CAT 3/30/17 SW06.1

Revised Groundwater Sampling and Analysis Plan

North and South Woodwaste Landfills
Arlington, Washington

PERMIT NUMBER: SW 006 / SW 007

March 2017

Prepared for
J.H. Baxter Co.

Prepared by

GSI Water Solutions, Inc.
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J.H. BAXTER & CO., a California Limited Partnership

March 1, 2017

Mike Young
Environmental Health Specialist
Snohomish Health District
3020 Rucker Avenue, Ste 300
Everett, WA 98201

Re: Revised Sampling and Analysis Plan, J.H. Baxter North and South Woodwaste Landfills, Arlington, Washington

The attached Revised Groundwater Sampling and Analysis Plan (SAP) has been modified to be in concurrence with Washington Department of Ecology's (Ecology) memorandum, *Baxter Variance Request to Reduce Groundwater Monitoring at Two WAC 173-304 Closed Woodwaste Landfills* dated February 7, 2017. Per Ecology's memorandum the following modifications were made to the Revised SAP, dated October, 2016.

- North Woodwaste Landfill: Groundwater sampling frequency modified to quarterly monitoring at well BXN-1.
- North Woodwaste Landfill: Analysis for pentachlorophenol in groundwater annually at wells BXN-1, BXN-2, BXN-3, and BXN-4.
- South Woodwaste Landfill: Groundwater sampling frequency modified to quarterly monitoring at well BXS-3.

Monitoring Schedule

Based upon ongoing correspondence with the Snohomish County Health District and concurrence provided in Ecology's above mentioned letter, Baxter will conduct the groundwater monitoring in accordance with the Revised SAP at both landfills beginning in the first quarter 2017. First quarter sampling is currently planned to begin the first week of March, 2017.

Sincerely,

Georgia Baxter

Georgia Baxter, J.H. Baxter & Co.

cc: Tim O'Conner, Washington Department of Ecology

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Abbreviations and Acronyms

CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
cm	centimeters
COC	chain-of-custody
COI	chemical of interest
CSM	conceptual site model
DM	Data Manager
DO	dissolved oxygen
DOT	Department of Transportation
EPA	United States Environmental Protection Agency
GPS	global positioning system
GSI	GSI Water Solutions, Inc.
HSP	Health and Safety Plan
IDW	investigation-derived waste
ID	identification
ISM	incremental sampling methodology
LCS	laboratory control sample
MRL	method reporting limit
MS	matrix spike
MSD	matrix spike duplicate
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QA	quality assurance
QC	quality control
RPD	relative percent difference
SAP	Sampling and Analysis Plan
TOC	total organic carbon

SECTION 1 Introduction

This Sampling and Analysis Plan (SAP) presents the approach and procedures for conducting groundwater sampling to support the post closure monitoring at the J.H. Baxter's (Baxter) North and South Woodwaste Landfills in Arlington, WA (Figure 1 and Figure 2). The SAP has been prepared to provide specific details on the sample collection and processing techniques to be utilized in ongoing site monitoring.

1.1 North Landfill Site History and Description

Baxter closed the North Landfill (SW 006) in 1991 and has conducted groundwater sampling generally on a quarterly basis since the late 1980s. The landfill is nearly 9 acres in size and contains approximately 335,000 cubic yards of woodwaste. The approximate maximum thickness of woodwaste in the landfill is 15 feet, and the top of the woodwaste is covered with approximately 2 feet of soil. The bottom of the woodwaste is more than 10 feet above the water table. The water table is approximately 42 feet below ground surface and groundwater flows to the northwest at a velocity of about 1.5 to 3.5 feet/day (Figure 3).

Four groundwater monitoring wells were installed in 1988, three downgradient wells (BXN-1, BXN-2, and BXN-3) and one upgradient well (BXN-4) (Figure 3). Baxter has conducted groundwater sampling generally on a quarterly basis since the late 1980s. Groundwater samples have been analyzed for 12 water quality parameters and 8 dissolved metals (Baxter, 2015a). Monitoring well BXN-3 was damaged in 2010 and has not been usable since.

1.2 South Landfill Site History and Description

The South Landfill (SW 007), which began accepting woodwaste in the mid-1980s, is nearly 7 acres in size and contains approximately 300,000 cubic yards of woodwaste. The approximate maximum thickness of woodwaste in the landfill is more than 10 feet, and the top of the woodwaste is covered with approximately 2 feet of soil. The bottom of the woodwaste is more than 10 feet above the water table. The water table is approximately 30 feet below ground surface and groundwater flows to the northwest at a velocity of about 5 to 10 feet/day (Figure 4).

Four groundwater monitoring wells were installed in 1988, three downgradient wells (BXS-1, BXS-2, and BXS-3) and one upgradient well (BXS-4) (Figure 4). As previously stated, Baxter has conducted groundwater sampling generally on a quarterly basis since the late 1980s. Groundwater samples have been analyzed for 12 water quality parameters and 8 dissolved metals (Baxter, 2015b).

1.3 Sampling Reduction

Following the sampling reduction rationale presented previously in Attachments 1 and 2 of the *Revised Sampling and Analysis Plan, North and South Arlington Woodwaste Landfills* dated October 2016, the following groundwater sampling plan incorporates the semi-annual

testing of an upgradient and downgradient wells as part of post closure monitoring for landfills. The sampling schedule is outlined in Table 1 for the North Landfill and Table 2 for the South Landfill, with associated analyte lists.

SECTION 2 Groundwater Sampling and Quality Control Procedures

2.1 Groundwater Sampling

The collection of groundwater samples from Site monitoring wells generally will consist of three steps:

1. Measurement of static water level
2. Well purging and monitoring for field parameter stabilization and low-flow sampling
3. Water quality sample collection

Groundwater samples will be collected on a quarterly basis for the furthest downgradient well and a semi-annual basis for remaining wells. Semi-annual sampling events will take place during the first quarter (between January and April) and third quarter (between July and October) of each year. Groundwater sample analysis will be performed by a Washington Department of Ecology approved analytical laboratory.

2.1.1 Static Water Level Measurements

Groundwater levels will be measured manually immediately before groundwater sampling. The wells will be uncapped and allowed to equilibrate with atmospheric pressure before measurement of groundwater levels. The water level in each well then will be measured from the surveyed top of casing location using an electric water level meter to the nearest 0.01 foot. Water level measurements and surveyed measuring point elevations will be used to compute groundwater elevations at each monitoring point. A complete set of static water level measurements will be obtained before initiating a water quality sampling event. Groundwater levels will be used to evaluate the groundwater gradients across the Site.

2.1.2 Well Purging, Field Parameter Measurement, and Water Quality Sample Collection

In general, groundwater sampling will proceed in order from background wells (e.g., upgradient) to downgradient wells (i.e., detected groundwater concentrations of COIs), based on anticipated conditions and previous data collected at the Site to reduce the potential for cross-contamination of water samples.

Monitoring wells will be purged using appropriate pre-cleaned equipment (e.g., bladder pump, low-flow electric pump, peristaltic pump). Before purging the well, pump tubing will be lowered in well and be allowed to sit so that disturbed sediments can settle before turning on the pump. Purge water will be directed through a flow-through cell containing field water quality parameter sensors. Groundwater purging and parameter measurement techniques to be used for this project are described below:

1. Calibrate field meters daily according to factory instructions, with calibration results recorded on calibration forms.
2. Measure water depth to the nearest 0.01 foot using an electronic water level meter. Record the depth to water measurement and the time of measurement on the groundwater sampling form.
3. Connect purge tubing in well to the pump and the flow-through cell.
4. Begin purging, typically at a rate of approximately 500 milliliters per minute, but no more than 1 liter per minute. Record the purge rate and time throughout the purging effort.
5. Field parameters will be measured using a flow-through device to minimize potential effects from atmospheric exposure. Monitor pH, temperature, conductivity, ORP, DO, and turbidity (from flow-through cell discharge) and record readings at regular intervals (e.g., approximately 2-liter purge interval or 5 minutes). Record parameter measurements on a groundwater sampling form. Water levels should be recorded with each parameter set.
6. Purging will be considered complete only after one of the following purge conditions is met:
    - Low-flow sampling: parameters have stabilized in accordance with EPA low-flow purging and sampling procedures (EPA, 1996b, 2010). A summary table of stabilization criteria are provided in Table 3.
    - Other sampling methods:
        - A minimum of three well volumes have been removed and field parameters have stabilized to within 10% of three successive measurements.
        - At least five well volumes have been removed, although field parameter stabilization criteria are not yet met.
        - The well has been pumped dry and allowed to recover sufficiently such that adequate sample volumes for rinsing equipment and collecting samples can be removed.
7. Record the final field-measured parameters of pH, temperature, conductivity, turbidity, DO, and ORP.
8. Purge water will be stored in DOT-approved 55-gallon drums, labeled, and stored onsite in a secure location pending receipt of the groundwater monitoring results. The purge water from sampling the landfill monitoring wells is managed concurrently with the purge water from groundwater sampling conducted at the RCRA wood-treating facility.

Following well purging, groundwater quality samples will be obtained. Sample bottles will be filled directly from an appropriate sampling port (e.g., bailer, sampling port before the pumped water passes through the flow-through cell, low-flow pump discharge). Sampling

procedures will be performed in a manner that strives to minimize disturbance/agitation of the water column or sample, appropriate tubing material will be used to reduce the potential for organic sorption (Teflon or stainless-steel generally is preferred, although plastic [high-density polyethylene] is acceptable). Low-flow rates will be used during sampling collection.

Water samples will be placed in appropriate, primary contract laboratory-supplied, pre-cleaned and preserved containers. Groundwater sampling equipment reused between monitoring locations (e.g., water level meter) will be thoroughly decontaminated between uses, as described in Section 2.3. If tubing is used during groundwater sampling, it will be discarded after each use or dedicated to a single monitoring well. The effectiveness of the decontamination procedure will be evaluated through the periodic collection of equipment rinsate blanks, as outlined in Section 2.2.1.

2.2 Field QA/QC Samples

QC requirements will be instituted during field sampling, sample transfer, and data management; detailed information on laboratory QA/QC procedures and reporting are provided in Section 3.

Field QC procedures for groundwater samples are used to evaluate the effectiveness of sample homogenization and within-sample variability (e.g., duplicates), confirm proper rinsing and decontamination procedures (e.g., rinse blank or field blank) or confirm proper shipping/storage conditions (e.g., temperature blanks). A duplicate sample will be collected from one downgradient well from one of the 2 Baxter Landfills during each sampling event.

2.2.1 Rinse Blanks

A rinse blank sample will be prepared each quarter by collecting deionized water rinsing over the outside of the submersible sampling equipment after the decontamination procedure has been completed. The rinse blank serves to check for the possibility of sample contamination due to inadequate decontamination of sampling equipment. The rinse blank will be prepared after collecting a sample from a well with historically higher levels of contamination relative to other wells on site.

2.2.2 Temperature Blanks

Temperature blanks are used to measure and ensure cooler temperature upon receipt of samples at the primary contract laboratory. One temperature blank will be prepared and submitted with each cooler shipped to the laboratory. The temperature blank will consist of a sample jar containing deionized water that will be packed into the cooler in the same manner as the rest of the samples and labeled "temp blank."

2.3 Equipment Decontamination Procedures

Equipment that comes in direct contact with groundwater, such as non-dedicated pumps, will be decontaminated in the following manner before use at each well:

- Wash with brush and Alconox or other phosphate-free detergent.

- Thoroughly rinse with deionized water and pump deionized water through the pump.

To minimize sample contamination, gloves will be replaced or thoroughly washed using Alconox or other phosphate-free detergent and rinsed with distilled water before and after handling each sample, as appropriate.

2.4 Sample Packaging and Shipping

The primary contract laboratory will supply sample coolers and packing materials for the sampling event. Upon completion of the final sample inventory, individual sample containers will be placed into a sealed plastic bag. Samples then will be packed in a cooler. Glass jars will be packed to prevent breakage and separated in the shipping container by bubble wrap or other shock-absorbent material. Ice in sealed plastic bags or "blue ice" then will be placed in the cooler to maintain a temperature of approximately 4°C.

When the cooler is full, the COC form will be placed into a resealable bag and taped onto the inside lid of the cooler. A temperature blank will be added to each cooler. Each cooler will be sealed with three custody seals. On each side of the cooler, a "This End Up" label with arrow will be attached; a "Fragile" label will be attached to the top of the cooler. Coolers will be transported to the primary contract laboratory by lab courier or overnight shipping service. These packaging and shipping procedures are in accordance with DOT regulations as specified in 49 CFR 173.6 and 49 CFR 173.24.

SECTION 3 Laboratory Analysis and Quality Assurance/Quality Control

Procedures for chemical analysis and laboratory QA/QC conform to the selected laboratory's QA Plan, which has been reviewed by the QA Chemist and approved to meet the QA requirements for this project. The QA Plan will minimally employ EPA and other regulatory-accepted methods and protocols. These protocols will be followed to ensure that data quality and representation are in accordance with method requirements and data usability is appropriately assessed for the project objectives.

3.1 Chemical Analysis

Target parameters described in Table 1 for the North Landfill and Table 2 for the South Landfill; identified for laboratory analysis will be subject to EPA standard analysis practices. Method and reporting limits for each parameter will be reported so as to be consistent with each respective testing method. Reportable and method detection limits will be provided with each annual monitoring report.

3.2 Laboratory QA/QC Procedures

Laboratory QA/QC will be maintained through the use of standard EPA methods and other accepted methods and standard analytical procedures for the target analytes. Analytical methods and QC measurements and criteria are based on the current SW-846 requirements, and EPA guidance.

As noted for the field QC protocols, the field samples will be packaged, managed, and transferred to the primary contract laboratory according to the appropriate procedures and with sufficient time and coordination to meet analytical holding times. Following the successful delivery of samples, the laboratory will follow the method-specific and other analytical and laboratory QC procedures and protocols that will be requested by the laboratory before selection.

3.2.1 Internal QC Samples

Various QC samples are used to evaluate the precision, accuracy, representativeness, completeness, and comparability of the analytical results. Analytical methods specify routine procedures that are required to evaluate if data are within proper QC limits.

3.2.2 Method Reporting Limit Check

Method reporting limit (MRL) checks, as applicable, are made to ensure that primary contract laboratory instrumentation can achieve the required MRLs. If the initial calibration curve contains a standard at the MRL, the laboratory may forgo analyzing a daily MRL check standard. If not, the laboratory will run an MRL check standard per analytical sequence. This sample will be after the instrument blank check sample and before analyzing samples from this group. The instrument must be able to achieve the requested MRLs

without interference. If the instrument cannot achieve these levels, the samples must be analyzed on a different instrument that is able to achieve the required MRLs for this project.

3.2.3 Method Blanks

Introduction of chemicals during sampling and analytical activities will be assessed by the analysis of blanks. Method blanks, as applicable, are used to check for laboratory contamination and instrument bias. Laboratory method blanks will be analyzed at a minimum frequency of 5 percent or one per analytical batch for all chemical parameter groups.

3.2.4 Laboratory Duplicates

Sample analytical variability and laboratory precision and accuracy will be determined by the analysis of primary contract laboratory-generated sample splits at a frequency of 5 percent or once per batch of 20 samples. The duplicate results will be used for determination of relative percent differences (RPD). Variability in organic compound analysis will be evaluated by analysis of matrix spike (MS) and matrix spike duplicate (MSD) samples. Duplicate samples for inorganic analysis will be analyzed at a frequency of 5 percent. Conventional parameters also will be analyzed in duplicate at a frequency of 5 percent.

3.2.5 Laboratory Control Samples

Laboratory control samples (LCS), as applicable, are used to monitor the primary contract laboratory's day-to-day performance of routine analytical methods independent of matrix effects. In this sampling effort an LCS/LCS-duplicate will be analyzed with each batch of organic and inorganic analysis. This should provide usable precision and accuracy measurements for each batch. For inorganic samples, a standard reference material (SRM) also will be run. If the laboratory runs a blank spike and blank spike duplicate for organics, then it also will run an appropriate SRM.

3.2.6 Matrix Spike and Matrix Spike Duplicates

MS and MSD samples, as applicable, provide information to assess precision and accuracy. The primary contract laboratory will follow EPA guidance for MS/MSD sample analysis. Percent recoveries, including RPD, will be assessed for organic compounds from the MS/MSD and for inorganic compounds from the MS. MS/MSD recovery will be measured at a minimum frequency of 5 percent or one per batch of up to 20 samples.

SECTION 4 Investigation Derived Waste Management

4.1 Groundwater

Groundwater produced during monitoring well testing (purge water) will be placed in 55-gallon drums stored onsite. The purge water will be managed according to RCRA regulations.

4.2 Other Waste

All disposable materials used in sample collection and processing, such as paper towels, tubing and gloves, will be placed in heavyweight garbage bags or other appropriate containers. Disposable supplies will be placed in a normal refuse container for disposal at a solid waste landfill.

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SECTION 5 Reporting

Annually, Baxter will prepare a groundwater monitoring report for submittal to the Snohomish County Health District (SCHD). The report will document the sampling activities, analytical results, and conclusions and recommendations of the previous two semi-annual events. By request of the SCHD, analytical data for arsenic (if exceeding MCLs) will be plotted with estimated areal extent in relation to nearby water wells. The formatting of the reports will be such as to maintain consistency with previously submitted reports for the Site. The reports will be prepared and submitted to the SCHD by the date indicated in the permit (April 1st).

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SECTION 6 References

Baxter. 2015a. 2014 Groundwater Monitoring Report. North Woodwaste Landfill. Arlington, Washington. Prepared by GSI Water Solutions, Inc. Submitted to Snohomish Health District. April 30..

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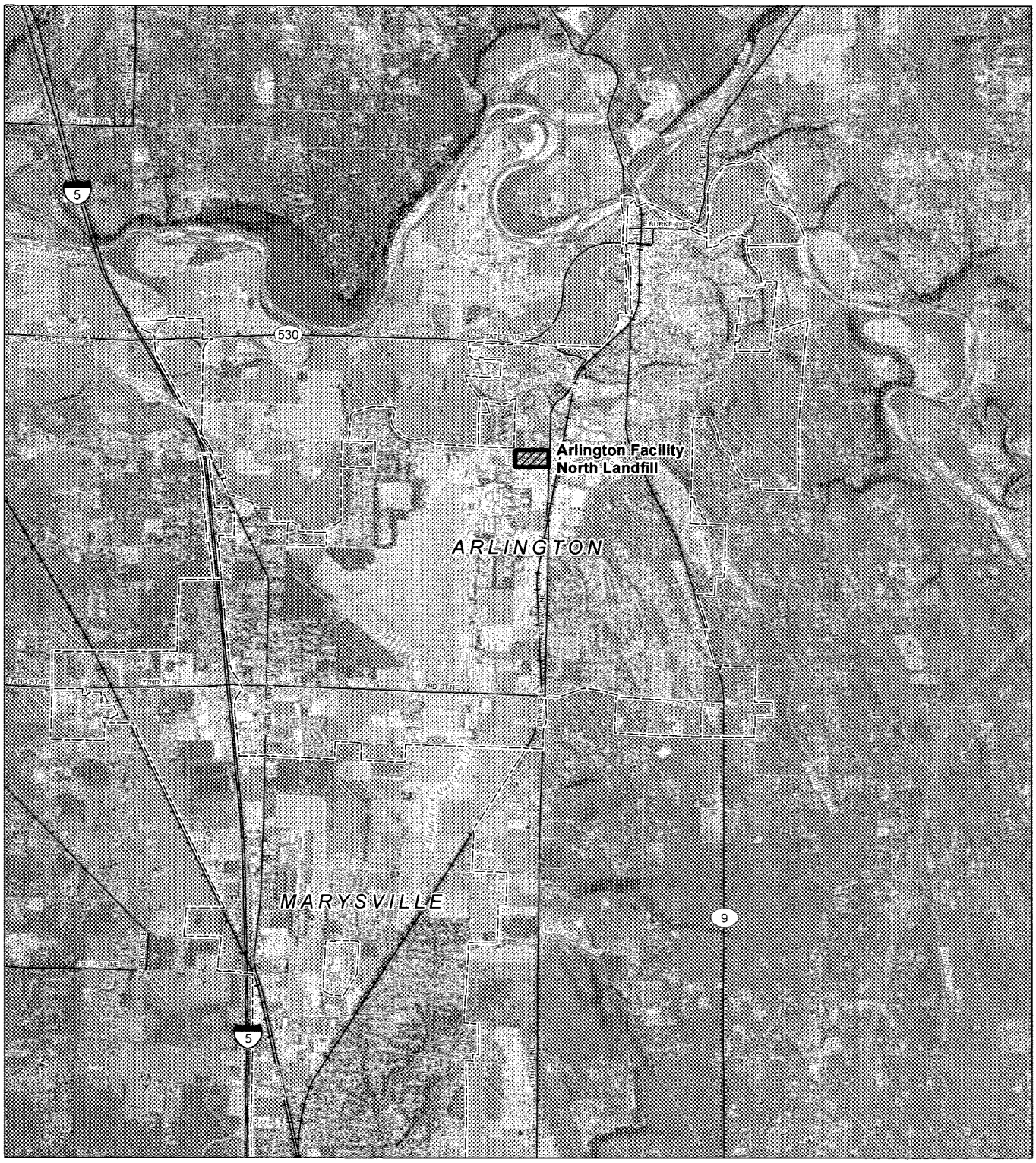
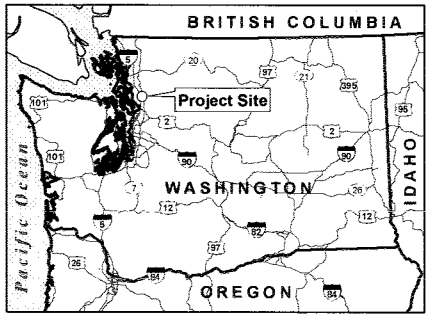
Figures





LEGEND

- Cities
- Railroads
- Major Roads
- Watercourses

MAP NOTES:
Date: March 31, 2015
Data Sources: Air photo taken on July 15, 2013 by the USDA

FIGURE 1

Site Vicinity Map
J.H. Baxter & Co. Closed North
Woodwaste Landfill
(Site Permit Number SW 006)

N

0 0.5 1
Miles

GSI Water Solutions, Inc.

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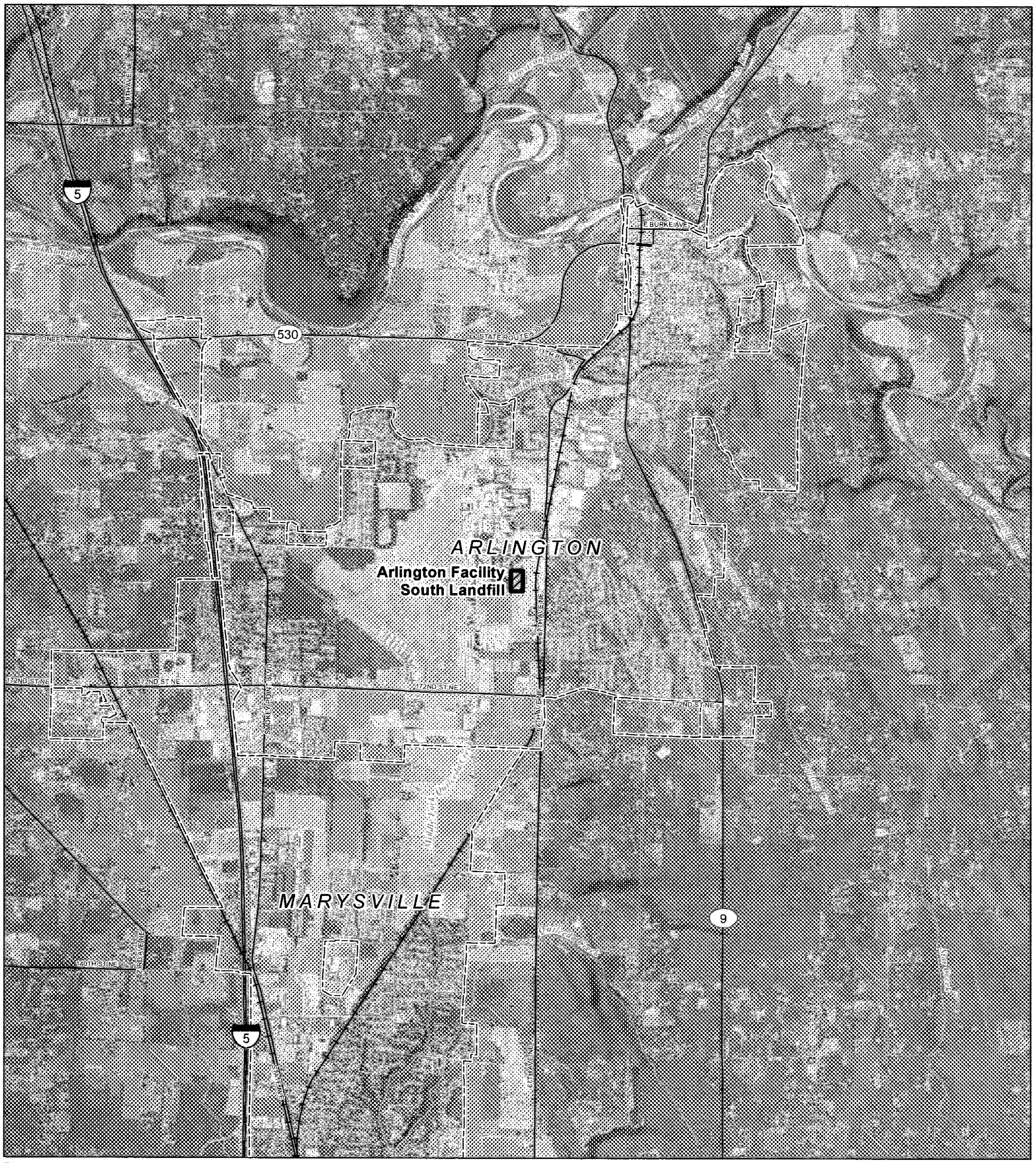

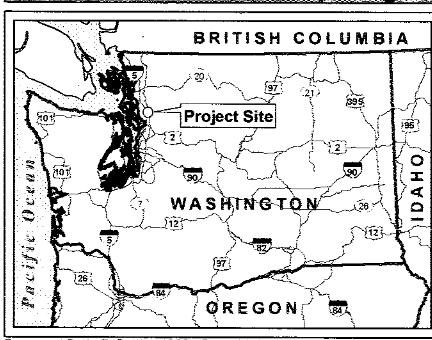

LEGEND

Cities

Railroads

Major Roads

Watercourses

MAP NOTES:
Date: March 31, 2015
Data Sources: Air photo taken on July 15, 2013 by the USDA

FIGURE 2

Site Vicinity Map
J.H. Baxter & Co. Closed South
Woodwaste Landfill
(Site Permit Number SW 007)

N

0 0.5 1
Miles

GSI Water Solutions, Inc.

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FIGURE 3

Well Location Map

J.H. Baxter & Co. Closed North Woodwaste Landfill
(Site Permit Number SW 006)

LEGEND

- Monitoring Well
- Direction of Groundwater Flow

N

0 75 150 225
Feet

MAP NOTES:
Date: March 31, 2015
Data Sources: AMEC, ESRI, Air photo taken on July 9, 2010 by Microsoft

GSI Water Solutions, Inc.

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FIGURE 4

Well Location Map

J.H. Baxter & Co. Closed South
Woodwaste Landfill
(Site Permit Number SW 007)

LEGEND

- Monitoring Well
- Direction of Groundwater Flow

N

0 100 200 300
Feet

MAP NOTES:
Date: March 31, 2015
Data Sources: AMEC, ESRI, Air photo taken on July 9, 2010 by Microsoft

GSI Water Solutions, Inc.

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Tables

Table 1. Proposed Sampling Parameters and Schedule North Landfill

Analytes	Field / Lab Analysis	Sample Frequency			
		BXN-1	BXN-2	BXN-3	BXN-4
pH	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
conductivity	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
temperature	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
dissolved oxygen	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
ORP/Eh	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
field methane	Field Measurement	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
ammonia as nitrogen	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
arsenic (dissolved)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
barium (dissolved)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
chloride	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
chemical oxygen demand (COD)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
iron (dissolved)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
manganese (dissolved)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
nitrate, nitrite as nitrogen	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
sulfate	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
tannin and lignin	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
total dissolved solids (TDS)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
total organic carbon (TOC)	Laboratory Analysis	Quarterly	Semi-Annual	Semi-Annual	Semi-Annual
PCP	Laboratory Analysis	Annual	Annual	Annual	Annual

Table 2. Proposed Sampling Parameters and Schedule South Landfill

Analytes	Field / Lab Analysis	Sample Frequency			
		BXS-1	BXS-2	BXS-3	BXS-4
pH	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
conductivity	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
temperature	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
dissolved oxygen	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
ORP/Eh	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
field methane	Field Measurement	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
ammonia as N	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
arsenic (dissolved)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
barium (dissolved)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
chemical oxygen demand (COD)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
iron (dissolved)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
manganese (dissolved)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
nickel	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
sulfate	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
tannin and lignin	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
total dissolved solids (TDS)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual
total organic carbon (TOC)	Laboratory Analysis	Semi-Annual	Semi-Annual	Quarterly	Semi-Annual

Table 3. Groundwater Field Parameter Stabilization Goals

Parameter	Units	Stabilization Goals[1]
pH	standard units	± 0.1
Temperature	°C	± 0.2
Specific Conductivity	µmhos/cm	± 5% (SC ≤ 100) ± 3% (SC > 100)
Dissolved Oxygen	mg/L	± 0.3
ORP/Eh	mV	± 10 [2]

Notes

1 Stability criteria obtained from USGS National Field Manual for the Collection of Water Quality Data: Chapter A4, Collection of Water Samples (USGS, 2006).

2 Stability criteria from the US Environmental Protection Agency (EPA) Region 1. Standard Operating Procedure for Low-Stress (low-flow) Purging and Sampling from Monitoring Wells (EPA, 2010). Available from http://www.epa.gov/region1/lab/qa/pdfs/EQASOP-GW001.pdf

ORP/Eh = oxidation reduction potential