the Surface Water Worksheet.
13. Take digital photographs at each location upstream and downstream unless collecting sediment samples, in which case the photographs would be taken after the sediment samples have been collected.

Procedure to Collect Surface Water Samples for Dissolved Metals

1. Rinse the syringe in the surface water downstream of the sampling location three times.
2. Facing upstream and using the same syringe, slowly lower the syringe into the water one to two inches below the surface and fill the syringe.

3. To rinse the filter prior to collecting the sample:
    a) Place the tip of the syringe into the inlet of the filter.
    b) Face downstream.
    c) Discharge the water through the filter downstream until a few centimeters of water exits the filter.
    d) Any remaining water in the syringe and filter apparatus can then be collected in the pre-preserved container.
4. Facing upstream and using the same syringe, slowly lower the syringe into the water one to two inches below the surface and fill the syringe.
5. Place the tip of the syringe into the inlet of the pre-rinsed filter and discharge the water directly into a pre-preserved container.
6. Repeat the previous two steps until the proper volume has been collected.

   The filter may clog and need to be replaced before the proper volume has been collected. If this is the case, rinse the new filter before use and continue until the proper volume has been collected.
7. Cap sample containers securely after filling each bottle. Sample containers should be wiped dry and store the sample in accordance with appropriate protocols.
8. Dispose of the filters and syringes after use.

B. PROCEDURE USING THE PERISTALTIC PUMP

Preliminary Procedure

1. Set up sampling equipment on shore as if following the low flow sampling procedure. Refer to the attached set-up diagram from the low flow sampling procedure in the SAP. Lay out sheet of clean polyethylene for monitoring and sampling equipment, unless equipment is elevated above the ground (e.g., on a table, bucket, etc.). Be sure to tilt the low flow cell in the ring stand with the outflow connection facing upward to eliminate and prevent air bubbles.

   DO NOT CONNECT THE TUBING TO THE FLOW THROUGH CELL.

   The samples shall be collected first. If there is still enough water, then the field parameters shall be collected.
2. Determine and cut the appropriate length of tubing needed to reach the surface water sampling location. The sample will be collected one to two inches below the surface of the water.
3. If necessary, secure a slender stake, stainless steel rod at the sampling location and secure the tubing to the rod so that the intake of the tubing is at least an inch below the top of the surface of the water.
4. Prepare bottles on shore.

Sampling Procedure

1. Start the pump at its lowest speed setting and slowly increase the speed until discharge occurs, making sure that the tubing is fat enough below the water surface so that surface scum or debris is not pulled into the tubing.
2. Check the tubing; the water flow during sampling needs to be a laminar flow without air bubbles. If air bubbles are observed they can usually be removed by elevating the discharge tube and pump to allow the air to continue rising until discharged with the water.
3. Once a laminar flow is achieved, begin collecting the samples.
    a) Remove the cap from the sample container and place it on the plastic sheet or in a location where it won't become contaminated.
    b) Refer to the SAP for specific samples to be collected. The order in which samples should be collected from each well includes:
        - VOCs
        - 1,4-Dioxane, as applicable
        - PFAS - (Refer to SOP-10 for specific sampling procedures related to PFAS sampling)
        - Total metals (Dissolved metals, as required)
        - Other parameters, as required
    c) All sample containers should be filled by allowing the discharge to flow gently down the inside of the container with minimal turbulence. Cap sample containers securely after filling each bottle. Sample containers should be wiped dry.
    d) If dissolved metals are required, stop the pump, attach a one use only 0.45 micron in-line filter to the tubing, start the pump again, and allow water to rinse through the filter before collecting the sample.
    e) Field duplicate and matrix spike, matrix spike duplicate (MS/MSD) samples should be collected by filling a separate container for each analysis immediately following the actual field sample collection and should be in the same priority order as indicated above. Refer to SAP for specific QC sampling requirements and appropriate COC notations required for MS/MSD samples.
    f) Place samples in re-sealable plastic bags and then in loose ice within the cooler. Metals samples do not require cooling.
5. Once the samples have been collected, stop the pump.
6. Connect the end of the tubing to the flow through cell of the multi-parameter meter.
7. Start the pump at the lowest speed.
8. Allow the parameters to stabilize for a minimum of two minutes.

9. Once the readings have stabilized, record the pH (unit), Specific Conductivity (µS/cm), Temperature (°C), ORP (millivolts) and DO (mg/L) on the worksheet.
10. Collect an aliquot of water from the three way stop cock for the Hach and analyze the sample for turbidity. Record the NTU value on the Surface Water Worksheet.
11. Disconnect equipment and dispose of the sampling tubing.

PART II – SEDIMENT SAMPLES

MATERIALS AND EQUIPMENT

- Informational materials for sampling event: A copy of the current approved site-specific Health and Safety Plan, site-specific SAP, HWRB Master QAPP, location map(s), field data from prior sampling events, manuals for sampling, and the monitoring instrument's operation and maintenance manuals, should be brought to the site.
- Appropriate personal protective equipment (PPE).
- Waders.
- Appropriate sample containers (pre-preserved as necessary).
- Logbook, pencil/pen/sharpies.
- Field Worksheets.
- Sample labels, and chain-of-custody records.
- Sample containers and spare containers, preserved as necessary, provided by the laboratory.
- Sample cooler/shipping containers and loose ice, re-sealable plastic bags and packing materials.
- Cut off disposable syringes (along with a stainless spoon if necessary) to collect the VOC samples.
- Disposable syringes for siphoning surface water off top of sediment sample.
- Stainless steel hand tools or utensils (spoons, spatulas, scoops, trowels).
- Stainless steel mixing bowls/spoons.
- Decontamination supplies as described in the Decontamination SOP included in the SAP.
- Digital camera.

SAMPLE COLLECTION PROCEDURE

If a sediment sample is to be collected at the same location as a surface water sample, the sediment sample should be collected after collection of the surface water sample.

In general, sediment samples will be collected from the designated locations to a depth of approximately 2 to 4 inches. One of the following two procedures may be used depending on the amount of water at the time. If the depth of water is greater than three feet no sample will be collected. Digital photographs shall be taken at each sampling location, upstream and downstream.

A. Sediment Sampling in Locations without Standing or Running Water

This section applies to collection of sediment samples from locations without standing or running water (i.e., non-submerged locations).

A stainless steel hand tool will be used to collect sediment samples from locations without standing or running water. The following procedures will be used.

1. Clear the sample location of any surface debris and spread out plastic sheeting adjacent to the sampling location for staging equipment.
2. Advance the hand tool or auger to the required depth.
3. Upon completion of the shallow excavation, use a stainless steel tool to clear away a small area and collect the VOC sample, if required. In order to limit exposure to air and potential loss of volatile contaminants, the VOC sample shall be collected from the side wall of the excavation at the approximate midpoint of the depth interval using a disposable syringe. Note that VOC sample collection will be conducted in accordance with the NHDES SOP "Preservation of VOCs in Soil Samples" included in the current NHDES Hazardous Waste Remediation Bureau Master Quality Assurance Project Plan (HWRB Master QAPP). The proper volume of soil is then added to the methanol preserved VOA vials until the volume in the VOA vial reaches the pre-marked line established by the laboratory (approximately 5 grams). Close tightly with the screw-on cap, label, and place in loose ice for delivery to the laboratory. A separate dry weight sample will not be necessary as long as the dry weight analysis is added to the analysis for the metals container.
4. Using a stainless steel tool, transfer soil from the same depth in the excavation to a pre-decontaminated stainless steel mixing bowl. Continue to collect additional sediment from areas adjacent to the original sample location until sufficient material has been gained to fill the remaining sample containers. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample containers. Close caps tightly. Place samples in re-sealable plastic bags and then place in loose ice for delivery to the laboratory.
5. Following VOCs sample collection, the sample containers should be filled in the following priority order:

- 1,4-dioxane, as applicable
- PFAS (Refer to SPO-10 for specific sampling procedures related to PFAS sampling)
- Metals
- Grain Size
- Other parameters as required

6. Collect field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples by filling a separate container for each analysis immediately following the actual field sample collection and it should be in the same priority order as indicated above. Note that the VOC sample shall be collected directly from the dredge, prior to sample mixing. Duplicate samples are not intended to be blind duplicate samples. They should be designated with a "DUP" after the sample designation as indicated in the SAP. Refer to the SAP for specific quality control (QC) sampling requirements.

7. Once samples are collected, digital photographs shall be taken at each sampling location, upstream and downstream.

8. Decontaminate equipment between each sampling location in accordance with the Decontamination SOP in the SAP.

9. Equipment blanks are required for sediment sampling equipment. Following sample collection and after equipment decontamination, gently pour DI water over the equipment used to collect the sediment samples (e.g. stainless steel tools, bowl, and mixing spoon). Collect the rinsate that flows off the equipment into the appropriate sample containers. Refer to the SAP for specific QC sampling requirements and analysis.

B. Sediment Sampling in Locations with Standing or Running Water

This section applies to collection of sediment samples below standing or running water (i.e., submerged locations).

Sample Collection with a Scoop

If sampling with standing water, a stainless steel scoop or similar hand tool may be used. If the location is reachable by hand, and the standing water will not overtop the sampler's glove, a hand tool may be used. If the location is unreachable by hand, or the standing water will overtop the sampler's glove, a stainless steel hand tool attached to a long handle may be used.

1. Using the appropriate sampling device, as determined above, scoop up sediment, allowing standing water to drain.

2. Collect a VOC sample directly from the from the central/interior portion of the sampling device as described in Section "A" above, if required. A separate dry weight sample will

not be necessary as long as the dry weight analysis is added to the analysis for the metals container.

3. Place the remaining sediment into a stainless steel bowl. Repeat Step 1 until sufficient sample volume is accumulated to fill the containers provided by the analytical laboratory.

4. Thoroughly mix sediment to obtain a homogeneous sample, and then transfer to the appropriate sample containers. Larger roots, twigs, leaves, etc. should be removed from the sample prior to placement in laboratory containers.

5. Following VOCs sample collection, the sample containers should be filled in the same order as indicated in Section "A" above. Close caps tightly. Place samples in re-sealable plastic bags and then place in loose ice for delivery to the laboratory.

6. Collect field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples as described in Section "A" above.

7. Once samples are collected, digital photographs shall be taken at each sampling location, upstream and downstream.

8. Decontaminate equipment between each sampling location in accordance with the Decontamination SOP in the SAP.

9. Collect an equipment blank as described in Section "A" above.

REFERENCES

Surface water and Sediment Sampling SOPs in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

"Preservation of VOCs in Soil Samples", included in the current HWRB Master QAPP, EPA RFA #13027, Revision 4, March 2017.

ATTACHMENTS

Surface Water / Leachate Seep/ Sediment Worksheet

Setup Diagram for Peristaltic Pump

Surface Water / Leachate Seep / Sediment Worksheet

Coakley Landfill Superfund Site, North Hampton and Greenland, New Hampshire

Date: Time: Field Personnel:

WEATHER CONDITIONS

CURRENT		PAST 7 DAYS							
Barometric Pressure (in mm/hg)		Date							
Storm (heavy rain)		Barometric Pressure (in mm/hg)							
Rain (Steady Rain)		Estimated Rainfall (in)							
Showers (Intermittent)		Comments							
Cloud Cover (%)									
Clear/Sunny									
Comments:									

SURFACE WATER / SEDIMENT SAMPLING LOCATION CHARACTERIZATION

Provide Physical Description of Sampling Locations At The Time of Sampling	Photograph # _____
	Photograph # _____
	Photograph # _____
	Photograph # _____
	Photograph # _____
	Photograph # _____

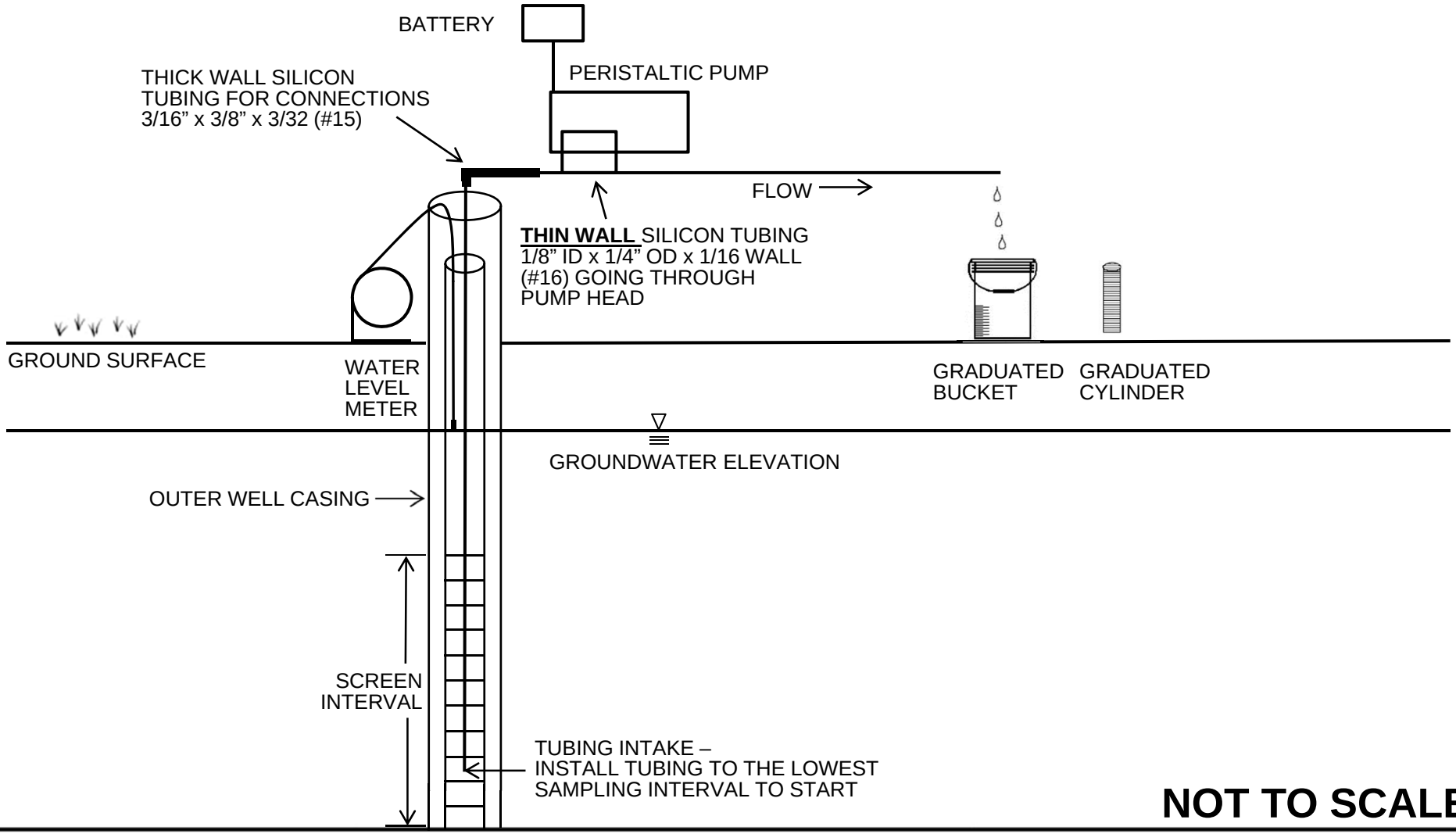
IN SITU SURFACE WATER QUALITY

Minimum 2 minute parameter stabilization period met (Y/N)?

Sample Location ID	Temperature (ºC)	Specific Conductivity (µS/cm)	pH units	ORP (mV)	DO (mg/L)	Turbidity (NTU)	Sample Time	Comments

Note:Surface Water Quality Parameters are collected using the YSI 600 XL/XLM and Hach 2100P or 2100Q units. Both units are calibrated in accordance with the calibration SOP in the SAP

EQUIPMENT SETUP DIAGRAM FOR INTERVAL SAMPLING USING A PERISTALTIC PUMP



NOT TO SCALE

DRINKING WATER SUPPLY WELL SAMPLING PROCEDURE

PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the procedure for collecting water samples from drinking water supply wells in the area of the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire.

Sampling household water supplies is essential to the proper investigation of groundwater contamination at a potential/ actual contaminated site for the protection of human health. Each well supplying a household also represents a monitoring well for local groundwater. Such information/data is factored into the groundwater investigation program.

The most current Sampling and Analysis Plan (SAP) for the Coakley Landfill Superfund Site contains the list of the water supply wells to be sampled and the list of analytes and the analytical methods, containers, sample volumes, preservation and holding times to be used. The water supply wells are shown on a sampling point location map included with the SAP.

Notification to homeowners will be made by the project manager or the sampler. There may be a water treatment system in place (e.g., water softener, point of entry (POE) treatment system, etc.). The sample must be collected prior to any type of water treatment system or the system must be bypassed. This information must be confirmed with the homeowner prior to sampling.

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

Sampling personnel must use common sense prior to and during sampling activities. For instance, samplers should avoid gassing up a vehicle on the day of the sampling event. Sampling personnel should also remember that they are at someone's home and so should not do anything to adversely impact the residence or unnecessarily inconvenience the resident.

EQUIPMENT AND MATERIALS

- An approved Health & Safety Plan and appropriate personal protective clothing and gear.
- Site-specific Sampling and Analysis Plan (SAP) which includes sampling location maps, well information, description of sampling points and other project-specific information.
- Trip blanks, sample containers preserved as necessary, labels, chain-of-custody forms, re-sealable plastic bags, cooler and loose ice.
- Brass tap apparatus with permanently attached polyethylene tubing section to obtain a laminar flow when collecting samples from an outside or basement tap. This apparatus is not to be used on kitchen or bathroom faucets. This apparatus must be used when collecting volatile samples.
- Distilled/Deionized (DI) water to rinse brass tap apparatus between locations, etc.

- Paper towels.
- Multi-Parameter Water Quality Meters (i.e., YSI 600XL/XLM or 6820 with a built in barometer) with a transparent 250 milliliter (ml) or less flow through cell and a ring stand; and Hach 2100P or 2100Q Turbidity Meter; calibrated in accordance with the Calibration of Field Instruments in the SAP.
- A three way stop cock to divert sample flow (before the multi-parameter meter) to collect turbidity samples.
- Plastic five gallon bucket to collect purge water from flow through cell.
- Various sizes of silicone tubing (e.g., ID x OD x Wall: #15 (3/16" x 3/8" x 3/32) and size 5/16 x 1/2 x 3/32) to connect the brass tap connector to the multi-parameter meter and extend the flow cell discharge line to a five gallon bucket.
- An appropriate container to collect purge water from a tap at the tank in the basement if necessary. This may require a low profile container to collect purge water from a low-lying tap (e.g. the top of a small cooler works well).
- Trash bags to containerize solid waste.

PRELIMINARY PROCEDURES

1. There may be a water treatment system in place, such as: a water softener; pH adjuster, point of entry (POE) treatment system radon system, or an ultra violet system. The sample must be collected prior to any type of water treatment system or the system must be bypassed.

2. The sample may be collected from any outside spigot or from a sampling tap on or in close proximity to the pressure tank, such as those commonly installed prior to a water treatment system (the sample must be collected prior to any water treatment system, or the water treatment system must be bypassed). *If the sampling point is not on the pressure tank, it may be necessary to use isolation valves to prevent backflow of water from a treatment system.*

3. Remove any hoses or attachments (valves, automatic timer, etc.) at the sampling point prior to purging and sample collection. *It may not be possible to remove all attachments; however, if there is a plastic attachment that cannot be removed, the sample should be collected at a different location.*

4. Make sure that the sample point is clean (i.e., no grease, lead soldering, or other possible contaminants) and that no possible sources of cross-contamination (gas cans, solvents, etc.) are nearby.

5. Always wear new personal protection gloves at each location when collecting samples.

SAMPLING PROCEDURE

The following steps should be followed once the preliminary steps have been completed.

1. If the sample is collected from an outside spigot, the water must be purged through a garden hose with the hose outlet directed away from the building foundation. If the sample is collected at the tap at the tank in the basement, first purge the well using the outside faucet (or using a long hose attached to sampling point). Turn on the water (cold water) at a high rate of flow for 10-15 minutes (a minimum of 10 minutes).

   Running the water will accomplish two goals. First, it will purge the pipes of any stagnant water; second, it will drain the pressure tank and cause the pump to turn on and start pumping the well. This should assure the collection of a fresh and representative sample from the well.

   While the water is running, record any observations and/or comments about matters pertinent to the sample and/or site in a field log book.

2. After the water has run for a minimum of ten minutes, shut the water off. Attach a decontaminated brass tap apparatus to the tap. Turn water back on at a very slow flow rate. Purge a small amount of water through the apparatus to rinse it with the water being sampled.

3. **Collect the water quality parameters using procedure outlined in a separate section below.**

4. Collect the sample(s) using the appropriate containers.

   a. Remove the cap from the sample container and place it on the plastic sheet or in a location where it won't become contaminated.

   b. Fill all sample containers by allowing the discharge to flow gently down the inside of the container with minimal turbulence.

   c. Fill the sample containers based on the following priority order.

      - Volatile Organic Compounds
      - 1,4-dioxane.
      - PFAS - (Refer to SOP-10 for specific sampling procedures related to PFAS sampling)
      - Total metals, as required; and
      - Additional samples, as required.

      Note: See separate section for Special Considerations for Volatile Organic Compound Sampling;

   d. Cap and seal the sample containers. Sample containers should be wiped dry, labeled, placed in re-sealable plastic bags and placed in a cooler in loose ice**.**

   e. Field duplicate and matrix spike, matrix spike duplicate (MS/MSD) samples should be collected by filling a separate container for each analysis immediately following the

actual field sample collection and should be in the same priority order as indicated above. Refer to SAP for specific QC sampling requirements and appropriate COC notations required for MS/MSD samples.

5. Once all the samples have been collected, remove the brass tap apparatus and return all plumbing to its original position. If water quality parameters were collected, dispose of any purge water as appropriate and dry container.

6. Decontaminate brass tap apparatus between locations with DI water.

Special Considerations for Volatile Organic Compound Sampling

The proper collection of a sample for volatile-organic compounds requires minimal disturbance of the sample to limit volatilization and therefore a minimal loss of volatiles from the sample. The following VOC procedures should be followed:

1. Open the vial, set cap in a protected place, and collect the sample. When collecting duplicates, samples should be collected by filling a separate container for each analysis immediately following actual field sample collection (e.g., VOC sample, VOC duplicate sample).

2. Do not rinse the vial or excessively overflow it.

3. Be sure the sample flow is laminar and there are no air bubbles in the sample flow.

4. There should be a convex meniscus on the top of the vial. You can use the cap to create the convex meniscus for VOC samples, if needed.

5. Check that the cap has not been contaminated (splashed) and carefully cap the vial.

6. Place the cap directly over the top and screw down firmly. Do not over-tighten and break the cap.

7. Invert the vial and tap gently. If an air bubble appears, uncap and attempt to add a small volume of sample to achieve the convex meniscus without excessively overfilling the vial. If there this has to be repeated more than twice, discard the sample and begin again with a new container and preservative. It is imperative that no entrapped air is in the sample vial.

8. Samples should be wiped dry and immediately place the vial in the re-sealable plastic bag or protective foam sleeve (if available) and place in loose ice within the cooler.

PROCEDURE FOR COLLECTING WATER QUALITY PARAMETERS

Refer to the Calibration SOP in the SAP for specific calibration information and procedures. Instruments will be calibrated at the beginning of each sampling day and will be checked (in the run mode) in the morning and again at the end of each day.

The water quality parameters are collected before the samples in order to properly rinse the brass tap apparatus with the water being sampled. The brass tap apparatus consists of a brass tap and

permanently attached sampling tubing and is used to obtain a laminar flow when collecting VOCs.

1. Turn on meters so they can warm up according to the manufactures manuals.
2. Review the attached equipment setup diagram.
3. After the water has run for a minimum of ten minutes, shut off the water and attach the brass tap apparatus to the tap.
4. Connect the other end of the brass tap apparatus to the three way stop cock and the three way stop cock to the multi-parameter meter flow through cell bottom inlet port using #15 (3/16" x 3/8" x 3/32) silicone tubing.
5. Attach the multi-parameter meter to the ring stand next to the five gallon bucket. The flow cell should be tilted with the outflow connection facing upward to eliminate and prevent air bubbles from building up.
6. Connect a piece of silicone tubing to the flow cell upper discharge port and direct that tubing into the five gallon bucket to collect the purge water.
7. Turn on the tap to the slow flow rate used for collecting the samples, allowing the water to slowly fill the flow cell and exit into the bucket. Check to make sure there are no bubbles forming at the top of the cell. Tilt the cell again or lightly tap the cell, as necessary, to remove any bubbles.
8. Allow the parameter values to stabilize for a minimum of two minutes. Record the values on the sampling worksheet.
9. Collect an aliquot of water from three way stop cock and analyze the sample for turbidity. Record the value on the sampling worksheet.
10. Turn off the meters once you have recorded all the readings.
11. Shut off the tap.
12. Disconnect silicone tubing from brass apparatus taking care to empty the contents into the bucket.
13. Allow the water to drain from the hose and the flow cell into the bucket.
14. Leave all hoses connected to the flow through cell.
15. Dispose the bucket of purge water as appropriate and dry the bucket.
16. Place the ring stand with unit still attached into the bucket along with the hoses and meter to bring to the next sampling location.
17. Turn water back on at a very slow flow rate and collect samples through the brass apparatus as described in the previous section.
18. Decontaminate the brass apparatus with a DI water rinse before each sample location.

QUALITY ASSURANCE

Collect an equipment blank on a decontaminated brass tap apparatus for analysis of the same

parameters as the drinking water supply was sampled for.

DECONTAMINATION

Decontamination of the brass apparatus with a DI water rinse shall be performed before each sample location.

REFERENCES

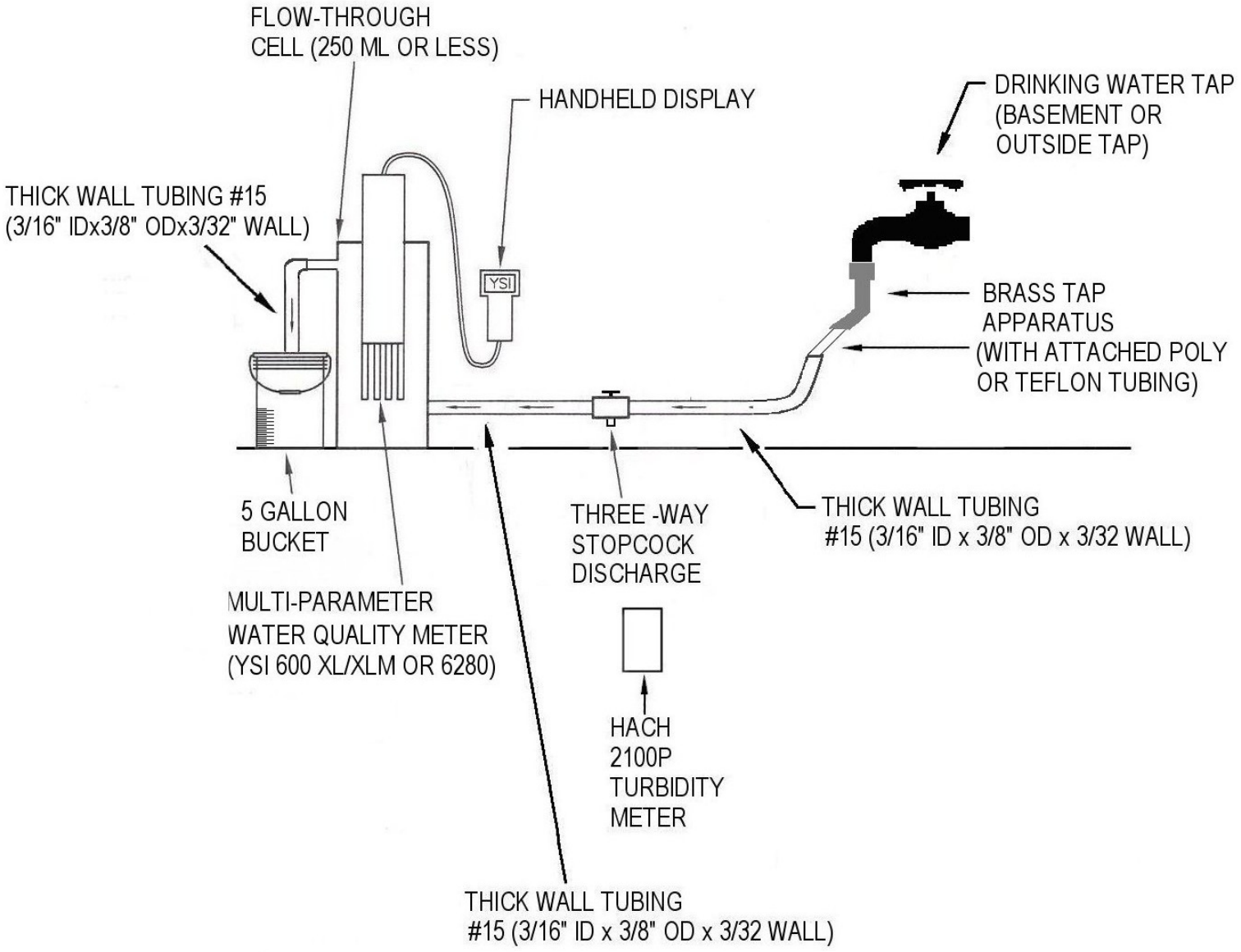
Drinking Water Sampling Procedure included in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

ATTACHMENTS

Drinking Water Set Up Diagram for Water Quality Parameters

Drinking Water Quality Parameter Worksheet

SET UP DIAGRAM FOR COLLECTING WATER QUALITY PARAMETERS AT DRINKING WATER WELLS



NOT TO SCALE

Drinking Water Quality Parameter Worksheet
Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire

Station ID	Date	Time	Temp ^0C	S.Cond uS/cm	DO mg/l	pH	ORP mv	Turbidity NTU

Notes:
When recording pH and dissolved oxygen data, only use one decimal place.
When recording specific conductance, temperature, turbidity, and ORP data, record only whole numbers.
When turbidity data is less than 5 NTU, data should be recorded as "< 5" or "less than 5".
When DO data is less than 0.5 mg/L, data should be recorded as "<0.5" or "less than 0.5".
"NR" indicates no reading taken.
YSI Multiparameter Meter 600XL/XLM or 6820; Hach 2100P/2100Q Turbidity Meter

Comments/Observations:

SAMPLING EQUIPMENT DECONTAMINATION PROCEDURE

PURPOSE

This Standard Operating Procedure (SOP) *Sampling Equipment Decontamination Procedure* is designed to provide a procedure for preventing, minimizing, or limiting cross-contamination of environmental samples at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire. This SOP focuses on small equipment decontamination (e.g., water level meters, split spoons, hand augers, sediment sampling tools). Removing or neutralizing contaminants from equipment not only minimizes the likelihood of sample cross contamination, but reduces or eliminates transfer of contaminants to clean areas and prevents the mixing of incompatible substances. Decontamination is not required on dedicated or disposable equipment.

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

EQUIPMENT AND MATERIALS

The following is a list of equipment and material commonly used for decontamination:

- An approved Health & Safety Plan (HASP) and appropriate personal protective clothing and gear. (e.g., safety glasses appropriate gloves, boots).
- Site-specific Sampling and Analysis Plan (SAP).
- Brushes.
- Spray bottles.
- Plastic tubs or buckets.
- Tap water.
- Distilled/Deionized water (distilled).
- Non-phosphate detergent.

  Note: Liquinox, Alconox and other non-phosphate detergents may contain 1,4-Dioxane. The equipment blank analysis must include analysis for 1,4-Dioxane. See section below on quality assurance samples.
- Drop cloth/plastic/polyethylene sheeting.
- Paper towels.
- Aluminum foil and/or re-sealable plastic bags.

DECONTAMINATION PROCEDURE

All sampling equipment will be decontaminated prior to the sampling event as follows:

1. Set up a decontamination line on polyethylene sheeting. The decontamination line should progress from "dirty" to "clean", with an area for drying decontaminated equipment.
2. Remove gross contamination from the equipment by brushing or using moist paper towels, where appropriate, and then rinsing with tap water.
3. Wash the equipment with a solution of non-phosphate detergent and tap water.
4. Rinse the equipment thoroughly with tap water.
5. Final rinse of equipment shall be distilled water. Shake excess water off equipment, taking care not to drop equipment. Use paper towel or air dry equipment.
6. Secure clean equipment (i.e. put brass water supply well sampling apparatus in new re-sealable plastic bag, or roll up water level meter and put in location away from potential contamination)

SPECIAL NOTES

The decontamination procedure for water level meter probes shall include the probes and, at a minimum, the length of tape used in that well.

All field activities must be carried out in accordance with the Health and Safety Plan contained in the SAP.

Sensitive equipment which is not waterproof should be wiped down with a damp cloth.

Solid Waste – Place all solid waste materials generated (i.e., gloves and plastic sheeting, etc.) in an approved container.

Liquid Waste – It is anticipated that the levels of contamination of the contaminated rinse liquids are sufficiently low and containerizing and disposal at a hazardous waste facility is not necessary. Based on this, liquid wastes generated shall be discharged to the ground surface.

When sampling for per- & poly-fluorinated alkyl substances (PFAS), PFAS free water obtained from the laboratory will be used for decontamination and blanks, as applicable.

QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

An equipment blank on the water level meter shall be collected after use in the most contaminated well and decontamination as described above to ensure that the equipment has been properly decontaminated and the decontamination procedures are adequate. The equipment blank shall include rinsate from the water level probe and, at a minimum, the length of tape used in that well. Refer to the SAP tables for specific location and analysis.

Due to possible 1,4 Dioxane contamination from the non-phosphate detergent, the equipment blank rinsate must be analyzed for 1,4-Dioxane to ensure that the decontamination procedure is adequate and that there is no 1,4-Dioxane residue. If 1,4-Dioxane is found in the equipment blank the sampling data must be qualified.

If an equipment blank is analyzed and found to contain a contaminant, possible sources of error will have to be investigated to determine whether or not the decontamination procedures were properly followed. Possible sources of error include: inadequate scrubbing/ washing/ rinsing of equipment; inadequate choice of chemical rinses; use of contaminated detergents or rinse waters; contact with contaminants after decontamination but prior to sampling, and/or, lab error.

RECORDS AND DOCUMENTATION

General decontamination procedures should be documented in the field log book.

REFERENCES

The Equipment Decontamination Procedure in the current Hazardous Waste Remediation Bureau Master Quality Assurance Project Plan (HWRB Master QAPP), EPA RFA #13027, Revision 4, March 2017.

CALIBRATION OF YSI AND HACH FIELD INSTRUMENTS

PURPOSE

This Standard Operating Procedure (SOP) *Calibration of YSI and Hach Field Instruments Standard Operating Procedure (SOP)* provides a general framework for calibrating field instruments used to measure water quality parameters for groundwater and surface water at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire. Water quality parameters include temperature, pH, dissolved oxygen (DO), specific conductance, oxidation reduction potential (ORP) and turbidity.

This SOP is written for instruments where the probe readings for pH, DO and specific conductance are automatically corrected for temperature (YSI Models 600XL/XLM with built in barometer). pH meters must be calibrated using three pH standards (4, 7 and 10 pH units). Turbidity must be taken with a separate meter (Hach 2100P or 2100Q).

Any modifications to this SOP shall be approved in advance by the NHDES Project Manager and QA Coordinator, in consultation with EPA, documented in the site logbook, and presented in the final report.

For ground water monitoring, the instrument must be equipped with a clear flow-through-cell with a maximum capacity of 250 milliliters and the display/logger or computer display screen needs to be large enough to simultaneously contain the readouts of each probe in the instrument. Turbidity must be taken at a point before the flow-through cell and from a meter separate from the flow through cell apparatus. A three way stopcock is required to divert sample flow for the turbidity reading. Turbidity cannot be measured in a flow-through-cell because the flow-through-cell acts as a sediment trap. This procedure is applicable for use with the current Low Flow Groundwater Purging and Sampling SOPs in the Coakley Landfill Superfund Site SAP.

HEALTH AND SAFETY WARNINGS

Read all labels on the standards and note any warnings on the labels. Wear appropriate personal protection equipment (e.g., gloves, eye shields, etc.) when handling the standards. If necessary, consult the Material Safety Data Sheets (MSDS) for additional safety information on the chemicals in the standards

CALIBRATION ACCEPTANCE CRITERIA

All field instruments shall be successfully calibrated, and have a successful calibration check, in the office prior to the field event (within one week) to ensure that the equipment is working properly and meets the QA criteria. The calibration/calibration check shall be documented on the Calibration Log.

The instruments shall be calibrated at the beginning of each sampling day at the Site prior to sample collection. The calibration shall then be checked immediately following the calibration to ensure

the instrument was calibrated properly. If the morning calibration check is not within the acceptable range for any parameter, the instrument shall be recalibrated using all the standards for that parameter and the calibration shall be checked again. See individual parameters for specific instructions. If the calibration or calibration check is not successful, replace the solutions, recalibrate and check the new calibration. If the calibration or calibration check is still unsuccessful, replace the unit. If problems with the instrument continue, backup instruments shall be calibrated and used in place of the inoperable unit.

The calibration shall be checked again at the end of the day of use to ensure that the instruments have remained in calibration throughout the day. In addition, should any erratic or illogical readings occur between calibrations, the instrument shall be recalibrated in order to ensure that representative measurements are obtained. All calibration and check values shall be documented on the calibration log maintained by each user (see attached log).

If a calibration check at the end of the day is not within the acceptable range for that parameter, the data collected that day for that parameter shall be qualified in its use. This qualification shall be documented on the calibration log and the field sheets/logs for the appropriate sampling locations. For example: pH measurements are collected as part of the low flow sampling procedure. If the afternoon pH calibration check was not within the acceptable range that day, the pH data collected by that instrument on that day would be qualified as useful only for determining stabilization and not as representative pH measurements of the water being sampled. That qualification would then be documented on the calibration log and the sampling worksheet for each of those locations where the instrument was used.

COLD WEATHER CONDITIONS

Given the temperature sensitivity of the calibration solutions in very cold weather conditions, the NHDES project manager may approve performing the morning calibration and calibration check in the office, or other facility, just prior to going into the field and the end of the day calibration check upon returning to that facility. Careful thought must be given before approval. On one hand this may avoid delays and budget increases due to weather calibration issues in the field. On the other hand, not being able to check the calibration or re-calibrate in the field may result in the qualification or loss of data if there are problems with the equipment that day. In each case, this deviation to the normal procedure must be approved by the NHDES project manager in advance. If approved, it must be documented on each Calibration Log and in all Site sampling reports (e.g. Annual Report) that the calibration and checks for that day were performed off-site due to very cold (or very hot) weather conditions, including where they were performed and that it was approved in advance by the NHDES project manager. See page two of the attached Calibration Log.

EQUIPMENT AND MATERIALS

The following is a list of equipment and materials typically used during calibration:

- Site-specific SAP.

- Manufacturer's instruction manuals (including the instrument specifications) to accompany the instruments into the field.
- Multi-meter sonde and handheld meter (YSI 600XL/XLM) with a built in barometer.
- Calibration solutions:
    - Small wet sponge or paper towel for DO 100% saturation calibration
    - "Zero" (0) mg/L DO check standard
    - pH buffers 4, 7 and 10 (plus additional pH 4 for overnight storage of YSI probes)
    - Two standards for specific conductance, one for calibration and one for checking the calibration: 1,413 micro Siemens per centimeter [µS/cm]) and 718 µS/cm; and
    - Zobell Solution for ORP
- Separate Turbidimeter (Hach 2100P or 2100Q Turbidity meter) w/calibration standards: <0.1, 10, 20, 100, 800 Nephelometric Turbidity Units (NTUs) as appropriate for each meter
- Calibration cup with cap
- Cooler (for storage of calibration solutions)
- Distilled water
- Paper towels
- Kimwipes
- NIST certified thermometer, degrees Celsius (if the vendor has not verified the accuracy of the instrument temperature sensor)
- Ring stand with clamp
- Calibration log

GENERAL INFORMATION

In general, all instrumentation necessary for field monitoring and health and safety purposes shall be maintained, tested and inspected according to the manufacturer's instructions.

It is assumed that most of this equipment will be rented and is not owned by the contractor. Any reference made to a vendor applies to the owner/renter of the equipment.

Prior to calibration, all instrument probes must be cleaned in accordance with the manufacturer's instructions, preferably by the vendor if the unit is rented. Failure to perform this proper maintenance step can lead to erratic measurements. The vendor is required to provide written documentation (which will be included in sampling reports) that indicates the equipment was cleaned, by who and dated.

Calibration standard values, check results, temperature and barometer checks, and maintenance

for each piece of equipment shall be documented on the calibration logs and included in the reports. This information includes dates, personnel, calibration standards expiration dates, etc. A calibration log is provided at the end of this SOP.

This SOP requires that the manufacturer's instruction manuals (including the instrument specifications) accompany the instruments into the field.

Turn on the instrument and allow it to warm up according to the manufactures instructions.
Program the multi-probe instrument so that the following parameters to be measured will be displayed: temperature in ˚C; pH, dissolved oxygen (DO) in % for calibration and mg/L for measurements; specific conductance in µS/cm; and ORP in mV.

All calibration solutions shall be placed into the calibration cup to calibrate the instrument and to check the calibration. The calibration cup shall be rinsed with DI water and dried with paper towels or kimwipes between each standard. The probes shall not be put directly into the bottles of calibration solutions from the vendor. The volume of the calibration solutions must be sufficient to cover both the probe and temperature sensor. See manufacturer's instructions for additional information. Do not pour the used calibration solutions back into the original bottles.

While calibrating or measuring, make sure there are no air bubbles lodged between the probe and the probe guard.

Mark the "date opened" on each new bottle of calibration solution. Record the lot number and expiration date on the calibration log.

All calibration solutions shall be stored in the dark and stored at cool/stable temperatures. Storage of calibration solutions in an insulated cooler kept in the shade will help to maintain calibration solution integrity.

CALIBRATION PROCEDURES

TEMPERATURE

This procedure is not to be done in the field.

For instrument probes that rely on the temperature sensor, each temperature sensor must be checked for accuracy against a thermometer that is traceable to the National Institute of Standards and Technology (NIST) prior to the sampling event. A temperature check is required once a year for each instrument at a minimum.

The temperature check shall be performed prior to the field event, preferably via the vendor if the unit is rented. If the check is not performed by the vendor it must be performed by field personal prior to using the unit. Verification and documentation, including accuracy, dates and personnel, of this procedure is required. The documentation shall be recorded on the calibration log and included in any sampling reports.

Temperature Sensory Accuracy Procedure

1. Allow a container filled with water to come to room temperature.

2. Place a NIST thermometer and the instrument's temperature sensor into the water and wait for both temperature readings to stabilize.

3. Compare the two measurements. The instrument's temperature sensor must agree with the reference thermometer measurement within the accuracy of the sensor (typically ±0.15°C or ±0.2°C). Check the manual that came with the instrument. If the measurements do not agree, the instrument may not be working properly and the vendor/manufacturer needs to be consulted and the unit replaced.

DISSOLVED OXYGEN

Dissolved oxygen (DO) content in water is measured using a membrane electrode.

The DO probe's membrane and electrolyte solution shall be replaced prior to the sampling event and replaced as needed thereafter. Failure to perform this step may lead to erratic measurements. If the vendor changes the membrane and electrolyte solution they must send the appropriate documentation with each unit. If there is no documentation with the unit, the field personnel will have to replace the membrane and electrolyte solution before the sampling event begins. Documentation shall be noted on the calibration log.

DO Calibration/Calibration Check Procedure

1. Record the DO charge on the worksheet. Note: according to the manufacturer, the DO charge should be between 25-75 millivolts for the probes to be working correctly. If the DO charge is outside the range, replace the membrane and electrolyte solution prior to calibration.

2. Gently dry the temperature sensor and remove any droplets of water from the DO probe's sensor membrane according to manufacturer's instructions and inspect the DO membrane for air bubbles and nicks. If any are found, replace the membrane and electrolyte solution.

3. Place a wet sponge or a wet paper towel on the bottom of the DO calibration container to create a 100 percent water-saturated air environment.

4. Loosely fit the DO probe into the calibration container to prevent the escape of moisture evaporating from the sponge or paper towel while maintaining ambient pressure (see manufacturer's instructions on attaching the calibration container to the instrument). Do not allow the probe to come in contact with the wet sponge or paper towel. **The storage cup must be vented to the atmosphere.** Do not screw the calibration cup tightly onto the sonde.

5. Allow the confined air to become saturated with water vapor (saturation occurs in

approximately 10 to 15 minutes). During this time, turn on the instrument to allow the DO probe to warm-up according the manufactures directions. Make sure that both the DO reading and the temperature have stabilized before starting the calibration sequence.

6. Select calibration mode; then select "DO %".

7. Enter the local barometric pressure (usually in mm of mercury) for the sampling location into the instrument using an on-site hand held barometer, unless the instrument already has a temperature-compensated barometer.

8. Record the barometric pressure on the calibration log.

9. The instrument should indicate that the calibration is in progress. Observe the readings for percent dissolved oxygen and temperature. When they show no significant change for approximately 30 seconds press enter. After calibration, the instrument should display dissolved oxygen in mg/L (% DO is only used for calibration).

10. Record the initial DO reading in mg/L and temperature reading in ˚C on the calibration log immediately after calibration.

11. To check the calibration, select monitoring/run mode (on a run/measurement screen), remove the probe from the container and place it into a 0.0 (zero) mg/L DO standard. Do not put the DO probe back into the storage cup (w/sponge), prior to performing the zero check.

12. Wait until the "mg/L DO" and temperature readings have stabilized. Record the zero mg/L DO reading on the calibration log. The instrument must read 0 to 0.5 mg/L DO. If the instrument cannot reach this value, it will be necessary to clean the probe, and change the membrane and electrolyte solution. If this is unsuccessful, use a new 0.0 mg/L DO standard. If these measures are still unsuccessful, consult the manufacturer/vendor or replace the unit.

13. If the afternoon calibration check is not within the acceptable range then the data collected using the instrument that day must be qualified in its use as described above under Calibration Acceptance Criteria.

14. Remove probe from the zero DO standard, rinse with distilled water, and gently blot dry.

pH (electrometric)

The pH of a sample is determined electrometrically using a glass electrode. Three standards are needed for the calibration: 4, 7 and 10.

pH Calibration/Calibration Check Procedure

1. Allow the buffered standards to equilibrate to the ambient temperature.

2. Fill calibration containers with the buffered standards so each standard will cover the pH probe and temperature sensor.

3. Remove probe from its storage container, rinse with distilled water, and gently blot dry with a Kimwipe. Use caution during drying that the dissolved oxygen probe membrane is not disturbed.

4. Select the calibration mode for a three point pH calibration.

5. Immerse probe into the initial standard, pH 7. Enter the buffered standard value (pH 7) into instrument. Wait until temperature and pH readings stabilize. If the readings do not change within 30 seconds, press enter to accept the calibration.

6. Remove probe from the initial standard, rinse with distilled water, and gently blot dry.

7. Immerse probe into the second standard (pH 4). Repeat step 5.

8. Remove probe from the second standard, rinse with distilled water, and gently blot dry.

9. Immerse probe in third buffered standard (pH-10) and repeat step *5*.

10. Remove probe from the third standard, rinse with distilled water, and gently blot dry.

11. To check the calibration, select monitoring/run mode (on a run/measurement screen) and immerse the probe into the pH 7 buffer solution. Wait for the temperature and pH readings to stabilize. Record the pH value on the calibration log. The value must be pH 7 +/-5% (pH 6.65-7.35). If the calibration check failed re-calibrate the instrument using fresh standards for all three values and check it again. If re-calibration fails, clean the pH probe, consult the manufacture/vendor or replace the unit.

12. If the afternoon calibration check is not within the acceptable range then the data collected using the instrument that day must be qualified in its use as described above under Calibration Acceptance Criteria.
13. Remove probe from the pH 7 check standard, rinse with distilled water, and gently blot dry. Rinse the calibration cup with distilled water and dry it with paper towels or Kimwipes.

SPECIFIC CONDUCTANCE

Conductivity is used to measure the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25°C. When monitoring ground water, surface water or pore water use the specific conductance readings and record in µS/cm.

Most instruments are calibrated against a single standard which is near, (above or below) the specific conductance of the environmental samples. A second standard is used to check the linearity of the instrument in the range of measurements. Specific conductivity standards concentrations are generally dependent on expected field conditions and availability. However, there have been some issues with the stability of some of the standards in the field. Unless specified in a site specific SAP, NHDES and EPA have agreed that specific conductivity is, in general, a non-critical measurement and it is more important to use standards that are stable in the field even though they may be above or below the actual field conditions.

The following standards have been field tested, are readily available from most vendors, and are acceptable for use by NHDES and EPA: a 1413 µS/cm standard and a 718 µS/cm standard. It is acceptable to use either one of the standards to calibrate and the other to check the calibration. For this project, the 718 µS/cm standard will be used to calibrate and the 1413 µS/cm standard will be used to check the calibration.

Specific Conductance Calibration/Calibration Check Procedure

1. Allow the calibration standards to equilibrate to the ambient temperature.

2. Remove the probe from its storage container, rinse the probe with a small amount of the first (718 µS/cm) specific conductance standard (discard the rinsate), and place the probe into the standard. Be sure that the temperature sensor and the probe's vent hole are immersed in the standard. Gently move the sonde up and down to dislodge any air bubbles from the conductivity cell.

3. Allow at least one minute for temperature equilibrium before proceeding.

4. Select the calibration mode for specific conductance. Enter the calibration value of the standard being used (718 µS/cm). Allow the temperature and specific conductance to stabilize. If the reading does not change within 30 seconds, press enter to accept the calibration.

5. To check the calibration, select the monitoring/run mode (a run/measurement screen). Remove the probe from the first standard, rinse the probe with distilled water and then a small amount of the second standard (discard the rinsate), and place the probe into the second (1413 µS/cm) standard. The second standard will serve to verify the linearity of the instrument. Wait until the specific conductance and temperature readings have stabilized. Read the specific conductance value from the instrument. Record the value on the calibration

log**,** and compare the value to the standard. The value must be +/-5% (1382-1484 µS/cm for the 1413 µS/cm standard). If not, recalibrate using new standards and check again. If the re-calibration does not correct the problem, clean the probe, consult the manufacturer/vendor or replace the unit.

6. Remove probe from the specific conductance check standard, rinse with distilled water, and gently blot dry. Rinse the calibration cup with distilled water and dry it with paper towels or Kimwipes.

OXIDATION/REDUCTION POTENTIAL (ORP)

The oxidation/reduction potential is the electrometric difference measured in a solution between an inert indicator electrode and a suitable reference electrode. The electrometric difference is measured in millivolts and is temperature dependent. A Zobell solution is required to calibrate ORP. Read the warning on the label before use.

ORP Calibration/Calibration Check Procedure

1. Allow the Zobell solution calibration standard to equilibrate to ambient temperature.

2. Remove the probe from its storage container, rinse the probe with distilled water, gently blot dry with a Kimwipe and place it into the standard.

3. Select monitoring/run mode.

4. Wait for the probe temperature to stabilize, and then read the temperature. Record the temperature reading on the calibration log.

5. Look up the millivolt (mV) value at this temperature from the temperature / millivolt chart found below and on the calibration log. These values have been rounded to the nearest whole number. Record this value on the calibration log.

Zobell Solution mV Values Based on Temperature for ORP Calibration
Calibration Check Range Values (+/- 5%)
(Round off temperature to whole number, e.g. 23.5 ºC rounds up to 24 ºC)

Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%	Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%	Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%
-3	**267**	254-280	10	**251**	238-264	23	**234**	222-246
-2	**266**	253-279	11	**249**	237-261	24	**232**	220-244
-1	**265**	252-278	12	**248**	236-260	25	**231**	219-243
0	**264**	251-277	13	**247**	235-259	26	**230**	219-242
1	**262**	249-275	14	**245**	233-257	27	**228**	217-239
2	**261**	248-274	15	**244**	232-256	28	**227**	216-238
3	**260**	247-273	16	**243**	231-255	29	**226**	215-237
4	**258**	245-271	17	**241**	229-253	30	**225**	214-236
5	**257**	244-270	18	**240**	228-252	31	**223**	212-234
6	**256**	243-269	19	**239**	227-251	32	**222**	211-233
7	**254**	241-267	20	**238**	226-250	33	**221**	210-232
8	**253**	240-266	21	**236**	224-248	34	**219**	208-230
9	**252**	239-265	22	**235**	223-247	35	**218**	207-229

6. Select the calibration mode for ORP. Enter the temperature-corrected ORP value into the instrument. Once the temperature and ORP values stabilize, press enter to accept the calibration.

7. To check the calibration, select monitoring/run mode (on a run/measurement screen). Immerse the probe in the Zobell solution. Wait until the ORP and temperature readings have stabilized. Read the ORP on the instrument. Record the check value on the calibration log**,** and compare the value to the ORP value of the standard in step 5. The instrument value must be +/- 5% of the calibration value. See the chart above for the check range. If it is not within +/- 5%, recalibrate using a new Zobell solution. If the re-calibration is not successful, consult the manufacture/vendor or replace the unit. For the afternoon calibration check, the instrument must be within +/- 5% of the mV value for the current temperature.

8. Remove the probe from the ORP check standard, rinse with distilled water, and gently blot dry. Rinse the calibration cup with distilled water and dry it with paper towels or Kimwipes.

TURBIDITY

The turbidity method is based upon a comparison of intensity of light scattered by a sample under defined conditions with the intensity of light scattered by a standard reference suspension. A turbidimeter is a nephelometer with a visible light source for illuminating the sample and one or more photo-electric detectors placed ninety degrees to the path of the light source.

The low flow procedure requires that the turbidity meter shall have a calibration range from 0.00 to 800 (1000) NTUs.

Condensation of Turbidity Vial (fogging):

Condensation may occur on the outside of the sample cell when measuring a cold sample in a warm, humid environment. Condensation interferes with turbidity measurement, so all moisture must be thoroughly wiped off the sample cell before measurement. If fogging recurs, let the sample warm slightly by standing at ambient temperature or immersing in a container of ambient temperature water for a short period. After warming, gently invert the sample cell to thoroughly mix the contents before measurement.

This procedure is based on the use of the Hach 2100P or the 2100Q Turbidimeter and the commercially available StablCal® Formazin Primary Turbidity Standards appropriate for each meter.

A - Calibration/Calibration Check Procedures for the Hach 2100P Turbidity Meter

1. Use the commercially available StablCal® Formazin Primary Turbidity Standards: <0.1, 20, 100 and 800 NTUs.

2. Before performing the calibration procedure, make sure the cells are not scratched. If the cell is scratched, the standard must be replaced.

3. Allow the calibration standards to equilibrate at the ambient temperature.

4. Turn on the meter.

5. The meter should be in the Auto Range. "Auto Rng" and 0.00 NTUs should show on the display. If not press the range key until it is in the auto range and reading to two (2) decimal points (e.g.. 0.00)

6. Gently invert the standards to thoroughly mix the contents. (**DO NOT SHAKE**)

7. Wipe the standards with a soft, lint free cloth or Kimwipe to make sure the outside surfaces are dry, free from fingerprints and dust.

8. Insert the standard into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment.

9. Insert the first (blank) standard, <0.1 NTU, into the cell compartment and close the lid.

10. Press **CAL.** The "CAL" and "S0**"** icons will be displayed (the "0" will flash).

11. Press **READ.** The instrument will count down from 60 to 0, read the blank and use it to calculate a correction factor for the second, 20 NTU standard. The display will automatically increment to the next standard. The display will now show "S1" (with the 1 flashing) and "20 NTU", the value of the second standard. Remove the <0.1 NTU standard from the compartment.

12. Insert the second, 20 NTU, standard into the cell compartment and close the lid.

13. Press **READ.** The instrument will count down from 60 to 0, measure the turbidity and store the value. The display will automatically increment to the next standard with the display showing "S2" (with the 2 flashing) and "100 NTU", the value of the third standard. Remove the 20 NTU standard from the compartment.

14. Insert the third, 100 NTU, standard into the cell compartment and close the lid.

15. Press **READ.** The instrument will count down from 60 to 0, measure the turbidity and store the value. The display will automatically increment to the next standard. The display will show the "S3" (with the 3 flashing) and the 800 NTU standard, the value of the fourth standard. Remove the 100 NTU standard from the compartment.

16. Insert the fourth and last, 800 NTU, standard into the cell compartment and close the lid.

17. Press **READ.** The instrument will count down from 60 to 0, measure the turbidity and store the value. Then the display will increment back to the S0 display. Remove the 800 NTU standard from the compartment and close the lid.

18. Press **CAL** to accept the calibration. The instrument will return to the measurement mode automatically.

19. To check the calibration (in run mode), insert the 20 NTU standard into the cell compartment and close the lid.

20. Press **READ.** The meter will display a lamp symbol (which looks like a light bulb) indicating that the reading is in progress. The lamp turns off and the measurement value is displayed. Record the turbidity reading on the calibration log. The calibration check must be +/- 5% (19-21 NTUs). If not, recalibrate using all standards. If re-calibration is unsuccessful, use new standards, consult the manufacture/vendor or replace the unit.

21. Remove the 20 NTU check standard from the compartment and close the lid.

B - Calibration/Calibration Check Procedures for the Hach 2100Q Turbidity Meter

1. Use the commercially available StablCal® Formazin Primary Turbidity Standards: 20, 100 and 800 NTUs and the 10 NTU Verification Standard.

2. Before performing the calibration procedure, make sure the cells are not scratched. If the cell is scratched, the standard must be replaced.

3. Allow the calibration standards to equilibrate at the ambient temperature.

4. Turn on the meter.

5. Push the **CALIBRATION** key to enter the Calibration mode.

The Calibration key is the graph symbol with 2 points in the lower left hand side.  The screen shows the three standards (20, 100 & 800 NTUs). The 20 NTU standard is shown bolded with a box around it indicating that is the first standard to be calibrated.

6. Gently invert the standards to thoroughly mix the contents. (**DO NOT SHAKE**)

7. Wipe the standards with a soft, lint free cloth or Kimwipe to make sure the outside surfaces are dry, free from fingerprints and dust.

8. Insert the first standard, 20 NTU, into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment and close the lid firmly. Note: the standard to be inserted is bordered.

9. Press **READ** (right hand key)**.** The display shows Stabilizing and then shows the results accompanied by an audio beep. The display will automatically request the next standard by bordering it and darkening the first standard. Remove the 20 NTU standard from the compartment.

10. Insert the second, 100 NTU, standard into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment and close the lid firmly.

11. Press **READ.** The display shows Stabilizing and then shows the results accompanied by an audio beep. The display will automatically request the next standard by bordering it and darkening the previous standards. Remove the 100 NTU standard from the compartment.

12. Insert the third and last, 800 NTU, standard into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment and close the lid firmly.

13. Press **READ.** The display shows Stabilizing and then shows the results accompanied by an audio beep. Remove the 800 NTU standard from the compartment.

14. Push **DONE** to complete a 3 point calibration and review the calibration details (values of the three standards).

15. Push **STORE** to save the results.

16. After a calibration is complete, the meter automatically goes into the Verify Cal mode.

17. Insert the 10 NTU Verification Standard into the cell compartment by aligning the orientation mark on the cell with the mark on the front of the cell compartment and close the lid firmly.

18. Push **READ** (right hand key). The display shows Stabilizing and then shows the results and the tolerance range. The calibration check must be +/- 10% (9.0- 11.0 NTUs).

19. Push **DONE** to return to the reading display.

20. If the calibration verification (Cal Check) is not within the +/- 10% range, repeat the calibration verification. If that fails, recalibrate using all standards. If re-calibration is unsuccessful, use new standards, consult the manufacture/vendor or replace the unit.

OVERNIGHT STORAGE OF THE YSI INSTRUMENT

Check with the vendor for the appropriate overnight storage of the probes. Some manufacturers/venders may recommend storing the multiparameter probes overnight in a calibration cup filled with pH 4 solution. If so, fill the calibration cup with pH 4 solution, place the probes into the calibration cup and seal tightly.

DATA MANAGEMENT AND RECORDS MANAGEMENT

All calibration information must be documented on the attached calibration log, including the instrument manufacturer, model number and identification number; standards used to calibrate the instruments (including source, lot numbers and expiration dates); date; personnel; the instrument readings, barometer reading, DO membrane inspection, changed DO membrane and solution, etcetera. Each daily calibration log shall be dated and signed by the user.

REFERENCES

Calibration of Field Instruments SOP included in the current Hazardous Waste Remediation Bureau Master QAPP, EPA RFA #13027, Revision 4, March 2017.

YSI Instruction Manual(s) as appropriate.

Hach Model 2100P/2100Q Portable Turbidity Instruction Manual(s) as appropriate

ATTACHMENT

Calibration Log

COAKLEY LANDFILL INSTRUMENT CALIBRATION / MAINTENANCE LOG

Date: **Time:**	Field Personnel:

Meter: (circle one) YSI: Model 600XL, Model 600XLM **Multimeter Serial Number:**

Rental Company:

Probe Pre-cleaned Certification Provided By: Personnel **Date:**

Temperature Calibration: Personnel: **Date:**

Manufactures Accuracy Range of Sensor (e.g. +/- 0.2˚C): **Temperature check results:**

Daily Instrument Calibration

Multimeter Calibration	Value of Standard	Check as Completed	Lot #	Expiration Date	Comments
DO (% saturation)	**100%**				**Allow time for stabilization per manufacture**
DO mg/L reading					**Record these values immediately after calibration**
DO Temp. (˚C) reading					
pH 1st Standard	**7**				
2nd Standard	**4**				
3rd Standard	**10**				
Specific Conductance **(µS/cm)**	**718**				**One standard is used to calibrate (718 standard), second one to check (1413 standard)**
ORP using Zobell Solution					**See Chart on Page 2 for ORP Zobell Solution mV Value Based on Temperature**
Zobell Solution _____ ˚C					

Additional Information for Dissolved Oxygen Calibration

Barometric Pressure of Meter: _____ mm Hg [BP inches _____ x 25.4 + BP _____ mm Hg]

Dissolved Oxygen Charge (YSI Meters): _____ (Acceptable Range: 25 to 75) You MUST change the membrane if charge is out of range.

Inspected DO membrane for nicks or bubbles (check as completed) _____ **Personnel:_____**

Changed Dissolved Oxygen Membrane and Electrolyte Solution (circle one) **YES or NO**

HACH 2100P or 2100Q * Turbidimeter Calibration	Value of Standard	Check as Completed	Lot #	Expiration Date	Comments
Turbidity 1st Standard (blank)	**<0.1 NTU**				**Calibrate w/ StablCal® Formazin Primary Turbidity Standards**
2nd Standard	**20 NTU**				
3rd Standard	**100 NTU**				
4th Standard	**800 NTU**				

HACH Serial Number: **Rental Company:**

*** NOTE: the 2100Q does not have a <0.1 standard, record N/A (not applicable) in the <0.1 standard boxes as appropriate.**

**** When performing calibration checks, wait for temperature and parameter readings to stabilize before recording the results.****

Post Calibration Check

Date: **Time:**	**Personnel:**

Calibration Check	Value of Standard	Check Results	Acceptable Range	Within Range (yes/no)	Lot #	Expiration Date	Comments
Zero DO check (mg/l)	**0**		**0 to 0.5 mg/L**				
pH 7 check	**7**		**+/- 5%**				**Range 6.65 - 7.35 pH**
Specific Conductance **(µS/cm)** Second standard used for check	**1413**		**+/- 5%**				**Range 1342 - 1484 µS/cm (1413)**
ORP check - Zobell (mV)			**+/- 5%**				**See Chart on Page 2 for ORP Zobell Solution mV Value Based on Temperature**
Zobell Solution _____ ˚C							
Turbidity Standard (NTU) **2100P**	**20**		**+/- 5%**				**Range 19.0 - 21.0 NTU (2100P)**
Turbidity Standard (NTU) **2100Q**	**10**		**+/- 10%**				**Range 9.0 - 11.0 NTU (2100Q)**

Notes: 1) If the post calibration check is not within the acceptable range the meter must be recalibrated.
2) All calibration checks must be made in the run mode (on a run/measurement screen), not the calibration mode.
3) If the lot numbers and expiration dates are the same as the initial calibration place a check mark √ in the appropriate box.
4) Record N/A (Not Applicable) in the boxes for the turbidity meter that was not used.

Calibration & Post Calibration Check Performed by: _____(Print)_____ (Sign)

** When performing calibration checks, wait for temperature and parameter readings to stabilize before recording the results.**							
END OF DAY INSTRUMENT CALIBRATION CHECK							
Calibration Check	**Value of Standard**	**Check Results**	**Acceptable Range**	**Within Range (yes/no)**	**Lot #**	**Expiration Date**	**Comments**
Date: Time:		**Personnel:**					
Zero DO check (mg/l)	**0**		**0 to 0.5 mg/L**				
pH 7 check	**7**		**+/- 5%**				**Range 6.65 - 7.35 pH**
Specific Conductance **(µS/cm)** Second standard used for check	**1413**		**+/- 5%**				**Range 1342 - 1484 µS/cm (1413)**
ORP check - Zobell (mV)			**+/- 5%**				**See Chart below for ORP Zobell Solution mV Value Based on Temperature**
Zobell Solution _____ ˚C							
Turbidity Standard (NTU) **2100P[4]**	**20**		**+/- 5%**				**Range 19.0 - 21.0 NTU (2100P)**
Turbidity Standard (NTU) **2100Q[4]**	**10**		**+/- 10%**				**Range 9.0 - 11.0 NTU (2100Q)**

Notes:

1) If the end of the day calibration check is not within the acceptable range the data collected that day for that parameter shall be qualified in it's use.

2) All calibration checks must be made in the run mode (on a run/measurement screen), not the calibration mode.

3) If the lot numbers and expiration dates are the same as the initial calibration place a check mark ✓ in the appropriate box.

4) Record N/A (Not Applicable) in the boxes for the turbidity meter that was not used.

Weather Conditions:

If the calibration/calibration check was performed off-site (e.g. in the office, etc) due to weather conditions, check (√) here:_____

Where off-site was the calibration/calibration check performed? _____

Calibration Check by _____ _____

Print Name Signature

<u>If data needs to be qualified,</u> list wells sampled using this equipment on this day

Zobell Solution mV Value Based on Temperature for ORP Calibration
Calibration Check Range Values (+/- 5%)
(Round off temperature to whole number, e.g. 23.5 ºC rounds up to 24 ºC)

Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%	Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%	Temp. ºC	ORP Zobell Solution mV Value	Calibration Check Range Values +/- 5%
-3	**267**	254-280	10	**251**	238-264	23	**234**	222-246
-2	**266**	253-279	11	**249**	237-261	24	**232**	220-244
-1	**265**	252-278	12	**248**	236-260	25	**231**	219-243
0	**264**	251-277	13	**247**	235-259	26	**230**	219-242
1	**262**	249-275	14	**245**	233-257	27	**228**	217-239
2	**261**	248-274	15	**244**	232-256	28	**227**	216-238
3	**260**	247-273	16	**243**	231-255	29	**226**	215-237
4	**258**	245-271	17	**241**	229-253	30	**225**	214-236
5	**257**	244-270	18	**240**	228-252	31	**223**	212-234
6	**256**	243-269	19	**239**	227-251	32	**222**	211-233
7	**254**	241-267	20	**238**	226-250	33	**221**	210-232
8	**253**	240-266	21	**236**	224-248	34	**219**	208-230
9	**252**	239-265	22	**235**	223-247	35	**218**	207-229

CHAIN-OF-CUSTODY, SAMPLE HANDLING AND SHIPPING PROCEDURES

PURPOSE

This Standard Operating Procedure (SOP) *Chain-of-Custody, Sample Packaging and Shipment Procedures* has been established to provide for sample integrity in addition to proper sample labeling and completion of Chain-Of-Custody (COC) forms; and proper sample packaging and shipment for the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire.

A COC is a legal document designed to track persons who are responsible for the preparation of the sample container, sample collection, sample delivery, sample storage, and sample analysis. The field sampler is personally responsible for the care and custody of the samples, including un-used sample containers, until they are transferred or properly dispatched. As few people as possible should handle the samples. A sample including empty sample containers, samples and coolers are under a person's custody if it meets the following requirements:

- It is in the person's possession;
- It is in the person's view, after being in the person's possession;
- It was in the person's possession and it was placed in a secured location; or
- It is in a designated secure area.

******Never leave samples including un-used sample containers unattended unless they are secured in a locked vehicle or building for which no one else has access******

All samples submitted to a laboratory shall be accompanied by a properly completed COC form, be packaged and shipped as appropriate. Always check with the Project Manager and selected laboratory-specific requirements regarding COCs.

Failure to maintain possession in the ways outlined in this SOP would constitute a break in sample custody and would likely discredit this sample as use of evidence in court proceedings. The sampler must assume that all samples collected will someday be used as evidence in court and treat the task of sample custody accordingly.

For this project, all samples will be delivered to the Eastern Analytical. Inc. Laboratory under their chain-of-custody form by Sampling and Reporting Contractor. The Sampling and Reporting Contractor will coordinate sample delivery arrangements directly with the lab. The laboratory Turn-Around-Time (TAT) requested for all samples will be the standard 10 to 15 business day TAT.

EQUIPMENT AND MATERIALS

The following is a list of equipment and material commonly used for labeling, packaging and shipping

samples:

- COC forms/seals
- Bubble wrap or air cushions
- Re-sealable plastic bags
- Permanent waterproof ink marker
- Black ink pen
- Loose ice
- Shipping coolers
- Sample labels
- Packing Tape

CUSTODY PROCEDURES

1. The field sampler will review the Sampling and Analysis Plan (SAP) provided by the project manager for specific COC record-keeping requirements. Note the following key COC related items:
   - The specific laboratory to be used along with contact information.
   - Quality Assurance/Quality Control (QA/QC) data package requirements (i.e., level A, B, or C) for project-specific data validation needs. – Level C is required for this project.
   - Laboratory reporting options, including preliminary results or electronic deliverables.
   - Standard or rush turn-around-times.
   - Special laboratory requirements including lower detection limits; short hold times; and sample volume issues.
2. The field sampler will label all sample bottles, using waterproof ink, with the following information at a minimum: Sample ID; Site name/location; sampler name; date and time sample was collected; laboratory analysis and test method requested; preservative used and CES project number.

   Note: If soil VOA samples are collected, no additional labels or tape should be used as these are pre-weighed by the laboratory.
3. Prior to leaving the site, the field sampler will check for errors on the sample label and COC form and verify that all pertinent data is present and correct.

   The unique laboratory COCs will be filled out and include the following: The site/project name, town the site is located in, New Hampshire Department of Environmental Services (NHDES) site number, unique sample IDs, time and date of collection, matrix type, laboratory analysis and method requested, number of containers, preservatives, name and phone numbers of all samplers and staff involved in filling out the COC forms, name and phone number of the Project contact person, specific requirements such as specific Reporting

Detection Limits (RDLs), any special notes or requirements such as the lab account number, OneStop Project ID, and all quality assurance/quality control (QA/QC) samples and associated information (i.e., trip, temperature and equipment blanks, duplicates, etc).

Either the field sampler or the onsite QA Officer will prepare the COCs. The names and phone numbers of all the field samplers and the QA Officer must be listed on the COC.

4. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to a mobile laboratory, to the permanent laboratory, or to/from a secure storage area.

   Only one of the field samplers signs the first "relinquished by" line. The person who receives the samples at the laboratory signs the COC last in the "received by" line. In case there are additional steps in the process requiring another person or persons to take custody of the sample, the form has additional lines for signatures. All signatures must be in ballpoint pen and are followed by a date and time that the COC was signed.

   Note: Any errors must be lined out and initialed, and the correction written in.

5. If the samples are shipped by public courier (i.e., Federal Express, UPS, etc.) the airbill generally serves as the chain-of-custody record for that portion of the trip and will be retained by the field sampler (and provided to the project manager) as part of the permanent documentation.

6. The Sampling and Reporting Contractor Manager or Quality Assurance Officer will review the COC to evaluate completeness; holding time or sample volume issues that may impact the validity of the results.

SAMPLE PACKAGING PROCEDURES

Sample containers are generally packaged in insulated coolers for shipment or pickup by the laboratory courier. Appropriate packing materials include bubble wrap and air cushions. Sample containers are packed tightly so minimize movement during shipment that may cause breakage.

1. To eliminate the chance of breakage during shipment, approximately 1 inch of inert material should be placed in the bottom of the cooler.

2. Include a temperature bank and any necessary trip blanks in loose ice in each cooler prior to sample collection.

3. Place each sample container inside a re-sealable plastic bag as a precaution against cross-contamination due to leakage or brakeage.

4. Place all containers in an upright position into the loose ice in the cooler and place all glass containers in such a way that they do not come into contact with each other during shipment.

5. After samples have been packed, **loose ice** will be added to the cooler to ensure temperature preservative is achieved (temperature 4 +/-2 degrees Celsius).

6. Include a completed COC in a sealed re-sealable bag within each cooler being shipped to or picked up by the laboratory.
7. Prior to any cooler being shipped that contains environmental samples, Sampling and Reporting Contractor Manager or Quality Assurance Officer is required to evaluate if the samples/sample containers being shipped are considered hazardous. Consult appropriate trained personnel for proper packaging and labeling requirements.

SAMPLE PICKUP/SHIPPING PROCEDURES

Samples will be properly packaged for shipment, and a separate signed COC record will be enclosed in each sample cooler if more than one is used. Shipping containers will be secured with strapping tape and a custody seal in at least two locations for shipment to the laboratory; however, when samples are transported via courier, strapping tape and custody seals are not required.

Samples will be transported to the laboratory in such a manner as to preserve their integrity and will be delivered at least every other day and if possible, no samples should be held over the weekend.

Samples requiring shipment shall be sent next-day delivery by Federal Express or an equivalent overnight carrier. The receiving laboratory shall be given advance notice by the field sampler no later than 48 hours before sample shipment.

For shipments by commercial carrier, the appropriate side of the shipping container should be prominently marked with a "This End Up" label with arrows pointing in the correct orientation. The Sampling and Reporting Contractor will affix the shipping company label to the top of the cooler. The label should include the shipper's name, address, and telephone number, and the name, address, and telephone number of the receiving laboratory. Also on the top of the shipping container, the shipper's return address should be written in black ink.

A Bill of Lading is not required. The shipping papers should include the COC Form sealed inside the sealed cooler, and the shipping company's airbill, affixed to the top of the container. As necessary, the Sampling and Reporting Contractor will assign an airbill number to each day's shipment (only one airbill number is required for containers shipped on a given day).
Refer to the organizational chart in the SAP for the contact information for the analytical laboratory.

If Friday sampling is unavoidable and Saturday delivery is not possible, samples shall be properly stored (custody and sample preservation must be maintained) over the weekend. If prompt shipping and laboratory receipt of samples cannot be guaranteed, the samplers will be responsible for proper storage of samples until adequate transportation arrangements can be made or sample collection schedules can be modified by the Sampling and Reporting Contractor. If holding times would be exceeded by storing the samples, alternative arrangements must be made for sample collection and shipment or pickup.

DOCUMENTATION

The original COC record will accompany the cooler and a copy will be retained by the sampler for return to the project manager.

REFERENCES

The Chain of Custody Sample Handling and Shipping found in the current version of the Hazardous Waste Remediation Bureau Master Quality Assurance Project Plan (HWRB Master QAPP), EQA RFA #13027, Revision 4, March 2017.

ATTACHMENTS

Eastern Analytical COC

SAMPLING FOR PER- & POLY-FLUORNIATED ALKYL SUBSTANCES

This Standard Operating Procedure (SOP) *Sampling for Per- & Poly-Fluorinated Alkyl Substances (PFAS)* provides guidance for collecting groundwater samples at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire that will minimize the potential for cross-contamination during sampling. *Please note that PFAS are emerging contaminants; therefore, this SOP will be modified as new information becomes available.*

PURPOSE

The purpose of this SOP is to provide guidance for collecting samples for PFAS analysis.

Because of the potential presence of PFAS in common consumer products and in equipment typically used to collect groundwater samples and the low detection limits associated with laboratory PFAS analysis, special handling and care must be taken when collecting samples for PFAS analysis.

This SOP outlines general practices for collecting PFAS samples and provides a summary of non-acceptable field and sampling materials (likely to contain PFAS) and acceptable alternatives.

Any modifications to this SOP shall be approved in advance by the New Hampshire Department of Environmental Services (NHDES) Project Manager, documented in the field logbook and presented in the final report.

SCOPE

This procedure applies to all CES personnel and subcontractors who collect or otherwise handle samples of groundwater for analysis of PFASs. This SOP should be reviewed by all on-site personnel prior to implementation of field activities.

BACKGROUND

Based on USEPA guidance, “per- and polyfluoroalkyl substances (PFAS)” is the preferred term to refer to this class of chemicals, although the general public and others may also refer to them as “perfluorinated chemicals (PFCs)” or “Perfluorinated compounds (PFCs).” For further information, see: https://www.epa.gov/pfas/what-are-pfcs-and-how-do-they-relate-and-polyfluoroalkyl-substances-pfass.

PFAS are a family of man-made compounds that do not naturally occur in the environment. They have a large number of industrial uses and are found in many commercial products because of their properties to resist heat, oil, grease and water. Once released to the environment, PFAS are persistent and do not readily biodegrade or break down. New Hampshire and several other northeast states are dealing with several sites where there have been widespread PFAS impacts to drinking water supplies.

The U.S. Environmental Protection Agency (USEPA) issued drinking water lifetime health advisories (HAs) for two PFAS, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), on May 19, 2016. After a review of USEPA’s information, NHDES filed an emergency rule to establish the HAs as Ambient Groundwater Quality Standards (AGQS) on May 31, 2016. NHDES set three groundwater standards: 70 parts per trillion (ppt) for PFOA, 70 ppt for PFOS,

and 70 ppt for PFOA and PFOS combined, where the chemicals are found together. After completing the regular rulemaking process, these rules became permanent on October 22, 2016.

Frequently asked questions, fact sheets and additional information concerning PFAS can be found on the NHDES website and on the New Hampshire Department of Health and Human Services (NHDHHS) website.

GENERAL

Given the low detection limits associated with PFAS analysis and the many potential sources of trace levels of PFASs, field personnel are advised to act on the side of caution by strictly following these protocols, frequently replacing nitrile gloves, and rinsing field equipment to help mitigate the potential for false detections of PFASs. Specific items related to field sampling are discussed below.

1. **Personal Protective Equipment**
   Disposable nitrile gloves must be worn at all times. Further, a new pair of nitrile gloves shall be donned prior to the following activities at each sample location:

   a. Decontamination of re-usable sampling equipment.
   b. Contact with sample bottles or water containers.
   c. Insertion of anything into the well (e.g., tubing, pump, bailer).
   d. Insertion of silicon tubing into the peristaltic pump.
   e. Sample collection, at completion of monitoring well purging.
   f. Handling of any quality assurance/quality control samples including field blanks and equipment blanks.

   New gloves shall also be donned after the handling of any non-dedicated sampling equipment, contact with non-decontaminated surfaces, or when judged necessary by field personnel.

2. **Sample Collection Method/Sequence**

   a. Using new nitrile gloves, collect the sample for PFAS ***first***, prior to collecting samples for any other parameters into any other containers; this avoids contact with any other type of sample container, bottles or package materials that may have PFAS-related content.
   b. Do not place the sample bottle cap on any surface when collecting the sample and avoid all contact with the inside of the sample bottle or it's cap.
   c. Once the sample is collected, capped and labeled, place the sample bottle(s) in an individual re-sealable plastic bag (e.g., Ziploc®) and place in an appropriate cooler packed only with loose ice (preferably from a verifiable PFAS-free source).

3. **For Samples Collected From Monitoring Wells**

   a. When feasible, use dedicated, single-use or disposable polyethylene or silicone materials (tubing, bailers, etc.) for monitoring well purging and sampling equipment.
   b. When reuse of materials or sampling equipment across multiple sampling locations is necessary, follow project decontamination protocols with allowed materials identified in the table below and incorporate collection of equipment blanks into sampling program, as appropriate.

c. When using positive displacement/submersible pump or bladder pump sampling equipment, familiarize yourself with the sampling pump/accessory equipment specifications to confirm that device components are not made of nor contain polytetrafluoroethylene (PTFE, a.k.a. Teflon®) or other PFAS-containing components.

4. For Samples Collected During Production Well Pumping Tests

a. Do not use tape or pipe thread sealant containing Teflon on pipe fittings or sampling tap threads on the pump discharge pipe.
b. As with all other sample parameters, the sample for PFAS will be collected at the last hour (or hours) of the pumping portion of the testing program, but before the collection of other sample parameters as stated in Item 2, above.
c. Discharge water will be purged through the sampling tap on the discharge pipe for a minimum of 20 minutes prior to collection of samples.

5. For Samples Collected From Active Production Wells

a. If feasible, avoid contact with any tape or pipe thread paste containing Teflon on pipe fittings or sampling tap threads that may be present on the water supply discharge pipe.
b. The sampling for PFAS will be collected while the production well pump is operating, and, preferably, has been operating for at least one hour.
c. Discharge water will be purged through the sampling tap on the discharge pipe for a minimum of 20 minutes prior to collection of samples.

6. Decontamination

Decontamination fluids have been seen as a possible source of equipment cross contamination. Therefore, more frequent changes of decontamination liquids may be warranted. Refer to the Equipment and Materials Table below for prohibited and acceptable decontamination liquids.

SITE SPECIFIC SAMPLING AND ANALYSIS PLAN

The details within this SOP shall be used in conjunction with an approved site-specific Sampling and Analysis Plan (SAP). The SAP will provide the following information:

- Sample collection objectives;
- Locations to be sampled;
- Number and volume of samples to be collected at each location
- Types of chemical analyses to be conducted for the samples;
- Specific quality control procedures and sampling required;
- Personnel responsibilities;
- Site-specific Health and Safety Plan; and
- Any additional sampling requirements or procedures beyond those covered in this SOP, as necessary.

All field personnel must confer with their Project Manager or Field Lead before deviating from approved procedures, and as previously stated, any modifications to this SOP shall be approved in advance by the NHDES Project Manager. All deviations must be documented in the field log book and presented in the final sampling report.

EQUIPMENT AND MATERIALS

The following table provides a summary of items that are likely to contain PFAS (i.e., prohibited items) and that are not to be used by the sampling team at the site, along with acceptable alternatives. This list may change as new information becomes available.

Category	Prohibited Items	Allowable Items
Field Equipment Including: ◆ Pumps ◆ Tubing ◆ Bailers	Teflon and other fluoropolymer containing materials (e.g., Teflon tubing, bailers, tape, Teflon-containing plumbing paste, or other Teflon materials) **Note:** The Grundfos Redi-Flow Submersible Pump is a submersible pump which, as of this revision, has a Teflon impeller and is not recommended for collecting PFAS samples.	High-density polyethylene (HDPE), low density polyethylene (LDPE) or silicone tubing HDPE/LDPE or stainless-steel bailers Peristaltic pumps Stainless steel submersible pumps (e.g., ProActive stainless-steel pumps with PVC (Polyvinyl chloride) leads and Geotech Stainless Steel Geosub pumps) Bladder pumps with polyethylene bladders and tubing need to be evaluated on a case by case basis because the gaskets and O-rings may contain PFAS Equipment with Viton components needs to be evaluated on a case by case basis. Viton contains PTFE, but may be acceptable if used in gaskets or O-rings that are sealed away and will not come into contact with sample or sampling equipment.
Decontamination	Decon 90	Alconox® or Liquinox®[1], potable water followed by laboratory "PFAS-free" deionized water rinse.
Sample Storage and Preservation	LDPE or glass bottles, PTFE-or Teflon®-lined caps, chemical ice packs[2]	Laboratory-provided sample container-*preferred*; or, HDPE or polypropylene bottles, regular loose ice (preferably from a known PFAS-free source)
Field Documentation	Waterproof/treated paper or field books, plastic clipboards, non-Sharpie® markers, Post-It® and other adhesive paper products	Plan Paper, metal clipboard, Sharpies®[3], pens
Clothing/ laundering	Clothing or boots made of or with Gore-Tex™ or other synthetic water proof/ resistant and/or stain resistant materials, coated Tyvek® material that may contain PFAS; Fabric softener	Synthetic or cotton material, previously laundered clothing (preferably previously washed greater than six times) without the use of fabric softeners. Polyurethane and wax coated materials. Boots made with polyurethane and PVC, well-worn or untreated leather boots Tyvek material that is PFAS free

Category	Prohibited Items	Allowable Items
Personal Care Products (for day of sample collection)	Cosmetics, moisturizers, hand cream and other related products	**Sunscreens:** Alba Organics Natural Yes to Cucumbers Aubrey Organics Jason Natural Sun Block Kiss My Face Baby-safe sunscreens ('free' or natural) **Insect Repellents:** Jason Natural Quit Bugging Me Repel Lemon Eucalyptus Herbal Armor California Baby Natural Bug Spray BabyGanics **Sunscreen and Insect Repellents:** Avon Skin So Soft Bug Guard-SPF 30
Food and Beverage	Pre-packaged food, fast food wrappers or containers	Bottled water or hydration drinks (i.e., Gatorade® and Powerade®)
Shelter	The use of a canopy/gazebo/tent, which can be erected over the sample location to provide shelter, may be considered. Note that the canopy is likely to have a treated surface and must be handled with care. Gloves must be worn when setting up and moving the tent and then changed immediately afterwards. Further contact with the tent must be avoided until all PFAS samples have been collected and properly stored.	

[1] While Alconox and Liquinox soap is acceptable for use for PFAS decontamination, they may contain 1,4-dioxane. If Alconox® and Liquinox® soap is used at sites where 1,4-dioxane is a contaminant of concern/interest, then equipment blanks analyzed for 1,4-dioxane will be required.

[2] The HWRB Master QAPP requires that all samples requiring cooling must be placed in loose ice within a cooler; the use of bagged ice, block ice and ice packs is not acceptable.

[3] Sharpies may be used if necessary; however, the HWRB does not recommend using Sharpies as they can bleed through pages and smudge, making the documentation hard to read.

QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control (QA/QC) samples (i.e trip blanks, field blanks, equipment blanks, duplicate samples, and matrix spike/matrix duplicate samples) will be collected as outlined in Table 4-4 of the SAP. An equipment blank will be collected on the water level meter using laboratory certified "PFC free" water.

PROCEDURES/CONSIDERATIONS

The following are procedures/considerations to be made during field activities at the Coakley Landfill during PFAS sampling. A summary of the prohibited and acceptable items for PFAS sites is included below.

FIELD EQUIPMENT

Samplers will use peristaltic pumps for groundwater sample collection at depths shallower than 25 feet. Tubing will consist of dedicated LDPE and silicon tubing previously installed in Site wells. Groundwater sample collection at depths greater than 25 feet will be collected utilizing bailers and twine made of acceptable materials.

EQUIPMENT DECONTAMINATION

Field sampling equipment, including water level indicators, that are utilized at each sample location will require cleaning between uses. The SAP dictates that we use Alconox®, which is an allowable item for PFAS sampling. Water used for the final rinse during decontamination of sampling equipment will be laboratory certified "PFC-free" water.

VISITORS

Visitors to the site are asked to remain outside of the exclusion zone during sampling activities.

ANALYTICAL

Groundwater samples will be analyzed for PFASs using EPA Method 537 with a 20 to 30-day turnaround time. A detection limit of at least 20 parts per trillion will be used. Results will be compared the current health standards. If results meet or exceed these provisional standards or any promulgated standard at the time, sampling will be expanded to other wells within the Groundwater Management Zone and residential homes.

Samples will be tested for the following PFASs:

- Perfluorbutanesulfonic acid (PFBS)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorooctanoic acid (PFOA)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanesulfonic acid (PFOS)

REFERENCES

Final Long-Term Residential Well PFC Monitoring Plan, Former Pease Air Force Base, Amec Foster Wheeler Environment & Infrastructure, Inc., February 2016

PFAS Sampling, Technical Training for Waste Site Cleanup Professionals, Chiang, Dora PD.D., P.E., AECOM Environment, August 3, 2016

NHDES Website – Investigation into Perfluorooctanoic Acid (PFOA) Found in Southern New Hampshire Drinking Water at http://www.des.nh.gov/organization/commissioner/pfoa/htm

NHDES PFC Notification Letter to Stakeholders, November 22, 2016.
http://www.des.nh.gov/organization/divisions/waste/hwrb/documents/pfc-stakeholder-notification-20161122.pdf

NHDES PerFluorinated Compound (PFC) Sample Collection Guidance, November 2016. This document is an attachment to the NHDES PFC Notification Letter to Stakeholders, November 22, 2016, listed above.

Draft PFAS Fact Sheet (FAQs) for HWRB Project Managers, January 19, 2017

MONITORING WELL DEVELOPMENT PROTOCOL

This Standard Operating Procedure (SOP), *Monitoring Well Development Protocol*, provides a general framework for developing monitoring wells at the Coakley Landfill Superfund Site in North Hampton and Greenland, New Hampshire that will be implemented to ensure the removal of fine grained sediments (fines) from the vicinity of the well screen. This will allow groundwater to move freely from the formation into the well, allowing a representative sample to be collected from the well.

PURPOSE

The purpose of this SOP is to provide well development protocols to remove sediment from the well and surrounding sand pack, residuals from well installation activities (drilling fluids) or to rehabilitate wells that have not been sampled for long periods of time. The most common well development methods are: surging, jetting, pumping/overpumping, and bailing. The most effective approach is generally a combination of one or more methods that allow for water movement in both directions through a well.

SCOPE

This procedure applies to all CES personnel and subcontractors who will be developing monitoring wells at the Site. This SOP should be reviewed by all on-site personnel prior to implementation of field activities.

DOCUMENTATION

Well development documentation is important to show that representative samples can be obtained. Development method(s), time spent on development, volume of water removed, depth of the well, depth to top of the screen, and diameter of the well will be recorded on the well development form.

Prior to developing the well, the well depth and depth to groundwater will be gauged using an electronic water meter. The current well depth will be compared to the depth of the well as per the well completion log. The well will then be developed by using one of the methods discussed below to evacuate a minimum of three well volumes of water or until water is clear and free of sediments and indicator parameters pH, temperature, and specific conductivity stabilize. Well depth will be recorded following the completion of well development.

Development will occur a minimum of 48 hours prior to sampling the well in order to allow the well to stabilize after purging.

WELL DEVELOPMENT PROCEDURES

Surging involves pulling and pushing water into and out of a well by using a plunger or surge block within the well casing or screen interval. The resulting surging motion forces the water into the formation and loosens sediment which is then pulled from the formation into the well. The surge effect can be generated by intermittent pumping and repeatedly allowing the water column to fall back into the well or by using a surge block device that is close in size to the well diameter. Water should be removed from the well as this process is occurring.

Jetting involves lowering a small diameter pipe into the well and injecting a high velocity horizontal stream of water or air through the pipe into the screen openings. The horizontal stream of water breaks up any sediment, or drilling related filter cake and flushes the adjacent sand pack. Water should be removed from the well as this process is occurring.

Pumping/overpumping is a technique where the intake of the pump is raised and lowered (without excessive surging) throughout the length of the screened interval with pumping beginning at the top of the screen at a low pumping rate. Utilizing pumps in which the pumping action creates gentle surging or pumps that can be fitted with a surge black may enhance development. The process should be repeated in reverse from the bottom to the top of the well. When there is no improvement in turbidity, the well should be allowed to equilibrate for approximately 15 minutes and then the process should be repeated. Alternate pumping and equilibration cycles should continue until the water is free of sediments and no additional sediment accumulates at the bottom of the well. This will be determined by water quality parameters stabilizing and/or turbidity being documented under 50 NTUs. This will be documented on the well development log.

Bailing includes the use of a manually operated check-valve bailer to remove water from the well. The bailer should be rapidly lowered down the well until it hits the water column. The impact of the bailer on the water surface will force water into the formation. The withdrawal of the bailer will cause water to flow back into the well. To properly develop the well, rapid motions along the entire length of the screen should be done to create an inward and outward thrust of the water to remove fines from the formation. Bailers may be used for shallow wells or wells that recharge slowly.

EQUIPMENT DECONTAMINATION

Field sampling equipment, including water level indicators and non-dedicated pumps, that are utilized at each sample location will require cleaning prior to and between uses. Alconox® will be used for decontamination purposes. Laboratory grade water used for the final rinse during decontamination of well development equipment.