South Park Landfill

Interim Site-wide Groundwater Monitoring Plan

Prepared for

Prepared for City of Seattle
South Park Property Development, LLC

Prepared by

Floyd|Snider-Aspect Team

FLOYD | SNIDER
strategy • science • engineering

Aspect CONSULTING

December 7, 2012

Signature of Approval _____ Date _____

DRAFT

LIMITATIONS

This work plan has been prepared for the exclusive use of the South Park Landfill Group (The City of Seattle, King County, and South Park Parcel Development, LLC.); their authorized agents, and regulatory agencies. It has been prepared following the described methods and information available at the time of the work. No other party should use this report for any purpose other than that originally intended, unless Floyd|Snider agrees in advance to such reliance in writing. The information contained herein should not be utilized for any purpose or project except the one originally intended. Under no circumstances shall this document be altered, updated, or revised without written authorization of Floyd|Snider.

South Park Landfill Interim Site-wide Groundwater Monitoring Plan

CERTIFICATION

This document has been prepared for the City of Seattle under the direction of:

Name: Stephen Bentsen, PE

Date: December 7, 2012

AUTHOR RECOGNITION

The following individuals have contributed to the preparation of this Interim Site-wide Groundwater Monitoring Plan:

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List of Abbreviations/Acronyms

Acronym/ Abbreviation	Definition
ARI	Analytical Resources, Inc.
°C	Degrees Celsius
CAP	Cleanup Action Plan
COC	Chemical of concern
CUL	Cleanup level
DCE	Dichloroethene
DNAPL	Dense non-aqueous phase liquid
DQI	Data quality indicator
DQO	Data quality objective
Draft RI/FS	Draft South Park Landfill Remedial Investigation/Feasibility Study
Ecology	Washington State Department of Ecology
Glitsa	Glitsa American, Inc.
Interim GWMP	Interim Groundwater Monitoring Plan
LNAPL	Low non-aqueous phase liquid
µg/L	Micrograms per liter
Mg/L	Milligrams per liter
MTCA	Model Toxics Control Act
mV	MilliVotls

Acronym/ Abbreviation	Definition
ORP	Oxidation reduction potential
PLP	Potentially liable person
POC	Point of Compliance
QA	Quality assurance
QC	Quality control
SPPD	South Park Property Development, LLC
TCE	Trichloroethene
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code

1.0 Introduction

This Interim Site-wide Groundwater Monitoring Plan (Interim GWMP) has been prepared to provide the framework for continued groundwater monitoring during review of the Draft South Park Landfill Remedial Investigation/Feasibility Study (Draft RI/FS; Floyd|Snider 2012) by the Washington State Department of Ecology (Ecology) and prior to completion and submittal of the Cleanup Action Plan (CAP). The groundwater monitoring will also coincide with the development of the South Park Property Development, LLC (SPPD) parcel as part of an Interim Action.

This monitoring plan outlines the protocols for sampling, sample handling and storage, chain-of-custody, laboratory and field analyses, and documentation and reporting. This plan was developed in accordance with *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies* (Ecology 2004) and Washington State Model Toxics Control Act (MTCA) Washington Administrative Code (WAC) 173-340-820 (Ecology 2007).

1.1 PURPOSE AND OBJECTIVES

The purpose of interim site-wide groundwater monitoring is to provide groundwater monitoring between the first quarter 2013 and the first quarter 2014, after which the Long-term Site-wide Groundwater Monitoring Plan is anticipated to be implemented. Therefore, interim site-wide groundwater monitoring is designed to meet the same requirements specified for the long-term site-wide groundwater monitoring in the Operations, Maintenance, and Monitoring section of the Draft RI/FS (refer to Section 15.1 of that document).

1.2 BACKGROUND

Based on the historical groundwater quality data and the Draft RI/FS (refer to Section 5.6 of that document), several chemicals of concern (COCs) were identified in groundwater at the site based on exceedances of the respective cleanup levels (CULs). These COCs include vinyl chloride, iron, and manganese. Two other chemicals, trichloroethene (TCE) and cis-1,2-dichloroethene (DCE), although not COCs, will be monitored because they are part of the chemical degradation pathway that results in the vinyl chloride, which is a COC. Evaluation of potential remedial alternatives (refer to Section 14.4 of the Draft RI/FS) indicated a preferred alternative of monitored natural attenuation and source control, with long-term site-wide groundwater monitoring as a part of the presumptive remedy. Concentrations of vinyl chloride, iron, and manganese that are elevated at levels greater than the respective CULs will naturally attenuate through either biological degradation (in the case of vinyl chloride) or by resorbing to native soils (in the case of iron and manganese).

1.3 CLEANUP LEVELS AND POINTS OF COMPLIANCE

As defined in the MTCA regulations, the cleanup standard for a contaminated site consists of CULs and the location(s) at which the CULs apply (i.e., the Point of Compliance [POC]). The POC for groundwater monitoring that is part of landfill closure is defined as the edge of solid waste, which under MTCA is considered a conditional POC. At the South Park Landfill, several downgradient edge of waste monitoring wells are located within the landfill boundary. These wells are used as conditional POC because no other wells are located immediately downgradient beyond the South Park Landfill boundary. For further details, refer to

Section 5.6.2 of the Draft RI/FS. CULs and the respective conditional POC for the site are determined in the Draft RI/FS, and are described in this section. This Interim GWMP is primarily designed to monitor if the cleanup standards for the site are met during the installation of the landfill cap and collection and treatment of landfill gas on the SPPD parcel as part of the corresponding Interim Action.

The conditional POC for groundwater at the site is along the downgradient edge of solid waste, which, based on the Draft RI/FS (refer to Section 7.5.2 of that document), includes the following monitoring wells: MW-08, MW-10, MW-18, MW-24, MW-25, MW-26, MW-27, MW-32, and MW-33 (refer to Figure 1).

The site-specific CULs for groundwater at the South Park Landfill are based on the protection of groundwater as a potential drinking water source and include the following:

Chemicals of Concern	**Cleanup Levels**
Vinyl Chloride	0.29 µg/L
Dissolved/Total Iron	11 mg/L
Dissolved/Total Manganese	2.0 mg/L
Other Chemicals Monitored	
cis-1,2-Dichloroethene	16 µg/L
Benzene	5.0 µg/L
Trichloroethene	4.9 µg/L

Abbreviations:
µg/L Micrograms per liter
mg/L Milligrams per liter

1.4 SCOPE

The scope of this Interim GWMP includes a total of three semiannual groundwater quality monitoring events to be conducted between March 2013 and March 2014. Two sampling events will take place during the wet season (March 2013 and March 2014), and one sampling event will take place during the dry season (August 2013). If the Final RI/FS for the site is not complete by August 2014, bi-annual sampling events will continue until the Final RI/FS and the Long-term Site-wide Groundwater Monitoring Plan have been approved.

Groundwater quality samples will be collected from a total of 17 monitoring wells to provide supplemental water quality information prior to the completion of the CAP and development of the Long-term Site-wide Groundwater Monitoring Plan. In addition, groundwater level measurements will also be collected during each of the groundwater quality sampling events to determine groundwater surface elevations, flow directions, and gradients. The following sections provide a description of the methods and procedures for completion of interim site-wide groundwater monitoring.

1.5 PROJECT RESPONSIBILITIES

Under the authorization of the Potentially Liable Persons (PLP) Group, the Floyd|Snider Team will perform the field activities identified in this document. Analytical Resources, Inc. (ARI) in Tukwila, Washington is the primary project laboratory providing all environmental laboratory analyses. The various quality assurance (QA) field, laboratory, and management responsibilities of key project personnel are defined below.

1.5.1 Management Responsibilities

Stephen Bentsen—Floyd|Snider Team Project Manager

The Project Manager will have overall responsibility for project implementation. As Project Manager, Stephen Bentsen will be responsible for the overall QA on this project, ensuring that it meets technical and contractual requirements. The Project Manager will report directly to the PLP Group and is responsible for technical quality control (QC) and project oversight.

The Project Manager will perform the following:

- Monitor project activity and quality.
- Provide overview of field activities to the PLP Group.
- Prepare and review Draft and Final RI/FS reports.
- Provide technical representation of project activities.
- Communicate with Ecology.
- Approve the Sampling Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP).

1.5.2 Quality Assurance Responsibilities

Chell Black—Floyd|Snider Team Data Quality Assurance Manager

The Data QA Manager reports directly to the Floyd|Snider Team Project Manager and will be responsible for ensuring that data QA/QC procedures for this project are followed. The Data QA Manager will be responsible for the data validation of all sample results from the analytical laboratories. Additional responsibilities include the following:

- Overview and review of field QA/QC.
- Coordinating supply of performance evaluation samples and review results from performance audits.
- Review of laboratory QA/QC.
- Advising on data corrective action procedures.
- Preparation and review of reports.
- QA/QC representation of project activities.

1.5.3 LABORATORY RESPONSIBILITIES

ARI will perform all analytical services in support of the site-wide RI/FS work activities.

Sue Dunihoo—ARI Project Manager

The Laboratory Project Manager will report directly to the Floyd|Snider QA Manager and will be responsible for the following:

- Ensuring all resources of the laboratory are available.
- Advising Floyd|Snider's Data QA Manager of laboratory status.
- Review and approval of final analytical reports.
- Coordinating laboratory analyses.
- Supervising in-house Chain-of-Custody procedures.
- Scheduling sample analyses.
- Overseeing data review.

1.5.4 FIELD RESPONSIBILITIES

John Strunk—Floyd|Snider Team Field Quality Assurance Officer

The Field QA Officer will be responsible for leading and coordinating the day-to-day activities in the field. The Field QA Officer will report directly to the Floyd|Snider Team Project Manager.

Specific responsibilities include the following:

- Day-to-day coordination with the Project Manager.
- Developing and implementing work plans, and setting the field schedule.
- Coordinating and managing field staff including sampling and drilling.
- Reviewing technical data provided by the field staff including field measurement data.
- Adhering to the work schedule.
- Coordinating and overseeing subcontractors.
- Identifying problems, resolving difficulties in consultation with the Project Manager, implementing and documenting corrective action procedures, and communicating between team and upper management.
- Preparation of the data report.

2.0 Groundwater Sampling and Analysis Plan

The requirements and objectives of interim site-wide groundwater monitoring, described in the previous sections, can be met through the groundwater sampling program described below.

Interim site-wide groundwater monitoring is intended primarily to monitor groundwater quality and water levels. Monitoring locations, sample collection details, and reporting requirements are discussed in the following sections.

2.1 MONITORING WELL NETWORK

A summary of the monitoring wells included for interim site-wide groundwater monitoring are included in Table 1 and Figure 1. In addition to the POC wells (MW-08, MW-10, MW-18, MW-24, MW-25, MW-26, MW-27, MW-32, and MW-33), the monitoring well network also includes monitoring wells used to monitor upgradient groundwater conditions (KMW-05, MW-12, MW-14, and MW-29); a monitoring well used to monitor groundwater conditions along the northern edge of the Kenyon Industrial Park (KMW-03A); and downgradient monitoring wells used to monitor groundwater conditions adjacent to the former Glitsa American, Inc. property (MW-30 and MW-31). Several additional wells included in the monitoring well network (MW-06, KMW-01A, KMW-02B, KMW-04, KMW-06, KMW-07, KMW-08) and surface water staff gage locations (SG-1S and SG-2N) are used to measure groundwater and surface water levels in order to determine representative groundwater flow directions and gradients at the site.

As discussed in the Draft RI/FS (refer to Section 5.5 of that document), the monitoring wells are primarily completed in one of three groundwater zones of interest (Perched Zone, A-Zone, or B-Zone), all of which are part of the Shallow Aquifer. The Perched Zone is a thin discontinuous layer of groundwater that exists above the Silt Overbank Deposit, which can often be in contact with solid waste and is thus conceptually equivalent to leachate in those locations. The A-Zone is immediately below the Silt Overbank Deposit and is the critical zone where leachate (and perched water) can enter the groundwater system and move off-site. The B-Zone represents the base of the Shallow Aquifer, overlying finer-grained estuarine deposits, and is where dense non-aqueous phase liquids (DNAPLs) would accumulate, if present. Well construction logs are presented in Appendix A for the wells included in the monitoring well network.

2.2 SITE-WIDE GROUNDWATER MONITORING COMPONENTS

Groundwater monitoring will consist of measuring groundwater levels, sampling groundwater for site-specific COCs and other relevant chemicals, and reporting the groundwater flow directions and laboratory analytical results for each monitoring event. A summary of the monitoring components, schedule, and reporting requirements are provided in this section.

2.2.1 Groundwater Level Measurements

Groundwater levels will be measured at the site to provide an indication of groundwater elevations, flow directions, and gradients. A complete round of applicable groundwater levels will be measured by hand prior to beginning groundwater sampling. Groundwater level measurements will be conducted to a precision of 0.01 foot using an electric water level indicator. All groundwater level measurements will be made relative to the surveyed top of the polyvinyl chloride (PVC) well casing or other defined measuring point at the wellhead. The water

level indicator will be lowered to contact the water in the well casing (contact determined by a light or sonic alarm on the indicator) and the reading noted. The indicator will then be immediately withdrawn from the water and the measurement repeated. If the two readings are consistent (i.e., within 0.1 foot of each other), the reading will be recorded on a field form along with the measurement date and time. If the two readings are not consistent, measurements will be repeated until a reproducible result is obtained.

Following completion of the groundwater level measurement and prior to the next measurement, the water level indicator will be decontaminated according to the following procedures:

1. Rinse and pre-clean in potable water.
2. Wash in a solution of laboratory grade, non-phosphate soap (for example, Liquinox) and potable water.
3. Rinse with distilled water.

In instances where light non-aqueous phase liquids (LNAPLs) are present, as historically noted in Well KMW-05, the thickness of the LNAPL will be measured using an oil-water interface probe in accordance with the procedures discussed above.

During the semiannual groundwater level measurements, water levels will also be measured at two locations (SG-1S and SG-2N) in the West Ditch (refer to Figure 1). SG-1S is a permanent staff gage installed at the southern end of the West Ditch, while SG-2N is a surveyed measuring point from the top of a concrete footing associated with a culvert at the northern end of the West Ditch.

2.2.2 Sampling Methods

Groundwater samples will be collected according to low-flow sampling procedures using either a dedicated bladder pump or a peristaltic pump with disposable low density polyethylene (LDPE) and silicon tubing (refer to Table 1). Using low-flow sampling procedures, the respective monitoring well will be purged at a flow rate of 500 milliliters/minute or less to obtain representative samples of groundwater conditions.

Field parameters, including temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential (ORP) will be monitored during purging, at 3- to 5-minute intervals until they stabilize, using a calibrated multiparameter probe with a flow-through cell or equivalent. Of these parameters, dissolved oxygen and ORP are considered the most important because they determine the redox conditions of the groundwater, which plays an important role in the potential natural attenuation of the COCs. Because dissolved oxygen and ORP are also expected to take the longest to stabilize, stabilization is defined as three successive readings where dissolved oxygen varies by less than 10 percent, and ORP varies by less than 10 milliVolts (mV). Additional stability criteria include 0.5 degrees Celsius (°C) for temperature, 10 percent for conductivity, and 0.1 units for pH. Flow rate (and depth to water, if possible) will also be measured during well purging. In addition, prior to sampling, a turbidity measurement will be collected to help evaluate the quality of dissolved/total metal analytical results. All field measurements will be documented on the respective Groundwater Sampling Record (provided in Appendix B) for each well.

The groundwater samples will be collected directly from the pump discharge line upstream of the flow-through cell by filling the laboratory-provided bottles at the same low-flow purge rate.

Any samples collected for dissolved metals will be field-filtered using a field conditioned 0.45 micron, high-capacity disposable filter.

Samples will be stored in a cooler with ice in order to maintain the samples at a temperature of approximately 4 °C until delivery to a certified Washington State laboratory. A Chain-of-Custody form will be completed for each sample location indicating the sample identification, number of bottles collected, date and time of collection, and analysis to be performed at the laboratory. The samples will be labeled as noted in Section 3.2.

Field duplicates will be collected at a frequency of approximately 10 percent or fraction thereof of the total number of sample locations per sampling event, exclusive of other QC samples. Field duplicates will be collected under the same conditions as primary samples. Field samples will be labeled as noted in Section 3.2.

2.2.3 Analytical Parameters

Groundwater samples will be analyzed for the COCs and other relevant chemicals previously discussed in Section 1.3 (vinyl chloride, total/dissolved iron, and total/dissolved manganese) in addition to benzene, TCE, and cis-1,2-DCE. A summary of the analytical parameters are provided in Table 2. Analytical methods, reporting limits, and sample collection and preservation requirements are further discussed in Section 3.0.

2.2.4 Managing Investigation Derived Wastes

All water from the purging of the monitoring wells and decontamination wash water will be collected and stored in 55-gallon drums. The drums will be stored on-site at a location indicated by the PLPs. The drums will be clearly labeled with a description of the contents and designated as non-hazardous waste. The water will be characterized based on the analytical results from the semiannual groundwater monitoring events. Following the completion of the interim site-wide groundwater monitoring, the consultant will coordinate the disposal of the water at an appropriate facility.

Disposable materials (e.g., nitrile gloves, empty tubing) used during field work that do not contain significant contaminants may be disposed of as conventional refuse.

2.3 MONITORING SCHEDULE

Interim site-wide groundwater monitoring will be conducted semiannually, beginning in March 2013. Groundwater monitoring will be conducted during both the wet season (March) and the dry season (August), through the March 2014 groundwater monitoring event, at which time the CAP is expected to be completed and long-term site-wide groundwater monitoring will have begun.

2.4 REPORTING REQUIREMENTS

A concise data report will be prepared for each semiannual monitoring event and submitted to Ecology within 60 days of the validation of the analytical data. The report will contain the following:

- Groundwater analytical results

- Groundwater level data
- Groundwater contour maps

A brief discussion of any important or relevant changes in the site conditions will be included in the semiannual monitoring event reports.

3.0 Quality Assurance Project Plan

3.1 DATA QUALITY OBJECTIVES

This section describes the quality objectives to be used during the interim groundwater monitoring at the South Park Landfill per the requirements outlined in WAC 173-340-820.

The overall objective of the data quality objectives (DQOs) is to ensure that data are of known and defensible quality. This section provides procedures for field sampling, Chain-of-Custody protocols, laboratory analysis and data verification and validation, and reporting that provides results that meet these objectives. The DQOs of the Interim GWMP are to:

- collect high quality and verifiable data,
- use resources cost-effectively, and
- collect data that are suitable for their intended use by the client group and Ecology.

To achieve the Interim GWMP objectives, data quality indicators (DQIs) of precision, accuracy (bias), comparability, completeness, representativeness, and sensitivity are used to assess DQOs.

A technical review of QA and quality control features will be conducted by the project team to ensure compliance with this document and an overall assessment of the data collected as part of this project.

3.2 SAMPLE COLLECTION AND ANALYSIS

Groundwater samples (refer to Table 2) including field quality control samples will be collected, and analyzed by Analytical Resources, Inc. (ARI), an accredited laboratory using applicable analytical test methods for monitoring groundwater quality. Samples will be collected from each well using low-flow sampling techniques and placed within new sample bottles beginning with the most sensitive (e.g., volatile) parameters.

Samples will be labeled at the time of sampling and will include sample name, location, date, time, sampler's initials, analyte, and preservatives if any are used.

Samples will be given unique identifiers using the following naming structure.

SPL-GW-###-mmyy

Where:

SPL-GW	Identifies the sample as South Park Landfill groundwater.
###	Identifies the monitoring well type and number (e.g., KMW05 or MW30).
mmyy	Indicates month and year sample was collected (e.g., 0313 for March 2013).

A fictitious identification identifier will be assigned to the two types of QA/QC samples (field duplicate and trip blank samples), using the following sample number ranges. Consecutive numbers will be required beginning with the lower limit of the range for each QA/QC sample type.

QA/QC Sample Type	Identifier Range
Field duplicate	MW60 to MW69
Trip blank	MW80 to MW89

Samples will be handled (including containerization and preservation, in accordance with Table 3), temporarily stored, and transported in such a manner that preserves the nature and integrity of the sample and complies with Chain-of-Custody protocols and documentation.

Groundwater samples will be analyzed by SW 846 8260C and SW 846 6010B for a custom list of analytes that only includes site-specific COCs, as described in Table 2.

To generate data of sufficient quality, the following approach for groundwater samples is followed:

- Field and laboratory quality control samples (field replicates, trip and temperature blanks) are used for assessing data quality.
- Laboratory QA will be implemented and maintained as described by ARI's Laboratory Quality Assurance Plan and Standard Operating Procedures
- Data summary packages will be generated and documentation provided will be sufficient to perform a Level I data quality review.
- Data quality review will be performed on the analytical data according to the procedures specified below.

Data quality review will be validated in accordance with the U.S. Environmental Protection Agency (USEPA) Contract Laboratory Program National Functional Guidelines for Inorganic and Organic Data Review (USEPA 2008, 2004, and 1999).

While a best effort will be made to achieve the project DQOs, there may be instances in which it is not possible to meet the specified goals. Limitations in data quality due to analytical problems (e.g., elevated detection limits due to matrix effect) will be identified within 48 hours of initial analysis and brought to the attention of the Floyd|Snider Team Project Manager. If necessary, corrective measures will be determined and implemented. ARI will document the problem, the correction, and the results. In addition, this information will be discussed in the data validation report.

3.3 FIELD DOCUMENTATION

Field event and sample documentation will include the following information on field sampling log sheets or project-specific field notebook:

- sampling personnel;
- daily equipment calibration;
- equipment decontamination steps (if not dedicated or single use);
- weather conditions;
- static water level;
- purging rate and volume;

- field parameters (pH, specific conductance, turbidity, redox potential, temperature, and dissolved oxygen);
- sampling times, bottle types, preservation;
- physical appearance and odor of sample;
- presence of free product.

The Floyd|Snider Team will file and maintain field logbooks, subcontractor reports, photographs, sampling logs, Chain-of-Custody documents, laboratory reports, data validation reports and supporting documentation, and final versions of monitoring reports.

3.4 DATA MANAGEMENT PROCEDURES

Field log requirements will include: name of project/location, identity of the field personnel, sequence of events, changes to the plan, site and atmospheric conditions, number of samples collected, sample details [date, time, location, sample identification, and description], instrument calibration procedures, field measurement results, identify of QC samples, and unusual circumstances that affect interpretation of the data.

Groundwater monitoring data generation includes groundwater elevation measurement data and analytical data. Data management will consist of database generation, data receipt and input of field and analytical data, as well as other data generated during groundwater monitoring activities, and data presentation. ARI will provide an electronic data deliverable in the format specified by the Floyd|Snider Team. ARI will also provide laboratory reports that contain a case narrative, description of any correction actions taken, changes to referenced methods, and an explanation of data qualifiers.

Upon data verification and validation (discussed below), site data will be submitted to Ecology's Environmental Information Management (EIM) database.

3.5 DATA QUALITY, VERIFICATION, AND VALIDATION

Field and laboratory data results are verified to ensure that:

- Proper sample collection and handling protocols are followed.
- Holding times are met and sample receiving conditions documented.
- Laboratory data packages are complete, free of transcription errors or misidentifications.
- Complete Electronic Data Deliverable (EDD) is delivered in an appropriate format.
- Chain-of-Custody and sample receipt documentation is complete.
- Compound quantification and detection limits are appropriate.
- Method or trip blank results do not affect data results negatively.
- Surrogate recovery values are within acceptable range.
- Field and laboratory duplicate analysis is within acceptable range.
- Laboratory data qualifiers are justified.

- Data results are complete and accurate.
- Established criteria for QA/QC were met.

The data quality review process for this project will follow the procedures in USEPA's Functional Guidelines (USEPA 1999 and 2007), as appropriate, but applicable to SW846, this document, method Standard Operating Procedures, and professional judgment.

4.0 References

Floyd|Snider, 2012, *Draft South Park Landfill Remedial Investigation/Feasibility Study*. Prepared for the City of Seattle and South Park Property Development, LLC. April 16, 2012.

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Interim Site-wide Groundwater Monitoring Plan

Tables

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Table 1
Groundwater Monitoring Network Program

Well Name	Proposed POC Well Location	Location	Aquifer Zone	GW Elevation	Chemical Analyses	GW Collection Method
Groundwater Quality and Elevation Monitoring[1]						
Upgradient Wells Representing Groundwater Quality Entering Site						
KMW-05	No	Upgradient	Perched Zone/A-Zone	Yes	B, cis, TCE, VC, Fe, Mn	Peristaltic Pump
MW-12	No	Upgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-14	No	Upgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-29	No	Upgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Peristaltic Pump
Downgradient Wells Representing Edge of Waste						
KMW-03A	No	Edge of waste	Perched Zone/A-Zone	Yes	cis, TCE, VC, Fe, Mn	Peristaltic Pump
MW-08	Yes	Downgradient	B-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-10	Yes	Downgradient	B-Zone	Yes	cis, TCE, VC, Fe, Mn	Peristaltic Pump
MW-24	Yes	Downgradient	B-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-26	Yes	Downgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-27	Yes	Downgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-18	Yes	Edge of waste	B-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-25	Yes	Edge of waste	A-Zone	Yes	B, cis, TCE, VC, Fe, Mn	Bladder Pump
MW-32	Yes	Edge of waste	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
MW-33	Yes	Edge of waste	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
Wells Representing Conditions Near Former Glitsa Property						
MW-30	No	Downgradient	Perched Zone	Yes	cis, TCE, VC, Fe, Mn	Peristaltic Pump
MW-31	No	Downgradient	A-Zone	Yes	cis, TCE, VC, Fe, Mn	Bladder Pump
Groundwater Elevation Monitoring Only						
Upgradient/Cross-gradient Wells						
KMW-08	NA	Upgradient	A-Zone	Yes	NA	NA
MW-06	NA	Cross-gradient	B-Zone	Yes	NA	NA
West Ditch Staff Gage						
SG-1S	NA	West Ditch	Staff Gage	Yes[2]	NA	NA
SG-2N[3]	NA	West Ditch	Staff Gage	Yes[2]	NA	NA
Kenyon Industrial Park Wells						
KMW-01A	NA	Upgradient	Perched Zone/A-Zone	Yes	NA	NA
KMW-02B	NA	Solid Waste	Perched Zone/A-Zone	Yes	NA	NA
KMW-04	NA	Solid Waste	Perched Zone/A-Zone	Yes	NA	NA
KMW-06	NA	Upgradient	Perched Zone/A-Zone	Yes	NA	NA
KMW-07	NA	Upgradient	Perched Zone/A-Zone	Yes	NA	NA

Note:

1 Locations monitored for groundwater quality will include the field monitoring of pH, temperature, specific conductance, redox potential, and dissolved oxygen.

2 Surface water monitored, but not used to determine groundwater surface.

3 Measured from surveyed location on top of concrete footing associated with culvert.

Abbreviations:

NA Not applicable
B Benzene
cis cis-1,2-Dichloroethene
Fe Iron (total and dissolved fractions)
GW Groundwater
Mn Manganese (total and dissolved fractions)
POC Point of Compliance
TCE Trichloroethene
VC Vinyl chloride

Table 2
Analytical Field Sample Requirements

Analysis	Method	Bottle Type	Preservative	Holding Time
Volatile Organic Carbons				
Benzene	SW846 – 8260C	(3) 40 mL vials, zero headspace	HCl to pH < 2.0, Cool ≤ 6°C	14 days, 7 days[1]
TCE				
cis-1,2-DCE				
Vinyl Chloride				
Metals				
Dissolved/Total Iron	SW846 – 6010B	(1) 500 mL HDPE	Cool, 4°C, Unfiltered-NA Filtered-HNO_3 pH<2	6 months
Dissolved/Total Manganese				

Note:

1 When unpreserved.

Abbreviations:

DCE Dichloroethene
HCl Hydrochloric acid
HDPE High-density polyethylene
HNO_3 Nitric acid
mL Milliliter
NA Not applicable
TCE Trichloroethene

Table 3
Summary of Field and Quality Control Samples

Parameter	Matrix	Reporting Limit/PQL	Precision	Accuracy	Completeness	Reference
Volatile Organic Carbons						
Benzene	Water	0.2 µg/L	± 50%	± 50%	95%	USEPA Method 8260B
TCE		0.2 µg/L				
cis-1,2-DCE		0.2 µg/L				
Vinyl Chloride		0.2 µg/L				
Metals						
Dissolved/Total Iron	Water	50 µg/L	±30%	±30%	95%	USEPA Method 6010B
Dissolved/Total Manganese		50 µg/L	±50%	±50%	95%	

Abbreviations:

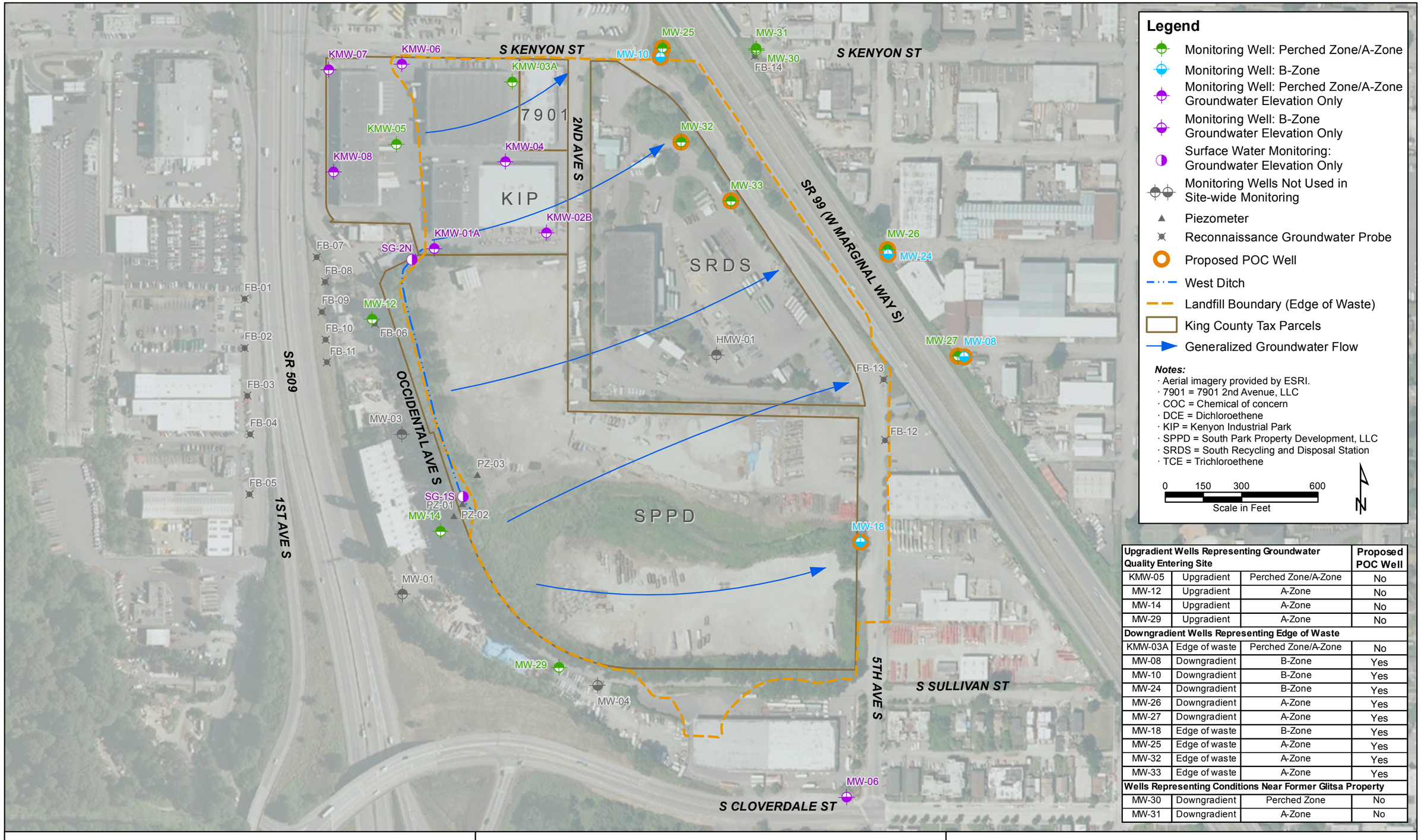
DCE Dichloroethene
µg/L Microgram per liter
PQL Practical Quantitation Limit
TCE Trichloroethene
USEPA U.S. Environmental Protection Agency

South Park Landfill

Interim Site-wide Groundwater Monitoring Plan

Figure

DRAFT



Upgradient Wells Representing Groundwater Quality Entering Site			Proposed POC Well
KMW-05	Upgradient	Perched Zone/A-Zone	No
MW-12	Upgradient	A-Zone	No
MW-14	Upgradient	A-Zone	No
MW-29	Upgradient	A-Zone	No
Downgradient Wells Representing Edge of Waste			
KMW-03A	Edge of waste	Perched Zone/A-Zone	No
MW-08	Downgradient	B-Zone	Yes
MW-10	Downgradient	B-Zone	Yes
MW-24	Downgradient	B-Zone	Yes
MW-26	Downgradient	A-Zone	Yes
MW-27	Downgradient	A-Zone	Yes
MW-18	Edge of waste	B-Zone	Yes
MW-25	Edge of waste	A-Zone	Yes
MW-32	Edge of waste	A-Zone	Yes
MW-33	Edge of waste	A-Zone	Yes
Wells Representing Conditions Near Former Glitsa Property			
MW-30	Downgradient	Perched Zone	No
MW-31	Downgradient	A-Zone	No

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Interim Site-wide Groundwater Monitoring Plan
South Park Landfill
Seattle, Washington

Figure 1
Groundwater
Monitoring Locations

F:\projects\COS-SPARK\GIS\MXD\Figure 1 (Groundwater Monitoring Locations)Version2.mxd
12/6/2012

South Park Landfill

Interim Site-wide Groundwater Monitoring Plan

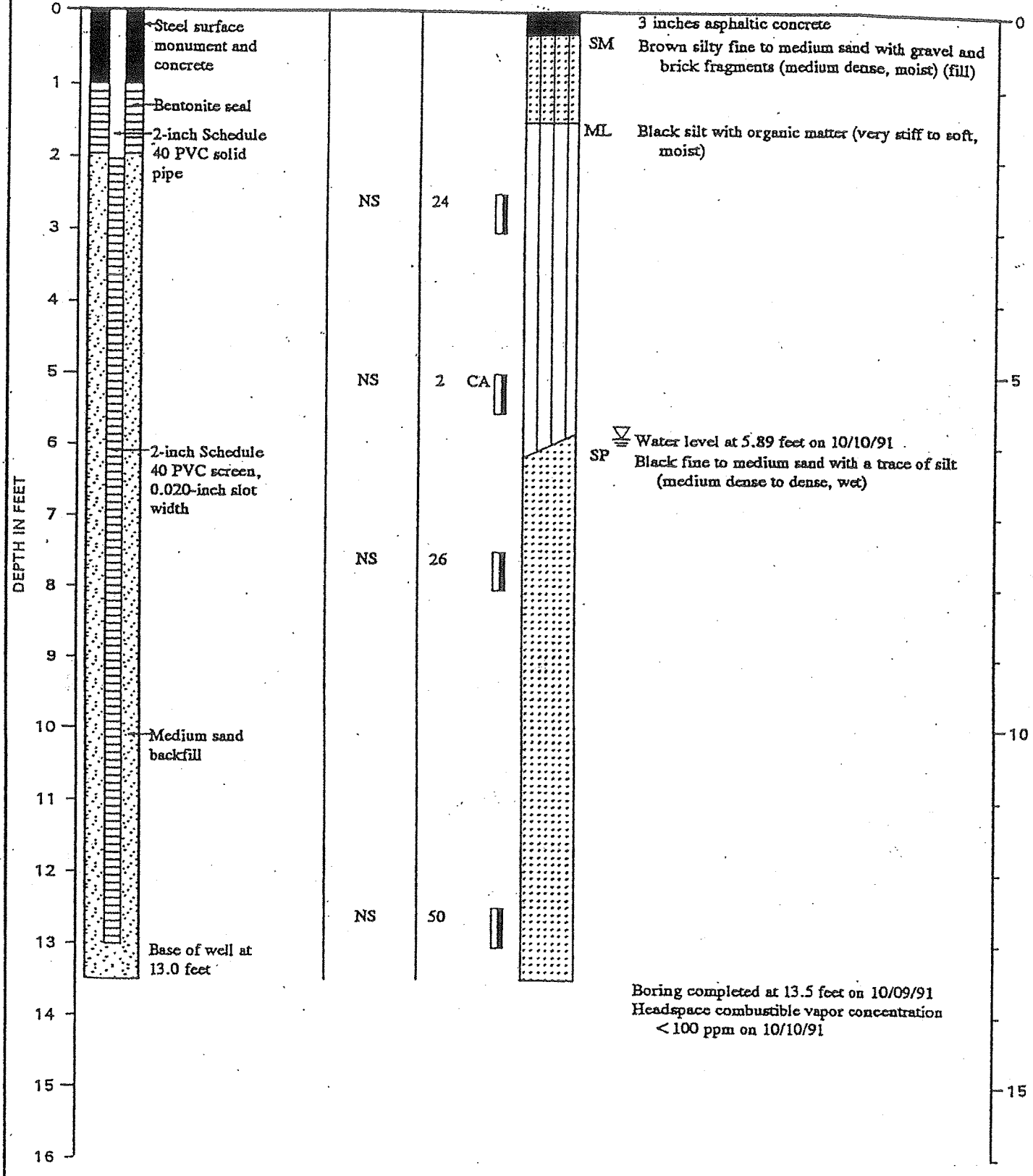
Appendix A
Monitoring Well Construction Logs

DRAFT

MONITOR WELL NO. MW-3 AKA MW-03

WELL SCHEMATIC

Casing Elevation (ft.): 100.68
Casing Stickup (ft.): -0.23



Note: See Figure A-2 for explanation of symbols

Geo Engineers

Log of Monitor Well

Figure A-14

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-6 AKA MW-06	1 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	17.35' NAVD 88
Location	King County	Water Depth (ft bgs)	11.6
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	December 3, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 3, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking, 8" steel monument						FILL
	Concrete seal						GRAVEL; angular (GP)
							SILT; brown; trace gravel, some fine to medium sand; moist, soft; no odors or discolorations (ML).
				5			
				4			
		0%		5			SILT; gray/brown; trace gravel; very moist, high plasticity, firm; no odors or discoloration (ML)
	Bentonite chip seal						
5				3			
				4			
				7			
				3			
	7.97 ft. bgs 12/10/98			4			
	Bentonite slurry, 30% by weight	0%		8			
							RECENT ALLUVIUM
10							SILT; gray; very moist, high plasticity, firm; no odor or discolorations (ML)
				3			
				3			
	11.6 ft. bgs ATD 12/3/98			7			
				3			
				4			
		0%		6			
	2" ID SCH 40 PVC Riser						
15							
				5			
				9			
				31			SAND; dark gray to black; fine to medium, trace silt; moist, medium dense to dense; no odors or discolorations, wet (SP)
				4			
				11			
		0%		30			

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-2

SPARKMW SPARKMW.G. Jul 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-6 AKA MW-06	2 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	17.35' NAVD 88
Location	King County	Water Depth (ft bgs)	11.6
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	December 3, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 3, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mll. Graphic	Description
	Bentonite slurry, 30% by weight	0%		6 26 50/5"			
				14 22 34			
25	Bentonite chips						
		0%		14 33 50			SAND; black; fine to medium, with occasional light gray silt laminations and wood debris, dense (SP)
30	Filter Pack, 10 x 20 Colorado silica sand						
		0%		5 23 46			
35	Well screen 2" ID SCH 40 PVC, 0.01" slot size						
		0%		5 14 35			
	Threaded end cap 2" ID						

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- ▽ ▼ Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-2

SPARKMW SPARKMW.GPJ August 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-6 AKA MW-06	3 of 3

Project Name: South Park Custodial Landfill
Location: King County
Drilling Method: Hollow Stem Auger 10.5" OD/6" ID
Sampling Method: 3" diameter, Split Spoon Sampler, 140 lb hammer

Surface Elevation: 17.35' NAVD 88
Water Depth (ft bgs): 11.6
Start Date: December 3, 1998
Finish Date: December 3, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Filter Pack, 10 x 20 Colorado Silica Sand						
		0%		10 10 12			SILT; gray; moist, stiff, high plasticity (ML)
45	Bentonite chips						
		0%		7 7 17			
50							Bottom of boring at depth 50 feet. Monitoring well installed to depth of 40 feet. Soil samples driven using 140-lb hammer falling 30 inches.
55							

Sampler Type (ST):
- 3" Split Spoon Sampler
- No Recovery

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB
Approved by: JJS
Figure No. A-2

gust 18, 1999
SPARKMW SPARKMW.C

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-8 AKA MW-08	1 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	12.88' NAVD 88
Location	King County	Water Depth (ft bgs)	4.5
Drilling Method	Hollow Stem Auger, 10.5" OD/6" ID	Start Date	December 7, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 8, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking 8" steel monument						FILL
	Concrete seal						GRAVEL; gray; angular (GP)
							SILTY SANDY GRAVEL; brown-gray; subrounded to 1-inch diameter; moist, medium dense; no odors or discolorations (GM)
		0%		16 16 15			
	Bentonite chips						
	4.5 ft. bgs ATD 12/8/98, casing at 47.5 ft. bgs 5.02 ft. bgs 12/10/98						
5				3 2 6			SILTY SANDY GRAVEL; brown; wet, very loose; no odors or discoloration (GM)
				3 2 5			SAND; dark brown; some silt and gravel; wet, very loose to loose; no odors or discoloration (SP)
		0%					
10				4 4 6			
							RECENT ALLUVIUM
							SILTY SAND; gray; fine-grained; wet, loose; no odors or discoloration (SM)
	2" ID SCH 40 PVC Riser			5 8 10			
		0%					
15				7 5 18			
	Bentonite slurry 30% by weight						
				5 14 19			
		0%					SAND; black; fine to medium grained, trace silt and wood; wet, medium dense; no odors or discolorations (SP)

Sampler Type (ST):
- 3" Split Spoon Sampler
- No Recovery

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB
Approved by: JJS
Figure No. A-3

SPARKMW SPARKMW.GPJ August 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-8 AKA MW-08	2 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	12.88' NAVD 88
Location	King County	Water Depth (ft bgs)	4.5
Drilling Method	Hollow Stem Auger, 10.5" OD/6" ID	Start Date	December 7, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 8, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
				12 22 24			SAND; black; fine to medium grained, trace silt and wood; wet, medium dense; no odors or discolorations (SP)
		0%		7 10 14			
25	Bentonite slurry, 30% by weight						
		0%		11 17 21			
30							
		0%		14 24 33			
35	Well screen 2" ID SCH 40 PVC, 0.01" slot size						
	Filter pack, 10 x 20 Colorado silica sand	0%		12 17 14			

gust 18, 1999

SPARKMW SPARKMW.C

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- ▽ ▼ Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-3

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-8 AKA MW1-08	3 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	12.88' NAVD 88
Location	King County	Water Depth (ft bgs)	4.5
Drilling Method	Hollow Stem Auger, 10.5" OD/6" ID	Start Date	December 7, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 8, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mll. Graphic	Description
							SILTY SAND; black; fine grained; wet, medium dense; no odors or discolorations (SM)
	Well screen 2" ID SCH 40 PVC, 0.01" slot size	0%		5 12 24			
45	Threaded end cap, 2" ID SCH 40 PVC						
	Bentonite chips						SAND; black; some silt; wet, medium dense (SP)
		0%		5 11 39			
50							Bottom of boring at depth 49 feet. Monitoring well installed to depth 45.59 feet. Soil sampler driven using 140-pound hammer falling 30-inches.
55							

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- ▽ ▼ Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-3

SPARKMW SPARKMW.GPJ August 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-10	1 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	17.7' NAVD 88
Location	King County	Water Depth (ft bgs)	9
Drilling Method	Hollow Stem Auger, 10.5" OD, 6" ID	Start Date	December 9, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 9, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking 8" steel monument						FILL
	Concrete seal						SAND; fine to medium grained, trace silt; moist, loose; no odors or discolorations (SP)
		0%		5 10 11			
	Bentonite chips						
5				4 3 10			5
							RECENT ALLUVIUM
							SILT; gray; with wood debris with roots; moist, firm, low plasticity; no odors or discolorations (ML)
							7
							SAND; fine to medium grained, trace silt; moist, medium dense; no odors or discolorations (SP)
		0%		10 12 12			
	9 ft. bgs ATD 12/9/98						
	9.64 ft. bgs 12/10/98						
10				3 4 8			10
							SILT; gray-brown; with burnt woody debris; moist, firm (ML)
							12
	2" ID SCH 40 PVC Riser						SILTY SAND; gray; fine grained, with wood debris; wet, loose to medium dense (SM)
		0%		3 6 8			
15				24			
	Bentonite slurry, 30% by weight						
				7 8 18			
		0%					18
							SAND; black; fine to medium grained; wet, loose to medium dense (SP)

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-4

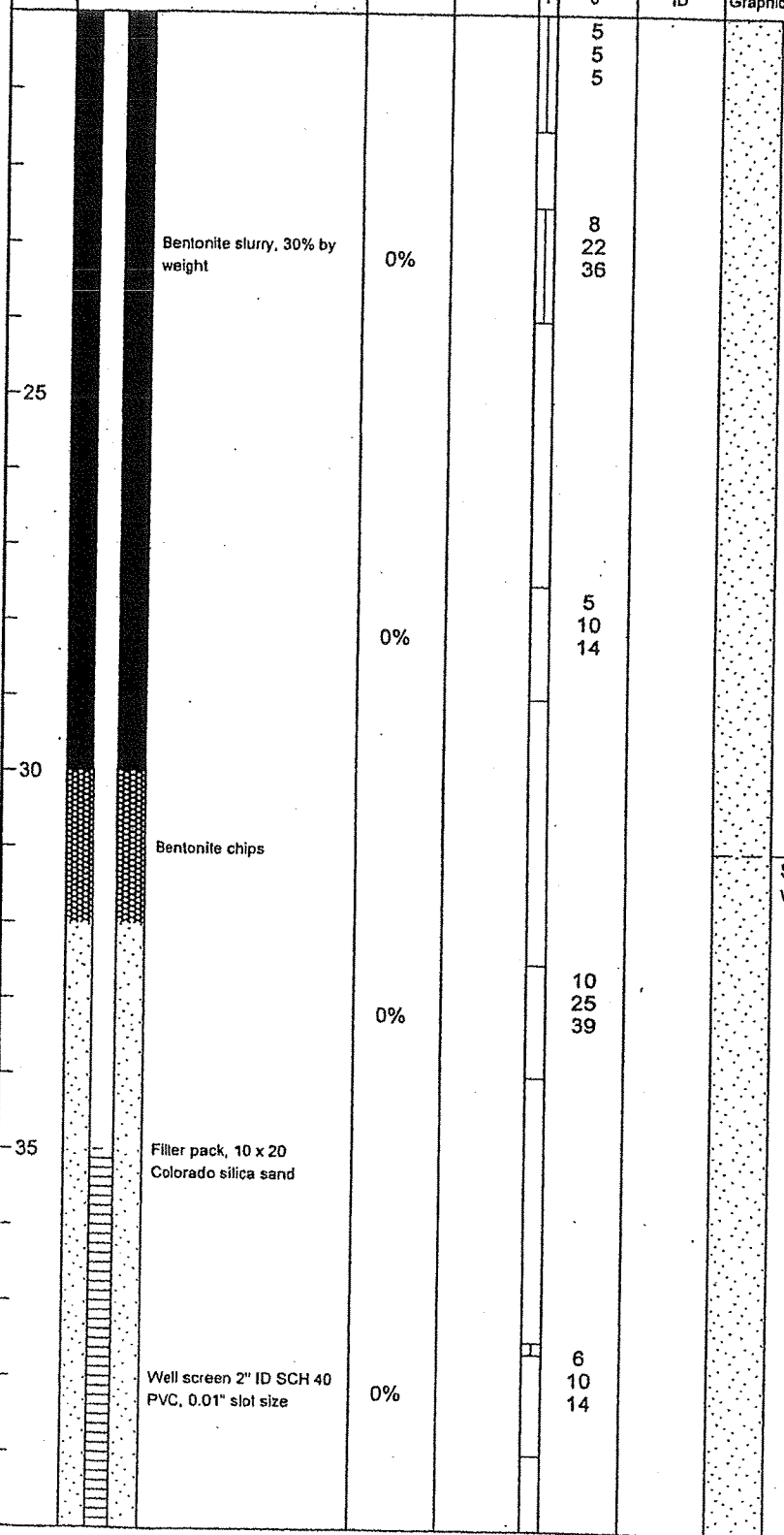
SPARKMW SPARKMW.GI gust 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-10	2 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	17.7' NAVD 88
Location	King County	Water Depth (ft bgs)	9
Drilling Method	Hollow Stem Auger, 10.5" OD, 6" ID	Start Date	December 9, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 9, 1998



Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-4

SPARKMW SPARKMW.GPJ August 18, 1999

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-10	3 of 3

Project Name	South Park Custodial Landfill	Surface Elevation	17.7' NAVD 88
Location	King County	Water Depth (ft bgs)	9
Drilling Method	Hollow Stem Auger, 10.5" OD, 6" ID	Start Date	December 9, 1998
Sampling Method	3" diameter, Split Spoon Sampler, 140 lb hammer	Finish Date	December 9, 1998

Depth feet	Well Construction	Methane	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
							SAND; black; trace silt; wet, medium dense (SP)
	Well screen 2" ID SCH 40 PVC, 0.01" slot size	0%		7 8 36			
45	Threaded end cap, 2" ID SCH 40 PVC						SANDY SILT; dark gray; very moist, stiff, low plasticity (ML)
	Filter pack, 10 x 20 Colorado silica sand	0%		7 12 31			
50							Bottom of boring at depth 49 feet. Monitoring well installed to depth 45 feet. Soil sampler driven using 140-pound hammer falling 30-inches.
55							

Sampler Type (ST):

- 3" Split Spoon Sampler
- No Recovery

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content
- Water Level (Date of Measurement)

Logged by: RSB

Approved by: JJS

Figure No. A-4

ust 18, 1999

SPARKMW SPARKMW.GI

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-12	1 of 1

Project Name: South Park Custodial Landfill
Location: Seattle, Washington
Drilling Method: Hollow Stem Auger 10.5" OD/6" ID
Sampling Method: 2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop

Surface Elevation: 19.11
Water Depth (ft bgs): 7.34
Start Date: September 20, 1999
Finish Date: September 20, 1999

Depth feet	Well Construction	Methane %	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking, 8" Steel Monument						FILL
	Concrete seal						Firm, moist; brown and tan mottled SILT
		0		3 4 4	S-1		
	Bentonite chips						
5		0		4 4 3	S-2		RECENT ALLUVIUM Loose, moist; red-brown SAND; silty interbeds, sand fine to coarse, red grains angular
	6.5 ft bgs ATD, 9/20/99, casing at 7.5 ft bgs						
	7.34 ft bgs, 10/14/99						
		0		2 6 7	S-3		-grades medium dense, wet, with fine sand bedding
10	Filter pack, 10x20 Colorado silica sand						
	Well screen 2" ID SCH 40 PVC, 0.01" slot size						
		0		5 11 17	S-4		- grades black
15	Threaded end cap, 2" ID SCH 40 PVC						
							Medium dense, wet; gray-brown SAND; some silt, sand fine, trace organics
		0		4 5 6	S-5		
	Bentonite chips						
20							ESTUARINE DEPOSITS - shell fragments in cuttings
							GLACIAL SEDIMENT Very dense, moist; gray SAND with GRAVEL; little silt
		0		27 50/4"	S-6		
							Bottom of boring at 22.5 feet. Monitoring well installed to depth of 15.3 feet.

Sampler Type (ST):
- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: JJS
Figure No. A-5

SPARKMW SPRK9_99.GPJ January 3, 2000

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-14	1 of 2

Project Name	South Park Custodial Landfill	Surface Elevation	19.05
Location	Seattle, Washington	Water Depth (ft bgs)	3.96
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	September 14, 1999
Sampling Method	2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop	Finish Date	September 14, 1999

Depth feet	Well Construction	Methane %	S T	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking, 8" Steel Monument Concrete seal						TOPSOIL Loose, moist; dark brown SAND with SILT and ORGANICS; concrete and bricks in cuttings
	Bentonite chips	0		14 10 6	S-1		FILL Medium dense, damp; brown SAND with SILT and GRAVEL; with brick
	3.96 ft bgs, 10/14/99 4.5 ft bgs ATD, 9/14/99, casing at 5 ft bgs						
5		0		4 3 5	S-2		Loose, wet; brown SILT; trace gravel, trace sand, trace wood
		0		4 8 9	S-3		RECENT ALLUVIUM Medium dense, wet; black SAND; silt interbeds to 1.5", sand fine to medium
10							
	Filter pack, 10x20 Colorado silica sand	0		4 9 9	S-4		- wood in auger
15							
	Well screen 2" ID SCH 40 PVC, 0.01" slot size						Stiff, wet; brown SILT; trace sand laminae, low plasticity
		0		2 5 5	S-5		
20							
	Threaded end cap, 2" ID SCH 40 PVC Pea gravel						- heaving at 21 feet
		0		2 7 6	S-6		ESTUARINE DEPOSIT Medium dense, wet; brown SAND; few silt, trace shell framents
	Bentonite chips						

Sampler Type (ST):

- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content

Water Level (ATD) ▽ Static Water Level

Logged by: RRH

Approved by: JJS

Figure No. A -6

ary 3, 2000

SPARKMW SPRK9_99.GP

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-14	2 of 2

Project Name: South Park Custodial Landfill
Location: Seattle, Washington
Drilling Method: Hollow Stem Auger 10.5" OD/6" ID
Sampling Method: 2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop

Surface Elevation: 19.05
Water Depth (ft bgs): 3.96
Start Date: September 14, 1999
Finish Date: September 14, 1999

Depth feet	Well Construction	Methane %	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Bentonite chips	0		4 7 23	S-7		GLACIAL SEDIMENT Hard, wet; brown and gray mottled SILT; trace sand lenses, gravel in shoe
30		0		3 16 37	S-8		Hard, moist to wet; gray and tan mottled SILT; few sand
35							Bottom of boring at 34 feet. Monitoring well installed to depth of 21.8 feet.
40							
45							

Sampler Type (ST):
- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content

Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: JJS

Figure No. A-6

SPARKMW SPRK9_99.GPJ January 3, 2000

Geologic & Monitoring Well Construction Log

ASSOCIATED EARTH SCIENCES, INC

Project Number	Well Number	Sheet
BV97041	MW-18	1 of 2

Project Name	South Park Custodial Landfill	Surface Elevation	20.78
Location	Seattle, Washington	Water Depth (ft bgs)	15.3
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	September 17, 1999
Sampling Method	2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop	Finish Date	September 17, 1999

Depth feet	Well Construction	Methane %	ST	Blows/ 6"	Sample ID	Mtl Graphic	Description
	Locking, 8" Steel Monument; Concrete seal						FILL
		0		6 9 8	S-1		Medium dense, damp; brown SAND with GRAVEL; trace silt, trace organics, 1 piece of glass
	Bentonite chips						REFUSE
5		0		7 7 7	S-2		Medium dense, damp; brown SAND, few gravels, trace silt, trace wood; plastic debris noted in shoe
		0.1		26 27 31	S-3		-very dense, damp; gray concrete cinder block
10		0		14 15 7	S-4		
	Bentonite slurry, 30% by weight						
		0		2 3 2	S-5A		Firm, moist to wet; gray grading to brown SILT some ORGANICS
					S-5B		RECENT ALLUVIUM
	14.5 ft bgs ATD, 9/17/99, casing at 17.5 ft bgs						Medium dense, moist; dark brown to black SAND; sand fine to medium, angular red grains visible of volcanic origin
15	15.30 ft bgs, 10/14/99						
		0		1 2 3	S-6A		- grades firm, wet, brown silt, some organics
					S-6B		Medium dense, wet; black SAND; sand fine to medium, angular red grains visible of volcanic origin
20							
		0		3 8 10	S-7		- trace silt interbeds

Sampler Type (ST):

- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH

Approved by: JJS

Figure No. A -7

ary 3, 2000

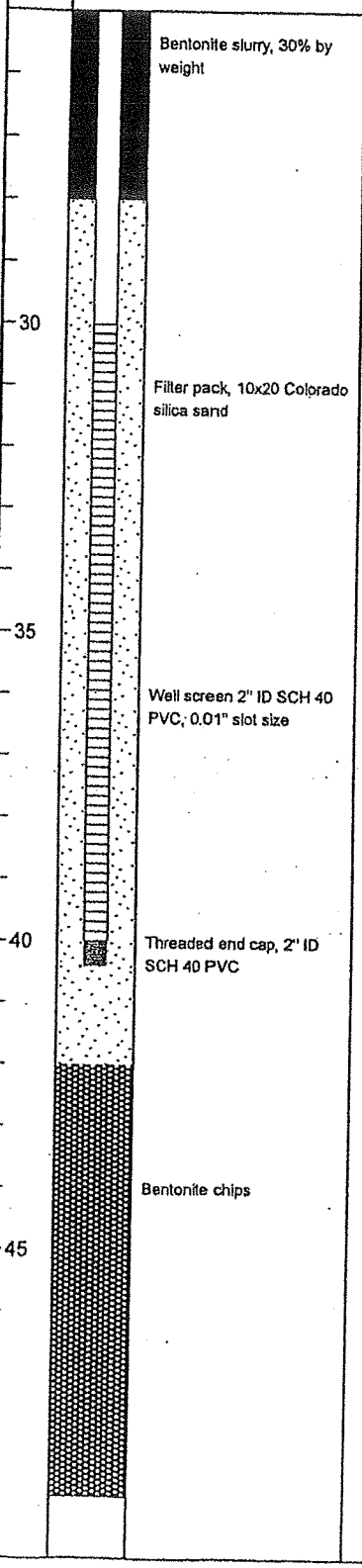
SPARKMW SPRK9_99.GP

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-18	2 of 2

Project Name	South Park Custodial Landfill	Surface Elevation	20.78
Location	Seattle, Washington	Water Depth (ft bgs)	15.3
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	September 17, 1999
Sampling Method	2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop	Finish Date	September 17, 1999



Depth feet	Methane %	ST	Blows/ 6"	Sample ID	Mil. Graphic	Description
	0		3 10 14	S-8		Medium dense, wet; black SAND; sand fine to medium, angular red grains visible of volcanic origin
	0		11 16 12	S-9		- sand fine to coarse
	0		7 8 16	S-10		- silt content increases
						Firm, wet; brown SILT few SAND; trace organics
	0		12 13 15	S-11		Medium dense, wet; black SAND; sand fine to medium, red grained and angular
	0		6 19 27	S-12		- grades dense, brown sand, trace silt, visible bedding
						Bottom of Boring at 49 feet. Monitoring well installed to depth of 40.4 feet.

Sampler Type (ST):
- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: JJS
Figure No. A -7

SPARKMW SPRK9_99.GPJ January 3, 2000

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-24	1 of 2

Project Name: South Park Custodial Landfill
Location: Seattle, Washington
Drilling Method: Hollow Stem Auger 10.5" OD/6" ID
Sampling Method: 2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop

Surface Elevation: 13.57
Water Depth (ft bgs): 8.35
Start Date: September 21, 1999
Finish Date: September 21, 1999

Depth feet	Well Construction	Methane %	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Locking, 8" Steel Monument						FILL
	Concrete seal						Medium dense, damp; dark red-brown SAND; sand fine to medium, sand angular
	Bentonite chips	0					
5							- grades moist to wet, dark brown to black
	6.0 ft bgs ATD, 9/21/99, casing at 7.5 ft bgs						
		0		1 3 6	S-1		Firm, wet to moist; brown SILT; mostly organics, peat-like
	8.35 ft bgs, 10/14/99						
10							- grades wet, gray and brown, trace sand
							RECENT ALLUVIUM
		0		3 2 9	S-2		Medium dense, wet; black SAND; some brown organic silt interbeds, sand fine to medium
15	Bentonite slurry, 30% by weight						
		0		5 11 14	S-3		- sand grades angular
20							
		0		2 15 37	S-4		- grades very dense

Sampler Type (ST):
- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:
- C - Chemical Properties
- P - Permeability
- M - Moisture Content

Water Level (ATD) ▽ Static Water Level

Logged by: RRH
Approved by: JJS
Figure No. A -8

:PARKMW SPRK9_99.GPJ ary 3, 2000

ASSOCIATED EARTH SCIENCES, INC

Geologic & Monitoring Well Construction Log

Project Number	Well Number	Sheet
BV97041	MW-24	2 of 2

Project Name	South Park Custodial Landfill	Surface Elevation	13.57
Location	Seattle, Washington	Water Depth (ft bgs)	8.35
Drilling Method	Hollow Stem Auger 10.5" OD/6" ID	Start Date	September 21, 1999
Sampling Method	2" diameter, Split Spoon Sampler, 140 lb hammer, 30-inch drop	Finish Date	September 21, 1999

Depth feet	Well Construction	Methane %	ST	Blows/ 6"	Sample ID	Mtl. Graphic	Description
	Bentonite slurry, 30% by weight						
		0		9 28 32	S-5		Very dense, wet; black SAND; some brown organic silt interbeds, sand fine to medium
30							
		0		9 24 33	S-6		
35	Filter pack, 10x20 Colorado silica sand						
		0		4 2 2	S-7		Firm, wet; dark brown SILT with SAND; organics present
40	Well screen 2" ID SCH 40 PVC, 0.01" slot size						Medium dense, wet; black SAND; sand fine to medium and angular
		0		4 8 10	S-8		
45	PVC slip cap, 55 screws						- grades siltier
	Pea gravel						
	Bentonite chips	0		3 9 14	S-9		- grades few silt, trace wood and organics
							Bottom of Boring at 49 feet. Monitoring well installed to depth of 45.3 feet.

Sampler Type (ST):

- 3.25" OD D&M Split-Spoon Ring Sampler
- No Recovery
- 2" OD Split-Spoon Sampler

Lab Tests:

- C - Chemical Properties
- P - Permeability
- M - Moisture Content

▼ Water Level (ATD) ▽ Static Water Level

Logged by: RRH

Approved by: JJS

Figure No. A-8

SPARKMW SPRK9_99.GPJ January 3, 2000

Aspect consulting
IN-DEPTH PERSPECTIVE

Monitoring Well Construction Log

Project Number	Well Number	Sheet
970041	MW-25	1 of 1

Project Name	South Park Custodial Landfill	Ground Surface Elev (NAVD88)	17.30
Location	Seattle, Washington	Top of Casing Elev. (NAVD88)	20.09
Driller/Method	Holt / Hollow Stem Auger	Depth to Water (BTOC)	12.54
Sampling Method	3.25" OD D&M Split-Spoon; 300 lbs Hammer	Start/Finish Date	2/23/2006

Depth / Elevation (feet)	Well Completion	Sample Type/ID	Tests / PID	Blows/ 6"	Material Type	Description
15	Above ground locking monument with bollards and slip cap; Concrete surface seal	S-1		3 3 3		FILL Loose, damp, brown, slightly silty fine SAND
5	Bentonite chip seal	S-2		3 3 4		RECENT ALLUVIUM Medium stiff, moist, gray SILT; scattered organics, wood debris
	▽ 2/23/2006					5.5
10		S-3		4 4 5		Loose, wet, black, fine to medium SAND
						7
10	2-inch PVC blank casing	S-4		1 0 1		Very soft, wet, gray SILT; abundant wood debris
5	▽ 2/27/2006	S-5		1 1 1		
						10
15		S-6		1 1 1		Very soft, wet, gray, sandy SILT; sand fine
0	Bentonite pellet plug	S-7		2 2 1		
						15
20		S-8		4 6 7		Medium dense, wet, black, slightly silty, fine to medium SAND
-5	10-20 filter pack	S-9	DS25060223-	6 10 12		
						20
25	2-inch, 20-slot, PVC well screen					Set pump intake ~ 24 ft BTOC
-10						Bottom of Boring at 26'
						Coordinates N: 197657.49 E: 1270566.75

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon
- Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: TDC
Approved by: JJS
Figure No. A-2

MONITORING WELL SOUTHPARK_WELLS.GPJ March 10, 2006

Aspect consulting
IN-DEPTH PERSPECTIVE

Monitoring Well Construction Log

Project Number	Well Number	Sheet
970041	MW-26	1 of 1

Project Name: South Park Custodial Landfill
Location: Seattle, Washington
Driller/Method: Holt / Hollow Stem Auger
Sampling Method: 3.25" OD D&M Split-Spoon; 300 lbs Hammer

Ground Surface Elev (NAVD88): 13.55
Top of Casing Elev. (NAVD88): 15.84
Depth to Water (BTOC): 8.27
Start/Finish Date: 2/23/2006

Depth / Elevation (feet)	Well Completion	Sample Type/ID	Tests / PID	Blows/ 6"	Material Type	Description
10 / 5 / 0 / -5 / -10 / -15	Above ground locking monument with bollards and slip cap Concrete surface seal 2-inch PVC blank casing Bentonite chip seal ▽ 2/23/2006 ▼ 2/27/2006 Bentonite pellet plug 10-20 filter pack 2-inch, 20-slot, PVC well screen	S-1		4 4 5		FILL Loose, damp, brown, fine to medium SAND
5		S-2		2 1 1		Loose, damp to wet, black, fine SAND
5		S-3 S-4		1 1 1		RECENT ALLUVIUM Very soft, wet, brown SILT; abundant organics Very soft, wet, brown SILT; few organics
10		S-5		2 4 4		Grades to medium stiff, wet, gray sandy SILT; sand fine
0		S-6		1 2 2		Very loose to loose, wet, black, fine SAND; trace silt
15		S-7	DS26060223-	3 4 5		
-5		S-8		4 4 4		
20		S-9		3 3 4		
-10 / 25 / -15						Bottom of Boring at 26' Coordinates N: 197121.60 E: 1271164.40

Set pump intake ~ 20 ft BTOC

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon
- Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: TDC
Approved by: JJS
Figure No. A-3

MONITORING WELL SOUTHPARK_WELLS.GPJ March 10, 2006

Aspect consulting
IN-DEPTH PERSPECTIVE

Monitoring Well Construction Log

Project Number	Well Number	Sheet
970041	MW-27	1 of 1

Project Name	South Park Custodial Landfill	Ground Surface Elev (NAVD88)	12.72
Location	Seattle, Washington	Top of Casing Elev. (NAVD88)	14.76
Driller/Method	Holt / Hollow Stem Auger	Depth to Water (BTOC)	6.91
Sampling Method	3.25" OD D&M Split-Spoon; 300 lbs Hammer	Start/Finish Date	2/23/2006

Depth / Elevation (feet)	Well Completion	Sample Type/ID	Tests / PID	Blows/ 6"	Material Type	Description
10	Above ground locking monument with bollards and slip cap Concrete surface seal	S-1		7 10 11		FILL (Loose), moist, gray, GRAVEL Medium dense, damp, brown-gray, silty sandy GRAVEL
5	2-inch PVC blank casing Bentonite chip seal	S-2		3 2 2		Medium dense to loose, damp to wet, slightly silty, slightly gravelly, fine SAND
	▽ 3/27/2006					
5		S-3				Loose, wet, brown, medium to fine SAND; trace silt, trace gravel
10	10-20 filter pack	S-4		2 1 1		-Very loose, wet, gray-brown GRAVEL: well rounded to 0.5-inch
0		S-5		2 2 2		RECENT ALLUVIUM Loose, wet, gray, silty fine SAND
15	2-inch, 20-slot PVC well screen	S-6		2 2 2		
-5		S-7	DS27060223-	2 2 2		
20		S-8		3 4 5		Loose, wet, black, fine to medium SAND; trace silt
-10						Bottom of Boring at 21' Coordinates N: 196835.06 E: 1271357.64
25						Set Prism Screw ~ 15 ft BTOC
-15						

Sampler Type:
- No Recovery
- 3.25" OD D&M Split-Spoon
- Ring Sampler

PID - Photoionization Detector
- Static Water Level
- Water Level (ATD)

Logged by: TDC
Approved by: JJS
Figure No. A-4

MONITORING WELL SOUTHPARK_WELLS.GPJ March 10, 2006

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100166	MW-29	1 of 1

Project Name: South Park Landfill
Location: Seattle, WA
Driller/Method: Cascade Drilling, LP / Direct Push Probe
Sampling Method: Continuous Core

Ground Surface Elev: 19.45' NAVD88
Depth to Water: 5.4' BGS (ATD)
Start/Finish Date: 1/14/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	Concrete seal, 0'-2'	S-1					Dense, moist, dark gray, slightly silty, sandy GRAVEL (GP-GM), occasional brick fragments.	0
							Dense, moist, brown, SAND (SP); medium sand.	
5	2-inch diameter schedule 40 PVC casing, 0'-20' ▽ 12/29/2010	S-2		0.0				5
	Hydrated bentonite chips, 2'-18'						Medium stiff, moist, dark brown SILT (ML); occasional wood fibers; glass pieces at 6'. Grades to light brown with frequent wood fibers.	
10		S-3		0.0			Grades to soft, dark gray, with black wood fragments.	10
							No wood, thin silt laminations.	
15		S-4		0.0			Dense, very moist, black SAND (SP); fine to medium sand.	15
		S-5		0.0			Dense, wet, dark gray, very silty SAND (SM); with occasional thin sandy silt interbeds.	
20	#8/12 sand filter pack, 18'-30'							20
	2-inch diameter schedule 40 PVC 20-slot prepacked screen, 20'-30'	S-6		0.0			Dense, wet, dark brown to black SAND (SP); with thick silty sand interbeds.	
25		S-7		0.0				25
							Dense, wet, dark brown to black, sandy SILT (ML).	
		S-8		0.0			Dense, wet, black SAND (SP); fine sand.	
30	PVC endcap Aluminum drive shoe							30
							Bottom of boring at 10' below ground surface. Soil vapors were measured using GEM 2000 gas analyzer, H2S meter, and PID: CH4: 0.2% CO2: 0.1% O2: 20.4% BAL: 79.5% H2S: 0.0 ppm PID: 0.0 ppm	
35								35

Sampler Type:
○ No Recovery
▌▌ Continuous Core

PID - Photoionization Detector (Headspace Measurement)
▼ Static Water Level
▽ Water Level (ATD)

Logged by: DFR
Approved by: JJS
Figure No. B- 25

_ENV BORING LOG SOUTH PARK LANDFILL 100116.GPJ December 1, 2011

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100166	MW-30	1 of 1

Project Name: South Park Landfill
Location: Seattle, WA
Driller/Method: Cascade Drilling, / Hollow Stem Auger
Sampling Method: Dames & Moore

Ground Surface Elev: 17.60' NAVD88
Depth to Water: 10.8' BGS (ATD)
Start/Finish Date: 6/15/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
	Concrete seal, 0'-2'						Loose, slightly moist, brown, trace to slightly silty SAND (SP-SM); fine to medium sand, predominantly fine.	
	2-inch diameter schedule 40 PVC casing, 0'-8'							
	Hydrated bentonite chips, 2'-6'							
5		S-1		0.0	1 1 1			5
	#2/12 sand filter pack, 6'-13'							
		S-2		0.0	1 1 1		Loose, slightly moist, brown, slightly silty SAND (SP-SM); with frequent, thin SILT (ML) lamina.	
	2-inch diameter schedule 40 PVC 10-slot screen, 8'-13'							
10							Loose, wet, brown, slightly silty SAND (SP-SM); trace fine gravel.	10
	▽6/15/2011	S-3		0.0	1 1 1		Soft, wet, gray, clayey SILT (ML).	
							Loose, wet, black, slightly silty to silty SAND (SP-SM). Gravelly.	
	PVC endcap	S-4		0.0	2 1 1		Loose, wet, black SAND (SP) with 2" gray SILT (ML) pockets.	
15	Slough						Loose, wet, black SAND (SP); fine to medium sand.	15
		S-5		0.0	3 4 6			
							Bottom of boring at 16.5' below ground surface.	

Sampler Type:
- ○ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: AET
Approved by: JJS
Figure No. B- 26

_ENV BORING LOG SOUTH PARK LANDFILL 100116.GPJ December 1, 2011

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100166	MW-31	1 of 1

Project Name: South Park Landfill
Location: Seattle, WA
Driller/Method: Cascade Drilling, / Hollow Stem Auger
Sampling Method: Dames & Moore

Ground Surface Elev: 17.58' NAVD88
Depth to Water: 11' BGS (ATD)
Start/Finish Date: 6/15/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	Concrete seal, 0'-2'						Loose, slightly moist, brown, slightly silty SAND (SP-SM); fine sand.	0
5	2-inch diameter schedule 40 PVC casing, 0'-18'	S-1		0.0	3 3 3			5
		S-2		0.0	3 3 4		Loose, slightly moist, dark gray SAND (SP); fine to medium sand.	
10	Hydrated bentonite chips, 2'-16' ▽6/15/2011	S-3		0.0	4 4 3		Wet.	10
15		S-4		0.0	3 5 8		Stiff, wet, gray SILT (ML); with wood debris.	15
	#2/12 sand filter pack, 16'-26'						Medium dense, wet, dark gray to black SAND (SP); trace silt; fine to medium sand.	
20	2-inch diameter schedule 40 PVC 10-slot screen, 18'-23'	S-5		0.0	4 6 8			20
	PVC endcap							
25		S-6		0.0	5 9 9		Bottom of boring at 26' below ground surface.	25

Sampler Type:
- ○ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)
- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: AET
Approved by: JJS
Figure No. B- 27

_ENV BORING LOG SOUTH PARK LANDFILL 100116.GPJ December 1, 2011

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100166	MW-32	1 of 1

Project Name: South Park Landfill
Location: Seattle, WA
Driller/Method: Cascade Drilling, / Hollow Stem Auger
Sampling Method: Dames & Moore

Ground Surface Elev: 17.51' NAVD88
Depth to Water: 10.90' bTOC
Start/Finish Date: 6/29/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	Concrete seal, 0'-2'						Very loose, moist, dark red-brown, slightly silty SAND (SP-SM); fine sand; glass shards, burnt woods debris, and other refuse present	0
	2-inch diameter schedule 40 PVC casing, 0'-20'	S-1	CH4: 0.1% CO2: 0.1% O2: 20.1%	0.0	2 2 2			
5	Well installed with 10.25" ID conductor casing installed to a depth of 11.5' bgs. A 1 ft thick bentonite seal was constructed from 10.5' to 11.5' bgs and hydrated for 1 hr before drilling to 24' bgs with 4.25" ID hollow stem augers.	S-2	CH4: 0.1% CO2: 0.1% O2: 19.1%	0.0	4 1 1			5
		S-3		0.0	2 5 5		Very loose, very moist, black SAND (SP); medium sand; no refuse present	
10	▽6/29/2011	S-4	CH4: 0.1% CO2: 0.1% O2: 20.0%	0.0	2 3 4		Medium stiff, wet, dark blue-gray SILT (ML)	10
		S-5		0.0	1 2 2			
15	Hydrated bentonite chips, 2'-17'	S-6		0.0	3 3 4			15
	#2/12 sand filter pack, 17'-24'						Medium dense, wet, dark gray to black SAND (SP); trace silt; fine to medium sand.	
20	2-inch diameter schedule 40 PVC 10-slot screen, 19'-24'							20
		S-7		0.0	10 12 13			
	PVC endcap						Bottom of boring at 24' below ground surface. Ecology Well ID Tag BHA-082	
25								25

Sampler Type:
- ◯ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)

▼ Static Water Level

▽ Water Level (ATD)

Logged by: DFR

Approved by: JJS

Figure No. B- 28

_ENV BORING LOG SOUTH PARK LANDFILL 100116.GPJ December 1, 2011

Boring Log

Aspect CONSULTING

Project Number	Boring Number	Sheet
100166	MW-33	1 of 1

Project Name: South Park Landfill
Location: Seattle, WA
Driller/Method: Cascade Drilling, / Hollow Stem Auger
Sampling Method: Dames & Moore

Ground Surface Elev: 17.81' NAVD88
Depth to Water: 11.05' bTOC
Start/Finish Date: 6/29/2011

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Drive/ Recovery	Material Type	Description	Depth (ft)
0	Concrete seal, 0'-2'						Very loose, slightly moist, brown, medium SAND (SP)	0
	2-inch diameter schedule 40 PVC casing, 0'-20'	S-1	CH4: 0.1% CO2: 0.1% O2: 19.1%	0.0	2 2 4			
5	Well installed with 10.25" ID conductor casing installed to a depth of 11.5' bgs. A 1 ft thick bentonite seal was constructed from 10.5' to 11.5' bgs and hydrated for 1 hr before drilling to 24' bgs with 4.25" ID hollow stem augers.	S-2	CH4: 0.1% CO2: 0.1% O2: 20.0%	0.0	2 3 4		Very loose, moist, dark red-brown, slightly silty SAND (SP-SM); fine sand; glass shards, burnt woods debris, and other refuse present	5
		S-3		0.0	8 16 20		Very loose, very moist, black SAND (SP); medium sand; no refuse present	
10	▽6/29/2011	S-4	CH4: 0.1% CO2: 0.1% O2: 20.1%	0.0	4 3 2		Medium stiff, wet, dark blue-gray SILT (ML)	10
		S-5		0.0	4 5 6		No sample recovery due to rock in sampler	
15	Hydrated bentonite chips, 2'-18'							15
		S-6		0.0	2 3 4		Medium dense, wet, dark gray to black SAND (SP); trace silt; fine to medium sand.	
	#2/12 sand filter pack, 18'-25'							
20	2-inch diameter schedule 40 PVC 10-slot screen, 19'-25'							20
		S-7		0.0	10 12 12			
25	PVC endcap						Bottom of boring at 25' below ground surface. Ecology Well ID Tag BHA-083	25

Sampler Type:
- ◯ No Recovery
- ◧ 3.25" OD D&M Split-Spoon Ring Sampler

PID - Photoionization Detector (Headspace Measurement)

▼ Static Water Level

▽ Water Level (ATD)

Logged by: DFR

Approved by: JJS

Figure No. B- 29

_ENV BORING LOG SOUTH PARK LANDFILL 100116.GPJ December 1, 2011

Date Start/Finish: 10/16/95 / 10/16/95
Drilling Company: Tacoma Drilling Company
Driller's Name: Butch Dietsche
Drilling Method: Hollow Stem Auger
Bit Size: 8.25-in. Auger Size: 8.25-in.
Rig Type: Mobile B61
Spoon Size: 2-in.

ARA - RMW-01A

Well Casing Elev.: 8.72 ft.
Borehole Depth: 21.5 ft.
Ground Surface Elev.: 9.32 ft.
Geologist: David W. Lay

Well No. MW-1A
Client: Nevander Asset Management, Inc.
Location: Seattle, Washington

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Blows/6 in.	N	Recovery (ft.)	PID (ppm) Headspace	Geotechnical Test	Geologic Column	Stratigraphic Description	Well Construction
gs elevation 9.32 ft.										GROUND SURFACE	Well cap.
										ASPHALT	Flush mount protective casing.
											Cement pad to 2.0' bgs.
										CLAY: Dark brown, some silt, soft, moist, no odor.	Bentonite seal, (2.0' – 5.0' bgs).
5	5	1		6 6 7	13	0.8	0.0			Grades with little fine sand.	2-inch schedule-40 PVC riser, (0.6' – 6.0' bgs).
	0										0.010" Slotted well screen, (6.0' – 21.0' bgs).
10		2		6 8 9	17	0.5	0.0			SILT: Black, stained, some fine to coarse sand, little clay, loose, wet, slight hydrocarbon odor.	
	-5										Sand pack, (5.0' – 21.0' bgs).
15										SILT and SAND: Dark brown/black, fine, trace organics, glass, wood fragments, loose, wet (FILL).	

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Saturated Zones

Date / Time	Elevation	Depth
10-20-95/ 1030	-0.9	9.62 ▼

Project: 02380
Script: nbblwell
Date: 11/15/95

Client:
Seattle, Washington

Well No. MW-1A
Total Depth = 21.5 ft.

Site:
Nevander Asset Management, Inc.

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Blows/6 in.	N	Recovery (ft.)	PID (ppm) Headspace	Geotechnical Test	Geologic Column	Stratigraphic Description	Well Construction
	3		7 7 8	15	1.5	0.0			SILT and SAND: Dark brown/black, fine, trace organics, glass, wood fragments, loose, wet (FILL).	0.010" Slotted well screen, (8.0' – 21.0' bgs).
20	4		7 10 13	23	1.5	0.0			Grades with slight sewage odor.	Sand pack, (5.0' – 21.0' bgs).
									Bottom of boring at 21.5' bgs.	
25										
30										
-25 35										

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Saturated Zones

Date / Time	Elevation	Depth
10-20-95/ 1030	-0.9	9.62 ▼

Project: 02380
Script: nbblwell
Date: 11/15/95

AKA KMW-03A

Date Start/Finish: 10/16/95 / 10/16/95 Drilling Company: Tacoma Drilling Company Driller's Name: Butch Dietsche Drilling Method: Hollow Stem Auger Bit Size: 8.25-in. Auger Size : 8.25-in. Rig Type: Mobile B61 Spoon Size: 2-in.	Well Casing Elev.: 9.33 ft. Borehole Depth: 24 ft. Ground Surface Elev.: 10.08 ft. Geologist: David W. Lay	Well No. MW-3A Client: Nevander Asset Management, Inc. Location: Seattle, Washington

DEPTH	ELEVATION	Sample Run Number	Sample/Int/Type	Blows/6 in.	N	Recovery (ft.)	PID (ppm) Headspace	Geotechnical Test	Geologic Column	Stratigraphic Description	Well Construction
gs elevation 10.08 ft.										GROUND SURFACE	Well cap.
0	10									ASPHALT	Flush mount protective casing.
											Cement pad to 2.0' bgs.
										SAND: Grey/green, fine to medium, some silt and gravel, trace cobbles, loose, moist.	Bentonite seal, (2.0' – 7.5' bgs).
5	5	1		25 50	>50	0.2	0.0				2-inch schedule-40 PVC riser, (0.6' – 9.0' bgs).
		2		20 20 30	50	1	0.0			WOOD FRAGMENTS, Brown, loose, moist (FILL).	
10	0	3		18 19 20	39	0.0	0.0				0.010" Slotted well screen, (9.0' – 24.0' bgs).
		4		20 21 45	>50	0.1	0.0			Grades with sand, wet, creosote odor.	
15										SAND: Brown, fine, some silt, little medium to coarse sand, trace wood particles, loose, wet (FILL).	Sand pack, (7.5' – 24.0' bgs).

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Saturated Zones

Date / Time	Elevation	Depth
10-20-95/1030	-1.99	11.32

Project: 02380 Script: nbblwell Date: 11/15/95

Client:
Seattle, Washington

Well No. MW-3A
Total Depth = 24 ft.

Site:
Nevander Asset Management, Inc.

DEPTH / ELEVATION	Sample Run Number	Sample/Int/Type	Blows/6 In.	N	Recovery (ft.)	PID (ppm) Headspace	Geotechnical Test	Geologic Column	Stratigraphic Description	Well Construction
	5		9 12 18	30	1.0	0.0			SAND: Brown, fine, some silt, little medium to coarse sand, trace wood particles, loose, wet (FILL).	0.010" Slotted well screen, (9.0' – 24.0' bgs).
20	6		20 28 30	>50	1.5	0.0			SILT: Dark grey, little very fine sand, dense, wet, no odor.	Sand pack, (7.5' – 24.0' bgs).
	7		20 21 25	46	1.5	0.0			SAND: Dark grey, trace silt, loose, wet, slight hydrocarbon odor.	
25									Bottom of boring at 24.0' bgs.	
30										
35										

BLASLAND, BOUCK & LEE
ENGINEERS & SCIENTISTS

Remarks:

Saturated Zones

Date / Time	Elevation	Depth
10-20-95/ 1030	-1.99	11.32 ▼

Project: 02380

Script: nbblwell
Date: 11/15/95

ARA KMW-04

WELL CONSTRUCTION	SAMPLE NO.	BLOW COUNT	DEPTH (FT)	USCS SYM.	LITH.	DESCRIPTION
TRAFFIC-RATED WELL COVER CONCRETE BENTONITE 5' RISER SECTION - 2" O.D. SCHEDULE 40 PVC CASING 10/20 SILICA SAND FILTER PACK 15' SCREEN SECTION - 2" O.D. SCHEDULE 40 PVC CASING - 0.01" SLOT	MW-4-3.5 MW-4-8.5 MW-4-13.5	2-2-2 7-00	5 10 15 20 25	SM SW ML SM		ASPHALT 4". GRAY, CLAYEY, SANDY, SILT, PLASTIC MOIST. DARK, SANDY, GRAVELLY DEBRIS, METAL, BRICK, WOOD. OUTGASSING - 5 TO 7 FEET. DARK, SANDY, GRAVELLY DEBRIS, METAL, BRICK, WOOD. GRAY, SILTY CLAY WITH DARK SPOTS, VERY PLASTIC, SATURATED. GRAY, SANDY SILT.

BORING NO. MW-4

SURFACE ELEVATION: 10 FEET
TOTAL DEPTH: 21 FEET
DATE DRILLED: 3/11/92

LOGGED BY: NEIL GILHAM
DRILL RIG: MOBILE DRILL B-61
DIAMETER OF BORING: 8 INCH
WATER ENCOUNTERED AT: 12 FEET

LIBERTY/SAMMIS - SEATTLE
PROJECT NAME: KENYON INDUSTRIAL PARK
PROJECT NO. 1A2996AA001
LOCATION: SOUTH PARK, SEATTLE, WA

DIAGNOSTIC ENGINEERING INC.
6347 SEAVIEW AVE NW, SEATTLE, WA

WELL CONSTRUCTION	SAMPLE NO.	BLOW COUNT	DEPTH (FT)	USCS SYM.	LITH.	KMW-05 DESCRIPTION
TRAFFIC-RATED WELL COVER CONCRETE BENTONITE						ASPHALT 4".
	MW-5-3.5	3-5-7		SM		SANDY SILT, LIGHT GRAY, FIRM, DAMP.
5' RISER SECTION - 2" O.D. SCHEDULE 40 PCV CASING			5			
	MW-5-8.5	2-1-0				DARK GREEN GRAY, SILTY CLAY, PLASTIC, WET.
10/20 SILICA SAND FILTER PACK			10	ML		DARK GREEN GRAY, SILTY CLAY TO SANDY SILT, PLASTIC, WET, ORGANIC MATERIAL, SOME DEBRIS.
	MW-5-13.5	1-0		SM		DARK GREEN GRAY, SILTY SAND, WET.
15' SCREEN SECTION - 2" O.D. SCHEDULE 40 PCV CASING - 0.01" SLOT			15			
			20			
			25			

BORING NO. MW-5

SURFACE ELEVATION: 10 FEET
TOTAL DEPTH: 21 FEET
DATE DRILLED: 3/12/92

LOGGED BY: NEIL GILHAM
DRILL RIG: MOBILE DRILL B-61
DIAMETER OF BORING: 8 INCH
WATER ENCOUNTERED AT: 6.5 FEET

LIBERTY/SAMMIS - SEATTLE
PROJECT NAME: KENYON INDUSTRIAL PARK
PROJECT NO. 1A2996AA001
LOCATION: SOUTH PARK, SEATTLE, WA

DIAGNOSTIC ENGINEERING INC.
6347 SEAVIEW AVE NW, SEATTLE, WA

WELL CONSTRUCTION	SAMPLE NO.	BLOW COUNT	DEPTH (FT)	USCS SYM.	AKA KMW-86 LITH.	DESCRIPTION
TRAFFIC-RATED WELL COVER CONCRETE BENTONITE 5' RISER SECTION - 2" O.D. SCHEDULE 40 PVC CASING 10/20 SILICA SAND FILTER PACK 15' SCREEN SECTION - 2" O.D. SCHEDULE 40 PVC CASING - 0.01" SLOT	MW-6-GRAB MW-6-3.5 MW-6-8.5	15-27-15 7-3-5	5 10 15 20 25	GW SW		ASPHALT 4". BROWN/GRAY SANDY GRAVEL, POORLY SORTED. BROWN/GRAY SANDY GRAVEL WITH LARGER GRIT. ASPHALT AND GRAVEL WITH DEBRIS, BLACK PLASTIC. GRAY, DARK GRAY, BROWN, MEDIUM GRIT SAND WITH DEBRIS. BROWN/GRAY, ROCK, SANDY GRAVEL, POORLY SORTED. GRAY/BROWN SILTY SAND.

BORING NO. MW-6

SURFACE ELEVATION: 10 FEET
TOTAL DEPTH: 21 FEET
DATE DRILLED: 3/12/92

LOGGED BY: BILL OFSTUN
DRILL RIG: MOBILE DRILL B-61
DIAMETER OF BORING: 8 INCH
WATER ENCOUNTERED AT: 8 FEET

LIBERTY/SAMMIS - SEATTLE
PROJECT NAME: KENYON INDUSTRIAL PARK
PROJECT NO. 1A2996AA001
LOCATION: SOUTH PARK, SEATTLE, WA

DIAGNOSTIC ENGINEERING INC.
6347 SEAVIEW AVE NW, SEATTLE, WA

WELL CONSTRUCTION	SAMPLE NO.	BLOW COUNT	DEPTH (FT)	USCS SYM.	AKA LITH.	KM W-07 DESCRIPTION
TRAFFIC-RATED WELL COVER CONCRETE BENTONITE 5' RISER SECTION - 2" O.D. SCHEDULE 40 PVC CASING 10/20 SILICA SAND FILTER PACK 15' SCREEN SECTION - 2" O.D. SCHEDULE 40 PVC CASING - 0.01" SLOT NATIVE SOIL COLLAPSE AT 17'	MW-7-3.5	3-3-1	5	SW		ASPHALT 4". GRAVEL FILL. GRAY GRAVELLY SAND, POORLY SORTED, WET.
	MW-7-8.5	6-5-6	10	SM		GRAY SILTY SAND, POORLY SORTED, WET.
	MW-7-13.5	12-18-20	15	SM		GRAY SILTY SAND, ORGANIC MATERIAL, WET.
	MW-7-18.5	7-4-7	20	SM		SILTY FINE SAND, GRAY BROWN, WITH SHELLS AND PLANT MATERIAL.
			25			

BORING NO. MW-7

SURFACE ELEVATION: 10 FEET
TOTAL DEPTH: 20 FEET
DATE DRILLED: 3/12/92

LOGGED BY: BILL OFSTUN
DRILL RIG: MOBILE DRILL B-61
DIAMETER OF BORING: 8 INCH
WATER ENCOUNTERED AT: 5 FEET

LIBERTY/SAMMIS - SEATTLE
PROJECT NAME: KENYON INDUSTRIAL PARK
PROJECT NO. 1A2996AA001
LOCATION: SOUTH PARK, SEATTLE, WA

DIAGNOSTIC ENGINEERING INC.
6347 SEAVIEW AVE NW, SEATTLE, WA

South Park Landfill

Interim Site-wide Groundwater Monitoring Plan

Appendix B
Groundwater Sampling Record Template

DRAFT

Aspect CONSULTING

GROUNDWATER SAMPLING RECORD

WELL NUMBER: _____ **Page:**____ **of** ____

Project Name: _____ Project Number: _____

Date: _____

Developed by: _____

Measuring Point of Well: _____

Screened Interval (ft. TOC) _____

Filter Pack Interval (ft. TOC) _____

Starting Water Level (ft TOC): _____

Casing Stickup (ft): _____

Total Depth (ft TOC): _____

Casing Diameter (inches): _____

Casing Volume _____ (ft Water) x _____ (Lpfv)(gpf) = _____ (L)(gal)

Casing volumes: 2" = 0.16 gpf 4" = 0.65 gpf 6" = 1.47 gpf

2" = 0.62 Lpf 4" = 2.46 Lpf 6" = 5.56 Lpf

Sample Intake Depth (ft TOC): _____

PURGING MEASUREMENTS

Criteria:		Typical 0.1-0.5 Lpm	Stable and minimal and	na	± 3%	± 10%	± 0.1	± 10 mV	± 10%	
Time	Cumul. Volume (gal or L)	Purge Rate (gpm or Lpm)	Water Level (ft)	Temp. (C or F)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH	Eh ORP (mv)	Turbidity (NTU)	Comments

Total Gallons Purged: _____ Total Casing Volumes Removed: _____

Ending Water Level (ft TOC): _____ Ending Total Depth (ft TOC): _____

SAMPLE INVENTORY

Time	Volume	Bottle Type		Quantity	Filtration	Preservation	Appearance		Remarks
							Color	Turbidity & Sediment	

METHODS

Sampling Equipment with IDs: _____

Purging Equipment: _____ Decon Equipment: _____

Disposal of Discharged Water: _____

Observations/Comments: _____

_____