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**WEBB HILL BIOSOLIDS FACILITY  
HYDROGEOLOGIC INVESTIGATION - PHASE 2  
Mason County, Washington**

**Prepared for: Mason County Department of Community Development  
on behalf of the WRIA 16 Planning Unit**

**Washington State Department of Ecology Grant No. G0800485**

Project No. 070041-004-13A • June 30, 2008 Interim Report

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## Acronyms

bgs	below ground surface
$^{14}\text{C}$	radioactive carbon isotope with atomic mass 14
CFC	chlorofluorocarbon
DNR	Washington Department of Natural Resources
DOH	Washington State Department of Health
Ecology	Washington State Department of Ecology
GWQC	Ground Water Quality Criteria
$^3\text{H}$	tritium, radioactive hydrogen isotope with atomic mass 3
$^3\text{He}$	non-radioactive helium isotope with atomic mass 3
HCDOP	Hood Canal Dissolved Oxygen Program
MCL	maximum contaminant level
mg/L	milligrams per liter
NTU	nephelometric unit
QAPP	Quality Assurance Project Plan
$\text{SF}_6$	sulphur hexafluoride
SMCL	secondary maximum contaminant level
TKN	total Kjeldahl nitrogen
TOC	total organic carbon; top of casing
TP	total phosphorus
$\mu\text{S/cm}$	microSiemens per centimeter
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAC	Washington Administrative Code

## Executive Summary

The BioRecycling Corporation's Webb Hill Facility is a state permitted biosolids treatment and land application facility on Webb Hill Road in Mason County, Washington. The Webb Hill facility was initially used as a Christmas tree farm and converted to biosolids application in September 1985. In about 1994, business ownership transferred from Solganics to the current operator BioRecycling Corp. This report presents the findings of the Phase 2 hydrogeologic investigation of the facility. The objectives of this investigation are to expand evaluation of impacted groundwater beneath the facility and to refine the groundwater flow (transport) directions and horizontal gradients on and off the site. Monitoring wells MW-1 through MW-4 were installed as part of the Phase I investigation in May 2007 by Aspect Consulting, LLC under contract to Mason County. In November 2007 monitoring well MW-5 was installed by BioRecycling's contractor Pacific Groundwater Group, Inc.

Under this Phase 2 program, two additional groundwater monitoring wells (MW-6 and MW-7) were installed at the facility using rotary-sonic drilling method. This drilling method allowed collection of continuous soil core and identification of perched zones. Well screens were 25 feet long to minimize effects of vertical gradients, but set 15 feet below estimated low water level to prevent the wells from seasonally going dry, as had occurred in MW-1, MW-2, MW-3, and MW-4 as a result of an unexpectedly large drop in water level during the first year of observation.

The new monitoring wells reinforce previous geologic interpretations of a thin layer of recessional soil over stratified glacial deposits, where the glacial deposits are highly variable, both laterally and vertically. The glacial soils are interpreted to have been deposited in a dynamic sub-glacial environment and include weakly cemented tills, sand and gravel fluvial layers, and some silt units.

Groundwater flow direction in the regional aquifer continued to be southwesterly throughout the last year of measurements (Table 3.1 and Figure 3.1). The groundwater gradient varies from 0.002 feet per foot (ft/ft) (about an 11-foot decline in groundwater level per mile) at the site to 0.007 ft/ft (37 feet per mile) southwest of the site. Greater regional definition of flow directions would be useful, particularly northeast of the site, northwest and southeast of the currently defined groundwater contours, and further southwest toward Purdy Creek.

Groundwater quality impacts beneath the facility are indicated by elevated nitrate concentrations, elevated specific conductance, and changes in major ion concentration and chemistry. Increases in specific conductance are well correlated with elevated nitrate concentrations. All available nitrate data for the existing wells are presented on Figure 3.1.

Maximum nitrate concentration in groundwater is listed by the Washington Department of Ecology (Ecology) groundwater quality criteria (GWQC), Washington Administrative

Code (WAC) 173-200, *Water Quality Standards for Ground Water of the State of Washington*). The allowable maximum contaminant level (MCL) of nitrate in drinking water is specified by Washington Department of Health, WAC 246-290-310, *Public Water Supplies*. In both cases, maximum nitrate concentration is 10 milligrams as nitrogen per liter (mg/L).

Exceedance of GWQC and MCL for nitrate was observed at monitoring well MW-6 (11.9 mg/L). Nitrate concentration at monitoring well MW-5 (4.0 mg/L) is elevated over background conditions. Nitrate at well MW-7 (0.7 mg/L) may be within background levels.

The USGS recently reported results of environmental tracer analyses for samples collected from Webb Hill facility wells MW-1 through 4. Sulphur hexafluoride (SF<sub>6</sub>) concentrations were found to be equivalent to atmospheric conditions in the late 1990s to early 2000's. USGS analyses for compounds typically found in waste water yielded few detections and the data was not considered to be of substantial use.

Results from USGS testing and also recently submitted dating samples for MW-5, MW-6, and MW-7 collected as part of this investigation will be reviewed in a future Aspect Consulting memorandum.

Conclusions based on the investigations to date are:

- Nitrate impacted groundwater is moving in a southwesterly direction from the biosolids application site;
- Nitrate concentration in groundwater exceeded the statutory limit of 10 mg/L along the site boundary at MW-6 and was near exceedance at MW-4. Both wells are located along the southern boundary; and
- Groundwater was not impacted at two off-site domestic supply wells located about 4,200 and 6,200 feet southwest of the site.

The following recommendations for additional work are presented. The intention of the recommendations is to use existing water-supply wells wherever possible and consider new well installation only if necessary:

- Define extent of impacts downgradient of facility through installation of an additional monitoring well downgradient of impacted well MW-6;
- Confirm groundwater flow direction in the northeast corner of the facility through a suitable off-site well or a new monitoring well, if a suitable off-site well cannot be identified. Depending on the groundwater elevation identified, water quality characterization may also be warranted.
- Expand definition of off-site groundwater flow paths by identifying additional off-site wells west, southwest, and south of the facility for water level measurements; and
- Continue water level and water quality monitoring for on-site and off-site wells and also continue annual data review.

# 1 Introduction

Aspect Consulting, LLC is contracted to perform a hydrogeologic investigation of the Bio Recycling Corporation's biosolids recycling facility located on Webb Hill Road in Mason County, Washington (Figure 1.1). This work is being performed cooperatively with the Webb Hill Technical Committee, Mason County, U.S. Environmental Protection Agency (USEPA), and U.S. Geological Survey (USGS). The Bio Recycling Webb Hill facility is a biosolids treatment and land application facility permitted to accept Class B biosolids and untreated sewage sludge. The facility is designated as a Regional Septage Management Facility. Biosolids treated at the facility originate from private septic tanks and area sewage treatment facilities.

An initial investigation of the facility was performed by Aspect Consulting in April and May of 2007 that included the installation and sampling of four groundwater monitoring wells (Aspect Consulting, 2007). Results of the initial investigation indicated that the site was underlain by a regional unconfined aquifer within stratified glacial deposits. Groundwater flow direction was found to be southwesterly. Groundwater quality impacts were identified beneath the facility including nitrate concentrations of 13.3 mg/L in one monitoring well (MW-1) in excess of the maximum contaminant level (MCL) of 10 mg/L. The 2007 Aspect Consulting report also summarized site history and operations and previous investigations.

Pacific Groundwater Group (PGG) under contract to BioRecycling observed installation of one monitoring well (MW-5), two 50-foot boreholes (L-1 and L-2) equipped with soil moisture sensors and lysimeters, and nine additional boreholes in November and December 2007. Installation results were summarized in a draft technical memorandum (PGG, 2007). The PGG investigation also indicated a southwesterly groundwater flow direction.

In addition to these investigations, Mason County Public Health has sampled and analyzed two off-site wells for nitrate concentration.

The objective of this Phase 2 investigation is to further evaluate groundwater conditions at the facility and better define the groundwater flow (transport) direction at the site. To accomplish these objectives, the following work elements were performed:

- Development of Quality Assurance Project Plan (Aspect Consulting, 2008);
- Installation of two groundwater monitoring wells using rotary-sonic drilling methods;
- Preparation of detailed geologic logs and stratigraphic analysis;
- Well development;
- Sampling and analysis for major ions and nitrogen compounds at the two new wells, MW-6 and MW-7, and previously installed well MW-5;



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- Groundwater sample collection and dating using Carbon 14 ( $^{14}\text{C}$ ), tritium/helium 3 ratio ( $^3\text{H}/^3\text{He}$ ), chlorofluorocarbon ratios (CFC), and sulfur hexafluoride ( $\text{SF}_6$ );
- Performance of one round of water levels from the on-site wells;
- Development of groundwater elevation contours; and
- Survey of the two new monitoring wells and two off-site wells identified to us by Mason County Public Health.

Results of this investigation are presented in this technical memorandum. Groundwater dating results will not be available for several months and will be presented in a separate memorandum. The remainder of this memorandum is organized into the following sections:

- Section 2 presents a summary of field activities;
- Section 3 describes site geologic and hydrogeologic conditions;
- Section 4 discusses results of water quality sampling and testing;
- Section 5 details conclusions and recommendations of the investigation; and
- Appendices, wherein Appendix A presents a detailed description of field activities (well installation, surveying, and sampling); Appendix B has available boring and well logs; Appendix C contains laboratory analytical reports; and Appendix D contains the USGS groundwater dating and water quality results (USGS, 2008) for wells MW-1, MW-2, MW-3, and MW-4. The USGS dating results will be incorporated in a forthcoming memorandum on groundwater age, to be prepared upon completion of dating analyses for wells MW-5 through MW-7.

## 2 Investigative Methods

### 2.1 Drilling and Monitoring Well Installation

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Two monitoring wells (MW-6 and MW-7) were installed at the facility using a rotary-sonic drilling method. Boart Longyear Company of Fife, Washington was contracted to complete this task. Geologic monitoring during drilling was performed by Aspect Consulting personnel. The rotary-sonic method produces near-continuous cores that allow detailed stratigraphic analysis. All drilling and related activities were performed in accordance with Quality Assurance Project Plan (Aspect Consulting, 2008) and Washington state regulations (Washington Administrative Code [WAC] 173-160, *Minimum Standards for Construction and Maintenance of Wells*). Drilling, well installation, well development, and soil and water sampling are discussed in detail in Appendix A, Sections A.1 and A.2.

A reconnaissance site visit was held on April 28, 2008, with drilling contractors, Aspect Consulting, and Mason County Department of Community Development to observe site features, discuss monitoring well locations, and evaluate access to proposed locations. Options for well locations, including one off-site alternative, were staked at this time.

Monitoring well drilling, installation, and development was performed between May 20 and June 3, 2008. The first boring, MW-6a, was decommissioned after the PVC well casing separated during installation. MW-6 was successfully redrilled 50 feet to the east of MW-6a. Monitoring wells were completed with 2-inch Schedule 40 PVC casing and machine slotted screen. Screens were 25-foot long with bottom of screen set about 30 feet below the water table at time of drilling.

The well construction followed criteria specified in the Quality Assurance Project Plan (QAPP) (Sections 3.1 and 3.2 in Aspect Consulting, 2008):

- Minimize influence of vertical gradient on static water level;
- Screen through interval most likely to be impacted; and
- Maintain a minimum of 15 feet of saturated screen during the seasonal low groundwater period.

Minimizing effect of vertical gradient requires minimizing the length of screen. Intercepting the zone of impact was met by screening as high as possible in the aquifer within the constraint imposed by the third requirement of maintaining a saturated portion of screen during low water levels. At time-of-drilling, water levels were estimated to be 15 feet above seasonal low. Therefore, the bottoms of well screens were set at 30 feet below water level at time-of-drilling, i.e. 15 feet to estimated seasonal low plus 15 feet of saturated screen.

No perched groundwater was encountered during drilling.

Both MW-6 and MW-7 met the alignment test by passing a 1.66-inch by 4.2 foot long slug to the bottom of the wells.

Monitoring wells MW-5, MW-6, and MW-7 were developed by surging with a bailer and then pumping until the discharge was sand free and turbidity was less than 50 nephelometric units (NTUs). Development of MW-5 was performed by the driller, but not supervised by Aspect Consulting as the work was under contract with Pacific Groundwater Group, Inc.

Wells MW-6 and MW-7 were surveyed by a licensed surveyor, MacLearnsberry, Inc., to top-of-casing after well installations were completed (Appendix 3.1). Depth-to-water measurements were made with an electronic water-level indicator to the nearest 0.01 foot.

## 2.2 Groundwater Sampling

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Monitoring wells MW-5, MW-6, and MW-7 were sampled on June 10 through June 12, 2008, using low-flow sampling protocol as specified in the QAPP (Aspect Consulting, 2008). Intake of the sample pump was placed 5, 15, and 12 feet below the water surface for MW-5, MW-6, and MW-7, respectively. Sampling procedures are detailed in Appendix A, Section A.3.3.

Field parameters of temperature, specific conductivity, dissolved oxygen, pH, Eh, and turbidity were measured during sampling. Laboratory-prepared sample containers for wet chemistry analyses were filled, cooled in an ice bath, stored in insulated coolers with cold packs to keep samples at less than 4°C, and submitted under chain-of-custody to a Washington-certified environmental laboratory (Columbia Analytical Services, Inc., Kelso, Washington) for the analysis of inorganic constituents, dissolved metals, total organic carbon (TOC), nitrate, nitrite, ammonia, total Kjeldahl nitrogen (TKN), and total phosphorous. Samples for metals analyses were field filtered. Analytical results and field measured parameters are discussed in Section 4.

Samples for groundwater dating by  $^{14}\text{C}$ ,  $^3\text{H}/^3\text{He}$  ratio, CFC, and  $\text{SF}_6$  techniques were taken in specified containers. For CFC and  $\text{SF}_6$  samples, collection procedures recommended by the USGS Reston Chlorofluorocarbon Laboratory and by the Department of Geology and Geophysics, University of Utah, were followed. Diffusion samplers for noble gas collection were installed immediately after groundwater sampling, June 10, 11, and 12, 2008, and removed on June 19, 2008. Additional details are provided in Appendix A, Section A.3.3.

## 2.3 Wellhead Surveys

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Wellheads MW-6 and MW-7 were surveyed in June 2007 by MacLearnsberry, Inc. of Bainbridge Island, Washington. Monitoring wells were surveyed to top of PVC casings as marked and notched. Two off-site wells (Biser and Williams) were surveyed on June 19, 2008. Survey data is presented in Table 2.1. Data for MW-5, also surveyed by MacLearnsberry, Inc., was provided by Pacific Groundwater Group, Inc. The surveyor's reports for MW-6, MW-7, and off-site wells are presented in Appendix A 3.1 and Figure A-1.

## 3 Facility Hydrogeology

The Webb Hill facility is underlain by a complex sequence of glacial deposits. These deposits, and the occurrence and movement of water within them, have previously been described in the Phase 1 report (Aspect Consulting, 2007b). Since that report, two lysimeters and three additional monitoring wells have been installed at the site: L-1, L-2, and MW-5 by Pacific Groundwater Group, Inc. and MW-6 and MW-7 by Aspect Consulting, LLC.

### 3.1 Geologic Investigation

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Detailed geologic data was obtained during the drilling and logging boreholes using rotary-sonic drilling method and continuous sampling. Detailed geologic logs for all monitoring wells and the two lysimeters are presented in Appendix B. Also included is the Well Drilling Report for the off-site Biser well; no log has been located for the off-site Williams well.

The subsurface geology in the new borings fits the previous description of a thin layer of recessional soil over stratified glacial deposits, where the latter are highly variable both laterally and vertically. The glacial materials are interpreted to have been deposited in a dynamic sub-glacial environment and include weakly cemented tills, sand and gravel fluvial layers, and some silt units. Variation in soil types in the continuous sample core was frequently noted on a scale of less than half a foot. As at previous borings, the occurrence of fairly clean (low silt) sands and gravels increased with depth, but the elevation of transition varied.

Relatively thick upper till units and thin lower till units were identified during the drilling at MW-7. Relatively thick till was present starting at 20 feet below ground surface (bgs) with thinner till units and lenses present to about 140 feet bgs. The upper till consisted of 2.5 and 32.5 foot layers, while the 10 lower layers varied from 1 to 8 feet in thickness. This stratigraphic assemblage is similar to that identified in MW-2 where the upper till layer also starts at 20 feet bgs and at is relatively thick (15 feet) compared to the 11 lower layers, which were typically about 1 foot thick.

Soils at MW-6 were primarily characterized by the log for decommissioned boring MW-6a. Till in MW-6a was identified at a depth of 12.5 feet in two layers of 21.5 and 5 feet thick. Although separated by only 50 feet, lateral heterogeneity was observed between the borings MW-6a and MW-6.

No thick silt layers were noted in either MW-6 or MW-7, as opposed to the 1.5- to 10.5-foot silt layers (non-till) found in MW-4.

## 3.2 Groundwater Occurrence

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No perched groundwater was identified during the drilling of MW-6a, MW-6, or MW-7.

The uppermost regional aquifer at the site is generally unconfined. Water level measurements over the past year (Table 3.1) show a significant variation which is estimated at 28 feet, from May to December 2007 (Aspect Consulting, 2008). Monitoring wells MW-1 through MW-4 are dry seasonally as a result of the water level fluctuations. A large unrecovered decline in water levels was noted between spring 2007 and spring 2008. For example, at MW-1 water elevation varied from approximately 299 feet in May 2007 to 285 feet in May 2008. Contributing factors to differences in recharge may include variations in precipitation and changes in biosolids application. No significant changes in withdrawals are expected.

A full round of on-site water levels was taken on June 12, 2008. Groundwater contour elevations were developed with the Surfer™ program (Golden Software, 2002) using the Kriging technique. Groundwater contours for June 12, 2008, are presented in Figure 3.1. All available nitrate results are also included.

The general flow direction continues to be southwesterly, generally in line with the northeast-southwest glacially formed ridges (drumlinoids) observable in the topographic base map in Figure 3.1. The coincidence of groundwater flow direction with the orientation of the drumlinoids supports the hypothesis that the depositional environment created lateral anisotropy within the aquifer.

The contour gradient appears to have a fairly uniform gradient (evenly spaced contours) of 0.007 ft/ft in the region from MW-7 to the Williams well. Northeast of MW-2, the gradient is lower (a more horizontal water surface), about 0.002 ft/ft, over the main portion of the biosolids site. The 0.002 ft/ft gradient at the site is the same as estimated during the Phase 1 investigation (Aspect Consulting, 2007b).

## 4 Groundwater Quality

This section provides a presentation and discussion of groundwater quality at the Webb Hill Biosolids Facility for sampling of MW-5, MW-6, and MW-7 performed June 10 through June 12, 2008. Table 4.1 summarizes the June 2008 groundwater analytical data. Sample results from May 2007 and January 2008 are also included in the table.

Data validation, performed by Aspect Consulting using criteria specified in the QAPP, is discussed in Appendix C.1 and the laboratory analytical reports are included in Appendix C.2.

Groundwater samples were analyzed for the following parameters using EPA or standard methods as specified below:

### Field Parameters

- Turbidity
- Temperature
- pH
- Specific Conductance
- Dissolved Oxygen
- Eh

### Dissolved Metals

- Iron (EPA Method 200.7)
- Manganese (EPA Method 200.7)

### Nutrients

- Ammonia as N (SM4500)
- Nitrate as N (EPA 300.0)
- Nitrite as N (subtraction of nitrate from nitrate+nitrite)
- Nitrate+nitrite (EPA 353.2)
- Total Kjeldahl Nitrogen (ASTM D 1426-93B)
- Phosphorous (EPA 365.3)

### Major Ions

- Calcium (EPA 200.7)
- Magnesium (EPA 200.7)
- Potassium (EPA 200.7)
- Sodium (EPA 200.7)
- Chloride (EPA 300.0)
- Sulfate (EPA 300.0)
- Bicarbonate Alkalinity (SM 2320B)
- Carbonate Alkalinity (SM 2320B)

### Miscellaneous Conventional Chemistry Parameters

Bromide (EPA 300.0)  
 Fluoride (EPA 340.2)  
 Total Organic Carbon (EPA 415.1)

A discussion of the conventional groundwater chemistry and distribution of detected analytes is presented below (Section 4.1) followed by a comparison of analytes with Washington state groundwater quality criteria and drinking water standards (Section 4.2). Wells MW-1 through MW-4 were not resampled as part of the Phase 2 investigation. Therefore, the June 2008 water quality results for MW-5, MW-6 and MW-7 are compared with the May 2007 data for MW-1, MW-2, MW-3, MW-4, and WS-2 (Section 4.1).

## 4.1 Nitrate Occurrence and Conventional Chemistry

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Nitrate and major ion data indicate water quality impacts are occurring at the facility boundary. A summary of groundwater quality data at the facility is presented on Table 4.1 and all available nitrate values are posted on Figure 3.1.

To date, the wells have been analyzed for nitrates at different times: MW-1, MW-2, MW-3, MW-4, and WS-2 in May 2007; Williams and Biser wells in November 2007; MW-5 in January 2008; and MW-5, MW-6, and MW-7 in June 2008. For future monitoring, after sampling pumps have been installed and regular sampling starts, all wells should be sampled within the same two week period.

Greatest water quality impacts at the site boundary were identified at monitoring wells MW-1, MW-4, MW-5, and MW-6 where nitrate (measured as nitrogen content, i.e., nitrate-N) was detected at concentrations of 13.3mg/L (May 2007), 9.8 mg/L (May 2007), 4.0 mg/L (June 2008) and 11.9 mg/L (June 2008), respectively. These wells are located hydraulically downgradient of biosolids application areas and have elevated major ion and nitrate data compared to previously collected data in upgradient monitoring well MW-3. Monitoring well MW-7 had a low nitrate detection (0.7 mg/L) similar to MW-2 (0.8 mg/L), but may prove to be within background conditions with continued monitoring<sup>1</sup>. Water quality test results for each new well (MW-5, MW-6, and MW-7) are discussed below.

### ***MW-5***

In general, water quality in this well indicates an impact above the upgradient conditions, observed at monitoring well MW-3. The nitrate concentration in MW-5 is greater than in wells along the northwest facility boundary (WS-2, MW-2 and MW-7), but less than concentrations in wells located in the center of or downgradient to the site (MW-1, MW-4, and MW-6).

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<sup>1</sup> Background nitrate concentrations in western Washington can be very low, including non-detect levels such as observed in MW-3. However, additional sampling, both spatially and temporally, would be required to specify the local background nitrate concentrations and variation in the Webb Hill area.

Monitoring well MW-5 lies near the southwest corner of the facility and close to the south boundary (Figure 3.1). Well MW-5 was installed in December 2007 and initially sampled in January 2008. The well had a nitrate-N concentration of 6.9 mg/L in January 2008 (Table 4.1). In the June 2008 sampling, nitrate-N was detected at 4.0 mg/L. The seasonal variation in nitrates is consistent with a dilution effect, as nitrate concentration is inversely related to seasonal water level fluctuation where higher concentrations correspond to lower water levels. However, variable rates of nitrogen application could also affect groundwater nitrate measurements. Specific conductance (152 umhos /cm) and major ion concentrations (Table 4.1) are generally consistent with the nitrate concentrations and reflect a greater water quality impact than at upgradient well MW-3 and wells WS-2, MW-2 and MW-7 along the northwest facility boundary, but a lesser impact than observed at wells MW-1, MW-4 and MW-6.

The pH in wells MW-1 through MW-4 ranged from about 6 to 7.5 with lowest pH occurring in the more impacted wells. The pH measured in wells MW-5 through MW-7 ranged from 8.2 to 8.4, but showed the same pattern of lowest pH occurring in the more impacted wells. Field calibration records were reviewed for the pH meter and no anomalies were identified.

#### **MW-6**

Of the recently installed wells, MW-6 shows the greatest water quality impact. This well is located downgradient of Field 4 and portion of Field 3 at the south facility boundary. Nitrate concentrations in this well were measured at 11.9 mg/L. Similar to MW-1 and MW-4, major ions and specific conductance are elevated in this well relative to upgradient conditions measured at MW-3.

#### **MW-7**

Monitoring well MW-7 is located on the westerly boundary of the facility, approximately 1,300 feet due south of MW-2. MW-7 is downgradient of Field 10 and portions of Fields 1 and 2. Water quality in this well is similar to that identified in monitoring wells MW-2 and WS-2 in the May 2007 sample event. Specific conductance, major ions, iron, and manganese concentrations are similar between these wells.

## **4.2 Comparison with Regulatory Standards**

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Water quality standards for analytes are presented in Table 4.1. The Maximum Contaminant Level (MCL) is a health-based standard used to determine the maximum permissible level of a contaminant in water delivered to any user of a public water drinking system. The Secondary Maximum Contaminant Level (SMCL) is a guideline based on factors other than health effects. SMCLs control aesthetic qualities of water such as taste, odor, or staining characteristics. MCLs and SMCLs listed in Table 4.1 were obtained from drinking water standards listed by Department of Health (DOH) in WAC 246-290.

The State of Washington has developed water quality standards for groundwater of the state (Ground Water Quality Criteria or GWQC) (WAC 173-200). The goals of the water quality standards are *“to maintain the highest quality of the state’s ground waters and*



*protect existing and future beneficial uses of the ground water through reduction or elimination of the discharge of contaminants to the state's ground waters and protect existing and future beneficial uses of the ground water through reduction or elimination of the discharge of contaminants to the state's ground waters".* The implementing rule, WAC 173-200, establishes water quality criteria for protection of the environment, human health, and current and future beneficial uses of ground water. Under WAC 173-200, enforcement limits are defined on a site specific basis but are generally less than the numeric criteria.

In Table 4.1, GWQC exceedances are indicated with a shaded pattern and MCL or SMCL exceedances are indicated with a bold outline.

For the constituents analyzed, primary GWQCs and/or MCLs have been established for nitrate, nitrite, and fluoride. The GWQC and MCL for nitrate (10 mg/L) were exceeded in monitoring well MW-6 (11.9 mg/L) in the June 2008 sample event

For the analytes tested, secondary groundwater criteria and/or drinking water SMCLs have been established for pH, iron, manganese, chloride, sulfate, and fluoride. No secondary standards were exceeded in the June 2008 sample event.

## 5 USGS Sampling and Analysis

Groundwater samples were obtained from Wells MW-1, MW-2, MW-3, and MW-4 in July 2007 by Steve Cox, USGS. These samples were submitted for analyses of sulphur hexafluoride (SF<sub>6</sub>), tritium-helium ratio (<sup>3</sup>H/<sup>3</sup>He), and a selected suite of 61 compounds typically found in domestic and industrial wastewater. Results or status of these tests are presented in Appendix D (USGS, 2008).

SF<sub>6</sub> results were successfully obtained for three samples (MW-1, MW-2, and MW-4). The SF<sub>6</sub> concentrations were equivalent to atmospheric conditions in the late 1990s to early 2000's. The USGS letter report indicates "Refinements to the estimates of recharge date could be made if information was available on groundwater temperature at point of recharge and measurement to determine if excess air was incorporated during the recharge process" (USGS, 2008).

The analyses for <sup>3</sup>H and <sup>3</sup>He are forthcoming.

Analyses for waste water compounds in wells MW-1, MW-3, and MW-4 are included in Appendix D. There were few detections and therefore the data was not considered to be of substantial use (USGS, 2008).

## 6 Summary of Findings and Recommendations

### 6.1 Summary of Findings

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1. Subsurface soils at the biosolids facility are generally characterized as a thin layer of recessional outwash underlain by laterally and vertically heterogeneous glacial deposits. The glacial deposits are interpreted to have formed predominantly in a dynamic subglacial environment. Till layers varying from less than 1-foot to over 30 feet were found interbedded with clean and debris rich sands and gravels.
2. The regional aquifer is present beneath the site under unconfined conditions at about elevation 300 feet. The aquifer is at least 55 feet thick. Groundwater flow within the unconfined regional aquifer is toward the southwest, in line with the drumlinoid surface features. Gradient at the site is low at 0.002 ft/ft, steepening to a gradient of 0.007 ft/ft between MW-7 and the Williams well.
3. No perched groundwater was identified in monitoring wells MW-6 or MW-7. Perched groundwater had been previously identified in monitoring well borings MW-1 through MW-4, although none of the perched zones were found to correlate between boreholes.
4. Water quality impacts are found in wells located downgradient of biosolids application areas. In the June 2008 sampling of wells MW-5, MW-6, and MW-7, nitrate concentrations above 1 mg/L as nitrogen occurred in MW-5 (4.0 mg/L) and MW-6 (11.9 mg/L). Nitrate concentrations elevated above 1 mg/L were previously identified in MW-1 (13.3 mg/L) and MW-4 (9.8 mg/L) in the May 2007 sample event. The Ecology groundwater criteria (WAC 173-200) and the DOH MCL for nitrate in groundwater are 10 mg/L. Slightly elevated nitrate concentrations were identified at monitoring well MW-7 (0.7 mg/L) and previously at MW-2 (0.8 mg/L) and on-site supply well WS-2 (0.7 mg/L). These wells may prove to be within background conditions with additional sampling.
5. USGS dating analysis of wells MW-1, MW-2, and MW-4 found sulphur hexafluoride (SF<sub>6</sub>) concentrations equivalent to atmospheric conditions in the late 1990s to early 2000's. Tritium and helium (<sup>3</sup>H/<sup>3</sup>He) analyses have been delayed. Results from USGS testing and also recently submitted dating samples for MW-5, MW-6, and MW-7 will be reviewed in a future Aspect Consulting memorandum that presents results of groundwater age dating samples collected from wells MW-5, MW-6, and MW-7 in this investigation.
6. USGS analyses for compounds typically found in waste water yielded few detections.

## 6.2 Recommendations

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Because of the exceedance of the numeric criteria for nitrate concentrations under WAC 173-200 in groundwater at the Webb Hill biosolids recycling facility, needs remain for:

- Definition of extent of impacts downgradient of facility;
- Confirm groundwater flow direction and background water quality in the northeast corner of the facility;
- Expanded definition of off-site groundwater flow paths; and,
- Continued monitoring and annual data review

These recommendations are detailed below.

### 6.2.1 *Define Extent of Downgradient Impacts*

Nitrate concentrations exceeded the MCL at the property boundary at well MW-6. Further definition of extent of impacts down-gradient of the facility is recommended through an additional monitoring well located downgradient of MW-6.

### 6.2.2 *Confirm Groundwater Flow Direction and Background Water Quality in Northeast Corner of Facility*

Existing data indicates a southwesterly groundwater flow direction beneath the site which suggests background water quality conditions are present in the northeast corner of the facility; however, the northeast corner of the facility is located close to a topographic divide that may also be a groundwater divide. To confirm that a southwesterly groundwater flow direction is present in this area of the facility and background water quality conditions are present, we recommend that a suitable off-site well northeast of the facility be identified, the water level measured, the well surveyed, and, if warranted, the well sampled. If no suitable off-site well can be identified or if a suitable off-site well indicates the potential for north to easterly flow from the northeast corner of the facility, then an on-site monitoring well should be installed in the northeast corner of the facility and monitored.

### 6.2.3 *Expand Definition of Off-Site Flow Paths*

Regional, off-site groundwater flow paths are currently characterized by the Biser and Williams wells that lie in close proximity to one another. To better define off-site regional flow patterns and groundwater discharge areas, additional off-site wells should be incorporated into the water level measurement program. Three general areas for these wells have been identified as follows: (1) northwest of the Williams well and west of MW-5, (2) east of the Williams well and south of MW-6 and MW-4, and (3) a location between the Biser well and the Brockdale area. Practically, these target areas for monitoring will be limited by the availability of off-site wells and the network adjusted based on this availability.

Criteria for inclusion of new off-site wells in the monitoring network include:

- Completion in the uppermost regional aquifer; and,
- Owner permission for quarterly water level measurement and, possibly, sampling and surveying.

#### **6.2.4 Continue Monitoring and Annual Data Review**

Continued water level and water quality monitoring are recommended to identify seasonal and potentially year to year changes in groundwater flow directions and groundwater quality. Specific monitoring recommendations are as follows:

##### **Water Level Monitoring**

- Continue monitoring water levels in wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, WS-2, and off-site wells on a monthly basis for one year and quarterly thereafter. Water level monitoring would be greatly facilitated by the installation of pressure transducers and dataloggers in the site monitoring wells.
- Continue monitoring water levels in off-site Biser and Williams wells. These wells provide good monitoring points about 4,200 and 6,200 feet, respectively, southwest and downgradient of the site. Incorporate additional off-site wells into the monitoring network as recommended in 6.2.1, 6.2.2, and 6.2.3 above.
- If flow patterns cannot be determined through the use of off-site wells, then additional monitoring wells should be considered.

##### **On-Site Water Quality Assessments**

- Start water quality monitoring on a quarterly basis at wells MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, and WS-2. Use of dedicated in-well sampling pumps is recommended. The water quality analytical testing scheme should be based on review of potential sources. Since metals may concentrate in biosolids, the analytical testing should include analysis for dissolved metals as a screening measure.
- Determine seasonal variation in nitrate concentrations.
- Sample all wells within the same two week period and coordinate off-site sampling during that same period.

##### **Off-Site Water Supply Water Quality Assessments**

- Install an off-site monitoring well downgradient of MW-6 to define the extent of off-site impacts. This information will be useful in evaluating water quality impacts to future domestic supply wells.
- As a precautionary measure, perform at least semi-annual sampling of potable water supply wells downgradient of the site for nitrate concentrations (see criteria in 5.2.1). Sampling should be done at seasonal high (late April to early May) and low water levels (December). The downgradient extent to which off-site wells are monitored for water quality should be determined based on identification of wells that indicate a return to background nitrate levels. The analytical testing scheme should be based on

analytes detected in the facility monitoring wells and should include nitrate analysis as a minimum.

- Sample all wells within the same two week period and coordinate with the on-site sampling schedule.

### **Annual Review**

Annually review the water quality and the water level data for monitoring wells and off-site wells. Also review surface water quality data.

- Review water level data and update groundwater elevation contours and flow paths.
- Review groundwater and surface water quality data. Assess whether installation of additional monitoring wells, on-site or off-site, is necessary to determine extent of nitrate impacted groundwater.
- If analyte concentrations vary significantly between quarters, implement a monthly monitoring program for a 1-year period.
- Review the monitoring and analytical testing scheme and make appropriate recommendations for modification.

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## Limitations

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Mason County Department of Community Development, on behalf of WRIA 16 Planning Unit for specific application to the referenced property. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

**Table 2.1 - Monitoring Well Completion Summary**Webb Hill Hydrogeologic Investigation - Phase 2  
Mason County, Washington

Well ID	Installation Date	Well Location Coordinates <sup>1</sup>		Ground Surface Elevation <sup>2</sup>	Monument Elevation <sup>2</sup>	Stickup	Top of Casing		Total Boring Depth	Well Depth <sup>3</sup>	Screen Length	Screen Interval Depth	Filter Pack Interval Depth
		Northing	Easting				Elevation <sup>2,3</sup>	Elevation Difference <sup>4</sup>					
		(feet)	(feet)				(feet)	(feet)					
MW-1	4/26/07	730844	993069	402.51	406.35	3.06	405.57	0.01	125	124.8	19.5	105.0 to 124.5	102.5 to 125.0
MW-2	5/3/07	731148	991371	443.97	447.17	2.76	446.73	0.01	168	168.7	24.5	143.9 to 168.4	140.6 to 166.0
MW-3	4/24/07	732495	992946	465.84	469.14	2.71	468.55	0.01	187	185.3	24.5	160.5 to 185.0	154.9 to 187.0
MW-4	4/30/07	729408	994200	375.99	379.89	3.25	379.24	0.01	105	97.7	24.5	72.9 to 97.4	68.2 to 96.0
MW-5	12/4/07	728694	990367	411.54	-	1.64	413.18	0.25	165	161.0	20	140.7 to 160.7	137.0 to 161.0
MW-6	5/28/08	728588	992589	397.46	400.33	2.81	400.27	-	146	145.2	24.6	120.2 to 144.8	117.0 to 145.0
MW-7	5/30/08	729866	991229	418.55	421.58	2.78	421.33	-	170	170.6	24.6	145.4 to 170.0	141.7 to 170.6
WS-2 <sup>5</sup>	4/18/00	731673	992697	444.85	-	1.9	446.75	0.03	197	197	6	191 to 197	None
Biser	10/10/94	725206	987893	-	-	-	332.28	-	110	110	10	100 to 105	None
Williams	-	726239	988343	-	-	-	337.20	-	-	-	-	-	-
Bench Mark	5/9/07	731757	992859	446.32	-	-	446.32	0.00	-	-	-	-	-

**Notes**<sup>1</sup>Well location coordinates are in Washington State Plane South NAD83 (2007) coordinate system using U.S. feet.<sup>2</sup>Elevations are NAVD88 (1996) using U.S. feet.<sup>3</sup>Measuring points for both PVC and steel casings were marked and notched.<sup>4</sup>Indicates elevation difference from previous surveys.<sup>5</sup>Below grade information taken from state Water Well Report. The reported casing depth of 193.2 ft bgs may be inconsistent with the screen interval of 191 to 197 feet indicated on log.**Abbreviations**

bgs = below ground surface

**Table 3.1 - Groundwater Levels**

Webb Hill Hydrogeologic Investigation - Phase 2  
Mason County, Washington

Well Name		MW-1		MW-2		MW-3		MW-4		MW-5		MW-6		MW-7		Water Supply- 2		Biser		Williams	
Ground Surface Elevation (ft MSL)		402.51		443.97		465.84		375.99		411.54		397.46		418.55		444.85		-		-	
Casing Stickup above Ground Surface (ft)		3.06		2.76		2.71		3.25		1.64		2.81		2.78		1.9		-		-	
Casing Elevation (ft)		405.57		446.73		468.55		379.24		413.18		400.27		421.33		446.75		332.28		337.20	
Top of Screen Elevation (ft MSL)		297.51		300.07		305.34		303.09		270.84		277.26		273.15		253.85		-		-	
Bottom of Screen Elevation (ft MSL)		278.01		275.57		280.84		278.59		250.84		252.66		248.55		247.85		-		-	
Date	Entity	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)	Depth (ft bTOC)	Elevation (ft, MSL)
5/23/2007	Aspect	106.92	298.65	149.98	296.75	168	300.55	80.37	298.87	-	-	-	-	-	-	147.49	299.26	-	-	-	-
5/30/2007	Aspect	-	-	150.55	296.18	168.56	299.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5/31/2007	Aspect	107.64	297.93	150.68	296.05	168.66	299.89	81.18	298.06	-	-	-	-	-	-	148.14	298.61	-	-	-	-
6/27/2007	MCPH	110.37	295.2	154.09	292.64	171.56	296.99	83.895	295.345	-	-	-	-	-	-	-	-	-	-	-	-
9/26/2007	MCPH	122.6	282.97	166.575	280.155	184.02	284.53	94.735	284.505	-	-	-	-	-	-	-	-	-	-	-	-
11/21/2007	PGG	Dry	< 278.01	Dry	< 275.57	Dry	< 280.84	Dry	< 278.59	-	-	-	-	-	-	-	-	-	-	-	-
12/3/2007	PGG	-	-	-	-	-	-	-	-	154.89	258.29	-	-	-	-	-	-	-	-	-	-
1/22/2008	PGG	Dry	< 278.01	Dry	< 275.57	Dry	< 280.84	95.82	283.42	152.68	260.5	-	-	-	-	-	-	-	-	-	-
1/23/2008	PGG	-	-	-	-	-	-	95.04	284.2	152.04	261.14	-	-	-	-	172.5	274.25	-	-	-	-
3/13/2008	PGG	120.44	285.13	163.73	283	182.4	286.15	91.55	287.69	141.54	271.64	-	-	-	-	-	-	-	-	-	-
4/21/2008	PGG	119.03	286.54	-	-	180.09	288.46	91.16	288.08	-	-	-	-	-	-	-	-	-	-	-	-
4/22/2008	PGG	119.14	286.43	161.62	285.11	-	-	-	-	140.53	272.65	-	-	-	-	160.71	286.04	80.22	252.06	83.85	253.35
5/21/2008	PGG	120.05	285.52	162.73	284	-	-	92.46	286.78	141.28	271.9	-	-	-	-	161.88	284.87	81.80	250.48	85.20	252.00
6/12/2008	Aspect	121.43	284.14	164.27	282.46	182.44	286.11	94.02	285.22	143.33	269.85	119	281.27	143.61	277.72	162.08	284.67	83.43	248.85	86.83	250.37

**Notes**

Shaded groundwater levels for the Biser and Williams domestic wells were calculated based on an average groundwater level change for MW-1, MW-2, MW-4 and MW-5 between the May 21st and June 12th 2008 measurements.  
Depth to groundwater was measured from the top of casing.  
The elevation datum is NAVD88 (1996).

**Abbreviations**

bTOC = Below Top of Casing  
MSL = Mean Sea Level



**Table 4.1 - Groundwater Quality Summary**

Webb Hill Hydrogeologic Investigation - Phase 2  
Mason County, Washington

Parameter or Chemical	Units	DOE Groundwater Quality Criteria <sup>1</sup>		DOH Drinking Water Standard <sup>2</sup>		May 2007 Sampling Event <sup>8,9</sup>						January 2008 Sampling Event <sup>8,9,10</sup>			June 2008 Sampling Event <sup>8,9</sup>		
		Primary	Secondary	MCL	SMCL	MW-1 5/31/07	MW-1 (Blind Dup.) 5/31/07	MW-2 5/30/07	MW-3 5/30/07	MW-4 5/31/07	WS-2 5/31/07	L-1 1/23/08	L-2 1/23/08	MW-5 1/23/08	MW-5 6/10/08	MW-6 6/12/08	MW-7 6/11/08
<b>Field Parameters</b>																	
Temperature	°C	-	-	-	-	14.08	-	13.58	15.44	15.37	10.58	-	-	-	10.16	9.98	10.59
pH	pH	-	6.5 to 8.5	-	-	6.66	-	7.11	7.28	6.55	7.49	-	-	-	8.39	8.18	8.44
Specific Conductance	µS/cm	-	-	-	-	374	-	95	82	299	101	-	-	-	152	253	98
Dissolved Oxygen	mg/L	-	-	-	-	8.85	-	8.81	9.71	8.65	10.83	-	-	-	9.37	9.43	9.55
Eh	mV	-	-	-	-	140.1	-	118.7	91.6	148	122.1	-	-	-	83.7	135.2	150.7
Turbidity	NTU	-	-	-	-	1.51	-	2.99	33.80	1.46	1.19	-	-	-	0.46	0.76	1.05
<b>Dissolved Metals</b>																	
Calcium	mg/L	-	-	-	-	40.4	40.2	10.1	9.15	31.6	10.7	-	-	-	15.5	24.4	10.1
Iron	mg/L	-	0.3	-	0.3	0.150 U	0.150 U	0.150 U	0.150 U	0.150 U	0.150 U	-	-	-	0.010 U	0.005 J	0.010 U
Magnesium	mg/L	-	-	-	-	17.8	17.8	4.86	3.99	13.3	5.39	-	-	-	7.45	11.7	4.95
Manganese	mg/L	-	0.05	-	0.05	0.0100 U	0.0100 U	0.0100 U	<b>0.0798</b>	0.0100 U	0.0100 U	-	-	-	0.0011 J	0.0056	0.0138
Potassium	mg/L	-	-	-	-	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	-	-	-	1.00 U	0.41 J	1.00 U
Sodium	mg/L	-	-	20 <sup>3</sup>	-	6.25	6.22	3.40	3.29	6.02	3.36	-	-	-	3.86	4.63	3.11
<b>Conventional Chemistry Parameters</b>																	
Bicarbonate Alkalinity	mg/L as CaCO <sub>3</sub>	-	-	-	-	69.6	70.4	39.8	41.4	50.8	44.6	-	-	-	48	50	29
Carbonate Alkalinity	mg/L as CaCO <sub>3</sub>	-	-	-	-	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	-	-	-	1.00 U	1.00 U	1.00 U
Hydroxide Alkalinity <sup>4</sup>	mg/L as CaCO <sub>3</sub>	-	-	-	-	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	5.00 U	-	-	-	-	-	-
Chloride	mg/L	-	250	-	250	15.5	15.6	2.22	1.71	15.8	2.22	88.8	38.8	11	6.9	15.7	3.8
Sulfate	mg/L	-	250	-	250	17.5	17.5	1.95	0.870	13.7	1.66	<b>274.0</b>	110	4.8	2.0	6.7	0.9
Bromide	mg/L	-	-	-	-	0.400 U	0.400 U	0.400 U	0.400 U	0.400 U	0.400 U	-	-	-	0.012 J	0.012 U	0.012 J
Ammonia as Nitrogen	mg/L as N	-	-	-	-	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.256	0.050	0.327	0.080	0.120	0.020 J
Nitrate as Nitrogen <sup>5</sup>	mg/L as N	10	-	10	-	<b>13.3</b>	<b>14.1</b>	0.785	0.0100 U	<b>9.78</b>	0.713	0.403	<b>27.8</b>	<b>6.9</b>	<b>4.0</b>	<b>11.9</b>	0.7
Nitrite as Nitrogen <sup>6</sup>	mg/L as N	-	-	1	-	0.0100 U	0.0100 U	0.0100 U	0.0100 U	0.0100 U	0.0100 U	0.04	0.13	0.32	0.09	0.10	0.13
Nitrate-Nitrite	mg/L as N	-	-	-	-	13.3	14.1	0.785	0.0100 U	9.78	0.713	0.44	27.90	7.22	4.09	12.00	0.83
Total Kjeldahl Nitrogen <sup>7</sup>	mg/L as N	-	-	-	-	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	1.00 U	0.65 J	0.60 R	1.27 J	0.80	2.00	1.00
Phosphorus	mg/L	-	-	-	-	0.0620	0.0430	0.155	0.0880	0.0310	0.0800	-	-	-	0.0100	0.0100	0.0200
Fluoride	mg/L	4	-	4	2	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	-	-	-	0.011 J	0.010 U	0.021 J
Total Organic Carbon	mg/L	-	-	-	-	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	9.14	3.72	1.50 U	1.00	1.00	0.70

**Notes**

<sup>1</sup>From Table 1 - Groundwater Quality Criteria in WAC 173-200.

<sup>2</sup>MCLs (Maximum Contaminant Levels) and SMCLs (Secondary Maximum Contaminant Levels) from WAC 246-290-310.

<sup>3</sup>20 mg/L is listed as a "level of concern" and is not an MCL.

<sup>4</sup>During the June 2008 sampling event, Hydroxide Alkalinity was not analyzed.

<sup>5</sup>Values greater than 1 mg/L are in bold.

<sup>6</sup>For the June 2008 sampling event, Nitrite was calculated as the difference between the laboratory reported results for Nitrate + Nitrite and Nitrate.

<sup>7</sup>For the January 2008 sampling event, Total Kjeldahl Nitrogen results (with dot pattern) were suspected of being inaccurate, as a quality control spike showed significant matrix interference. Reporting limit = 0.6 mg/L. (Pacific Groundwater Group and Bennett-Cumming, 2008).

<sup>8</sup>Concentrations in shaded cells exceed Groundwater Quality Criteria in WAC 173-200.

<sup>9</sup>Concentrations located within thick borders exceed Drinking Water Standard MCLs or SMCLs.

<sup>10</sup>Pacific Groundwater Group (2008).

**Abbreviations**

U - The compound was analyzed for, but was not detected ("Non-detect") at or above the Minimum Reporting Limit (MRL) or Minimum Detection Limit (MDL).

J - The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.

R - The laboratory-reported result for L-2 was non-detect at 0.6 mg/L. Result was rejected by Pacific Groundwater Group due to 0% matrix spike recovery. (Pacific Groundwater Group and Bennett-Cumming, 2008).

DOE - Washington Department of Ecology

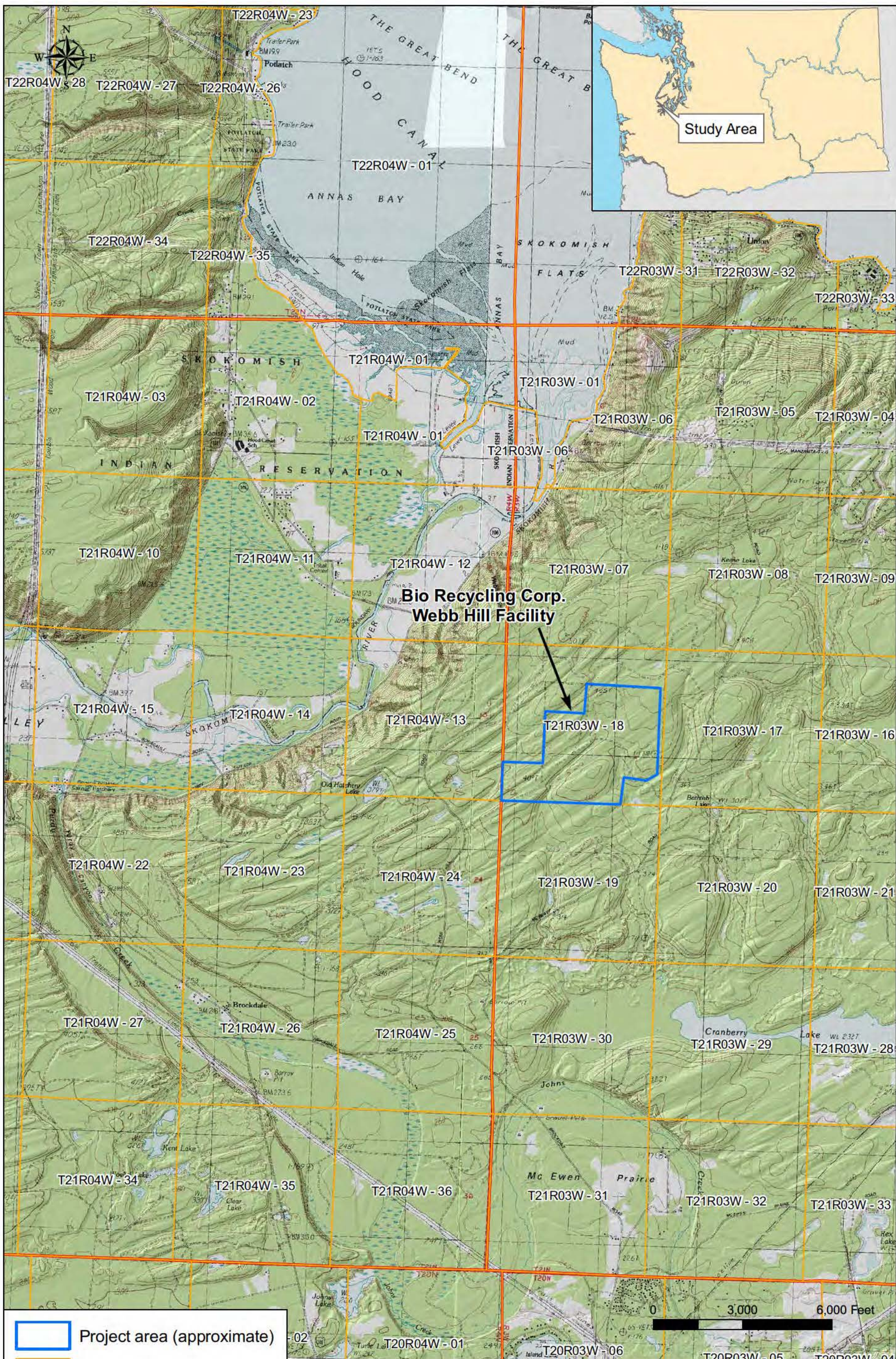
DOH - Washington Department of Health

Aspect Consulting, LLC

6/30/2008

W:\070041 WRIA 16 - Webb Hill\Deliverables\Phase 2\Interim Report\Table 4.1 - Groundwater Quality Summary.xls





- Project area (approximate)
- Sections
- Township and range



**Project Vicinity Map**  
 Webb Hill Hydrogeologic Investigation  
 Mason County, Washington

DATE	June 2008	PROJECT NO.	070041
DRAWN BY	EWM	FIGURE NO.	1.1
CHECKED BY	ACM		
APPROVED BY	SCC		

T:\projects\_8\mason\_county\ProjectVicinity\_06-2008.mxd





- Monitoring well
- Water supply well
- MW-4 Well Identifier
- Decommissioned well (location approximate)
- Surface water sample location
- Sections

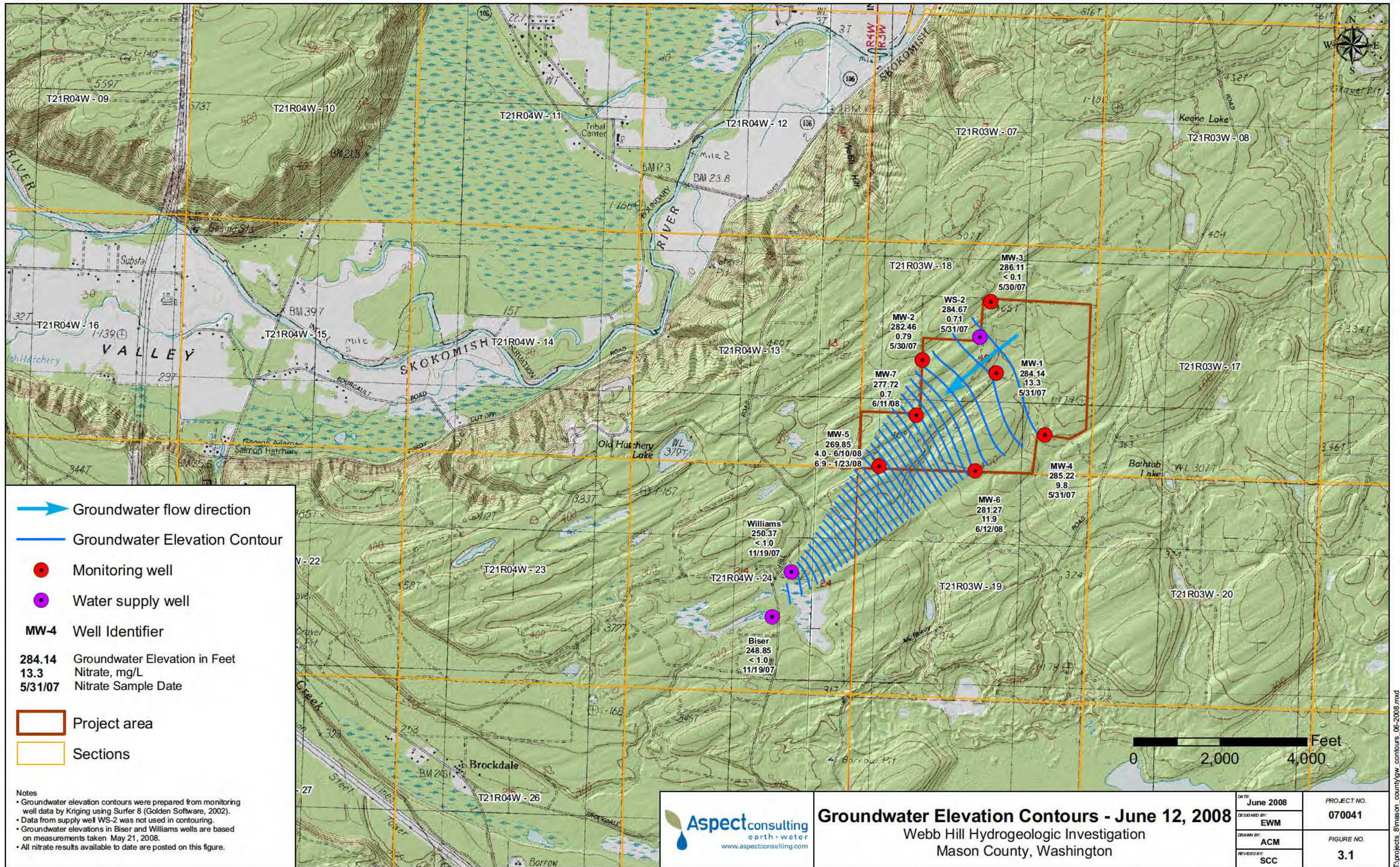


**Site Layout**  
Webb Hill Hydrogeologic Investigation  
Mason County, Washington

DATE	June 2008	PROJECT NO.	070041
DESIGNED BY	EWM	FIGURE NO.	1.2
DRAWN BY	ACM		
REVISED BY	SCC		

T:\projects\_8\mason\_county\SiteLayout\_06-2008





**Groundwater Elevation Contours - June 12, 2008**  
 Webb Hill Hydrogeologic Investigation  
 Mason County, Washington

DATE: June 2008	PROJECT NO.: 070041
DESIGNED BY: EWM	FIGURE NO.: 3.1
DRAWN BY: ACM	
REVIEWED BY: SCC	

T:\projects\_8\mason\_county\gw\_contours\_06-2008.mxd



## **APPENDIX A**

### **Exploration Methods**



## A.1 Drilling

### A.1.1 Overview and Drilling Preparation

---

Well MW-6 was located near the center of the south property line as recommended in the Phase 1 investigative report (Figure 5.1 in Aspect Consulting, 2007b). MW-7 was located in the northeast corner of Field 11. The locations were reviewed by Mason County and Bio Recycling personnel and approved with respect to existing operations and subsurface waste lines. MW-6 was not accessible for a truck mounted rotary-sonic drill rig and therefore a track mounted rotary-sonic drill rig was utilized. The borings were drilled from existing grade without any modifications.

### A.1.2 Drilling Procedures

---

Three borings were drilled using rotary-sonic equipment by Boart Longyear Company, Fife, Washington. Drilling activities took place from May 20 through May 30, 2008. Borings are identified as MW-6a, MW-6, and MW-7. The first boring, MW-6a, was abandoned after the PVC well casing separated during installation of a ¾-inch bentonite chip seal and bentonite was found within the screened zone during clean-out of the hole. The borehole was decommissioned by drilling out the monitoring well installation and backfilling the borehole with bentonite chips as the drill casing was retracted. MW-6 was successfully redrilled 50 feet to the east of MW-6a.

Drill casing was 5.56-inch outside diameter (OD) and the borehole was nominally 6-inch diameter. The drill bit and core barrel were advanced into the formation and a core sample approximately 3 inches in diameter retrieved. Temporary drill casing was then advanced into the hole and slough removed before drilling ahead to procure another sample. Drilling runs were typically 10 feet long.

### A.1.3 Groundwater Sampling During Drilling

---

Per Section 6.1 of the Quality Assurance Project Plan (Aspect Consulting, 2008), the driller was requested to identify any perched water and the on-site Aspect Consulting representative inspected soil cores for evidence of perched water. No perched water was found, although moist soils indicative of wetting fronts were encountered.

### A.1.4 Soil Sample Collection

---

Samples were vibrated from the core barrel into polyethylene sheet tubes and sample depths estimated by the driller. Samples were moved away from the drill rig in approximately 2.5-foot lengths.

## **A.1.5 Sampling Logging**

---

Cores were laid end-to-end, recovery measured for each sample run, and samples photographed with depth markers and stadia rod. In the field, soil descriptions were written on standard forms, grab samples taken at lithologic changes or at least every 5 feet, and chip trays prepared. Cores were retained on-site until completion of well development, but were severely disturbed by cattle.

## **A.2 Well Installation and Development**

### **A.2.1 Well Installation**

---

Wells were constructed using threaded Schedule 40 PVC pipe and machine slotted screen. Slot size was 0.020 inches wide by 0.13 feet long with three slots per row and rows at 0.012 feet on center. Overall screen length was 24.6 feet.

The screen zone was filter packed with 10/20 Colorado silica sand and topped with nominally 1 foot of 20/40 Colorado silica sand to inhibit grout migration. The remainder of the annulus was sealed to ground surface with bentonite. A nominal 10 foot layer of unhydrated bentonite as ¼-inch pellets (PDSCo Pel-Plug™) and 3/8-inch chips (Halliburton Holeplug™) was placed above the sand. The remaining annulus was filled with bentonite grout (Baroid Quik-Grout™) placed by 1-inch tremie pipe. Grout was prepared by power mixing bentonite powder in a 55-gallon drum with a known volume of water. Bentonite chips were used to fill any remaining open hole near the surface and the upper two feet filled with concrete to set the monument.

Details of well construction are provided on the boring logs in Appendix B. Monument, casing, and ground surface elevations are included in Table 2.1.

Well monuments were 5-foot long square steel with a hinged, locking lid and protected by three 7-foot long steel bollards. Monument and bollards were all set in concrete.

### **A.2.2 Alignment Testing**

---

Wells were tested for satisfactory alignment by dropping slugs, or dummies, downhole. Both MW-6 and MW-7 passed the largest 1.66-inch diameter by 4.2-foot long slug to the bottom of the well.

### **A.2.3 Well Development**

---

Wells MW-5, MW-6, and MW-7 were developed from June 2 through June 3, 2007 by mechanical surging followed by pumping. (Development of MW-5 was also performed at this time by the driller, but under contract with Pacific Groundwater Group.) Surging was done by hand oscillating a 3-foot bailer on a 3/8-inch nylon rope and pulley with a 3 foot

stroke at a rate of 30 strokes per minute. Surging was done at eight successive positions within the nominal 25-foot well screen for 7.5 minutes at each station, with an extra 7.5 minutes spent at the bottom of MW-6 due to slight heave at the bottom of that well. (MW-5 was swabbed at seven stations.) Sand content was measured using an Imhoff cone at end of swabbing as 3.0, 2.2 and 2.0 mg/L for MW-5, MW-6, and MW-7 respectively.

Wells MW-6 and MW-7 were then pumped at 3.5 gpm for one hour with a Grundfos RediFlo-2 pump until turbidity was approximately 50 NTU at each station as measured with a Hach 2100P turbidimeter. MW-5 was pumped for 47 minutes.

## **A.3 Groundwater Level Measurements and Sampling**

### **A.3.1 Survey**

---

Wellheads MW-6 and MW-7 were surveyed in June 2008 by MacLearnsberry, Inc. of Bainbridge Island, Washington. Monitoring wells were surveyed to top of PVC casings. Casings were marked and notched. Two off-site wells (Biser and Williams) were surveyed on June 19, 2008. The surveyor's report is presented in Figure A-1.

### **A.3.2 Groundwater Level Measurements**

---

Groundwater levels were measured with a Waterline Model 300 level indicator to the nearest 0.01 feet. Reference point in all cases was top of casing, where the measuring point was marked and notched.

Water level was measured at all on-site wells (seven monitoring wells and the supply well) on June 12, 2008. These data are reported in Table 3.1.

### **A.3.3 Groundwater Sampling**

---

Groundwater samples from MW-5, MW-6, and MW-7 were obtained on June 10 through June 12, 2007 using low flow sampling methodology as specified in the QAPP (Aspect Consulting, 2008).

Monitoring wells were pumped using a QED Environmental, Inc. SamplePro bladder pump. Air source was a Mi-T-M Corporation Model AC1-PH55-08M air compressor. Dedicated bladders and tubing were used for each well. The discharge lines were ¼-inch Nylon 6 tubing; the bladders were polyethylene. The bladders and nylon tubing were bagged, labeled, and retained for possible future use.

Pump intakes were set at 5, 15, and 12 feet below initial water level for MW-5, MW-6, and MW-7, respectively. Flow rates were 0.20, 0.25, and 0.27 lpm (0.053, 0.066, and 0.071 gpm). Drawdowns were very low at 0.16, 0.00, and 0.01 feet.

Wells were purged until all water quality parameters had stabilized. Parameters were monitored with a calibrated YSI 556 multi-parameter instrument. Measured parameters were temperature, specific conductance, dissolved oxygen, pH, and Eh (ORP). Samples were taken after parameters had stabilized to  $\pm 0.1$  °C, 1  $\mu\text{S}/\text{cm}$ , 2 percent mg/l DO, 0.05 pH, and 10 mV Eh or better over previous three readings taken 3 to 5 minutes apart. The Eh values were the slowest to stabilize and were recorded when dropping at rates of less than 0.3, 0.4, and 0.7 mV/min for MW-5, MW-6, and MW-7, respectively. The wells were purged for 81, 108, and 143 minutes, respectively. An additional 2.5 to 3 hours was spent filling sample bottles.

Samples for wet chemistry were pre-cooled in an ice bath, stored in insulated coolers with cold packs to keep samples at less than 4°C, and sent to Columbia Analytical Services, Inc. within not more than 44 hours of sampling. Samples for metals analysis were field filtered with Enviro-Tech 0.45 micron filters.

Samples for age dating were collected in specified containers (wide mouth polyethylene with NaOH for  $^{14}\text{C}$ , 500 ml polyethylene for  $^3\text{H}$ , 125 ml clear glass with foil cap for CFC, and 1 L amber glass with cone-seal cap for  $\text{SF}_6$ ). Samples for CFC and  $\text{SF}_6$  analysis were filled last and two liters of groundwater were flowed through each glass bottle. CFC bottles were filled and capped under water. All caps were secured with electrical tape.

As CFC and  $\text{SF}_6$  compounds tend to adsorb onto polyethylene and Teflon components, food grade 1/4-inch Nylon 6 tubing and stainless steel couplings were used for the discharge line. Bladders used in the sampling pump were polyethylene. The surface area of the bladder represented 2.5 percent to 3 percent of the total surface area (bladder plus tubing) to which the groundwater was exposed. To additionally minimize any effects, bladders for MW-7 and MW-6 were conditioned in the wells for 1 and 2 days, respectively, prior to sampling.

Diffusion samplers for noble gas analysis were installed in each well after sampling. All were removed on June 19, 2008.

Samples for  $^{14}\text{C}$  analysis were sent to Beta Analytic, Inc., Miami, Florida; for  $\text{SF}_6$  analysis to Steve Cox, USGS at Tacoma, Washington, for transfer to the USGS Reston Chlorofluorocarbon Laboratory; and for CFC and  $^3\text{H}/^3\text{He}$  ratio dating to Department of Geology and Geophysics, University of Utah, in Salt Lake City.

Wet chemistry laboratory results are reported in Appendix C and discussed in Section 4. Age dating laboratory results will be presented and discussed in a supplementary report.

**FIGURE A-1**

**MACLEARNSBERRY, Inc.**  
Land Surveyors ◦ Planners ◦ Civil Engineers

159 Wyatt Way NE  
Bainbridge Island, WA 98110  
206 842-5514



P.O. Box 65382  
Port Ludlow, WA 98365  
360 437-0430

Joseph Lubischer, PE  
Aspect Consulting, LLC  
179 Madrone Lane North  
Bainbridge Island, WA 98110

Friday, June 27, 2008

Re: Webb Hill Monitoring Well Survey

Dear Joe:

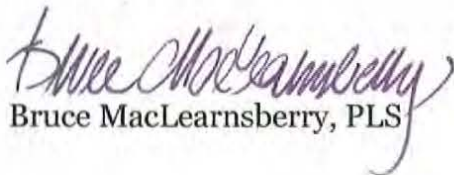
Accompanying is our map depicting the results of our measurements of wells 6 and 7 at Webb Hill, along with diagrams of the positional tolerances.

The network of GPS stations from which the measurements of this project are taken is maintained by the Washington State Department of Transportation. This past year, they have been in the process of updating the network from NAD83 1991 to NAD83 2007. All updated stations, including the ones used for this project, now have new horizontal and vertical coordinates. In order to continuing using these stations, we have transformed our coordinates to WSDOT's.

In addition, we are now using ellipsoidal values rather than orthometric values. Various public agencies are using different geoid models to report orthometric elevations and we are having difficulty finding reliable conversion processes. The current project datum is thus 70.89 feet lower than the datum we used last year.

Feel free to call me with any comments or questions.

Sincerely,

  
Bruce MacLearnsberry, PLS

encl.

# MACLEARNSBERRY, Inc.

Land Surveyors ◦ Planners ◦ Civil Engineers

159 Wyatt Way NE  
Bainbridge Island, WA 98110  
206 842-5514



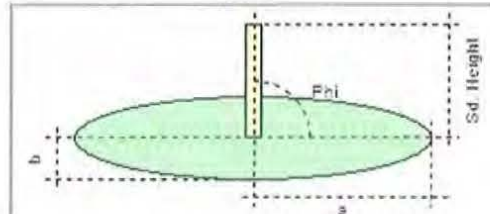
P.O. Box 65382  
Port Ludlow, WA 98365  
360 437-0430

Webb Hill  
Aspect Consulting  
Job No. 8033  
Double-Vector, Dual-Frequency Static GPS

## Monitoring Well No. 6

M0:		<input type="text" value="0.0196"/>	fts		
Qxx:	11:	<input type="text" value="3.66717982"/>		12:	<input type="text" value="0.0"/>
				13:	<input type="text" value="0.0"/>
				22:	<input type="text" value="0.32309985"/>
				23:	<input type="text" value="0.0"/>
				33:	<input type="text" value="0.00236025"/>

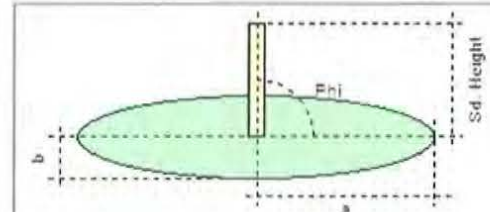
Semi-major (a):	<input type="text" value="0.0375"/>	fts
Semi-minor (b):	<input type="text" value="0.0112"/>	fts
Orientation (Phi):	<input type="text" value="0' 0' 0.0"/>	
Sd. Height:	<input type="text" value="0.001"/>	fts



## Monitoring Well No. 7

M0:		<input type="text" value="0.0169"/>	fts		
Qxx:	11:	<input type="text" value="0.5553363"/>		12:	<input type="text" value="0.0"/>
				13:	<input type="text" value="0.0"/>
				22:	<input type="text" value="0.00775142"/>
				23:	<input type="text" value="0.0"/>
				33:	<input type="text" value="1.71845615"/>

Semi-major (a):	<input type="text" value="0.0126"/>	fts
Semi-minor (b):	<input type="text" value="0.0015"/>	fts
Orientation (Phi):	<input type="text" value="0' 0' 0.0"/>	
Sd. Height:	<input type="text" value="0.0221"/>	fts



# MACLEARNSBERRY, Inc.

Land Surveyors ◦ Planners ◦ Civil Engineers

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Bainbridge Island, WA 98110  
206 842-5514



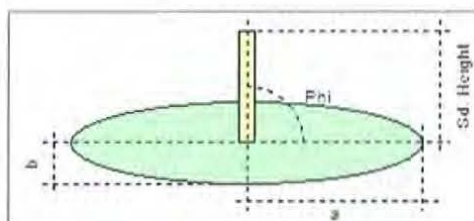
P.O. Box 65382  
Port Ludlow, WA 98365  
360 437-0430

Webb Hill  
Aspect Consulting  
Job No. 8033  
Double-Vector, Dual-Frequency Static GPS

## Biser Well

MO:		<u>0.0094</u>	fts		
Qxx:	11:	<u>0.00016233</u>		12:	<u>0.0</u>
				13:	<u>0.0</u>
				22:	<u>0.24477921</u>
				23:	<u>0.0</u>
				33:	<u>1.87752926</u>

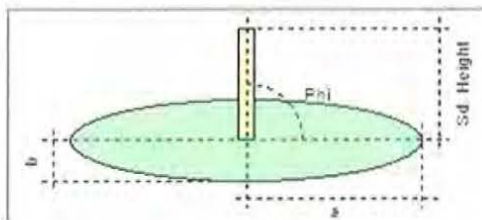
Semi-major (a):	<u>0.0046</u>	fts
Semi-minor (b):	<u>0.0001</u>	fts
Orientation (Phi):	<u>90° 0' 0.0"</u>	
Sd. Height:	<u>0.0129</u>	fts



## Williams Well

MO:		<u>0.0222</u>	fts		
Qxx:	11:	<u>0.00432681</u>		12:	<u>0.0</u>
				13:	<u>0.0</u>
				22:	<u>0.00459746</u>
				23:	<u>0.0</u>
				33:	<u>1.99553788</u>

Semi-major (a):	<u>0.0015</u>	fts
Semi-minor (b):	<u>0.0015</u>	fts
Orientation (Phi):	<u>90° 0' 0.0"</u>	
Sd. Height:	<u>0.0313</u>	fts



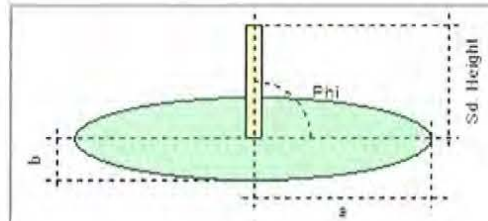


Webb Hill  
 Aspect Consulting  
 Job No. 8033  
 Double-Vector, Dual-Frequency Static GPS

### Monitoring Well No. 6

M0:	0.0196			fts		
Qxx:	11:	3.66717982	12:	0.0	13:	0.0
			22:	0.32809985	23:	0.0
					33:	0.00236025

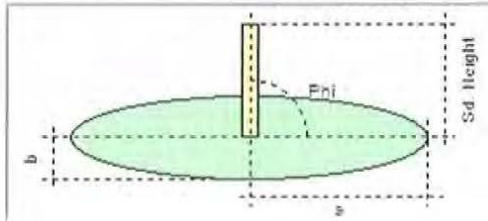
Semi-major (a):	0.0375	fts
Semi-minor (b):	0.0112	fts
Orientation (Phi):	0° 0' 0.0"	
Sd. Height:	0.001	fts



### Monitoring Well No. 7

M0:	0.0169			fts		
Qxx:	11:	0.5553363	12:	0.0	13:	0.0
			22:	0.00775142	23:	0.0
					33:	1.71845615

Semi-major (a):	0.0126	fts
Semi-minor (b):	0.0015	fts
Orientation (Phi):	0° 0' 0.0"	
Sd. Height:	0.0221	fts



**MACLEARNSBERRY, Inc.**  
Land Surveyors ◦ Planners ◦ Civil Engineers

159 Wyatt Way NE  
Bainbridge Island, WA 98110  
206 842-5514



P.O. Box 65382  
Port Ludlow, WA 98365  
360 437-0430

**Webb Hill Well Monitoring Survey  
For Aspect Consulting/Mason County**

**Job No. 8033  
June 27, 2008**

**Static GPS Individual Resolved Vector Solutions**

**MW-6**

Reference Station	Epoch	Posn. Diff.	Hgt. Diff.	Posn.+Hgt. Diff.	Posn. Qlty.	Hgt. Qlty.	Posn.+Hgt. Qlty.	Latitude	Longitude	Height (Ellipsoidal)
WSDOT CRANBERRY	06/18/2008 12:03:25	0.0197	0.0009	0.0197	0.0011	0.0018	0.0021	47°18'06.50267" N	123°06'41.24878" W	329.38
WSDOT GP23101-28	06/23/2008 14:08:22	0.0811	-0.0011	0.0811	0.0020	0.0020	0.0028	47°18'06.50171" N	123°06'41.24845" W	329.39

**MW-7**

WSDOT CRANBERRY	06/18/2008 13:03:24	0.0058	0.0160	0.0170	0.0008	0.0014	0.0016	47°18'18.66903" N	123°07'01.57998" W	350.42
WSDOT GP23101-28	06/23/2008 14:58:14	0.0276	-0.0305	0.0412	0.0016	0.0019	0.0025	47°18'18.66870" N	123°07'01.58003" W	350.47

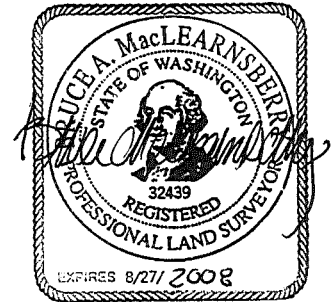
**Biser**

WSDOT CRANBERRY	06/19/2008 12:55:26	0.0094	-0.0282	0.0297	0.0017	0.0033	0.0037	47°17'31.05834" N	123°07'45.44250" W	270.17
WSDOT GP23101-28	06/23/2008 12:22:02	0.0023	0.0059	0.0063	0.0008	0.0015	0.0017	47°17'31.05833" N	123°07'45.44267" W	270.14

**Williams**

WSDOT CRANBERRY	06/19/2008 12:09:11	0.0008	0.0125	0.0125	0.0007	0.0012	0.0014	47°17'41.78441" N	123°07'41.54618" W	265.23
WSDOT GP23101-28	06/23/2008 16:05:38	0.0056	-0.0786	0.0788	0.0019	0.0030	0.0035	47°17'41.78436" N	123°07'41.54624" W	265.32

All units above except latitudes and longitudes are U.S. survey feet.



facsimile: 206 780-2408

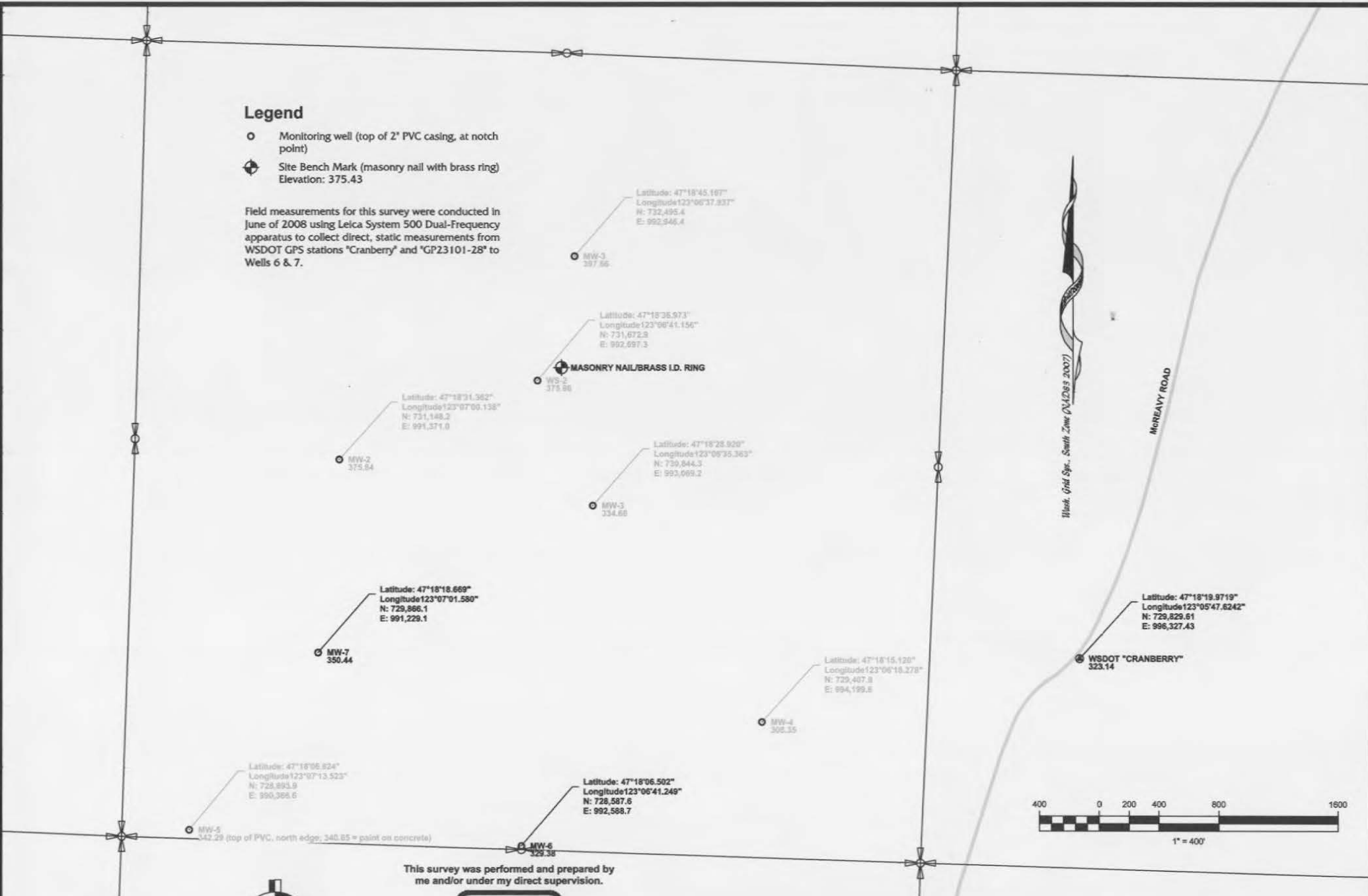
הנני יודע בציון אכן אכן בזה פנת יקרת מוסד מוסד המאמין לא יחיש ושמתי משפט לקו וצדקה למשקלה  
Ο δε ποιων την οληθειαν εργαται προς το φινος να φαναροσθη αυτου τα εργα

e-mail: bruce@scalandsurvey.com

**Legend**

- Monitoring well (top of 2" PVC casing, at notch point)
- ⊕ Site Bench Mark (masonry nail with brass ring)  
Elevation: 375.43

Field measurements for this survey were conducted in June of 2008 using Leica System 500 Dual-Frequency apparatus to collect direct, static measurements from WSDOT GPS stations "Cranberry" and "GP23101-28" to Wells 6 & 7.



This survey was performed and prepared by me and/or under my direct supervision.

This is a true and correct copy of the original survey records as shown on the drawings. It is subject to the provisions of the original contract and the provisions of the Professional Land Surveyors Act of 1986. The original survey records are on file with the Board of Professional Land Surveyors, State of Washington, 32439 159 Wyatt Way NE Bainbridge Island, WA 98110. The original survey records are on file with the Board of Professional Land Surveyors, State of Washington, 32439 159 Wyatt Way NE Bainbridge Island, WA 98110. The original survey records are on file with the Board of Professional Land Surveyors, State of Washington, 32439 159 Wyatt Way NE Bainbridge Island, WA 98110.

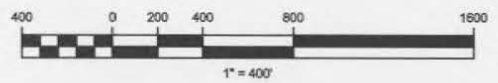
**BRUCE A. MACLEARNBERRY**  
 BOARD OF PROFESSIONAL LAND SURVEYORS  
 32439 159 WYATT WAY NE BAINBRIDGE ISLAND, WA 98110  
 EXPIRES AUGUST 27, 2009  
 Date: 6/26/2008



**MACLEARNBERRY, INC.**  
 Land Surveyors • Civil Engineers • Planners  
 159 Wyatt Way NE Bainbridge Island, WA 98110  
 phone: (206) 842-5514 facsimile: (206) 780-2408

**SINCE 1976**

**DATUM**  
 NAD83 2007 - Ellipsoidal  
 WSDOT "Cranberry" & "GP23101-28"



Client		
<b>Mason County</b>		
<b>Webb Hill Monitoring Well Survey</b>		
Drawn by: BAM	Date: June 26, 2008	Job No. 8033
Checked by: BAM	Scale: 1" = 400'	Sheet 1 of 1

Latitude: 47°18'06.874"  
 Longitude: 123°07'13.523"  
 N: 728,693.9  
 E: 990,366.6

MW-5  
 325.36 (top of PVC, north edge; 340.65 = point on concrete)

**Legend**

○ Well

Field measurements for this survey were conducted in June of 2008 using Leica System 500 Dual-Frequency apparatus to collect direct, static measurements from WSDOT GPS stations "Cranberry" and "GP23101-28" to Wells 6 & 7.

Latitude: 47°17'41.939"  
 Longitude: 123°07'41.684"  
 N: 726,238.6  
 E: 988,342.8

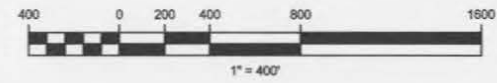
○ WILLIAMS  
 266.31

Latitude: 47°17'31.609"  
 Longitude: 123°07'47.701"  
 N: 725,206.3  
 E: 987,893.3

○ BISER  
 261.39

Wash. Grid Sys., South Zone (NAD83 2007)

MORENVY ROAD



This survey was performed and prepared by me and/or under my direct supervision.

**SINCE  
 1976**



NAD83 2007 - Ellipsoidal  
 WSDOT "Cranberry" & "GP23101-28"

Professional seal for Bruce A. Maclearnsberry, State of Washington, Registered Professional Land Surveyor No. 3249. The seal includes the text: "I, Bruce A. Maclearnsberry, do hereby certify that I am a duly licensed and registered professional land surveyor in the State of Washington. My registration expires August 27, 2008." The date "Date: 6/27/2008" is written below the seal.



**MACLEARNSBERRY, INC.**  
 Land Surveyors ◦ Civil Engineers ◦ Planners  
 159 Wyatt Way NE Bainbridge Island, WA 98110  
 phone: (206) 842-5514 facsimile: (206) 780-2408

Client		
<b>Mason County</b>		
<b>Biser &amp; Williams Wells Monitoring Well Survey</b>		
Drawn by: BAM	Date: June 27, 2008	Job No. 8033
Checked by: BAM	Scale: 1" = 400'	Sheet 1 of 1

## **APPENDIX B**

### **Monitoring Well and On-Site Water Supply Well Logs**



## Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-1

 Sheet  
 1 of 5

 Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

 Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

 Driller/Method Boart Longyear / Rotosonic

 Depth to Water 104.6 - 5/31/2007

 Sampling Method Continuous

 Start/Finish Date 4/23/2007-4/26/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
	Square steel monument with locking thermos well cap Concrete surface seal (0-2')  Bentonite chips (2-10')						<b>TOPSOIL</b> Slightly moist, dark brown GRAVEL (GP); gravel is fine; abundant organics, roots <b>RECESSIONAL OUTWASH</b> Slightly moist, brown, slightly silty, very gravelly SAND (SP-SM); sand is fine to coarse; gravel is fine, subrounded to rounded Slightly moist, brown, silty, gravelly SAND (SM); sand is fine to coarse; gravel is fine to coarse (60mm), subrounded to rounded 3-4.5' gravel is subangular to rounded (35mm) <b>STRATIFIED GLACIAL DEPOSITS</b> till Slightly moist, brown to gray, silty sandy GRAVEL (GM) glaciofluvial Slightly moist, dark brown, silty, gravelly SAND (SM) till Slightly moist, dark brown, silty, gravelly SAND (SM) glaciofluvial Drilling fractured rock: dark brown with maroon tinge, angular gravel Slightly moist, dark brown, slightly silty, gravelly SAND (SW-SM); gravel is subrounded to rounded Very gravelly Cobble at 11' Cobble at 12'	5
	Bentonite grout (10-95.3')	1					Slightly moist to dry, brown, silty, very gravelly SAND (SM); sand is fine to coarse; gravel is fine to coarse (40mm), subrounded to rounded  Trace clay  Dark brown, increased moisture 22 to 22.5'	15
		2					Slightly moist, dark brown to gray, slightly clayey, silty, gravelly SAND (SM); sand is fine to coarse; gravel is fine to coarse, subrounded to rounded  Dark brown at 25' Cobble at 26'  Trace clay at 28'	20
		3						25

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 2



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-1

Sheet  
2 of 5

Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotasonic Depth to Water 104.6 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/23/2007-4/26/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
35		4					Moist, brown to light brown, silty, slightly gravelly SAND (SM); trace clay, sand is fine to coarse, predominantly medium to coarse; gravel is fine to coarse (40mm), predominantly fine, subrounded to rounded Gravelly at 31' Slightly moist at 32'	35
							No clay, yellow ochre tones at 37'	
							Trace silt at 38' (SW)	
40							Slightly silty at 39' (SW-SM)	40
							Light brown to brown at 40'	
							Brown at 41'	
							Dark brown, increase silt at 42'	
							Trace clay 43-49.5', decreasing 46-49.5'	
45	Bentonite grout (10-95.3')	5					Light and dark brown at 46' Dark brown at 46.5'	45
							Light and dark brown at 48.5'	
50							Slightly moist to moist, brown SAND (SW); trace silt; trace gravel; sand is fine to coarse; gravel is fine to coarse (20mm)	50
							Slightly moist, dark brown and gray, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse; gravel is fine to coarse (50mm)	
							Trace silt at 53.5' (SW)	
55		6					Slightly silty at 56.3' (SW-SM)	55
							Trace silt at 57' (SW)	
							Moist, slightly silty, very gravelly, cobble (SW-SM)	
		7					Slightly moist at 59.7'	

MONITORING WELL - WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-2





## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-1

Sheet  
3 of 5

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotasonic

Depth to Water 104.6 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/23/2007-4/26/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
65		7				Trace silt (SW)		65
						Slightly silty (SW-SM)		
						Slightly moist, dark brown, very gravelly SAND (SW); trace silt; sand is fine to coarse; gravel is fine to coarse (55 mm), predominantly fine		
70		8						70
75	Bentonite grout (10-95.3')	9						75
80		10				Increase sand 83.5 to 84'		80
85	Perched water level 86.3' 4/24/2007	10				Slightly silty (SW-SM) Trace silt (SW)		85

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-2



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-1

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Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 104.6 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/23/2007-4/26/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
95	Bentonite grout (10-95.3')	11					Cobble at 94'	95
95	Bentonite pellets/chips (95.3-102.5')	○					Moist, slightly silty from 96 to 97'	
100	▽ 4/26/2007 SC=430 µmhos/cm on 4/25/2007	○					Slightly gravelly; sand is fine to medium (SP), trace silt Gravelly Very gravelly; sand is fine to coarse (SW)	100
105	▽ 5/31/2007 Probable 2' formation collapse (between 103' and 110')	12					till Slightly moist, brown, silty, gravelly SAND (SM); sand is fine to coarse; gravel is fine to coarse (42 mm) Slightly moist, brown, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse; gravel is fine to coarse (40 mm) Slightly moist, brown, silty, gravelly SAND (SM); sand is fine to coarse; gravel is fine to coarse	105
110	10/20 Colorado silica sand filter pack (102.5-125')	○					glaciofluvial Moist, dark brown, gravelly SAND (SW); trace silt; sand is fine to coarse; gravel is fine to coarse (55 mm), predominantly fine Moist Grades to very gravelly Slightly moist	110
115		○					Gravelly Very gravelly Cobble at 115'	115

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-2



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-1

Sheet  
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Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotosonic Depth to Water 104.6 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/23/2007-4/26/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
125	<p>2" schedule 80 PVC slotted pipe 0.020" slot size (105.2-124.6') 2" PVC pipe cap</p>					<p>Slightly silty (SW-SM) Trace silt (SW) Slightly silty (SW-SM) Trace silt (SW)</p>	<p>Slightly silty (SW-SM) Trace silt (SW) Slightly silty (SW-SM) Trace silt (SW)</p> <p>Bottom of hole at 125'.</p>	125
130								130
135								135
140								140
145								145

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-2



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

Sheet  
1 of 6

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotasonic

Depth to Water 147.9 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
0-2'	Square steel monument with locking thermos well cap Concrete surface seal (0-2')	1					<b>FILL (Reworked Glacial Deposits)</b> Slightly moist, yellow red/brown, silty, gravelly SAND (SM); sand is predominantly fine to medium, gravel is fine to coarse (60mm), subrounded/rounded, 30% felsic	
2-4'	Soil (2-4')							
4-10'	Bentonite chips (4-10')	2					Slightly moist, gray, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (70mm), subangular/subrounded, 15% felsic <b>RECESSIONAL OUTWASH</b> Moist/very moist, slightly silty, slightly gravelly SAND (SP-SM); sand is fine to medium predominantly fine, fairly well sorted, gravel is fine to coarse (60mm), subrounded/rounded, 10% felsic, gradational decrease in gravel	5
10-15'		3					<b>STRATIFIED GLACIAL DEPOSITS glaciofluvial</b> Moist, dark brown/gray, slightly silty, very sandy GRAVEL (GW-GM); sand is fine to coarse but predominantly coarse, gravel is fine to coarse (50mm), subrounded/rounded, 15% felsic	10
15-20'		4					Dry, dark brown/brown, silty, gravelly SAND (SM); sand is fine to coarse predominantly fine to medium, gravel is fine to coarse (50mm), subrounded/rounded, 20% felsic  Moist, dark brown/gray, slightly silty, sand predominantly medium to coarse, <10% felsic	15
20-25'	Bentonite grout (10-131')	5					<b>till</b> Moist, yellow red/dark brown, silty, very sandy GRAVEL (GM); matrix supported, sand is fine to coarse, gravel is fine to coarse (60mm), subrounded/rounded, 20% felsic	20
25-26'		6					Dry, dark brown/brown, silty, very gravelly SAND (SM); matrix supported, sand is fine to coarse, gravel is fine to coarse (50mm), subrounded/rounded, 15% felsic	25
26-27'		7					Dry/slightly moist, yellow red/brown, silty, very sandy GRAVEL (GM); matrix supported, gravel (70mm), subrounded/rounded, 15% felsic  Dry, light gray/brown, silty, very sandy GRAVEL (GM); with cobblesmatrix supported, sand is fine to coarse predominantly fine to medium, gravel is fine to coarse (90mm), subrounded/rounded, 20% felsic	

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:-

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-3



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

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2 of 6

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 147.9 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
35		7				(Symbol: circles in a row)		35
		8				(Symbol: circles in a row)	glaciofluvial Slightly moist/moist, yellow red/red brown, slightly silty, very sandy GRAVEL (GW-GM); sand is fine to coarse predominantly medium to coarse, subangular/subrounded, gravel is fine to coarse (60mm), subrounded/rounded <10% felsic Silty, very sandy gravel lens (6") at 37.5'	40
40		9				(Symbol: circles in a row)	Dry/slightly moist, dark brown/brown, silty, very sandy GRAVEL (GM); sand is fine to coarse predominantly fine to medium, gravel is fine to coarse rounded, 15% felsic, matrix supported	45
	Bentonite grout (10-131')	10				(Symbol: circles in a row)	Slightly moist, red brown/yellow red, slightly silty, very sandy GRAVEL (GW-GM); sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse, subrounded/rounded, 15% felsic	50
45		11				(Symbol: circles in a row)	Slightly moist, dark brown, silty, very gravelly, SAND (SM); sand is fine to coarse, gravel is fine to coarse (40mm), subrounded/rounded, 10% felsic (gravelly 45-45.5')	55
						(Symbol: circles in a row)	Trace clay	55
						(Symbol: circles in a row)	Slightly moist/moist brown/dark brown, slightly clayey, silty, gravelly, SAND (SM); sand is fine to coarse, gravel is fine to coarse predominantly fine (60mm), rounded/subrounded, 10% felsic, matrix supported	55
						(Symbol: circles in a row)	Slightly moist, dark brown, slightly silty, slightly gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse, subrounded/rounded, 10% felsic	55
						(Symbol: circles in a row)	Slightly moist, dark brown, slightly silty, very gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (60mm), subangular/rounded, <10% felsic, matrix supported	55
						(Symbol: circles in a row)	Slightly moist/moist	55

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 3



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

Sheet  
3 of 6

Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotosonic Depth to Water 147.9 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
65		11					Slightly moist/moist, dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (60mm), 15% felsic, subrounded/rounded	
							till	
							Slightly moist/dry, light brown, silty, gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine, subangular/round, matrix supported, <10% felsic	65
							glaciofluvial	
							Slightly moist/moist, dark brown, silty, gravelly SAND (SM); trace clay, sand is fine to coarse, gravel is fine, subangular/rounded, <10% felsic	
70		12					till	
							Slightly moist/dry, brown, slightly gravelly, very silty SAND (SM); sand is fine to coarse, gravel is fine to coarse (30mm), 10% felsic, matrix supported	
							Slightly moist/moist, dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (70mm), angular/rounded, 10% felsic	70
75	Bentonite grout (10-131')	13						75
80		14					till	
							Slightly moist/dry, brown, silty, very gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse	85
							glaciofluvial	
	Perched water level 86.3' 4/24/2007						Slightly moist/moist, dark brown/gray, silty, very gravelly SAND (SM); trace clay, sand is fine to coarse, gravel is fine to coarse (65mm), angular/subrounded, 10% felsic No clay at 86.5'	

MONITORING WELL WEBB HILL GPJ June 25, 2007

Sampler Type:  No Recovery       Bulk Sample  
 PID - Photoionization Detector (Headspace Measurement)      Logged by: JMS/JSL  
 Static Water Level      Approved by: EWM  
 Water Level (ATD)      Figure No. B- 3



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

Sheet  
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Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotasonic

Depth to Water 147.9 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
		○ 15				Boulder		
		● 16				till Slightly moist/dry, brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse predominantly fine (30mm) glaciofluvial		
95		● 17				Moist/very moist, dark brown, very sandy GRAVEL (GP); trace silt, sand is fine to coarse, gravel is fine to coarse predominantly fine (55mm), subangular/rounded, 10% felsic till Slightly moist/dry, brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (40mm) glaciofluvial		95
100		● 18				Slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (48mm), subangular/rounded, <10% felsic, matrix supported Slightly moist/moist, dark brown/yellow red/gray, silty, very gravelly/gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (55mm), subrounded/rounded, <5% felsic		100
	Perched water level 101.7 5/1/2007 Hole drilled to 105' SC=300 μmhos/cm	● 19				Slightly moist, dark brown, very gravelly SAND (SW); trace silt, sand is fine to coarse predominantly fine to medium, gravel is fine to coarse (30mm), subangular/subrounded, <5% felsic Slightly silty, sand is fine to coarse at 105.5' Very silty, gravelly SAND (SM); sand is fine to coarse Slightly moist, brown, slightly silty, slightly gravelly SAND (SW-SM); gravel is fine (<1/4") till (106.7-107.3') as till at 112', gravel is fine glaciofluvial (107.3-110') as glaciofluvial at 112.5'		105
105	Bentonite grout (10-131')	● 20				till (110-110.5') as till at 112', gravel is fine glaciofluvial (110.5-111') as glaciofluvial at 112.5' till (111-111.5') as till at 112' glaciofluvial (111.5-112') as glaciofluvial at 112.5' till Slightly moist/dry, dark brown/brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (20-60mm), subangular/rounded, 5-10% felsic glaciofluvial		110
110		● 21				Slightly moist/moist, dark brown/brown, slightly silty/trace silt, gravelly/very gravelly SAND (SW-SM to SW); sand is fine to coarse, gravel is fine to coarse (30-65mm), subangular/subrounded, 5-10% felsic		115
115	Perched water level 112.9 5/1/2007 Hole drilled to 115' SC=150 μmhos/cm							

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-3



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

Sheet  
5 of 6

Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotosonic Depth to Water 147.9 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
125	Bentonite grout (10-131')	21						
		22					Moist, dark brown, slightly gravelly SAND (SW); trace silt, sand is fine to coarse, gravel is fine, subangular/subrounded, <15% felsic	125
130		23					Slightly moist/dry, brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (40mm), subangular/subrounded, 10% felsic Moist, dark brown, very gravelly SAND (SW); trace silt, sand is fine to coarse, gravel is fine to coarse (50mm), subrounded, 10% felsic Slightly silty at 128.3' Trace silt at 128.7' Slightly moist, dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (70mm), subangular/subrounded, <10% felsic	130
							Slightly silty	
135	Bentonite chips (131-140.6')	24					till Slightly moist/dry, brown, very silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (45mm), subangular/subrounded, <10% felsic glaciofluvial Slightly moist, dark brown, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (55mm), subangular/subrounded, 10% felsic Moist at 136.5' Sand predominantly fine to medium at 137' Sand is fine to coarse at 138' Sand is predominantly fine to medium at 139.1'	135
140							till Slightly moist, brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse predominantly fine (30mm), subangular/subrounded, <10% felsic glaciofluvial Moist/slightly moist, dark brown, gravelly SAND (SP); trace silt, sand is fine to coarse predominantly fine to medium, gravel is fine Very gravelly, gravel is fine to coarse (50mm) at 142' Sand is fine to coarse at 143.5' Gravelly at 144'	140
145		25					Silt increases at 145' Very moist, dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (50mm), subangular/subrounded, 10% felsic Trace silt at 146'	145

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:  No Recovery       Bulk Sample  
 PID - Photoionization Detector (Headspace Measurement)      Logged by: JMS/JSL  
 ▼ Static Water Level      Approved by: EWM  
 ▽ Water Level (ATD)      Figure No. B- 3





## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-2

Sheet  
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Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotasonic Depth to Water 147.9 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/30/2007-5/3/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
155	10/20 Colorado silica sand filter pack (140.6-166')  2" schedule 80 PVC slotted pipe 0.020" slot size (143.9-168.3')	25				Slightly silty	155	
		26						
160		27				Very moist, dark brown, gravelly SAND (SW); trace silt, sand is fine to coarse, gravel is fine to coarse (50mm), subrounded, <5% felsic Slightly silty, very gravelly (SW-SM) silt lens  Trace silt	160	
165		28				Very moist, dark brown, slightly clayey, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine, includes silt lens 0.1' Very moist, dark brown, slightly silty, very gravelly SAND (SW-SM); trace silt, sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (70mm), subangular/subrounded (mostly subrounded), <5% felsic Sand is fine to coarse at 161.5', silt increases Silt decreases at 164' Cobble at 166'	165	
170	Formation (166-168')  2" PVC pipe cap					Bottom of hole at 168'	170	
175							175	

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:  No Recovery       Bulk Sample  
 PID - Photoionization Detector (Headspace Measurement)      Static Water Level      Water Level (ATD)  
 Logged by: JMS/JSL      Approved by: EWM      Figure No. B-3



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

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1 of 7

Project Name Webb Hill Biosolids Facility Ground Surface Elev. \_\_\_\_\_  
 Location Mason County, WA Top of Casing Elev. \_\_\_\_\_  
 Driller/Method Boart Longyear / Rotosonic Depth to Water 166 - 5/31/2007  
 Sampling Method Continuous Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
	Square steel monument with locking thermos well cap Concrete surface seal (0-1')	1					<b>RECESSIONAL OUTWASH</b> Dry, yellow red, slightly silty, gravelly SAND (SW-SM); sand is fine to medium, gravel is fine to coarse, rounded, roots.	
5	Bentonite chips (1-10')	2					Dry, light gray/yellow red, silty, very gravelly SAND (SM); sand is fine to coarse, predominantly coarse; gravel is fine to coarse (40 mm), rounded to well rounded.	5
10		3					<b>STRATIFIED GLACIAL DEPOSITS</b> till Slightly moist, dark brown/yellow red, slightly sandy, gravelly SILT (ML); sand is fine; gravel is fine to coarse (80 mm), matrix supported.	10
15		4					Slightly moist, dark brown, sandy, very gravelly SILT (ML); sand is fine to medium; gravel is fine to coarse (40 mm), subrounded/rounded, matrix supported.	15
20	Bentonite grout (10-139.4')	5					glaciofluvial Dry, dark brown, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse; gravel is fine to coarse (50 mm), subrounded/rounded, predominantly matrix supported. Dry, dark brown/yellow red, slightly silty, sandy GRAVEL (GW-GM); sand is fine to coarse; gravel is fine to coarse (60 mm), subrounded to rounded.	20
25		6					Dry/slightly moist, dark brown/yellow red, silty, very sandy GRAVEL (GM) sand is fine to coarse; gravel is fine to coarse (35 mm), subrounded to rounded.	25
							Dry, yellow red/brown, silty, very sandy, GRAVEL (GM); sand is fine to coarse, gravel is fine to coarse,	
							Dry, dark brown/yellow red/ trace gray-blue, silty, very sandy, GRAVEL (GM); sand is fine to coarse, gravel is fine to coarse (40mm), subrounded to rounded, primarily mafic origin	

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 4



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

Sheet  
2 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
35		7					Dry, dark brown/yellow red, slightly silty, very gravelly, SAND (SP-SM); sand is fine to coarse predominantly coarse, gravel is fine to coarse (75mm), predominantly mafic (80%)	35
							Dry, dark brown/yellow red, slightly silty, gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse with small cobbles (85mm), rounded/subrounded, predominantly mafic (90%)	
40		8					Dry, dark brown, slightly silty, very sandy, GRAVEL (GW-GM); sand is fine to coarse predominantly medium, gravel is fine to coarse (70mm), subrounded to rounded; presence of quartzite and granite (20%)	40
							Dry, dark brown, silty, gravelly, SAND (SM); sand is fine to coarse, gravel is fine to coarse, small cobbles (100mm), subrounded/rounded, presence of quartzite and granite (10%)	
45	Bentonite grout (10-139.4')						Dry, dark brown, slightly silty, sandy, GRAVEL (GW-GM); sand is fine to coarse, gravel is fine to coarse, subrounded/rounded	45
		9					Dry/slightly moist, dark brown/yellow red, slightly silty, very gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (70mm), rounded/subrounded, <10% felsic	
55		10					Slightly moist/moist, dark brown/yellow red, silty, gravelly, SAND (SM); sand is fine to coarse, gravel is fine to coarse (30mm), rounded, <10% felsic	55
							Dry, dark brown with yellow red oxidization, slightly silty, gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse, subrounded/rounded, 20% felsic, 2' boulder present	
		11					Slightly moist/moist, dark brown, slightly silty, gravelly, SAND (SP-SM); sand is fine to coarse predominantly	

MONITORING WELL, WEBB HILL, GP.J June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 4



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

Sheet  
3 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
65	Probable formation collapse (8' cumulative between 157.3 & 177.4')	11					medium to coarse, subangular/subrounded, gravel is fine to coarse (80mm), subrounded/rounded, ~15% felsic  Slightly gravelly sand pocket, sand is medium to coarse	65
70		12					Slightly moist/moist, dark brown, slightly silty, gravelly, SAND (SP-SM); sand is fine to coarse predominantly medium, gravel is fine to coarse (50mm), rounded/subrounded, ~15% felsic  Silty	70
75	Bentonite grout (10-139.4')	13					Moist, dark brown, slightly silty, very gravelly, SAND (SP-SM); sand is fine to coarse but predominantly medium to coarse, rounded/subrounded, gravel is fine to coarse (70mm), subrounded/rounded, ~10% felsic	75
80		14					Slightly moist, dark brown, silty, very sandy, GRAVEL (GM); sand is fine to coarse predominantly fine to medium, gravel is fine to coarse (50mm), subrounded/rounded, ~15% felsic, matrix supported	80
85		14					Slightly moist/dry, dark brown, slightly silty, very gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (80mm), subrounded, ~10% felsic	85
							Decreasing silt, increase in medium sand	

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 4



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

Sheet  
4 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotasonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
95		14				[Symbol]		95
						[Symbol]	Wet, dark brown and yellow red, gravelly, SAND (SP); trace silt, sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (50mm), rounded/subrounded, 20% felsic	
						[Symbol]	Decreasing silt	
100	Bentonite grout (10-139.4')	15				[Symbol]	Very gravelly	100
						[Symbol]		
	Perched water Ephemeral	[Symbol]						
105		16				[Symbol]	Wet (top) to moist (bottom), gray, silty, gravelly, SAND (SM), sand is fine to coarse, gravel is fine to coarse (30mm), subrounded/rounded	105
						[Symbol]	Slightly moist to moist, dark brown, slightly silty, gravelly, SAND (SP-SM); sand is fine to coarse, gravel is fine to coarse (55mm), subrounded/rounded, 20% felsic	
110	Drill casing (105-125')	17				[Symbol]		110
						[Symbol]		
115		18				[Symbol]	Moist, dark brown, very gravelly, SAND (SW); trace silt, sand is fine to coarse, gravel is fine to coarse (55mm), subrounded/rounded	115
						[Symbol]	Slightly moist, dark brown, very sandy, GRAVEL (GW); trace silt, sand is fine to coarse, gravel is fine to coarse	

MONITORING WELL, WEBB HILL, GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-4

**Monitoring Well Construction Log**

Project Number  
070041-001

Well Number  
MW-3

Sheet  
5 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
125	Drill casing (105-125')					(60mm), subrounded/rounded, 10% felsic		
125	Bentonite grout (10-139.4')	19				Moist, slightly silty (GW-GM) Slightly moist		125
130								130
135		20				Moist, dark brown, gravelly, SAND (SP); trace silt, sand is fine to coarse, gravel is fine to coarse (60mm), subrounded/round, 15% felsic		135
140		21				Moist, dark brown, gravelly, SAND (SP); trace silt, sand is fine to coarse predominantly fine to medium, gravel is fine to coarse (50mm), subrounded/rounded, 10% felsic Very moist to moist, dark brown, slightly silty, very gravelly, SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (40mm), subrounded/rounded Gravelly at 140'		140
145	Bentonite pellets (50 lbs) (139.4-154.9') (Note: 3.2 lb/ft is less than recommended usage of 13.3 lb/ft)	22				Very moist, dark brown, gravelly, SAND (SP); sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (60mm), subrounded/rounded Very moist to moist, gravel is predominantly fine Increased fine to coarse gravel (45 mm), subrounded/rounded Slightly silty (SP-SM) Trace silt (SP) Gravel predominantly fine		145

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 4



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

Sheet  
6 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
155	20/40 Colorado silica sand cap (154.9-157.3')	23					Moist, dark brown, gravelly SAND (SP); trace silt, sand is fine to coarse predominantly fine to medium, gravel is fine	155
160	10/20 Colorado silica sand filter pack (157.3-187')						Moist/slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (60mm)	160
	▽ 5/2/2007						SAND (SP); trace gravel, trace silt, sand is fine to coarse predominantly fine to medium, gravel is fine (20mm), subrounded/rounded	
165	▽ 5/31/2007	24					Moist/slightly moist, dark brown, slightly silty, gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (45mm), 10% felsic	165
							Very moist, dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, gravel is fine to coarse (65mm), 10% felsic, silt is variable	
170	2" schedule 80 PVC slotted pipe 0.020" slot size (160.5-185')	25					Trace silt	170
							Slightly silty	
							Trace silt	
175		26					Slightly silty	175
		27						

MONITORING WELL WEBB HILL GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- ▽ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B-4



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-3

Sheet  
7 of 7

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

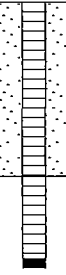

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 166 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/17/2007-4/23/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
185	 Probable formation collapse (183.4-185.7') 2" PVC pipe cap	27				 Gravelly, trace silt Very gravelly	Bottom of hole at 187'.	185
190	Formation (185.7-187')							190
195								195
200								200
205								205

\_MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 4





## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-4

Sheet  
1 of 4

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotosonic

Depth to Water 77.9 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/26/2007-4/30/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
	Square steel monument with locking thermos well cap Concrete surface seal (0-2')	1					<b>RECESSIONAL OUTWASH</b> Slightly moist, yellow red, silty, very sandy GRAVEL (GM); sand is fine to coarse, subrounded, gravel is fine to coarse (60mm), subrounded/rounded, 15% felsic, matrix supported	
5	Bentonite chips (2-10')	2					<b>STRATIFIED GLACIAL DEPOSITS glaciofluvial</b> Slightly moist, dark brown/gray, slightly sandy, very gravelly SILT (ML); sand is fine to coarse (80mm), subrounded/rounded, matrix supported, 10% felsic	5
10		3					Moist, dark brown, silty, sandy GRAVEL (GM); sand is predominantly fine to medium, gravel is fine to coarse (60mm), subrounded/rounded 50% felsic Slightly moist, yellow red, slightly sandy, very silty GRAVEL (GM); sand is fine to medium, gravel is fine to coarse (80mm), rounded, 35% felsic, matrix supported	10
15		4					Moist, yellow red, clayey SILT (MH) bedding, ~1' Slightly moist, yellow red, sandy, very silty GRAVEL (GM); sand predominantly fine to medium, gravel is fine to coarse (40mm), rounded, 30% felsic	15
20	Bentonite grout (10-61')	5					Slightly moist, yellow red/red brown, slightly silty, very gravelly SAND (SP-SM); sand is fine to medium, gravel is fine to coarse (60mm), rounded Very moist, yellow red, slightly sandy, silty, very clayey GRAVEL (GM); sand is fine to medium, gravel is fine to coarse (75mm), subrounded/rounded, 25% felsic, matrix supported	20
25	Perched water level 16' 4/27/2007 Hole drilled to 18' SC=250 µmhos/cm	6					Brown/dark brown Slightly moist, dark brown/brown, slightly sandy, gravelly SILT (ML); sand is fine to medium, gravel is fine to coarse (70mm), rounded, matrix supported, 20% felsic	25
	Perched water level 22.5' 4/27/2007 Hole drilled to 31.5'							

\_MONITORING WELL WEBB HILL-GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 5



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-4

Sheet  
2 of 4

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. \_\_\_\_\_

Location Mason County, WA

Top of Casing Elev. \_\_\_\_\_

Driller/Method Boart Longyear / Rotasonic

Depth to Water 77.9 - 5/31/2007

Sampling Method Continuous

Start/Finish Date 4/26/2007-4/30/2007

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
		6				(Symbol: vertical lines with circles)	Wet, brown, silty, sandy, GRAVEL (GM); sand is fine to coarse, gravel is fine to coarse predominantly fine (40mm), subangular/rounded, <10% felsic	
35		7				(Symbol: vertical lines with circles)	Moist, brown/yellow red, slightly sandy, very gravelly SILT (ML); sand is fine to coarse, gravel is fine to coarse (40mm), subrounded/rounded, matrix supported, 15% felsic  Olive gray, coarse sand bedding, 0.5' at 34' Slightly moist at 35'	35
		8				(Symbol: vertical lines with circles)	Slightly moist, dark brown/light brown, slightly sandy, gravelly SILT (ML); sand is fine to coarse, gravel is fine to coarse (45mm), angular/subangular, <5% felsic	
40		9				(Symbol: vertical lines with circles)	Slightly moist, dark brown, sandy, gravelly SILT (ML); sand is fine to coarse, gravel is fine, subrounded/rounded, matrix supported, 20% felsic  Slightly moist, light gray/dark brown, slightly sandy, gravelly SILT (ML); sand is fine to coarse, gravel is fine to coarse predominantly fine (30mm), angular/rounded, matrix supported	40
	Bentonite grout (10-61')	10				(Symbol: vertical lines with circles)	Slightly moist, red brown/dark brown, silty, gravelly SAND (SM); sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (60mm), subrounded/rounded, 20% felsic	45
50		11				(Symbol: vertical lines with circles)	Slightly moist, dark brown, sandy, gravelly SILT (ML); sand is fine to coarse predominantly fine to medium, gravel is fine to coarse predominantly fine (50mm), angular/subrounded, matrix supported, <10% felsic Slightly moist, yellow red/dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (60mm), subrounded/rounded, 10% felsic, matrix supported Light brown, slightly clayey, silty, sandy GRAVEL (GM); bedding, 0.5', sand is fine to coarse, gravel is fine to coarse	50
55						(Symbol: vertical lines with circles)	Slightly moist, gray/dark brown, gravelly SAND (SP); trace silt, sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (55mm), subrounded/rounded, 20% felsic	55
						(Symbol: vertical lines with circles)	Slightly moist, yellow red/dark brown, sandy, gravelly	

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 5



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-4

Sheet  
3 of 4

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

Driller/Method **Boart Longyear / Rotosonic**

Depth to Water **77.9 - 5/31/2007**

Sampling Method **Continuous**

Start/Finish Date **4/26/2007-4/30/2007**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
61-65	Bentonite grout (10-61')	12					SILT (ML); sand is fine to coarse, gravel is fine to coarse (30mm), subrounded/rounded, 30% felsic	
65-68.2	Bentonite chips (61-68.2')	13					Slightly moist, dark brown, slightly silty, very gravelly SAND (SP-SM); sand is fine to coarse predominantly medium to coarse, gravel is fine to coarse (80mm), occasional cobbles	65
68.2-70							Slightly moist, dark brown, gravelly SAND (SW); trace silt, sand is fine to coarse, gravel is fine to coarse Slightly moist, brown/dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (60mm), angular/rounded, <10% felsic Light brown, slightly clayey, 0.7'	
70-75		14					till Sandy, gravelly SILT (ML) glaciofluvial Slightly moist, brown/dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (60mm), angular/rounded, <10% felsic	70
75-80	SC=330 μmhos/cm on 4/27/2007 5/9/2007 5/31/2007 10/20 Colorado silica sand filter pack (68.2-96')	15					till Sandy, gravelly SILT (ML) glaciofluvial Slightly moist, brown/dark brown, silty, gravelly SAND (SM); sand is fine to coarse, gravel is fine to coarse (60mm), angular/rounded, <10% felsic Very moist/wet, brown/dark brown, slightly silty, very sandy GRAVEL (GW-GM); sand is medium to coarse predominantly coarse, angular, gravel is fine to coarse (40mm), subrounded/rounded Slightly sandy, gravelly, silty CLAY (CL) bedding, 0.5', sand is fine to coarse, gravel is fine (77-77.5') Very moist, brown/dark brown, slightly silty, very gravelly SAND (SW-SM); sand is fine to coarse, subrounded, gravel is fine to coarse (50mm), rounded, 15% felsic	75
80-85							Light brown, sandy, gravelly, silty CLAY (CL), 1'	
85-97.4	2" schedule 80 PVC slotted pipe 0.020" slot size (72.9-97.4')	16					Very moist, dark brown, gravelly SAND (SW); sand is medium to coarse, rounded, gravel is fine, rounded, 1'	85

MONITORING WELL WEBB HILL.GPJ June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 5

### Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-4

 Sheet  
 4 of 4

Project Name <u>Webb Hill Biosolids Facility</u>	Ground Surface Elev. _____
Location <u>Mason County, WA</u>	Top of Casing Elev. _____
Driller/Method <u>Boart Longyear / Rotasonic</u>	Depth to Water <u>77.9 - 5/31/2007</u>
Sampling Method <u>Continuous</u>	Start/Finish Date <u>4/26/2007-4/30/2007</u>

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
95	2" PVC pipe cap  Formation (96-105')	16					Very moist, dark brown, slightly silty, very gravelly SAND (SP-SM); sand is fine to coarse predominantly medium to coarse, subangular/subrounded, gravel is fine to coarse (50mm), subrounded/rounded, clast supported, 40% felsic	95
100		17					Very moist, dark brown, very gravelly SAND (SP); trace silt, trace gravel, sand is medium  Very moist, dark brown, very gravelly SAND (SP); trace silt, sand is medium to coarse, gravel is fine to coarse predominantly fine (30mm), rounded, ~20% felsic	100
105							Bottom of hole at 105'.	105
110								110
115								115

MONITORING WELL WEBB HILL GP.J June 25, 2007

Sampler Type:

- No Recovery
- Bulk Sample

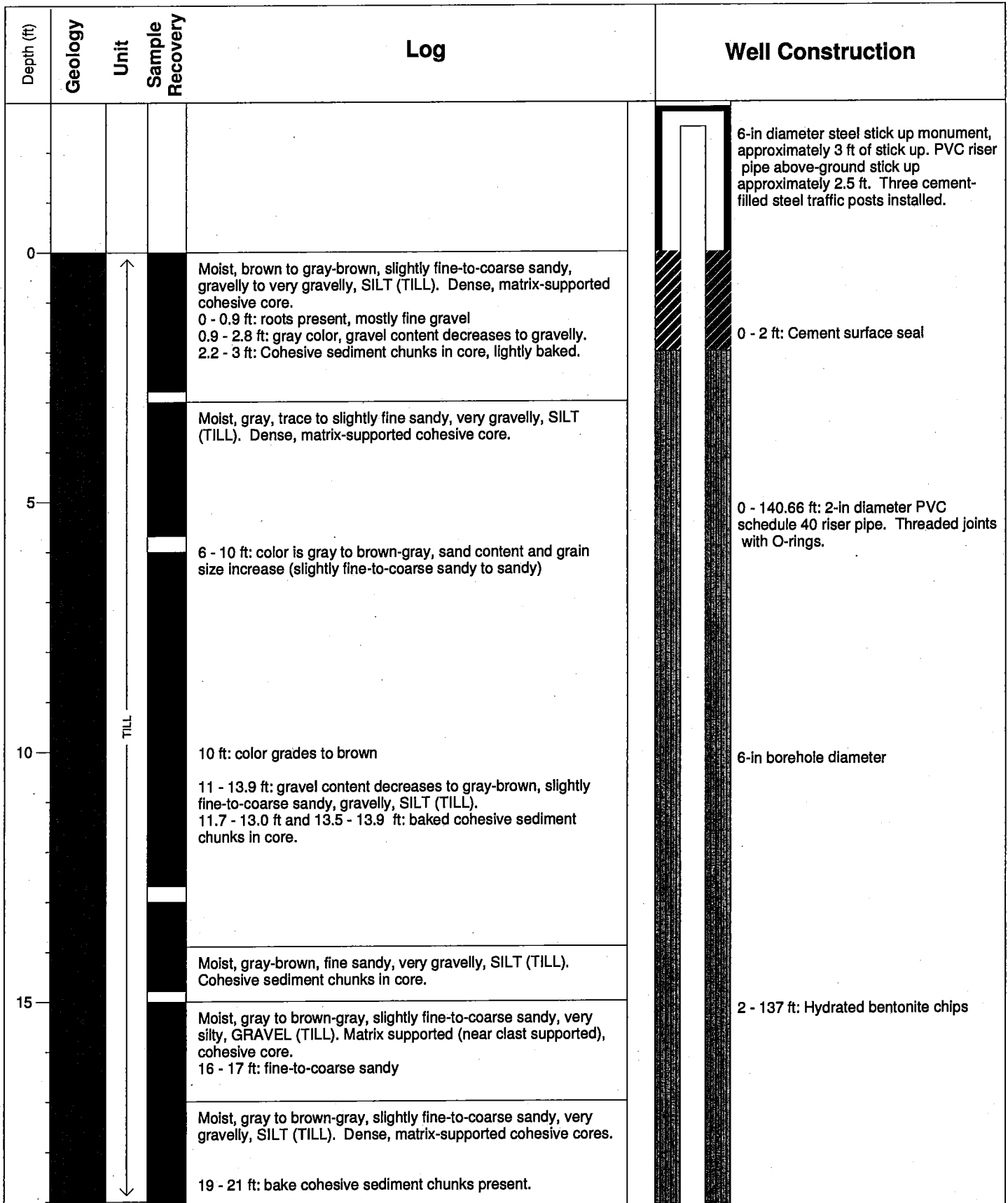
PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 5



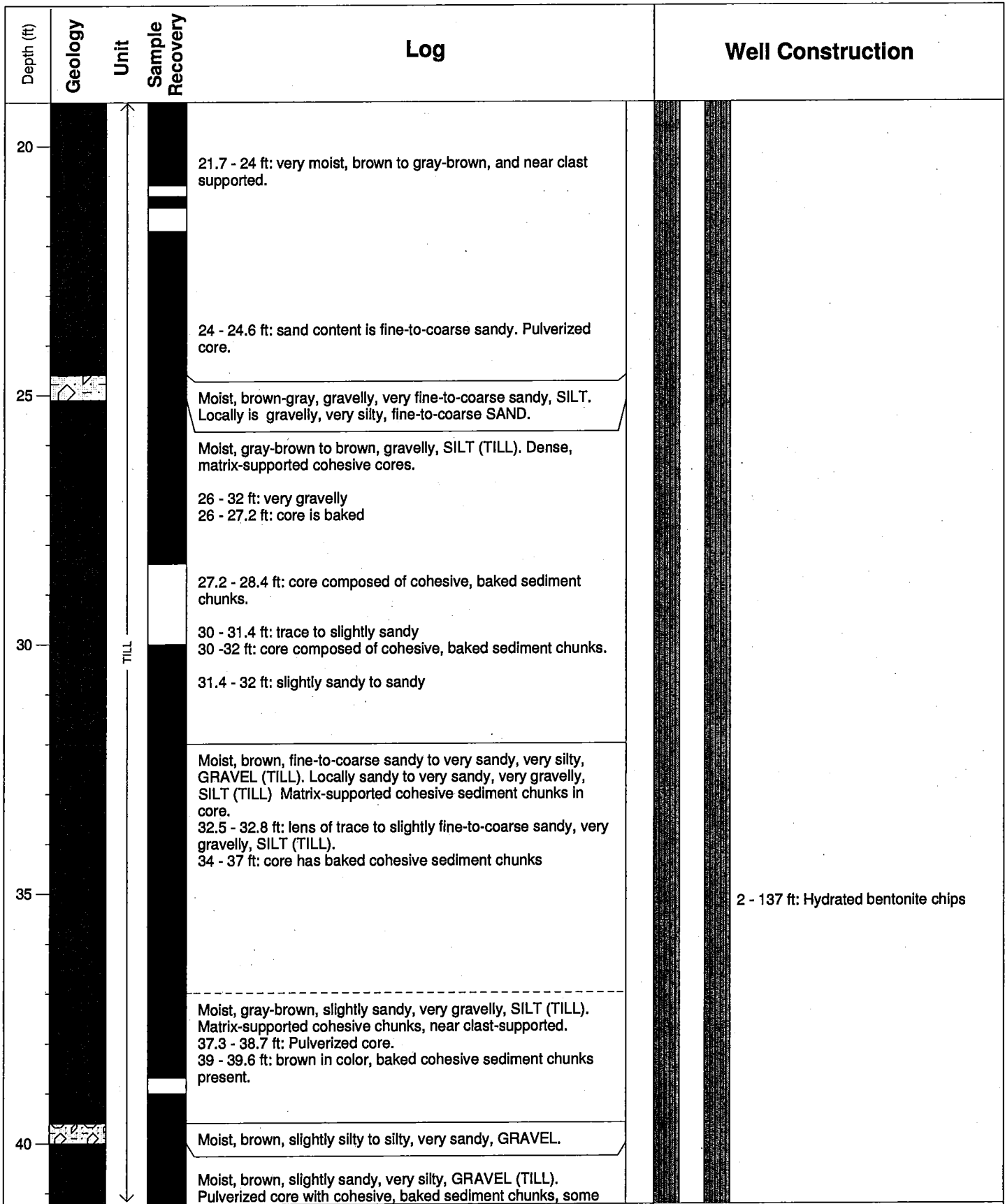
Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**

North Ranch  
 Shelton, Washington  
 JS0712, 12/2007






Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





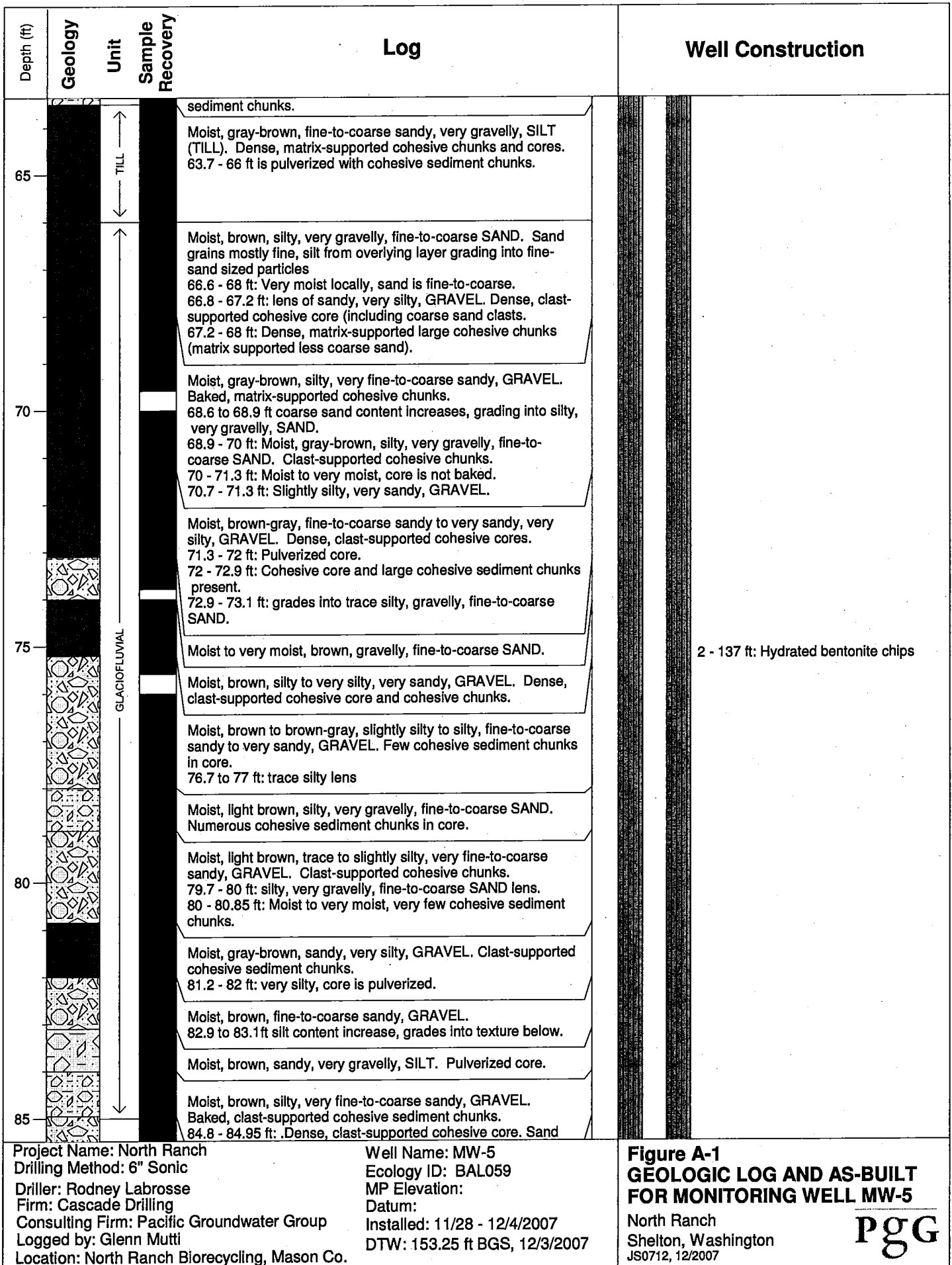
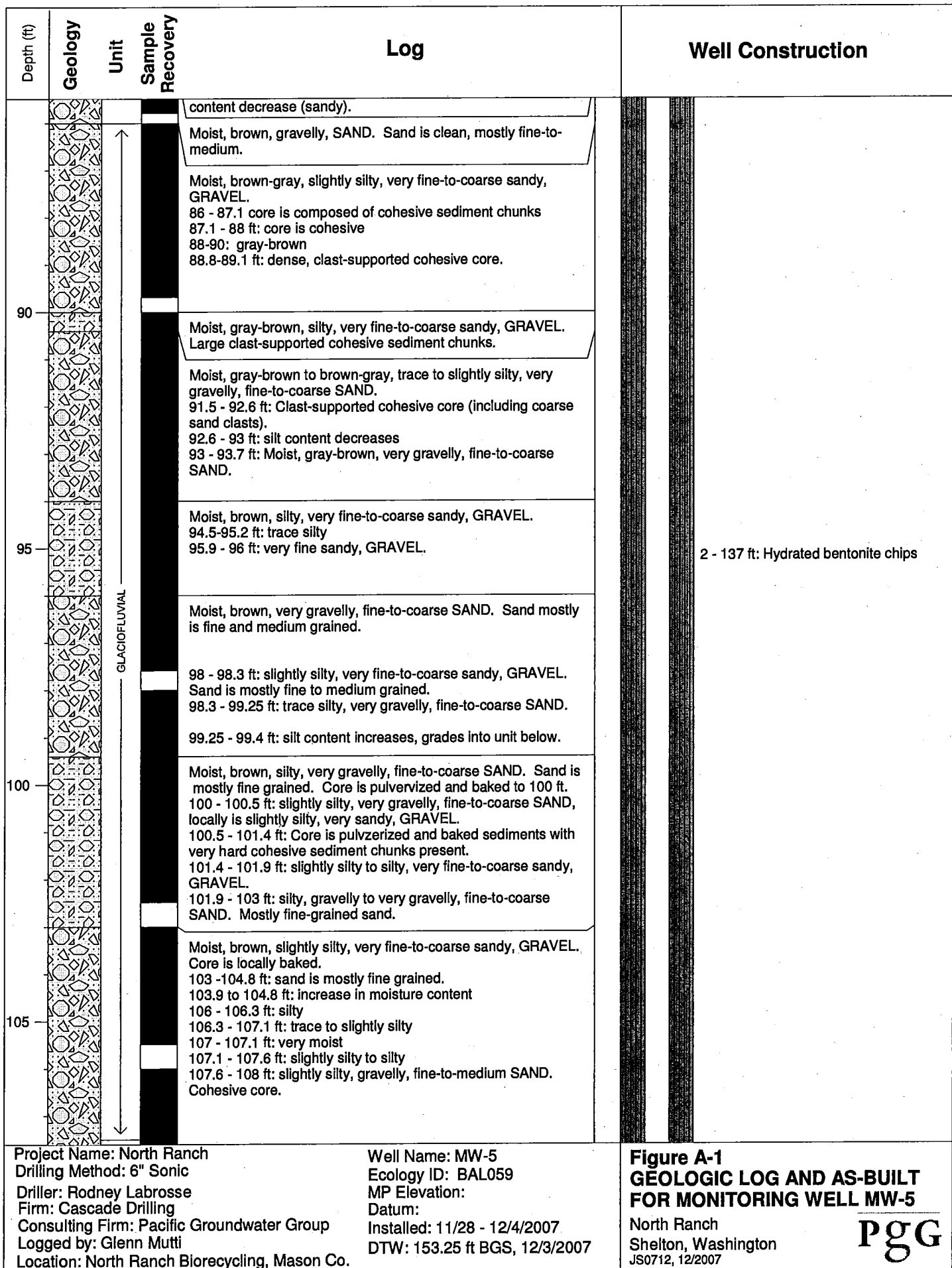


Figure No. B-6




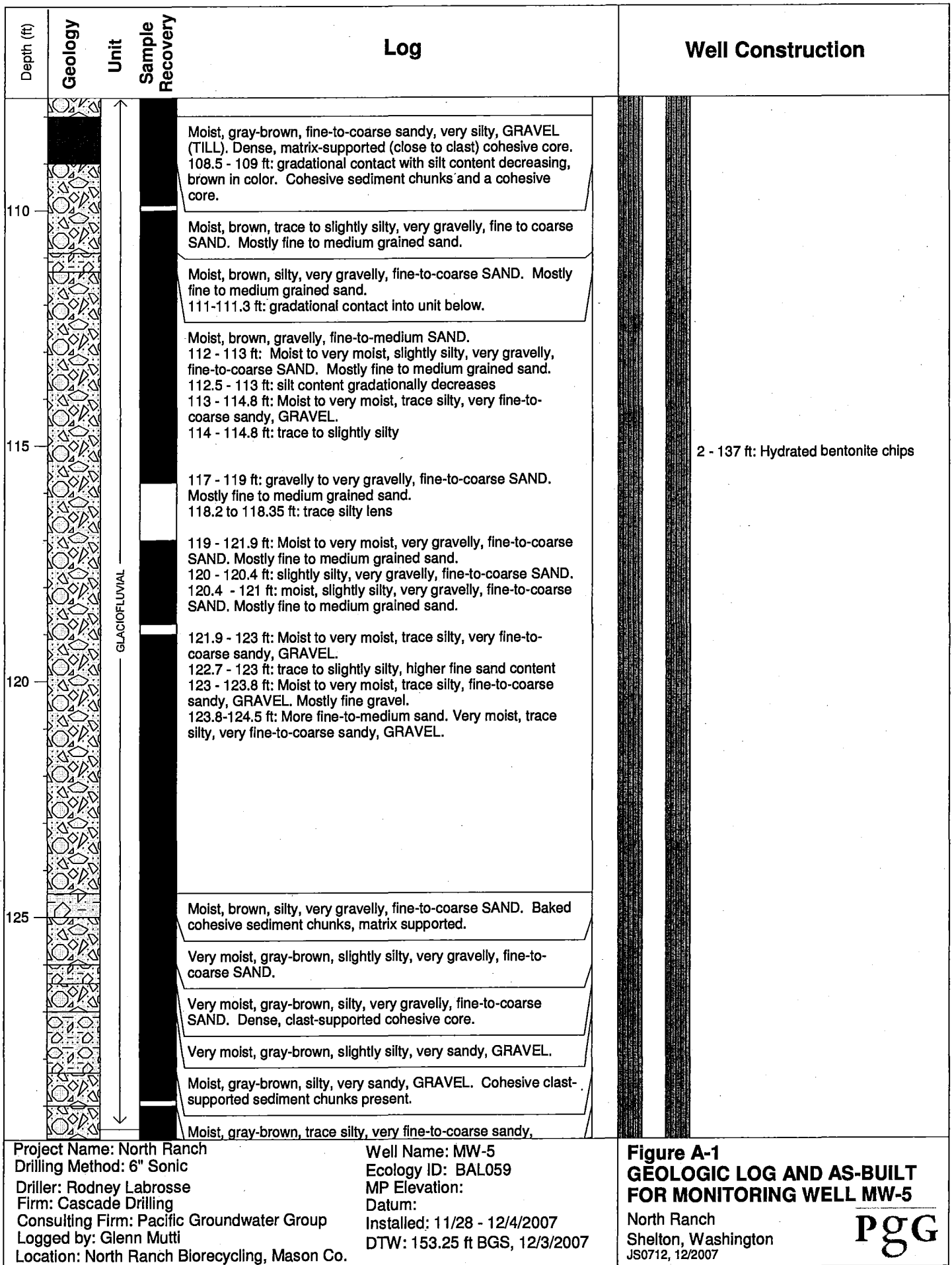


Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





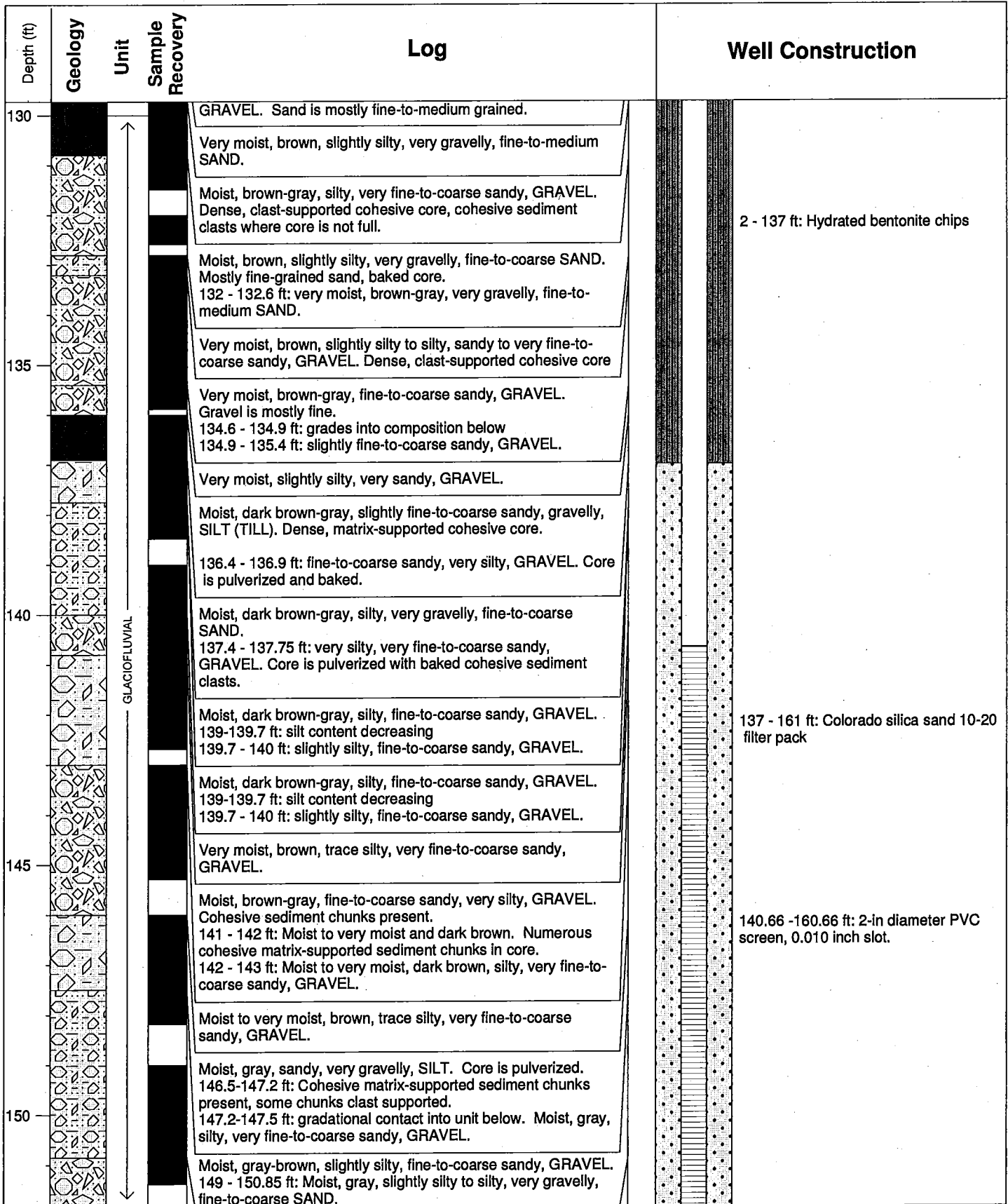
Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**

North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





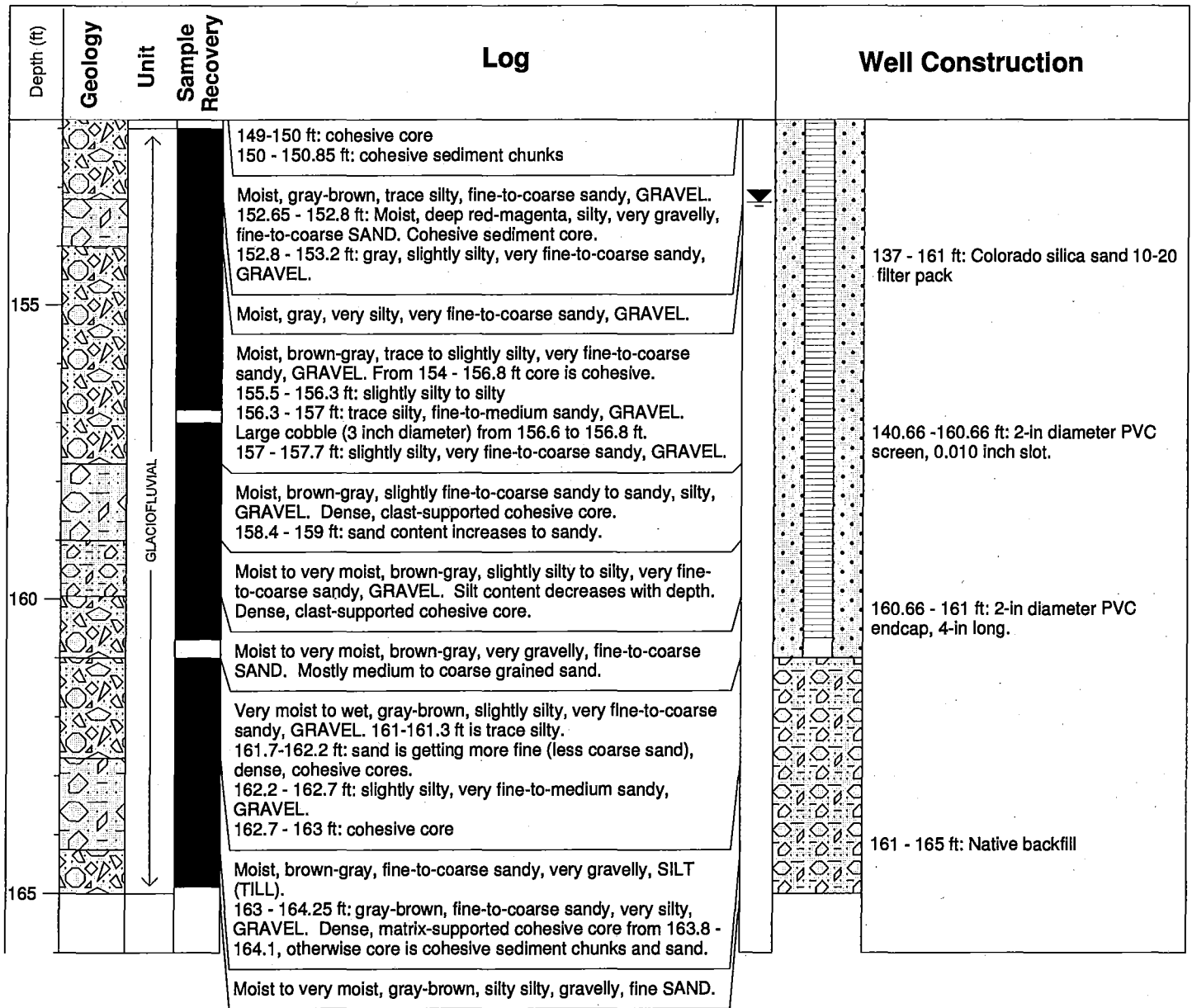
Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**

North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Well Name: MW-5  
 Ecology ID: BAL059  
 MP Elevation:  
 Datum:  
 Installed: 11/28 - 12/4/2007  
 DTW: 153.25 ft BGS, 12/3/2007

**Figure A-1**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR MONITORING WELL MW-5**

North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-6

Sheet  
2 of 5

Project Name Webb Hill Biosolids Facility

Ground Surface Elev 397.46

Location Mason County, WA

Top of Casing Elev. 400.27

Driller/Method Boart Longyear / Rotasonic

Depth to Water (ft BGS) 116.19 - 6/12/2008

Sampling Method Continuous where sampled

Start/Finish Date 5/21/2008-5/28/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
365								
35								35
360								
40							Large boulder <b>till</b>	40
355		3					Dry/slightly moist, dark brown, sandy, very gravelly SILT (ML); fine to coarse sand; fine to coarse gravel (45 mm), rounded to subangular, matrix supported	
45		○					Dry/slightly moist, dark brown, slightly clayey, silty, sandy GRAVEL (GM-GC); fine to coarse sand, poorly sorted; fine to coarse gravel (50 mm), rounded to subangular, matrix supported	45
350								
50								50
345								
55							<b>glaciofluvial</b> Slightly moist/moist, yellow-red, silty, very sandy GRAVEL (GM); fine to coarse sand, poorly sorted; fine to coarse gravel (60 mm), rounded to subrounded	55
340		4					Slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (50 mm), rounded to subangular	
		○					Slightly moist/moist, dark brown, silty, very sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel (50 mm)	

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 7



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-6

Sheet  
3 of 5

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. 397.46

Location Mason County, WA

Top of Casing Elev. 400.27

Driller/Method Boart Longyear / Rotasonic

Depth to Water (ft BGS) 116.19 - 6/12/2008

Sampling Method Continuous where sampled

Start/Finish Date 5/21/2008-5/28/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
335								
65								65
330								
70		5				till	Dry/slightly moist, brown, sandy, very gravelly SILT (ML); fine to coarse sand, poorly sorted; fine to coarse gravel (30 mm), rounded to subangular, matrix supported.	70
325		5				glaciofluvial	Slightly moist/moist, dark brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand, poorly sorted; fine gravel to cobbles (90 mm), rounded to subrounded	
75								75
320								
80								80
315								
85		6				glaciofluvial	Moist, dark brown, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand; fine to coarse gravel (55 mm), rounded to subangular	85
310								

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: JMS/JSL

Approved by: EWM

Figure No. B- 7

## Monitoring Well Construction Log

Project Number  
**070041-001**

Well Number  
**MW-6**

Sheet  
**4 of 5**

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. **397.46**

Location **Mason County, WA**

Top of Casing Elev. **400.27**

Driller/Method **Boart Longyear / Rotosonic**



Depth to Water (ft BGS) **116.19 - 6/12/2008**

Sampling Method **Continuous where sampled**



Start/Finish Date **5/21/2008-5/28/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
305								
95								95
300								
100								100
295		7					Moist, dark brown, very gravelly SAND (SP); fine to coarse gravel (60 mm), rounded to subangular	
105							Moist, dark brown, slightly silty, gravelly SAND (SP-SM); medium to coarse sand, predominantly medium, well sorted; fine to coarse gravel (35 mm), rounded Slightly moist/moist, dark brown, very gravelly SAND (SP); predominantly medium to coarse sand; fine to coarse gravel (50 mm), rounded to subangular	105
290	Bentonite chips (106.8-112')							
110								110
285	Bentonite pellets (112-117')	8					Moist, dark brown, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand; fine gravel, rounded to subrounded	
115	5/28/2008						Slightly moist/moist, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (40 mm), rounded to subangular	
280	6/12/2008						Very moist, dark brown, slightly silty, very gravelly SAND (SP-SM); medium to coarse, predominantly coarse sand; fine to coarse gravel (55 mm), rounded to subrounded	115
280	20/40 Colorado silica sand (117-118')	9					Occasional, slightly silty, gravelly medium sand pockets (2-inches thick)	
280	10/20 Colorado silica sand (118-145')						Very moist, dark brown, slightly silty, very gravelly SAND (SP-SM); medium to coarse sand, predominantly coarse sand; fine to coarse gravel (40 mm), rounded to subrounded; occasional, slightly silty,	

Sampler Type:

-  No Recovery
-  Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

-  Static Water Level
-  Water Level (ATD)

Logged by: **JMS/JSL**

Approved by: **EWM**

Figure No. **B- 7**



## Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-6

 Sheet  
 5 of 5

 Project Name **Webb Hill Biosolids Facility**

 Ground Surface Elev. **397.46**

 Location **Mason County, WA**

 Top of Casing Elev. **400.27**

 Driller/Method **Boart Longyear / Rotasonic**

 Depth to Water (ft BGS) **116.19 - 6/12/2008**

 Sampling Method **Continuous where sampled**

 Start/Finish Date **5/21/2008-5/28/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
275	Centralizer (119.9')  2" schedule 40 PVC slotted pipe 0.020" slot size (120.2-144.8')	9					gravelly, medium SAND (SP-SM) pockets (2-inches thick)	
125							Very moist, brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand; fine to coarse gravel (60 mm), rounded to subrounded	125
270							Very moist, gray, gravelly SAND (SP); trace silt; fine to coarse sand, predominantly fine to medium; fine to coarse gravel, predominantly fine (30 mm), rounded to subrounded	
130	Centralizer (129.9')						Very moist/wet, brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand; fine gravel, subrounded; transition at 127 ft to fine to coarse gravel (45 mm), rounded to subrounded	130
265		10					Very moist/wet, brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (60 mm), predominantly fine; subrounded to rounded Silty (SM) at 131.3 ft	
135							Very moist/wet, brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand, fine gravel to cobbles (90 mm), rounded to subrounded	135
260							Very moist/wet, brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (60 mm)	
140	Centralizer (139.9')						Wet, gray, slightly gravelly SAND (SP); trace silt; fine to coarse sand, predominantly medium to coarse; fine to coarse gravel (40 mm), rounded to subrounded	140
255		11					Wet, brown, slightly silty/clayey, sandy GRAVEL (GW-GC); predominantly medium to coarse sand; fine to coarse gravel (60 mm), rounded to subrounded	
145	2" PVC pipe cap (144.8-145.2') Heave (145-146')						Gray, trace silt (GW); fine to coarse sand Silty (GM); predominantly medium to coarse sand	145
250								

MONITORING WELL WEBB HILL.GPJ June 30, 2008

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

 Logged by: **JMS/JSL**

 Approved by: **EWM**

 Figure No. **B- 7**

## Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-6a

 Sheet  
 1 of 5

 Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

 Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

 Driller/Method **Boart Longyear / Rotasonic**

Depth to Water (ft BGS) \_\_\_\_\_

 Sampling Method **Continuous**

 Start/Finish Date **5/19/2008-5/21/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
	Abandoned boring Concrete (0-1') Bentonite chips (1-140)						<b>RECESSIONAL OUTWASH</b> Dry/slightly moist, yellow-red/brown, silty, very gravelly SAND (SM); fine to coarse sand, poorly sorted; fine to coarse gravel (45 mm), rounded to angular	
5		1						
							<b>STRATIFIED GLACIAL DEPOSITS</b> <b>till</b> Slightly moist/moist, dark brown, slightly silty, very sandy GRAVEL(GW-GM); fine to coarse sand, poorly sorted; fine to coarse gravel (60 mm), rounded to angular (weathered till)	5
		2					Moist, light gray, slightly sandy, gravelly SILT (ML); fine gravels (20 mm), predominantly rounded, matrix supported	
10		3					Slightly moist, sandy, very silty GRAVEL (GM); fine to coarse sand, poorly sorted; fine to coarse gravel (50 mm), subrounded to rounded	10
							<b>glaciofluvial</b> Slightly moist/moist, dark brown/gray, gravelly, very silty SAND (SM); predominantly fine to medium sand; fine to coarse gravel (65 mm), subrounded to subangular	
		4					Moist, dark brown, slightly sandy, very gravelly SILT (ML); predominantly fine sand; fine to coarse gravel (50 mm), rounded to subangular, matrix supported	
15		5					Slightly moist, dark brown, silty, sandy GRAVEL (GM); predominantly medium to coarse sand; fine to coarse gravel (50 mm), subrounded to subangular; scattered pockets of matrix supported gravelly silt	15
							Dry/slightly moist, dark brown, silty, gravelly SAND (SM); fine to coarse sand, poorly sorted; fine to coarse gravel (65 mm), rounded to subangular	
20							Slightly moist, brown/dark brown, slightly sandy, very gravelly SILT (ML); predominantly fine sand; fine gravel, rounded to subrounded, matrix supported	20
25							Slightly moist, dark brown, silty, very gravelly SAND (SM); fine to coarse sand, poorly sorted; fine to coarse gravel (30 mm); rounded to subrounded	25

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

 Logged by: **JMS/JSL**

 Approved by: **EWM**

 Figure No. **B- 8**

## Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-6a

 Sheet  
 2 of 5

 Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

 Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

 Driller/Method **Boart Longyear / Rotasonic**

Depth to Water (ft BGS) \_\_\_\_\_

 Sampling Method **Continuous**

 Start/Finish Date **5/19/2008-5/21/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
							Slightly moist, red-brown, sandy, very gravelly SILT (ML); fine to coarse sand, poorly sorted; fine to coarse gravel (40 mm), rounded to subrounded, matrix supported	
35	Checked for perched water (none)	6				<b>glaciofluvial</b>	Very moist, red-brown/dark brown, slightly silty, very gravelly SAND (SP-SM), predominantly medium to coarse sand, moderately well sorted; fine to coarse gravel (40 mm), rounded to subrounded	35
							Moist, red-brown, silty, sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel, subrounded to subangular, clast supported	
		7				<b>till</b>	Slightly moist, brown/dark brown, silty, very sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel (70 mm), round to subangular, matrix supported	
40	Casing at 17 ft; checked for water (none)						Slightly moist, brown/dark brown, sandy, very gravelly SILT (ML); fine to coarse sand; fine to coarse gravel (50 mm), rounded to subangular, matrix supported	40
		8				<b>glaciofluvial</b>	Slightly moist, dark brown, silty/clayey, sandy GRAVEL (GC); fine to coarse sand, poorly sorted; fine to coarse gravel (50mm), rounded to subrounded	45
45							Slightly moist, magenta, sandy, very silty GRAVEL (GM); fine to coarse sand; fine to coarse gravel, rounded to subangular, clast supported	
		9					Slightly moist/moist, red brown/dark brown, slightly sandy, very silty GRAVEL (GM); fine to coarse sand; fine gravel, rounded to subrounded	50
	Casing at 37 ft; checked for water (none)						Moist/very moist, dark brown/dark gray, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand; fine to coarse gravel (50 mm), rounded to subrounded	
50							Moist, gray, silty, very sandy GRAVEL (GM); fine to coarse sand, poorly sorted; fine to coarse gravel (60 mm), rounded to subangular	55
55							Slightly moist/moist, gray/dark brown, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand, moderately well sorted; fine to coarse gravel (45 mm)	

Sampler Type:

PID - Photoionization Detector (Headspace Measurement)

 Logged by: **JMS/JSL**
 No Recovery

 Static Water Level

 Approved by: **EWM**
 Bulk Sample

 Water Level (ATD)

 Figure No. **B- 8**

## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-6a

Sheet  
3 of 5

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

Driller/Method **Boart Longyear / Rotasonic**

Depth to Water (ft BGS) \_\_\_\_\_

Sampling Method **Continuous**

Start/Finish Date **5/19/2008-5/21/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
65	Casing at 57 ft; checked for water (none)	10				Gravel	Slightly moist/moist, red-brown/gray, silty, very sandy GRAVEL (GM); predominantly medium to coarse sand; fine to coarse gravel (60 mm), rounded to subrounded	65
70		11				Sand	Moist, red-brown/dark-brown, slightly silty/clayey, very gravelly SAND (SP-SC); predominantly medium to coarse sand; fine to coarse gravel (60 mm), rounded to subrounded	65
70		11				Sand	Moist, red-brown/dark brown, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand; fine to coarse gravel (40 mm)	70
75		12				Gravel	Moist, red-brown/dark brown, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand; fine to coarse gravel (50 mm), rounded to subrounded	70
75		12				Silt	Sandy, gravelly SILT (ML) interbed (6-inches thick)	75
75		12				Sand	Gravelly SAND (SP) interbed (6-inches thick)	75
75		12				Sand	Moist, gray/dark brown, very gravelly SAND (SP); predominantly medium to coarse sand; fine to coarse gravel (40 mm), rounded to subrounded	75
80		13				Sand	Very moist, gray/dark brown, very gravelly SAND (SP);	80
80		13				Gravel	Moist, dark brown/gray, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand; fine to coarse gravel (40 mm), rounded to subangular	80
85		14				Sand	Moist, dark brown, very gravelly SAND (SP); predominantly medium, well sorted sand; fine to coarse gravel (55 mm)	85
85		14				Gravel	Moist, dark brown, silty, very sandy GRAVEL (GM); fine to coarse sand, poorly sorted, fine to coarse gravel (40 mm), rounded to subrounded	85
85		14				Gravel	Moist, dark brown/gray, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium sand; fine	85

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- Static Water Level
- Water Level (ATD)

Logged by: **JMS/JSL**

Approved by: **EWM**

Figure No. **B- 8**

## Monitoring Well Construction Log

Project Number  
**070041-001**

Well Number  
**MW-6a**

Sheet  
**4 of 5**

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

Driller/Method **Boart Longyear / Rotasonic**

Depth to Water (ft BGS) \_\_\_\_\_

Sampling Method **Continuous**

Start/Finish Date **5/19/2008-5/21/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
95		14					to coarse gravel (65 mm), rounded to subrounded	95
		○					Moist, dark brown, slightly silty, very sandy gravel (GW-GM); fine to coarse sand, poorly sorted; fine to coarse gravel (40 mm), rounded to subrounded	
100		15					Moist, dark gray/dark brown, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand; fine to coarse gravel (60 mm), rounded to subangular	95
		○					Moist, dark brown, very gravelly SAND (SP); predominantly medium, well sorted sand; fine to coarse gravel (70 mm), rounded to subrounded	100
105		16					Moist, dark brown, very sandy GRAVEL (GW); predominantly medium, well sorted sand; fine to coarse gravel (40 mm), rounded to subrounded	105
		○					Slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand, poorly sorted; fine to coarse gravel (60 mm), rounded to angular	105
110		17					Slightly moist, yellow-red/dark brown, silty, very sandy GRAVEL (GM); fine to coarse sand, poorly sorted; fine to coarse gravel (50 mm), rounded to subangular	110
		○					Very moist, dark brown/gray, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand; fine to coarse gravel (60 mm), rounded to subrounded	110
115		○					Slightly moist/moist, gray/dark brown, silty, very gravelly SAND (SM); predominantly medium to coarse sand; fine to coarse gravel (40 mm), rounded to subrounded	115

▽ 5/20/2008

Sampler Type:

- No Recovery
- Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

- ▼ Static Water Level
- ▽ Water Level (ATD)

Logged by: **JMS/JSL**

Approved by: **EWM**

Figure No. **B- 8**



## Monitoring Well Construction Log

 Project Number  
 070041-001

 Well Number  
 MW-6a

 Sheet  
 5 of 5

 Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. \_\_\_\_\_

 Location **Mason County, WA**

Top of Casing Elev. \_\_\_\_\_

 Driller/Method **Boart Longyear / Rotasonic**

Depth to Water (ft BGS) \_\_\_\_\_

 Sampling Method **Continuous**

 Start/Finish Date **5/19/2008-5/21/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
125	Casing at 117 ft; checked for water (none)	18				(Material Type Diagram)	Wet, gray/dark brown, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand, moderately well sorted; fine to coarse gravel (55 mm), rounded to subrounded; scattered gravelly sand pockets with medium, well sorted sand (6-inches thick)	125
130	Casing at 117 ft; ATD of 116.3 ft	19				(Material Type Diagram)	Wet, gray, slightly silty, very gravelly SAND (SP-SM); predominantly medium to coarse sand; fine to coarse gravel (60 mm)	130
135		19				(Material Type Diagram)	Wet, gray/dark brown, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand; fine to coarse gravel (70 mm), rounded to subrounded; occasional, slightly silty, slightly sandy GRAVEL (GP-GM) pockets with fine gravel (6-inches thick)	135
140	Heave (140-146')	20				(Material Type Diagram)	Wet, gray, gravelly SAND (SP); well sorted medium sand; fine gravel Wet, brown/gray, silty, very sandy GRAVEL (GM); predominantly medium to coarse sand; fine to coarse gravel (25 mm) (Sluff?)	140
145		20				(Material Type Diagram)	Wet, slightly silty, very sandy GRAVEL (GW-GM); predominantly medium to coarse sand, moderately well sorted; fine to coarse gravel (50 mm), subrounded to rounded	145

Sampler Type:

PID - Photoionization Detector (Headspace Measurement)

 Logged by: **JMS/JSL**
 No Recovery

 Static Water Level

 Approved by: **EWM**
 Bulk Sample

 Water Level (ATD)

 Figure No. **B- 8**

## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-7

Sheet  
1 of 6

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. 418.55

Location Mason County, WA

Top of Casing Elev. 421.33

Driller/Method Boart Longyear / Rotasonic

Depth to Water (ft BGS) 140.83 - 6/12/2008

Sampling Method Continuous, except for 10' to 12' depth

Start/Finish Date 5/29/2008-5/30/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
415	Square steel monument with locking thermos well cap Concrete surface seal (0-2') Bentonite chips (2-5')						<b>TOPSOIL</b> Dry, yellow-red, silty gravelly SAND (SM), predominantly fine sand.	5
5	Bentonite grout (5-131')	1					<b>RECESSIONAL OUTWASH</b> Dry/slightly moist, brown/gray, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand, fine to coarse gravel (60 mm), round to subround.	5
410								10
405							Cobble.	
15		2					<b>STRATIFIED GLACIAL DEPOSITS</b> <b>till</b> Moist, brown, sandy, very silty GRAVEL (GM); fine to coarse sand; fine to coarse gravel (50 mm), round to subround.	15
							<b>glaciofluvial</b> Moist, brown, silty, gravelly SAND (SM); fine to coarse sand; fine to coarse gravel (40 mm), subround to round.	
400							<b>till</b> Moist, brown, very silty SAND (SP); fine sand (weakly cemented). Moist, brown, silty, sandy GRAVEL (GM); fine to coarse sand; fine to coarse gravel (40 mm), subround to round.	20
20		3					Dry, light gray, sandy, gravelly SILT (ML); fine to coarse sand; fine to coarse gravel (50 mm), subround to round.	
395							Slightly moist, brown, silty, gravelly SAND (SM); fine to coarse sand; fine to coarse gravel (60 mm), subround to round.	
25							Slightly moist, brown, silty, sandy GRAVEL (GM); fine to coarse sand predominantly fine to medium; fine to coarse gravel (65 mm), subround to round.	25
390								

Sampler Type:

PID - Photoionization Detector (Headspace Measurement)

Logged by: JSL

○ No Recovery

▼ Static Water Level

Approved by: EWM

■ Bulk Sample

▽ Water Level (ATD)

Figure No. B- 9

## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-7

Sheet  
2 of 6

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. 418.55

Location Mason County, WA

Top of Casing Elev. 421.33

Driller/Method Boart Longyear / Rotasonic

Depth to Water (ft BGS) 140.83 - 6/12/2008

Sampling Method Continuous, except for 10' to 12' depth

Start/Finish Date 5/29/2008-5/30/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
385							Trace clay (30.5 to 30.7 ft).	
35		4					Trace clay (32 to 32.5 ft).	35
380							Trace clay (37 to 37.5 ft).	
40							Slightly moist, brown, sandy, very gravelly SILT (ML), fine to coarse sand, fine to coarse gravel (60 mm), subround to round.	
40							Brown, slightly moist, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand, fine to coarse gravel (75 mm), subround to round.	40
375							Silty (GM) (43 ft).	
45		5					Slightly moist, brown, slightly silty, very gravelly SAND (SW-SM).	45
370							Cobble.	
50							Cobble.	50
365							<b>glaciofluvial</b> Slightly moist, brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand, fine to coarse gravel (50 mm), subround to round.	
55		6					Till lense (56 ft).	55
360							Moist, brown, slightly silty, gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (50 mm), subround to round.	

Sampler Type:

PID - Photoionization Detector (Headspace Measurement)

Logged by: JSL

○ No Recovery

▼ Static Water Level

Approved by: EWM

■ Bulk Sample

▽ Water Level (ATD)

Figure No. B- 9

## Monitoring Well Construction Log

Project Number  
**070041-001**

Well Number  
**MW-7**

Sheet  
**3 of 6**

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. **418.55**

Location **Mason County, WA**

Top of Casing Elev. **421.33**

Driller/Method **Boart Longyear / Rotasonic**



Depth to Water (ft BGS) **140.83 - 6/12/2008**

Sampling Method **Continuous, except for 10' to 12' depth**



Start/Finish Date **5/29/2008-5/30/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
355							Slightly moist, brown, silty very gravelly SAND (SM); trace clay; fine to coarse sand; fine to coarse gravel (75 mm), subround to round.	
65		7					<b>till</b> Dry, gray, slightly sandy SILT (ML); trace gravel with cobble; fine to coarse sand; fine gravel; "till-like". <b>glaciofluvial</b> Slightly moist, brown, slightly silty, gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (48 mm), subround to round. Silty (SM) (65 ft).	65
350							Slightly silty (SW-SM) (67 ft).	
70							Very gravelly (68 ft).	70
345		8					<b>till</b> Slightly moist, brown/gray, sandy, gravelly SILT (ML); fine to coarse sand; fine to coarse gravel (70 mm), subround to round. <b>glaciofluvial</b> Slightly moist, brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (70 mm), subround to round.	75
75							Dry/slightly moist, light brown, sandy, gravelly SILT (ML), fine to coarse sand; fine to coarse gravel (40 mm), subround to round.	
340							Slightly moist, dark brown, slightly gravelly, very sandy SILT (ML); trace clay; fine to coarse sand; fine to coarse gravel (70 mm), subround to round.	
80							<b>till</b> Slightly moist, dark brown/gray, gravelly, very silty SAND (SM); fine to coarse sand; fine to coarse gravel (75 mm), subround to round.	80
335		9					Cobble.	
85							<b>glaciofluvial</b> Moist, dark brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand, fine to coarse gravel (30mm) subrounded.	85
330							<b>till</b> Dry/slightly moist, light brown/gray, gravelly, very silty SAND (SM); fine to coarse sand; fine to coarse gravel (40 mm), subrounded to rounded. <b>glaciofluvial</b> Moist/slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to	

Sampler Type:

-  No Recovery
-  Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

-  Static Water Level
-  Water Level (ATD)

Logged by: **JSL**

Approved by: **EWM**

Figure No. **B- 9**

## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-7

Sheet  
4 of 6

Project Name Webb Hill Biosolids Facility

Ground Surface Elev. 418.55

Location Mason County, WA

Top of Casing Elev. 421.33

Driller/Method Boart Longyear / Rotasonic



Depth to Water (ft BGS) 140.83 - 6/12/2008

Sampling Method Continuous, except for 10' to 12' depth



Start/Finish Date 5/29/2008-5/30/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
325							coarse gravel (50 mm), subrounded.	
							<b>till</b>	
							Dry, light brown, gravelly, silty SAND (SM). Slightly moist, dark brown/brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (40 mm), subrounded.	
95		10					Increase in sand content and decrease in silt content.	
							Dry/slightly moist, light brown, very gravelly, very silty SAND (SM); fine to coarse sand, fine to coarse gravel (50 mm), subrounded.	95
320							<b>glaciofluvial</b>	
							Slightly moist, brown, slightly silty, gravelly SAND (SW-SM).	
							<b>till</b>	
100							Dry/slightly moist, light brown, very gravelly, very silty SAND (SM); fine to coarse sand, fine to coarse gravel (50 mm), subrounded.	
							Slightly moist, dark brown, silty, gravelly SAND (SM); fine to coarse sand; fine to coarse gravel (75 mm), subrounded.	100
315							Increase in sand content (98.5 ft). Brown-yellow, slightly silty; fine to coarse gravel (70 mm) predominantly fine (SW-SM) (99.2 ft). Brown yellow with magenta (99.5 ft). Dark brown, silty (SM) (99.7 ft). Slightly silty (SW-SM) (102.5 ft). Silty (SM) (103 ft).	
105		11					<b>glaciofluvial</b>	105
							Slightly moist, dark brown, gravelly SAND (SP); trace silt; fine to coarse sand, predominantly medium; fine gravel.	
							Slightly silty, fine to coarse gravel (50 mm), subrounded (SP-SM) (106 ft).	
							Trace silt (SP) (106.5 ft).	
							Slightly silty (SP-SM) (107 ft).	
							Trace silt (SP) (108 ft).	
310							Slightly moist, dark brown, slightly silty, very gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (30 mm), subrounded.	
110		12					Slightly moist, dark brown, gravelly SAND (SP/SW); trace silt; fine to coarse sand, predominantly fine to medium (at 110 ft); fine to coarse gravel (35 mm), subrounded.	110
							Fine to coarse sand (111 ft). Fine to coarse sand predominantly fine to medium; fine gravel (112.5 ft). Fine to coarse sand (113 ft).	
305							<b>till</b>	
							Slightly moist, dark brown, silty, gravelly SAND (SM).	115
115							Very silty (114.4 ft). Dark brown with magenta (114.9 ft).	
							<b>glaciofluvial</b>	
							Slightly moist, dark brown, gravelly SAND (SW); trace silt; fine to coarse gravel (30 mm), subrounded.	
							Slightly gravelly (116 to 116.8 ft).	
300							<b>till</b>	
							Slightly moist, light brown, slightly silty, very gravelly SAND (SM); fine to coarse sand; fine to coarse gravel (35 mm) subrounded.	

Sampler Type:

-  No Recovery
-  Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

-  Static Water Level
-  Water Level (ATD)

Logged by: JSL

Approved by: EWM

Figure No. B- 9



## Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-7

Sheet  
5 of 6

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. **418.55**

Location **Mason County, WA**

Top of Casing Elev. **421.33**

Driller/Method **Boart Longyear / Rotasonic**



Depth to Water (ft BGS) **140.83 - 6/12/2008**

Sampling Method **Continuous, except for 10' to 12' depth**



Start/Finish Date **5/29/2008-5/30/2008**

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
295		13				glaciofluvial	Slightly moist, dark brown, gravelly SAND (SW); trace silt; fine to coarse gravel (50 mm), subrounded. Moist, dark brown, slightly silty, very gravelly SAND (SW-SM).	
125		14				till	Slightly moist, dark brown, silty, gravelly SAND (SM); fine to coarse sand; fine to coarse gravel (25 mm), subrounded.	125
290		14				glaciofluvial	Moist, dark brown, gravelly SAND (SW); trace silt; fine to coarse sand; fine to coarse gravel (40 mm), subrounded. Dry/moist, gray/brown, silty, gravelly SAND (SM). Moist, dark brown, slightly gravelly SAND (SW); trace silt; fine to coarse sand; fine to coarse gravel (50 mm). Wet, gravelly (127 ft). Moist, slightly silty (SW-SM) (127.5 ft). Trace silt (SW) (127.8 ft). Wet (128 ft). Moist (129 ft).	
130		15					Slightly moist, brown, slightly silty, gravelly SAND (SW-SM); fine to coarse sand; fine to coarse gravel (45 mm). Silty (SM). Very silty; "till-like". Dark brown, silty, not "till-like". Dry/slightly moist, light brown, very silty; "till-like".	130
285	Bentonite pellets (131-141.7')	15						
140	20/40 Colorado silica sand (141.7-143.1')	16					Moist, dark brown, slightly gravelly SAND (SP); trace silt; fine to coarse sand, predominantly fine to medium; fine to coarse gravel (40 mm). Moist/wet, brown, very gravelly; fine to coarse sand (SW) (140 ft). Slightly silty (SW-SM) (141 ft). Gravelly; trace silt (SW) (142.2 ft). Slightly silty "till-like" (SW-SM) (143.7 ft). Very gravelly; trace silt (SW) (144.5 ft). Slightly silty (SW-SM) (146.5 ft). Wet, dark brown, very gravelly SAND (SW); trace silt; fine to coarse sand; fine to coarse gravel (45 mm), subrounded. Gravelly; coarse sand; fine gravel.	140
275	10/20 Colorado silica sand (143.1-170.6')	16						
145	Centralizer (145')	16						145
270	2" schedule 40 PVC slotted pipe 0.020" slot size (145.4-170')	16						

Sampler Type:

-  No Recovery
-  Bulk Sample

PID - Photoionization Detector (Headspace Measurement)

-  Static Water Level
-  Water Level (ATD)

Logged by: **JSL**

Approved by: **EWM**

Figure No. **B- 9**



# Monitoring Well Construction Log

Project Number  
070041-001

Well Number  
MW-7

Sheet  
6 of 6

Project Name **Webb Hill Biosolids Facility**

Ground Surface Elev. 418.55

Location Mason County, WA

Top of Casing Elev. 421.33

Driller/Method Boart Longyear / Rotasonic

Depth to Water (ft BGS) 140.83 - 6/12/2008

Sampling Method Continuous, except for 10' to 12' depth

Start/Finish Date 5/29/2008-5/30/2008

Depth / Elevation (feet)	Borehole Completion	Sample Type/ID	Tests	PID (ppm)	Blows/ 6"	Material Type	Description	Depth (ft)
265	Centralizer (155')	17				Slightly silty (SW-SM); fine to coarse gravel (75 mm), subrounded.	155	
			Very gravelly; trace silt; fine to coarse sand (SW).					
			Cobble.					
			Slightly silty (SW-SM).					
			No silt (SW).					
			Trace silt.					
155			Wet, dark brown, slightly silty, very sandy GRAVEL (GW-GM); fine to coarse sand; fine to coarse gravel (40 mm), subrounded.					
			Wet, dark brown, very gravelly SAND (SW); fine to coarse sand; fine to coarse gravel (50 mm), subrounded.					
260			Coarse sand, fine gravel (SP) (156.8 ft).					
			Trace silt (157 ft).					
160	No silt, fine to coarse sand (SW) (157.5 ft).							
	Dark brown/gray, gravelly; sand predominantly fine to medium; gravel predominantly fine (25mm) (SP) (160 ft).							
	Sand predominantly medium to coarse (160.5 ft).							
	Sand predominantly fine to medium (161 ft).							
	Slightly silty, very gravelly; fine to coarse sand; fine to coarse gravel (60 mm) (SW-SM)(161.5 ft).							
	Gray (162.6 ft).							
255	Centralizer (165')	18				Trace silt (SW) (167 ft).	165	
			No silt (167.8 ft).					
250								
170	2" PVC pipe cap (170-170.4')						170	
245								
175								175
240								

Sampler Type:

PID - Photoionization Detector (Headspace Measurement)

Logged by: JSL

○ No Recovery

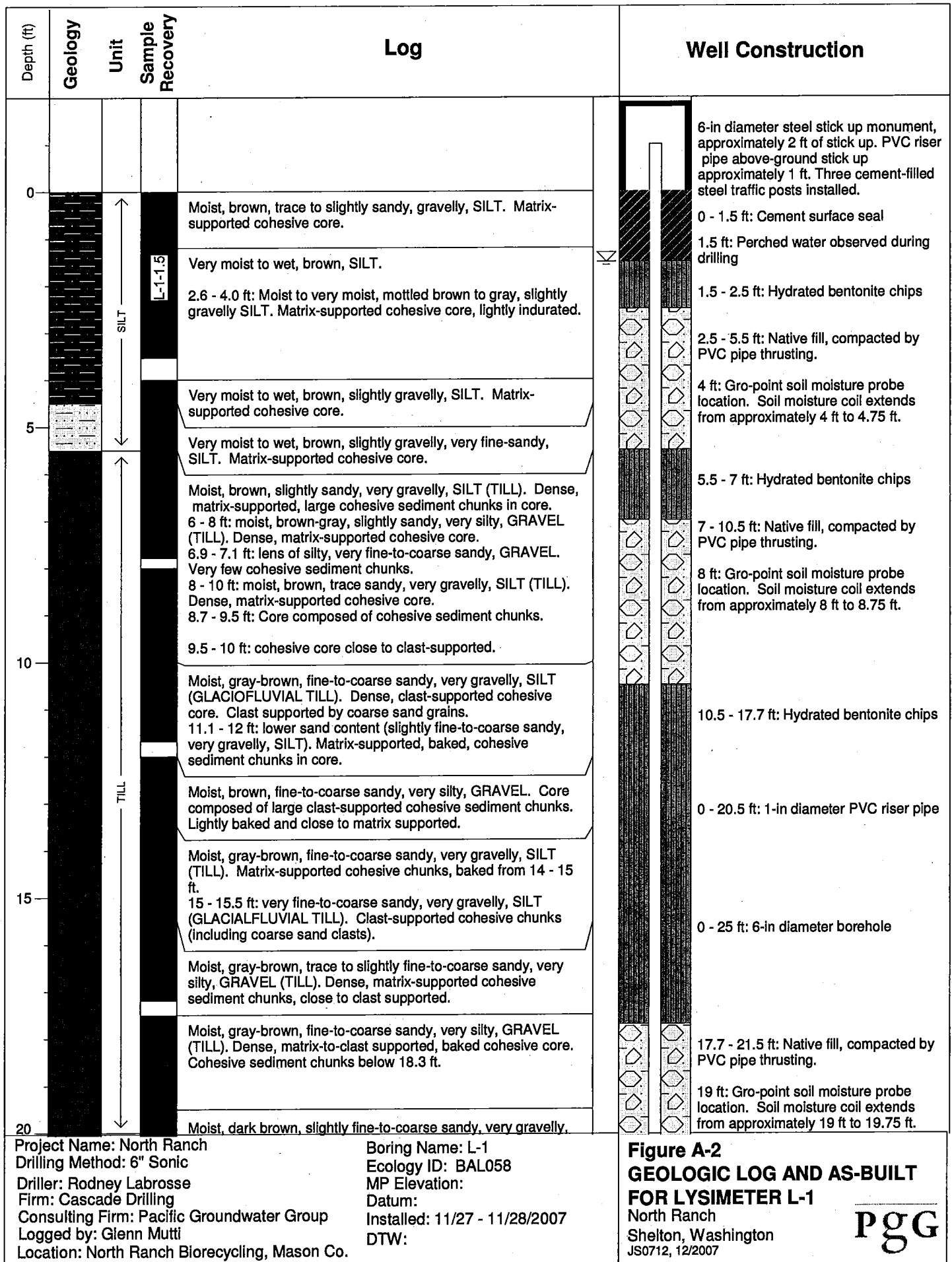
▼ Static Water Level

Approved by: EWM

■ Bulk Sample

▽ Water Level (ATD)


Figure No. B- 9



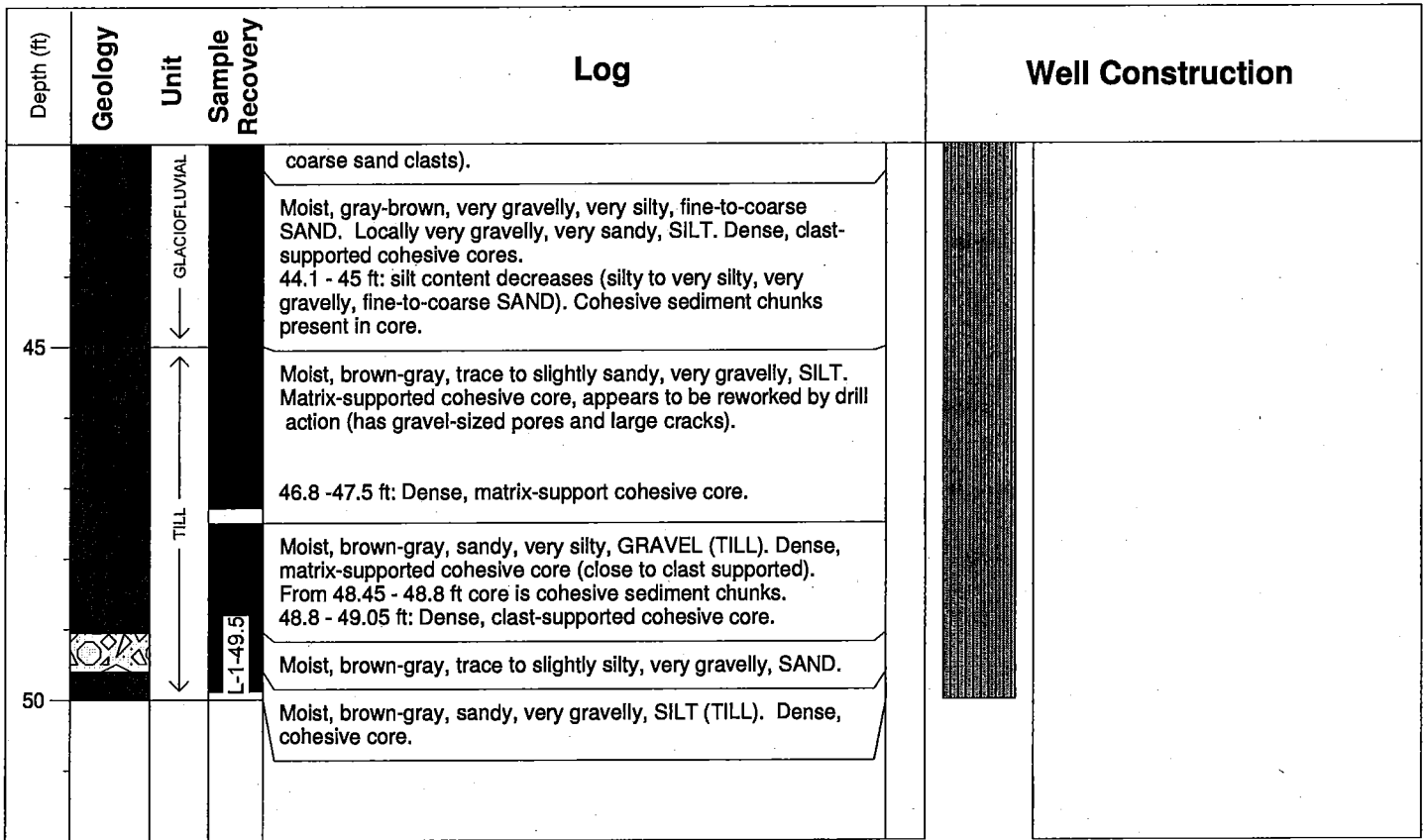
Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Boring Name: L-1  
 Ecology ID: BAL058  
 MP Elevation:  
 Datum:  
 Installed: 11/27 - 11/28/2007  
 DTW:

**Figure A-2**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR LYSIMETER L-1**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007







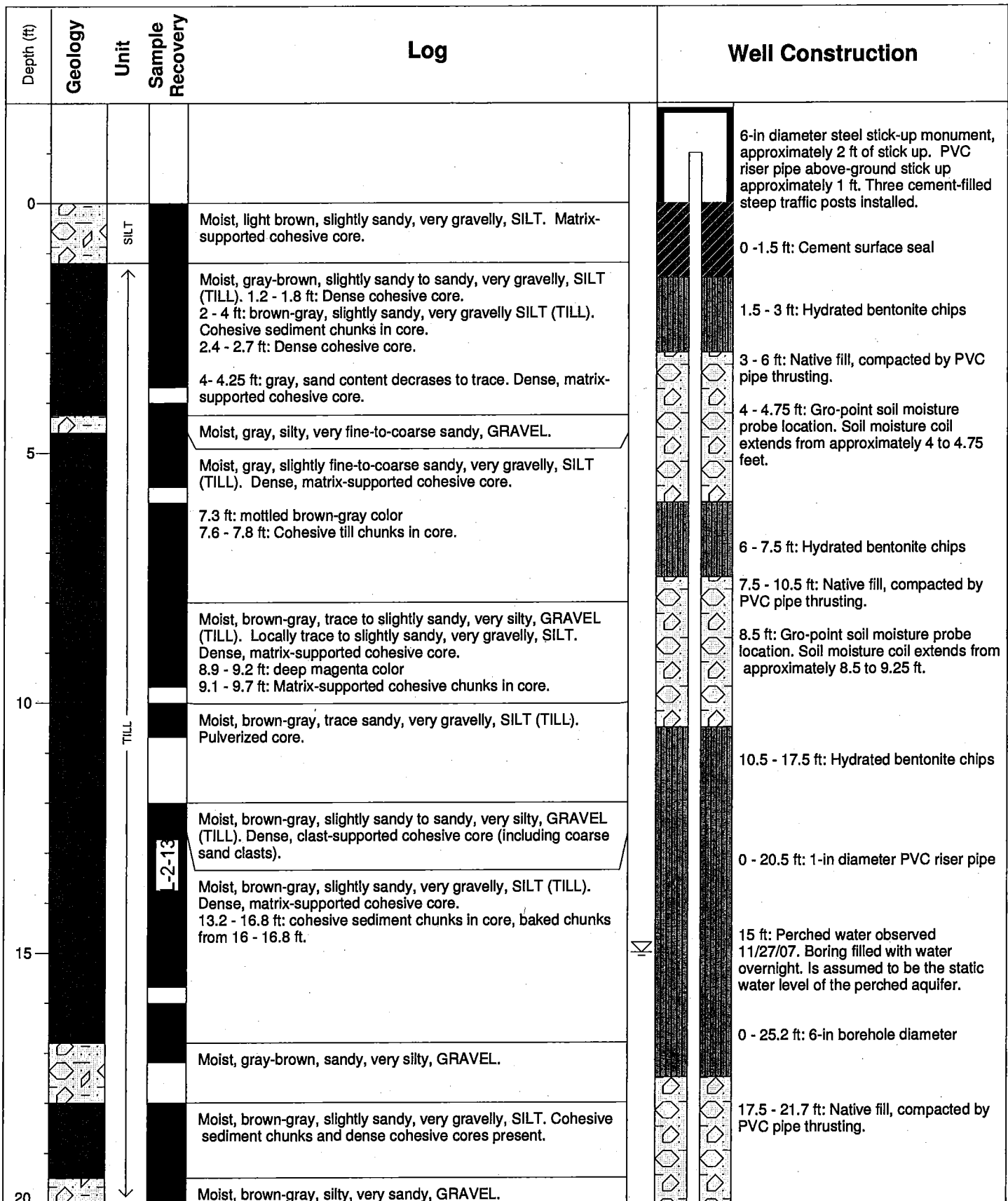
Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Boring Name: L-1  
 Ecology ID: BAL058  
 MP Elevation:  
 Datum:  
 Installed: 11/27 - 11/28/2007  
 DTW:

**Figure A-2**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR LYSIMETER L-1**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007





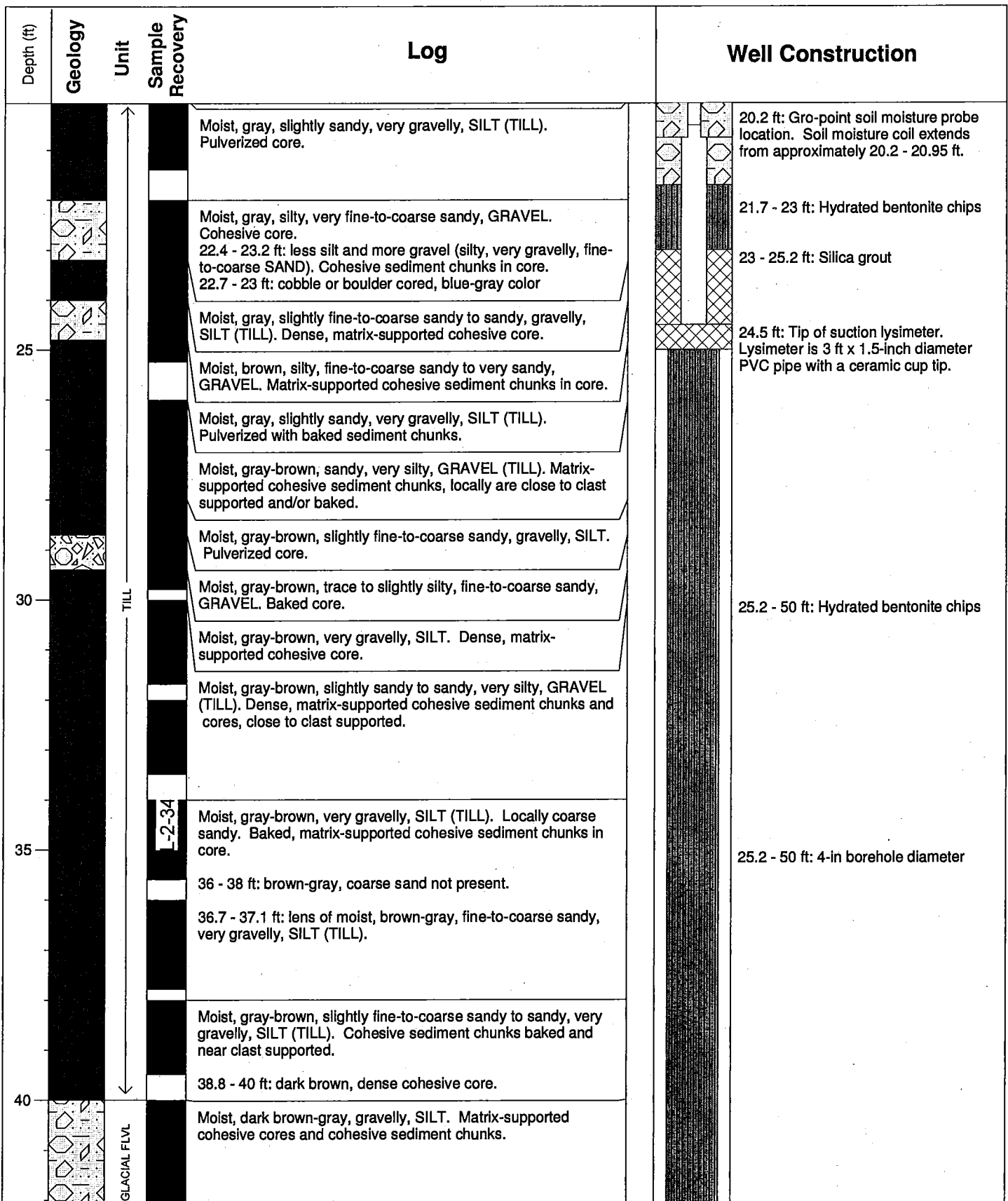


Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Boring Name: L-2  
 Ecology ID: BAL057  
 MP Elevation:  
 Datum:  
 Installed: 11/26 - 11/27/2007  
 DTW:

**Figure A-3**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR LYSIMETER L-2**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007

**PGG**




Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Boring Name: L-2  
 Ecology ID: BAL057  
 MP Elevation:  
 Datum:  
 Installed: 11/26 - 11/27/2007  
 DTW:

**Figure A-3**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR LYSIMETER L-2**  
 North Ranch  
 Shelton, Washington  
 JS0712, 12/2007

**PGG**

Depth (ft)	Geology	Unit	Sample Recovery	Log	Well Construction
45		TILL	L-2-46	<p>Moist, dark brown-gray, fine-to-coarse sandy, gravelly, SILT (TILL). Matrix-supported cohesive sediment chunks in core. 43.4 - 44 ft: locally very sandy. Dense, matrix-supported cohesive cores.</p> <p>Moist, dark gray, trace to slightly sandy, very gravelly, SILT (TILL). Dense, cohesive cores. 46.2 - 47.5 ft: sand content trace sandy. 46.2 - 47 ft: Cohesive sediment chunks in core. 47 - 47.5 ft: Core is pulverized and has a 3-inch, dense cohesive core.</p> <p>Moist, brown-gray, slightly sandy, very gravelly, SILT (TILL). Matrix-supported cohesive sediment chunks.</p> <p>48.2 - 50 ft: dark gray 48.2 - 48.7 ft: lens of moist, very gravelly SILT (TILL). Dense, cohesive sediment chunks present. 48.7 - 49.1 ft: baked cohesive sediment chunks in core.</p>	
50					

Project Name: North Ranch  
 Drilling Method: 6" Sonic  
 Driller: Rodney Labrosse  
 Firm: Cascade Drilling  
 Consulting Firm: Pacific Groundwater Group  
 Logged by: Glenn Mutti  
 Location: North Ranch Biorecycling, Mason Co.

Boring Name: L-2  
 Ecology ID: BAL057  
 MP Elevation:  
 Datum:  
 Installed: 11/26 - 11/27/2007  
 DTW:

**Figure A-3**  
**GEOLOGIC LOG AND AS-BUILT**  
**FOR LYSIMETER L-2**

North Ranch  
 Shelton, Washington  
 JS0712, 12/2007

**PGG**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.

WS-2

WATER WELL REPORT

Start Card No. W124738  
 Unique Well I.D. # AWK643  
 Water Right Permit No.

STATE OF WASHINGTON

(1) OWNER: Name **MIO RECYCLING** Address **PO BOX 382 CENTRALIA, WA 98531-**

(2) LOCATION OF WELL: County **MASON** - SE 1/4 NW 1/4 Sec 18 T 21 N., R 3  
 (2a) STREET ADDRESS OF WELL (or nearest address) **WEBB HILL ROAD, SEKLTON**

(3) PROPOSED USE: **DOMESTIC** (10) WELL LOG

(4) TYPE OF WORK: Owner's Number of well  
 (If more than one)  
**NEW WELL** Method: **ROTARY**  
 Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.

(5) DIMENSIONS: Diameter of well **6** inches  
 Drilled **197** ft. Depth of completed well **197** ft.

(6) CONSTRUCTION DETAILS:  
 Casing installed: **6** \* Dia. from **+2** ft. to **193.2** ft.  
**WELDED CASING** \* Dia. from ft. to ft.  
 \* Dia. from ft. to ft.  
 Perforations: **NO**  
 Type of perforator used  
 SIZE of perforations in. by in.  
 perforations from ft. to ft.  
 perforations from ft. to ft.  
 perforations from ft. to ft.  
 MATERIAL FROM TO  
**LOOSE PACKED SAND FEA GRAVEL** 0 5  
**LOOSE PACKED SAND GRAVEL** 5 28  
**SAND & GRAVEL BRN CLAY BINDER HARD PAN** 28 54  
**PACKED COURSE SAND GRAVEL** 54 87  
**MULTI-COLOR GRV LOOSE COURSE SAND** 87 151  
**LOOSE MULTI-COLOR GRV COURSE SAND** 151 160  
**MULTI-COLOR GRV COURSE SAND WATER** 160 197

Screens: **YES**  
 Manufacturer's Name **HOUSTON**  
 Type **SLOTTED** Model No.  
 Diam. **5** slot size **.030** from **197** ft. to **191** ft.  
 Diam. slot size from ft. to ft.

Gravel packed: **NO** Size of gravel  
 Gravel placed from ft. to ft.

Surface seal: **YES** To what depth? **20** ft.  
 Material used in seal **BENTONITE**  
 Did any strata contain unusable water? **NO**  
 Type of water? Depth of strata ft.  
 Method of sealing strata off

(7) PUMP: Manufacturer's Name  
 Type H.P.

(8) WATER LEVELS: Land-surface elevation  
 above mean sea level ... ft.  
 Static level **146** ft. below top of well Date **04/18/00**  
 Artesian Pressure lbs. per square inch Date  
 Artesian water controlled by

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.  
 Was a pump test made? **NO** If yes, by whom?  
 Yield: gal./min with ft. drawdown after hrs.

Recovery data  
 Time Water Level Time Water Level Time Water Level  
 Date of test / /  
 Bailor test gal./min. ft. drawdown after hrs.  
 Air test 40 gal./min. w/ stem set at 100 ft. for 1 hrs.  
 Artesian flow g.p.m. Date  
 Temperature of water Was a chemical analysis made? **NO**

RECEIVED

MAY - 1 2000

DEPARTMENT OF ECOLOGY  
 WELL DRILLING UNIT

Work started **04/17/00** Completed **04/18/00**

WELL CONSTRUCTOR CERTIFICATION:  
 I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington Well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME **ARCADIA DRILLING INC.**  
 (Person, firm, or corporation) (Type or print)

ADDRESS **SE 170 WILSON PARK RD**

(SIGNED) *[Signature]* License No. **2053**

Contractor's  
 Registration No. **ARCADDIO98K1** Date **04/18/00**



WATER WELL REPORT

Start Card No. A49208  
 Unique Well I.D. # N/A  
 Water Right Permit No.

STATE OF WASHINGTON

(1) OWNER: Name **BIO RECYCLING** Address **PO BOX 982 CENTRAILIA, WA 98531-**

(2) LOCATION OF WELL: County **MASON** - SE 1/4 NW 1/4 Sec 18 T 21 N., R 3 W

(2a) STREET ADDRESS OF WELL (or nearest address) **WEBB HILL ROAD, SHELTON**

(3) PROPOSED USE: **DOMESTIC** (10) WELL LOG

(4) TYPE OF WORK: Owner's Number of well (If more than one) **DECOMMISSION** Method: **ROTARY**  
 Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.

(5) DIMENSIONS: Diameter of well **6** inches  
 Drilled ft. Depth of completed well **160** ft.

(6) CONSTRUCTION DETAILS:  
 Casing installed: **6** " Dia. from ft. to **160.6** ft.  
**WELDED CASING** " Dia. from ft. to ft.  
 " Dia. from ft. to ft.

Perforations: **YES**  
 Type of perforator used **AIR PERFORATOR**  
 SIZE of perforations **1/4** in. by **1** in.  
**2560** perforations from **150** ft. to **0** ft.  
 perforations from ft. to ft.  
 perforations from ft. to ft.

Screens: **NO**  
 Manufacturer's Name  
 Type Model No.  
 Diam. slot size from ft. to ft.  
 Diam. slot size from ft. to ft.

Gravel packed: **NO** Size of gravel  
 Gravel placed from ft. to ft.

Surface seal: **NO** To what depth? ft.  
 Material used in seal  
 Did any strata contain unusable water? **NO**  
 Type of water? Depth of strata ft.  
 Method of sealing strata off

(7) PUMP: Manufacturer's Name  
 Type H.P.

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.  
 Static level **105** ft. below top of well Date **05/01/00**  
 Artesian Pressure lbs. per square inch Date  
 Artesian water controlled by

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.  
 Was a pump test made? **NO** IF yes, by whom?  
 Yield: gal./min with ft. drawdown after hrs.

Recovery data  
 Time Water Level Time Water Level Time Water Level

Date of test / /  
 Bailer test gal/min. ft. drawdown after hrs.  
 Air test gal/min. w/ stem set at ft. for hrs.  
 Artesian flow g.p.m. Date  
 Temperature of water Was a chemical analysis made? **NO**

MATERIAL FROM TO

Perferated 4 sides of casing  
 Filled with Bentonite Slurry topped off with Hole Plug

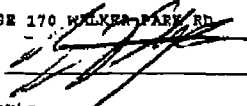
Work started **05/01/00** Completed **05/01/00**

RECEIVED  
 JUN 02 2000  
 DEPARTMENT OF ECOLOGY  
 WELL DRILLING UNIT

WELL CONSTRUCTOR CERTIFICATION:  
 I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME **ARCADIA DRILLING INC.**  
 (Person, firm, or corporation) (Type or print)

ADDRESS **SR 170 WALKER PARK RD**

[SIGNED]  License No. **2053**

Contractor's  
 Registration No. **ARCADDIO98K1** Date **05/02/00**

The Department of Ecology does NOT Warranty the Data and/or the Information on this Well Report.





## **APPENDIX C**

### **Groundwater Chemistry: Data Validation and Laboratory Reports**

## **C.1 DATA VALIDATION**

## C.1 Data Validation

Laboratory analyses were performed by Columbia Analytical Services, Inc., Kelso, Washington. Analytical data and quality control reports are provided in Appendix C.2 and additional quality assurance reports by laboratory are on file. The analytical test results are discussed in Section 4.

Samples were packed in coolers with cold packs and shipped to the test laboratory for delivery within not more than 44 hours from time of sampling. No deviation from required holding temperature was noted by the laboratory.

Samples were analyzed for nitrate within the required 48 hour holding time. All other lab tests were completed within 9 days from time of sampling.

Results of laboratory verification tests—laboratory blank, laboratory control spike (LCS), laboratory duplicate, and matrix spike—were all within acceptable limits, as specified in the QAPP, for all analytes except as noted:

- Duplicate analyses of total phosphorus (TP) and total organic carbon (TOC) for MW-5 differed by 50 percent and 22 percent, respectively. However, the relative percent difference criterion is not applicable because analyte concentrations were not significantly greater than the minimum reporting limits (MRLs).

## **C.2 LABORATORY REPORTS**

June 24, 2008

Analytical Report for Service Request No: K0805184

Erick Miller  
Aspect Consulting  
179 Madrone Lane North  
Bainbridge Island, WA 98110

**RE: Webb Hill Biosolids Facility/070041**

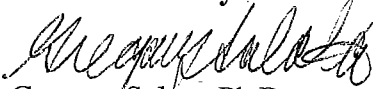
Dear Erick:

Enclosed are the results of the rush samples submitted to our laboratory on June 12, 2008. For your reference, these analyses have been assigned our service request number K0805184.

All analyses were performed according to our laboratory's quality assurance program. Where applicable, the methods cited conform to the Methods Update Rule (effective 4/11/2007), which relates to the use of analytical methods for the drinking water and waste water programs. The test results meet requirements of the NELAC standards. Exceptions are noted in the case narrative report where applicable. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for use of less than the complete report. Results apply only to the items submitted to the laboratory for analysis and individual items (samples) analyzed, as listed in the report.

Please call if you have any questions. My extension is 3376. You may also contact me via Email at [GSalata@caslab.com](mailto:GSalata@caslab.com).

Respectfully submitted,

**Columbia Analytical Services, Inc.**

Gregory Salata, Ph.D.  
Project Chemist

GS/ss

Page 1 of 433



## Acronyms

ASTM	American Society for Testing and Materials
A2LA	American Association for Laboratory Accreditation
CARB	California Air Resources Board
CAS Number	Chemical Abstract Service registry Number
CFC	Chlorofluorocarbon
CFU	Colony-Forming Unit
DEC	Department of Environmental Conservation
DEQ	Department of Environmental Quality
DHS	Department of Health Services
DOE	Department of Ecology
DOH	Department of Health
EPA	U. S. Environmental Protection Agency
ELAP	Environmental Laboratory Accreditation Program
GC	Gas Chromatography
GC/MS	Gas Chromatography/Mass Spectrometry
LUFT	Leaking Underground Fuel Tank
M	Modified
MCL	Maximum Contaminant Level is the highest permissible concentration of a substance allowed in drinking water as established by the USEPA.
MDL	Method Detection Limit
MPN	Most Probable Number
MRL	Method Reporting Limit
NA	Not Applicable
NC	Not Calculated
NCASI	National Council of the Paper Industry for Air and Stream Improvement
ND	Not Detected
NIOSH	National Institute for Occupational Safety and Health
PQL	Practical Quantitation Limit
RCRA	Resource Conservation and Recovery Act
SIM	Selected Ion Monitoring
TPH	Total Petroleum Hydrocarbons
tr	Trace level is the concentration of an analyte that is less than the PQL but greater than or equal to the MDL.

### Inorganic Data Qualifiers

- \* The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
- U The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
- i The MRL/MDL has been elevated due to a matrix interference.
- X See case narrative.

### Metals Data Qualifiers

- # The control limit criteria is not applicable. See case narrative.
- B The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
- E The percent difference for the serial dilution was greater than 10%, indicating a possible matrix interference in the sample.
- M The duplicate injection precision was not met.
- N The Matrix Spike sample recovery is not within control limits. See case narrative.
- S The reported value was determined by the Method of Standard Additions (MSA).
- U The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
- W The post-digestion spike for furnace AA analysis is out of control limits, while sample absorbance is less than 50% of spike absorbance.
- i The MRL/MDL has been elevated due to a matrix interference.
- X See case narrative.
- \* The duplicate analysis not within control limits. See case narrative.
- + The correlation coefficient for the MSA is less than 0.995.

### Organic Data Qualifiers

- \* The result is an outlier. See case narrative.
- # The control limit criteria is not applicable. See case narrative.
- A A tentatively identified compound, a suspected aldol-condensation product.
- B The analyte was found in the associated method blank at a level that is significant relative to the sample result.
- C The analyte was qualitatively confirmed using GC/MS techniques, pattern recognition, or by comparing to historical data.
- D The reported result is from a dilution.
- E The result is an estimate amount because the value exceeded the instrument calibration range.
- J The result is an estimated concentration that is less than the MRL but greater than or equal to the MDL.
- N The result is presumptive. The analyte was tentatively identified, but a confirmation analysis was not performed.
- P The GC or HPLC confirmation criteria was exceeded. The relative percent difference is greater than 40% between the two analytical results (25% for CLP Pesticides).
- U The compound was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL.
- i The MRL/MDL has been elevated due to a chromatographic interference.
- X See case narrative.

### Additional Petroleum Hydrocarbon Specific Qualifiers

- F The chromatographic fingerprint of the sample matches the elution pattern of the calibration standard.
- L The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of lighter molecular weight constituents than the calibration standard.
- H The chromatographic fingerprint of the sample resembles a petroleum product, but the elution pattern indicates the presence of a greater amount of heavier molecular weight constituents than the calibration standard.
- O The chromatographic fingerprint of the sample resembles an oil, but does not match the calibration standard.
- Y The chromatographic fingerprint of the sample resembles a petroleum product eluting in approximately the correct carbon range, but the elution pattern does not match the calibration standard.
- Z The chromatographic fingerprint does not resemble a petroleum product.

**Columbia Analytical Services, Inc.**  
**Kelso, WA**  
**State Certifications, Accreditations, and Licenses**

<b>Program</b>	<b>Number</b>
Alaska DEC UST	UST-040
Arizona DHS	AZ0339
Arkansas - DEQ	88-0637
California DHS	2286
Colorado DPHE	-
Florida DOH	E87412
Hawaii DOH	-
Idaho DHW	-
Indiana DOH	C-WA-01
Louisiana DEQ	3016
Louisiana DHH	LA050010
Maine DHS	WA0035
Michigan DEQ	9949
Minnesota DOH	053-999-368
Montana DPHHS	CERT0047
Nevada DEP	WA35
New Jersey DEP	WA005
New Mexico ED	-
North Carolina DWQ	605
Oklahoma DEQ	9801
Oregon - DHS	WA200001
South Carolina DHEC	61002
Utah DOH	COLU
Washington DOE	C1203
Wisconsin DNR	998386840
Wyoming (EPA Region 8)	-



COLUMBIA ANALYTICAL SERVICES, INC.

Client: Aspect Consulting Service Request No.: K0805184  
Project: Webb Hill Biosolids Facility/070041 Date Received: 06/12/08 to  
Sample Matrix: Water 06/13/08

CASE NARRATIVE

All analyses were performed consistent with the quality assurance program of Columbia Analytical Services, Inc. (CAS). This report contains analytical results for samples designated for Tier III validation deliverables including summary forms and all of the associated raw data for each of the analyses. When appropriate to the method, method blank results have been reported with each analytical test.

Sample Receipt

Three water samples were received for analysis at Columbia Analytical Services on 06/12/08 to 06/13/08. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4°C upon receipt at the laboratory.

General Chemistry Parameters

Phosphorus, Total by EPA 365.3

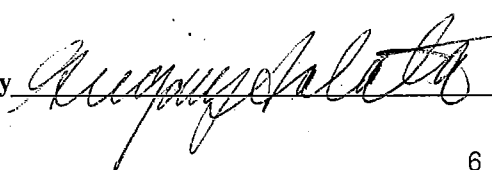
Carbon, Total Organic by EPA 415.1

The Relative Percent Difference (RPD) criterion for the replicate analysis of Total Phosphorus and Total Organic Carbon in sample MW-5 is not applicable because the analyte concentration was not significantly greater than the Method Reporting Limit (MRL). Analytical values derived from measurements close to the detection limit are not subject to the same accuracy and precision criteria as results derived from measurements higher on the calibration range for the method.

No other anomalies associated with the analysis of these samples were observed.

Total Metals

No anomalies associated with the analysis of these samples were observed.

Approved by  Date 6/24/08

PROJECT NAME: <u>Webb Hill</u>					NUMBER OF CONTAINERS	Semi-volatile Organics by GC/MS 625 <input type="checkbox"/> 8270 <input type="checkbox"/> 8270LL <input type="checkbox"/>	Volatile Organics 624 <input type="checkbox"/> 8260 <input type="checkbox"/>	Hydrocarbons (*see below) Gas <input type="checkbox"/> Diesel <input type="checkbox"/> Oil <input type="checkbox"/>	Fuel Fingerprint (FIQ) Oil & Grease/TRPH 1664 HEM <input type="checkbox"/> 1664 SGT <input type="checkbox"/>	PCB's Aroclors <input type="checkbox"/> Congeners <input type="checkbox"/>	Pesticides/Herbicides 608 <input type="checkbox"/> 8087A <input type="checkbox"/>	Chlorophenolics - 8141A <input type="checkbox"/> 8151A <input type="checkbox"/>	Tri <input type="checkbox"/> Tetra <input type="checkbox"/> PCP <input type="checkbox"/>	PAHS 8310 <input type="checkbox"/> SIM <input type="checkbox"/>	Metals, Total or Dissolved (See list below)	Cyanide <input type="checkbox"/>	pH Cond. (Cl, SO4) (NO3)BOB, TSS, TDS (circle) DOC (circle) NO2, NO3 TOX 9020 <input type="checkbox"/> AOX 1650 <input type="checkbox"/> 506 <input type="checkbox"/>	Hex-Chrom <input type="checkbox"/>	Bromide <input type="checkbox"/> Cyanide <input type="checkbox"/>	REMARKS	
PROJECT NUMBER: <u>070041</u>																					
PROJECT MANAGER: <u>Eric Miller</u>																					
COMPANY ADDRESS: <u>Aspect Consulting</u>																					
CITY/STATE/ZIP: <u>179 Madrone Lane N Gainbridge Is. WA 98110</u>																					
E-MAIL ADDRESS: <u>libischer@aspectconsulting.com</u>																					
PHONE # <u>360-780-7721</u> FAX# _____																					
SAMPLER'S SIGNATURE: <u>Joseph Libischer</u>																					
SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX																	
MW-5	6/10/08				4																
MW-7	6/11/08	11:40			4																

<p><b>REPORT REQUIREMENTS</b></p> <p><input type="checkbox"/> I. Routine Report: Method Blank, Surrogate, as required</p> <p><input type="checkbox"/> II. Report Dup., MS, MSD as required</p> <p><input checked="" type="checkbox"/> III. Data Validation Report (includes all raw data)</p> <p><input type="checkbox"/> IV. CLP Deliverable Report</p> <p><input checked="" type="checkbox"/> V. EDD</p>	<p><b>INVOICE INFORMATION</b></p> <p>P.O. # <u>070041</u></p> <p>Bill To: <u>Aspect</u></p>	<p>Circle which metals are to be analyzed:</p> <p>Total Metals: Al As Sb Ba Be B <u>Ca</u> Cd Co Cr Cu <u>Fe</u> Pb <u>Mg</u> <u>Mn</u> Mo Ni <u>K</u> Ag <u>Na</u> Se Sr Ti Sn V Zn Hg</p> <p>Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Ti Sn V Zn Hg</p> <p>*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)</p> <p><b>SPECIAL INSTRUCTIONS/COMMENTS:</b></p> <p><u>Report with other samples from this project.</u></p>
<p><b>TURNAROUND REQUIREMENTS</b></p> <p>___ 24 hr. ___ 48 hr.</p> <p><input checked="" type="checkbox"/> <u>5 Day</u></p> <p>___ Standard (10-15 working days)</p> <p>___ Provide FAX Results</p> <p>Requested Report Date _____</p>		

<p>RELINQUISHED BY:</p> <p><u>Joseph Libischer</u> <u>6/10/08 15:00</u></p> <p>Signature Date/Time</p> <p>Printed Name Firm</p>	<p>RECEIVED BY:</p> <p><u>Jan [Signature]</u> <u>6/12/08 0930</u></p> <p>Signature Date/Time</p> <p>Printed Name Firm <u>CAS</u></p>	<p>RELINQUISHED BY:</p> <p>Signature Date/Time</p> <p>Printed Name Firm</p>	<p>RECEIVED BY:</p> <p>Signature Date/Time</p> <p>Printed Name Firm</p>
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PROJECT NAME <u>Webb Hill</u>					NUMBER OF CONTAINERS	Semi-volatile Organics by GC/MS 625 <input type="checkbox"/> 8270 <input type="checkbox"/> 8270LL <input type="checkbox"/>	Volatile Organics 624 <input type="checkbox"/> 8260 <input type="checkbox"/>	Hydrocarbons Gas <input type="checkbox"/> 8021 <input type="checkbox"/> BTEX <input type="checkbox"/>	Fuel Fingerprint Oil <input type="checkbox"/>	Oil & Grease/TPH 1664 HEM <input type="checkbox"/> 1664 SGT <input type="checkbox"/>	PCBs Aroclors <input type="checkbox"/> Congeners <input type="checkbox"/>	Pesticides/Herbicides 608 <input type="checkbox"/> 8081A <input type="checkbox"/>	Chlorophenolics Tri <input type="checkbox"/> 8141A <input type="checkbox"/> 8151A <input type="checkbox"/>	PAHS 8310 <input type="checkbox"/> SIM <input type="checkbox"/>	Metals, Total or Dissolved (See list below)	Cyanide <input type="checkbox"/>	pH Cond. (C) BO (S) PO 4(F) NO <sub>3</sub> (N) COB, Total (circle) 2', TOX 9020 <input type="checkbox"/> AOX 1650 <input type="checkbox"/> 506 <input type="checkbox"/>	Hex-Chrom <input type="checkbox"/>	Stenide Carbonate Bicarbonate HCO <sub>3</sub> CO <sub>2</sub>	REMARKS	
PROJECT NUMBER <u>070041</u>																					
PROJECT MANAGER <u>Erick Miller</u>																					
COMPANY/ADDRESS <u>Aspect Consulting</u>																					
CITY/STATE/ZIP <u>Gainbridge Is, WA 98110</u>																					
E-MAIL ADDRESS <u>ljobischer@aspectconsulting.com</u>																					
PHONE # <u>206-780-7774</u> FAX# _____																					
SAMPLER'S SIGNATURE <u>[Signature]</u>																					
SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX																	
<u>MW-6</u>	<u>4/12/08</u>	<u>11:00</u>			<u>4</u>																

<b>REPORT REQUIREMENTS</b> ___ I. Routine Report: Method Blank, Surrogate, as required ___ II. Report Dup., MS, MSD as required ___ III. Data Validation Report (includes all raw data) ___ IV. CLP Deliverable Report ___ V. EDD	<b>INVOICE INFORMATION</b> P.O. # _____ Bill To: _____	Circle which metals are to be analyzed: Total Metals: Al As Sb Ba Be B <u>Ca</u> Cd Co Cr Cu <u>Fe</u> <u>Pb</u> <u>Mg</u> <u>Mn</u> Mo Ni <u>K</u> Ag <u>Na</u> Se Sr Tl Sn V Zn Hg Dissolved Metals: Al As Sb Ba Be B Ca Cd Co Cr Cu Fe Pb Mg Mn Mo Ni K Ag Na Se Sr Tl Sn V Zn Hg
	<b>TURNAROUND REQUIREMENTS</b> ___ 24 hr. ___ 48 hr. ___ 5 Day ___ Standard (10-15 working days) ___ Provide FAX Results Requested Report Date _____	<b>SPECIAL INSTRUCTIONS/COMMENTS:</b> <u>Report with previous samples from this project.</u> <u>All HNO<sub>3</sub> bottles were 0.45µ filtered in the field.</u>

<b>RELINQUISHED BY:</b> <u>[Signature]</u> <u>4/12/08</u> Signature <u>Joseph L. Jobischer</u> Date/Time <u>15:20</u> Printed Name <u>Joseph L. Jobischer</u> Firm _____	<b>RECEIVED BY:</b> <u>[Signature]</u> <u>4/13/08</u> Signature <u>[Signature]</u> Date/Time <u>0930</u> Printed Name _____ Firm _____	<b>RELINQUISHED BY:</b> Signature _____ Date/Time _____ Printed Name _____ Firm _____	<b>RECEIVED BY:</b> Signature _____ Date/Time _____ Printed Name _____ Firm _____
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**Columbia Analytical Services, Inc.  
Cooler Receipt and Preservation Form**

PC Greg  
05184

Client / Project: Aspect Service Request K08  
 Received: 6/13/08 Opened: 6/13/08 By: AJ

1. Samples were received via? US Mail ~~Fed Ex~~ UPS DHL GH GS PDX Courier Hand Delivered  
 2. Samples were received in: (circle) Cooler Box Envelope Other NA  
 3. Were custody seals on coolers? NA  N If yes, how many and where? 1F  
 If present, were custody seals intact?  N If present, were they signed and dated?  N  
 4. Is shipper's air-bill filed? If not, record air-bill number: NA Y N

5. Temperature of cooler(s) upon receipt (°C): 3.0  
 Temperature Blank (°C): 6.3  
 6. If applicable, list Chain of Custody Numbers: \_\_\_\_\_  
 7. Were custody papers properly filled out (ink, signed, etc.)? NA  N  
 8. Packing material used. Inserts Baggies Bubble Wrap Gel Packs Wet Ice Sleeves Other \_\_\_\_\_  
 9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA  N  
 10. Were all sample labels complete (i.e analysis, preservation, etc.)?  N  
 11. Did all sample labels and tags agree with custody papers? *Indicate in the table below*  N  
 12. Were appropriate bottles/containers and volumes received for the tests indicated? NA  N  
 13. Were the pH-preserved bottles tested\* received at the appropriate pH? *Indicate in the table below* NA  N  
 14. Were VOA vials and 1631 Mercury bottles received without headspace? *Indicate in the table below.*  Y N  
 15. Are CWA Microbiology samples received with >1/2 the 24hr. hold time remaining from collection?  Y N  
 16. Was C12/Res negative?  Y N

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Sample ID	Bottle Count	Bottle Type	Out of Temp	Head-space	Broken	pH	Reagent	Volume added	Reagent Lot Number	Initials

\*Does not include all pH preserved sample aliquots received. See sample receiving SOP (SMO-GEN).  
 Additional Notes, Discrepancies, & Resolutions:  
Label on metal bottle says Field Filtered.

**Columbia Analytical Services, Inc.  
Cooler Receipt and Preservation Form**

PC *Shay*

Client / Project: Aspect Consulting Service Request K08 05184  
 Received: 1/12/08 Opened: 1/12/08 By: K Smith

1. Samples were received via? US Mail Fed Ex UPS DHL GH GS PDX Courier Hand Delivered  
 2. Samples were received in: (circle) Cooler Box Envelope Other NA  
 3. Were custody seals on coolers? NA Y (N) If yes, how many and where? \_\_\_\_\_  
 If present, were custody seals intact? Y (N) If present, were they signed and dated? Y (N)  
 4. Is shipper's air-bill filed? If not, record air-bill number: \_\_\_\_\_ NA (Y) N

5. Temperature of cooler(s) upon receipt (°C): 4.7C  
 Temperature Blank (°C): 4.8C  
 6. If applicable, list Chain of Custody Numbers: \_\_\_\_\_

**RUSH**

7. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N  
 8. Packing material used. Inserts Baggies Bubble Wrap Gel Packs Wet Ice Sleeves Other \_\_\_\_\_  
 9. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N  
 10. Were all sample labels complete (i.e analysis, preservation, etc.)? (Y) N  
 11. Did all sample labels and tags agree with custody papers? *Indicate in the table below* (Y) N  
 12. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N  
 13. Were the pH-preserved bottles tested\* received at the appropriate pH? *Indicate in the table below* NA (Y) N  
 14. Were VOA vials and 1631 Mercury bottles received without headspace? *Indicate in the table below.* (NA) Y N  
 15. Are CWA Microbiology samples received with >1/2 the 24hr. hold time remaining from collection? (NA) Y N  
 16. Was C12/Res negative? (NA) Y N

**SHORT HOLD TIME**

Sample ID on Bottle	Sample ID on COC	Sample ID on Bottle	Sample ID on COC

Sample ID	Bottle Count	Bottle Type	Out of Temp	Head-space	Broken	pH	Reagent	Volume added	Reagent Lot Number	Initials

\*Does not include all pH preserved sample aliquots received. See sample receiving SOP (SMO-GEN).

Additional Notes, Discrepancies, & Resolutions: \_\_\_\_\_

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client :** Aspect Consulting  
**Project Name :** Webb Hill Biosolids Facility  
**Project Number :** 070041  
**Sample Matrix :** WATER

**Service Request :** K0805184  
**Date Collected :** 06/10-12/08  
**Date Received :** 06/12,13/08

Ammonia as Nitrogen

**Analysis Method :** SM 4500 NH3 E  
**Test Notes :**

**Units :** mg/L  
**Basis :** NA

<b>Sample Name</b>	<b>Lab Code</b>	<b>MRL</b>	<b>MDL</b>	<b>Dilution Factor</b>	<b>Date Analyzed</b>	<b>Result</b>	<b>Result Notes</b>
MW-5	K0805184-001	0.05	0.02	1	06/19/08	0.08	
MW-7	K0805184-002	0.05	0.02	1	06/19/08	0.02	J
MW-6	K0805184-003	0.05	0.02	1	06/19/08	0.12	
Method Blank	K0805184-MB	0.05	0.02	1	06/19/08	ND	

SM Standard Methods for the Examination of Water and Wastewater, 20th Ed., 1998.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Bicarbonate as CaCO3

Analysis Method : SM 2320 B  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
4W-5	K0805184-001	2	1	1	06/13/08	48	
4W-7	K0805184-002	2	1	1	06/13/08	29	
4W-6	K0805184-003	2	1	1	06/14/08	50	
Method Blank	K0805184-MB	2	1	1	06/13/08	ND	
Method Blank	K0805184-MB	2	1	1	06/14/08	ND	

SM Standard Methods for the Examination of Water and Wastewater, 20th Ed., 1998.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Carbonate as CaCO3

Analysis Method : SM 2320 B  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	2	1	1	06/13/08	ND	
MW-7	K0805184-002	2	1	1	06/13/08	ND	
MW-6	K0805184-003	2	1	1	06/14/08	ND	
Method Blank	K0805184-MB	2	1	1	06/13/08	ND	
Method Blank	K0805184-MB	2	1	1	06/14/08	ND	

SM Standard Methods for the Examination of Water and Wastewater, 20th Ed., 1998.

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Bromide

Analysis Method : 300.0  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.1	0.012	2	06/12/08	0.012	J
MW-7	K0805184-002	0.1	0.012	2	06/12/08	ND	
MW-6	K0805184-003	0.1	0.012	2	06/13/08	0.012	J
Method Blank	K0805184-MB	0.1	0.006	1	06/13/08	ND	
Method Blank	K0805184-MB	0.1	0.006	1	06/12/08	ND	



COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Chloride

Analysis Method : 300.0  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.2	0.016	2	06/12/08	6.9	
MW-7	K0805184-002	0.2	0.016	2	06/12/08	3.8	
MW-6	K0805184-003	0.2	0.016	2	06/13/08	15.7	
Method Blank	K0805184-MB	0.2	0.008	1	06/13/08	ND	
Method Blank	K0805184-MB	0.2	0.008	1	06/12/08	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Fluoride

Analysis Method : 300.0  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.2	0.010	2	06/12/08	0.011	J
MW-7	K0805184-002	0.2	0.010	2	06/12/08	0.021	J
MW-6	K0805184-003	0.2	0.010	2	06/13/08	ND	
Method Blank	K0805184-MB	0.2	0.005	1	06/13/08	ND	
Method Blank	K0805184-MB	0.2	0.005	1	06/12/08	ND	

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client :** Aspect Consulting  
**Project Name :** Webb Hill Biosolids Facility  
**Project Number :** 070041  
**Sample Matrix :** WATER

**Service Request :** K0805184  
**Date Collected :** 06/10-12/08  
**Date Received :** 06/12,13/08

Nitrate as Nitrogen

**Analysis Method :** 300.0  
**Test Notes :**

**Units :** mg/L  
**Basis :** NA

<b>Sample Name</b>	<b>Lab Code</b>	<b>MRL</b>	<b>MDL</b>	<b>Dilution Factor</b>	<b>Date/Time Analyzed</b>	<b>Result</b>	<b>Result Notes</b>
MW-5	K0805184-001	0.1	0.008	2	06/12/08 14:13	4.0	
MW-7	K0805184-002	0.1	0.008	2	06/12/08 14:24	0.7	
MW-6	K0805184-003	0.5	0.020	5	06/13/08 15:40	11.9	
Method Blank	K0805184-MB	0.1	0.004	1	06/12/08 09:27	ND	
Method Blank	K0805184-MB	0.1	0.004	1	06/13/08 09:38	ND	

**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client :** Aspect Consulting  
**Project Name :** Webb Hill Biosolids Facility  
**Project Number :** 070041  
**Sample Matrix :** WATER

**Service Request :** K0805184  
**Date Collected :** 06/10-12/08  
**Date Received :** 06/12,13/08

Sulfate

**Analysis Method :** 300.0  
**Test Notes :**

**Units :** mg/L  
**Basis :** NA

<b>Sample Name</b>	<b>Lab Code</b>	<b>MRL</b>	<b>MDL</b>	<b>Dilution Factor</b>	<b>Date Analyzed</b>	<b>Result</b>	<b>Result Notes</b>
MW-5	K0805184-001	0.2	0.012	2	06/12/08	2.0	
MW-7	K0805184-002	0.2	0.012	2	06/12/08	0.9	
MW-6	K0805184-003	0.2	0.012	2	06/13/08	6.7	
Method Blank	K0805184-MB	0.2	0.006	1	06/13/08	ND	
Method Blank	K0805184-MB	0.2	0.006	1	06/12/08	ND	

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Nitrate+Nitrite as Nitrogen

Analysis Method : 353.2  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.05	0.005	1	06/13/08	4.09	
MW-7	K0805184-002	0.05	0.005	1	06/13/08	0.83	
MW-6	K0805184-003	0.50	0.050	10	06/19/08	12.0	
Method Blank	K0805184-MB	0.05	0.005	1	06/13/08	0.007	J
Method Blank	K0805184-MB	0.05	0.005	1	06/19/08	ND	

# COLUMBIA ANALYTICAL SERVICES, INC.

## Analytical Report

**Client :** Aspect Consulting  
**Project Name :** Webb Hill Biosolids Facility  
**Project Number :** 070041  
**Sample Matrix :** WATER

**Service Request :** K0805184  
**Date Collected :** 06/10-12/08  
**Date Received :** 06/12,13/08

### Phosphorus, Total

**Prep Method :** Method  
**Analysis Method :** 365.3  
**Test Notes :**

**Units :** mg/L  
**Basis :** NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Prepared	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.01	0.004	1	6/13/2008	06/13/08	0.01	
MW-7	K0805184-002	0.01	0.004	1	6/13/2008	06/13/08	0.02	
MW-6	K0805184-003	0.01	0.004	1	6/13/2008	06/17/08	0.01	
Method Blank	K0805184-MB	0.01	0.004	1	6/13/2008	06/17/08	ND	
Method Blank	K0805184-MB	0.01	0.004	1	6/13/2008	06/13/08	ND	



**COLUMBIA ANALYTICAL SERVICES, INC.**

Analytical Report

**Client :** Aspect Consulting  
**Project Name :** Webb Hill Biosolids Facility  
**Project Number :** 070041  
**Sample Matrix :** WATER

**Service Request :** K0805184  
**Date Collected :** 06/10-12/08  
**Date Received :** 06/12,13/08

Nitrogen, Total Kjeldahl (TKN)

**Prep Method :** ASTM D 3590-89B-21.1  
**Analysis Method :** ASTM D 1426-93B  
**Test Notes :**

**Units :** mg/L  
**Basis :** NA

<b>Sample Name</b>	<b>Lab Code</b>	<b>MRL</b>	<b>MDL</b>	<b>Dilution Factor</b>	<b>Date Prepared</b>	<b>Date Analyzed</b>	<b>Result</b>	<b>Result Notes</b>
MW-5	K0805184-001	0.2	0.07	1	6/17/2008	06/18/08	0.8	
MW-7	K0805184-002	0.2	0.07	1	6/17/2008	06/18/08	1.0	
MW-6	K0805184-003	0.2	0.07	1	6/17/2008	06/18/08	2.0	
Method Blank	K0805184-MB	0.2	0.07	1	6/17/2008	06/18/08	0.14	J

COLUMBIA ANALYTICAL SERVICES, INC.

Analytical Report

Client : Aspect Consulting  
Project Name : Webb Hill Biosolids Facility  
Project Number : 070041  
Sample Matrix : WATER

Service Request : K0805184  
Date Collected : 06/10-12/08  
Date Received : 06/12,13/08

Carbon, Total Organic

Analysis Method : 415.1  
Test Notes :

Units : mg/L  
Basis : NA

Sample Name	Lab Code	MRL	MDL	Dilution Factor	Date Analyzed	Result	Result Notes
MW-5	K0805184-001	0.5	0.05	1	06/16/08	1.0	
MW-7	K0805184-002	0.5	0.05	1	06/16/08	0.7	
MW-6	K0805184-003	0.5	0.05	1	06/16/08	1.0	
Method Blank	K0805184-MB	0.5	0.05	1	06/16/08	ND	

Columbia Analytical Services

- Cover Page -  
INORGANIC ANALYSIS DATA PACKAGE

Client: Aspect Consulting  
Project Name: Webb Hill Biosolids Facility  
Project No.: 070041

Service Request: K0805184

Sample Name:

MW-5

MW-5D

MW-5S

MW-7

MW-6

MW-6D

MW-6S

Method Blank

Method Blank

Lab Code:

K0805184-001 DISS

K0805184-001D DISS

K0805184-001S DISS

K0805184-002 DISS

K0805184-003 DISS

K0805184-003D DISS

K0805184-003S DISS

K0805184-MB

K0805184-MB2

Comments:

Approved By: 3C

Date: 6/20/08



Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Aspect Consulting Service Request: K0805184  
Project No.: 070041 Date Collected: 6/11/08  
Project Name: Webb Hill Biosolids Facility Date Received: 6/12/08  
Matrix: WATER Units: ug/L  
Basis: N/A

Sample Name: MW-7 Lab Code: K0805184-002 DISS

Analyte	Analysis Method	MRL	MDL	Dil. Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	200.7	50	10	1.0	06/17/08	06/18/08	10100		
Iron	200.7	20.0	10.0	1.0	06/17/08	06/18/08	10.0	U	
Magnesium	200.7	20	1.5	1.0	06/17/08	06/18/08	4950		
Manganese	200.7	5.0	1.0	1.0	06/17/08	06/18/08	13.8		
Potassium	200.7	2000	1000	1.0	06/17/08	06/18/08	1000	U	
Sodium	200.7	100	35	1.0	06/17/08	06/18/08	3110		

% Solids: 0.0

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Aspect Consulting Service Request: K0805184  
Project No.: 070041 Date Collected: 6/12/08  
Project Name: Webb Hill Biosolids Facility Date Received: 6/13/08  
Matrix: WATER Units: ug/L  
Basis: N/A

Sample Name: MW-6 Lab Code: K0805184-003 DISS

Analyte	Analysis Method	MRL	MDL	Dil. Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	200.7	50	9	1.0	06/19/08	06/19/08	24400		
Iron	200.7	20.0	2.0	1.0	06/19/08	06/19/08	4.8	B	
Magnesium	200.7	20	4.0	1.0	06/19/08	06/19/08	11700		
Manganese	200.7	5.0	0.3	1.0	06/19/08	06/19/08	5.6		
Potassium	200.7	2000	30	1.0	06/19/08	06/19/08	405	B	
Sodium	200.7	100	20	1.0	06/19/08	06/19/08	4630		

% Solids: 0.0

Comments:

## **APPENDIX D**

### **USGS Groundwater Dating and Water Quality Report**





# United States Department of the Interior

U.S. Geological Survey

## USGS Washington Water Science Center

934 Broadway, Suite 300  
Tacoma, Washington 98402  
(253) 552-1600 . FAX (253) 552-1581  
<http://wa.water.usgs.gov/>

June 26, 2008

Ms. Pam Bennett-Cumming  
Mason County Department of Community Development  
Senior Planner - Water Resource Planning  
411 North 5th  
P.O. Box 279  
Shelton, Washington 98584

Dear Ms. Bennett-Cumming:

Attached are results of the laboratory analyses of archived water-quality samples collected by the U.S. Geological Survey (USGS) from four Webb Hill monitoring wells (MW-1, MW-2, MW-3 and MW-4) in July 2007. The USGS unique site identification numbers for these wells are 4718281223063501, 471831123070001, 471845123063701, and 471815123061801, respectively. Sample results are stored in and can be retrieved from our National Water Quality Database (<http://waterdata.usgs.gov/nwis>) using these site identification numbers. For future reference, please refer to these numbers.

The samples were analyzed for selected constituents that have been identified by the USGS National Research Program as useful tracers of recently recharged ground water. These types of data, in particular the sulfur hexafluoride data, may provide information useful to Mason County in its ongoing hydrologic investigation of the Webb Hill Biosolids disposal facility and nutrient issues in Hood Canal. General discussions of the use of environmental tracers for dating recently recharged ground water are summarized by Plummer and others, 1993.

Samples were collected to analyze for three suites of environmental tracers, including sulfur-hexafluoride, tritium-helium, and waste-water treatment compounds. Sulfur-hexafluoride ( $\text{SF}_6$ ) is present in the atmosphere primarily as a result of anthropogenic origin. The atmospheric concentration of  $\text{SF}_6$  has increased from a steady-state value of about 0.05 parts per trillion to more than 4 parts per trillion during the past 40 years. The date of ground-water recharge can be estimated from  $\text{SF}_6$  concentrations if it is in equilibrium with atmospheric  $\text{SF}_6$  at the time of recharge. Methods describing the sulfur hexafluoride technique and its limitations can be found in E. Busenberg and L.N. Plummer, 2000.

Results from three of the four sulfur hexafluoride ( $\text{SF}_6$ ) samples provided good estimates of the year of ground-water recharge. The  $\text{SF}_6$  measurements results are reported using a NOAA scale as mass concentrations (FMoles/kg) but have been converted to equivalent concentrations as partial volume (pptv) for comparison to regularly monitored atmospheric  $\text{SF}_6$  concentrations. On the attached figure, the results of the analysis of MW1, MW2, and MW4 are plotted on the curve of  $\text{SF}_6$  concentrations in air. Their location on the curve indicates that these samples contained  $\text{SF}_6$  concentrations equivalent to atmospheric concentrations present in late 1990's to early 2000's. Refinements to the estimates of recharge date could be made if additional information was available on the temperature of ground water at the point of recharge and measurements to determine if excess air was incorporated during the recharge process. The very large concentrations of  $\text{SF}_6$  in the sample from MW-3 indicate that the sample was contaminated, which will result in inaccurate estimates of the recharge.

Large tritium ( $^3\text{H}$ ) inputs to ground water occurred in a series of spikes resulting from atmospheric testing of nuclear devices occurring from 1952 to 1963. Concentrations of  $^3\text{H}$  in precipitation have decreased since the mid-1960's bomb peak and provide limited information on recharge related to the period of nuclear testing. Measurements of tritium ( $^3\text{H}$ ) and its decay product, tritiogenic helium ( $^3\text{He}$ ), provide a  $^3\text{H}/^3\text{He}$  ratio which can be used to calculate the  $^3\text{H}/^3\text{He}$  apparent age of ground water from a single water sample (Schlosser and others, 1988, 1989; Poreda and others, 1988; Solomon and others, 1992, 1993).

The process for the analysis of  $^3\text{H}/^3\text{He}$  ratios is lengthy, because the accumulation of daughter products requires several months to generate measureable quantities when the initial concentrations of  $^3\text{H}$  are small. The analytical laboratory at Lamont-Doherty Earth Observatory has been experiencing difficulties with the specialized mass-spectrophotometer that is used for this analysis and thus has delayed the analysis of the  $^3\text{H}/^3\text{He}$  data. Once these data are released from the laboratory, they will be provided to you.

The analysis of waste-water compounds in samples from three wells (MW1, MW3, and MW4) resulted in few detections and thus did not provide substantial useful data when applied to ground-water samples from this site. The waste-water analytical suite focuses on compounds typically found in domestic and industrial wastewater. The suite analyzes for 61 compounds that include the alkylphenol ethoxylate nonionic surfactants and their degradates, food additives, fragrances, antioxidants, flame retardants, plasticizers, industrial solvents, disinfectants, fecal sterols, polycyclicaromatic hydrocarbons, and high-use domestic pesticides. Data from these samples are in the attached table.

If you have any questions, please don't hesitate to call Steve Cox of this office at 253-552-1623.

Sincerely yours,

//s//

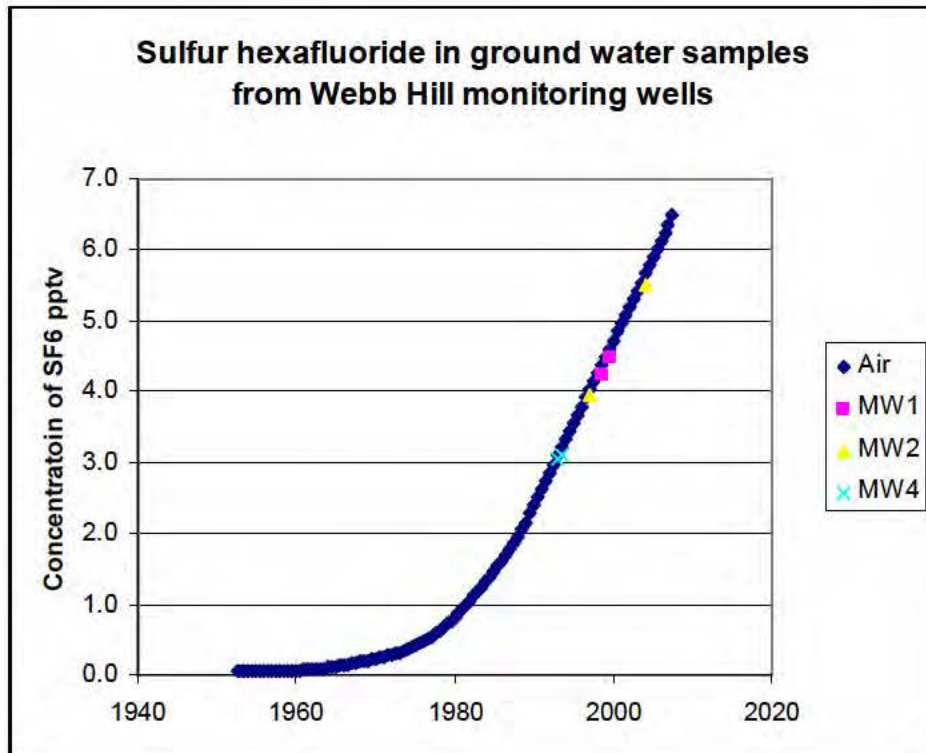
Cynthia Barton, Ph.D., L.G., L.H.G.  
Director

#### References

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- Schlosser P., Stute, M., Dorr, H., Sonntag, C., and Munnich, K.O., 1988, Tritium/ $^3\text{He}$  dating of shallow groundwater: *Earth and Planetary Science Letters*, v. 89, p. 353-362.
- Schlosser P., Stute, M., Sonntag, C., and Munnich, K.O., 1989, Tritiogenic  $^3\text{He}$  in shallow groundwater: *Earth and Planetary Science Letters*, v. 94, p. 245-256.
- Solomon, D.K., Poreda, R.J., Schiff, S.L., and Cherry, J.A., 1992, Tritium and Helium 3 as groundwater age tracers in the Borden Aquifer: *Water Resources Research*, v. 28, no. 3, p. 741-755.
- Solomon, D.K., and Sudicky, E.A., 1992, Correction to "Tritium and helium 3 isotope ratios for direct estimation of spatial variations in groundwater recharge": *Water Resources Research*, v. 28, no. 4, p. 1197.

**Results of SF6 analyses in ground-water samples from monitoring wells collected by the USGS in July 2007, at Webb Hill Biosolids Facility, Mason County, WA**

Sample Name	Sampling Date (Mo/day/year)	Time	NOAA Scale fMol/L	Calculated SF6 (pptv)
MW-1	07/09/07	1410	1.8040	4.4779
MW-1	07/09/07	1410	1.7104	4.2456
MW-2	07/11/07	1200	1.5844	3.9388
MW-2	07/11/07	1200	2.2187	5.5156
MW-3	07/11/07	1300	10.4911	26.1021
MW-3	07/11/07	1300	4.6028	11.4518
MW-4	07/11/07	930	1.2576	3.1185
MW-4	07/11/07	930	1.2270	3.0427
Tap water	01/28/08		4.7782	15.0989
Tap water	01/28/08		4.7652	15.0579



**Concentrations of waste water treatment compounds in ground-water samples from monitoring wells collected by the USGS in July 2007, at Webb Hill Biosolids Facility, Mason County, WA**

[Abbreviations: ug/L, micrograms per liter; E, estimated value, concentration is less than the detection limit; M, presence verified but not quantified; <, actual value is less than value shown]

Analyte	USGS Site ID, Well number, and date sampled		
	471828123063501	471845123063701	471815123061801
	MW-1	MW-3	MW-4
	7/10/07 2:10 PM	7/11/07 1:00 PM	7/11/07 9:30 AM
	(ug/L)	(ug/L)	(ug/L)
1,4-Dichlorobenzene	<.1	<.5	<.1
1-Methylnaphthalene	<.1	<.6	<.1
2,6-Dimethylnaphthalene	<.2	<1.2	<.2
2-Methylnaphthalene	<.1	<.5	<.1
3-beta-Coprostanol	<2	<10	<2
3-Methyl-1H-indole	<.08	<.48	<.08
3-tert-Butyl-4-hydroxyanisole	<.6	<4	<.6
4-Cumylphenol	<.14	<.84	<.14
4-Nonylphenol	<2	<11	<2
4-Octylphenol	<.16	<.96	<.16
4-tert-Octylphenol	<.10	<.6	<.10
5-Methyl-1H-benzotriazole	<2	<11	<2
9,10-Anthraquinone	<.2	<1.0	<.2
Acetophenone	<.1	<.6	<.1
Acetyl hexamethyl tetrahydro naphthalene	<.5	<3.0	<.5
Anthracene	<.1	<.5	<.1
Benzo[a]pyrene	<.1	<.7	<.1
Benzophenone	<.2	<1.1	<.2
beta-Sitosterol	<2	<12	<2
beta-Stigmastanol	<2	<12	<2
Bromacil	<.4	<2.4	<.4
Caffeine	<.2	<1.2	<.2
Camphor	<.1	<.6	<.1
Carbaryl	<1	<6	<1
Carbazole	<.1	<.5	<.1
Chlorpyrifos	<.2	<1.2	<.2
Cholesterol	<1	<8	<1
Cotinine	<.400	<2.40	<.400
p-Cresol	<.18	<b>M</b>	<.18
DEET	<b>M</b>	<1.2	<.2
Diazinon	<.2	<1.0	<.2
Diethoxynonylphenol	<5	<30	<5
Diethoxyoctylphenol	<1	<6	<1
D-Limonener	<.1	<.8	<.1
Fluoranthene	<.1	<.5	<.1
Hexahydrohexamethyl cyclopentabenzopyran	<.5	<3.0	<.5

Indole	<.1	<.8	<.1
Isoborneol	<.1	<.4	<.1
Isophorone	<.1	<.8	<.1
Isopropylbenzene	<.1	<.6	<.1
Isoquinoline	<.4	<2.4	<.4
Menthol	<.2	<1.2	<.2
Metalaxyl	<.2	<1.2	<.2
Methyl salicylate	<.2	<1.1	<.2
Metolachlor	<.2	<1.0	<.2
Monoethoxyoctylphenol	<1	<6	<1
Naphthalene	<.1	<.6	<.1
Phenanthrene	<.1	<.5	<.1
Phenol	<.4	<b>E.3</b>	<b>7.2</b>
Prometon	<.4	<2.4	<.4
Pyrene	<.1	<.5	<.1
Tetrachloroethene	<.2	<1.1	<.2
Tribromomethane	<.1	<.5	<.1
Tributyl phosphate	<.2	<1.2	<b>E1.8</b>
Triclosan	<.2	<1	<.2
Triethyl citrate	<.4	<2.4	<.4
Triphenyl phosphate	<.2	<1.0	<b>0.4</b>
Tris(2-butoxyethyl) phosphate	<.5	<3.0	<.5
Tris(2-chloroethyl) phosphate	<b>M</b>	<1.1	<.2
Tris(dichloroisopropyl) phosphate	<.2	<1.1	<.2