APPENDIX F

Hydrogeologic Report

REPORT

PORT GAMBLE UPLAND LOSS

Site Risk Survey and Hydrogeologic Report – Rev. 3

DOH #2012-035

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EXECUTIVE SUMMARY

Olympic Property Group, LLC (OPG) is planning the development of a Large On-site Sewage System (LOSS) on the Port Gamble Upland area in Northern Kitsap County. This LOSS will receive treated effluent from two distinct sources:

- The first source will be treated effluent redirected from the existing Port Gamble wastewater treatment plant, which currently discharges approximately to Hood Canal. This plant is antiquated and has at times failed to meet discharge standards. Eliminating the marine discharge may allow the state to open aquaculture resources in the area to recreational and commercial harvest, and improve water quality and habitat (e.g., eel grass beds). This work is supported by the Washington Department of Ecology to improve Puget Sound environmental health.
- The second source of treated effluent will be new commercial and residential development planned by OPG in the Limited Area of More Intense Rural Development (LAMIRD).

A Pre-Design report was submitted by Jensen Engineering (Jensen 2012) to the Washington Department of Health (DOH) on behalf of OPG. DOH approved proceeding with submission of a Hydrogeologic Report to address the fate and transport of the effluent in the drain field area (DOH 2013a; Appendix C). This report addresses sections 03200 (Site Risk Survey) and 03300 (Hydrogeological Report) of the Washington Administrative Code (WAC) 246-272B (LOSS Regulations).

Findings of the Site Risk Survey include:

- The LOSS is being designed to receive 100,000 gallons per day (gpd; 70 gallons per minute [gpm]) of commercial and residential effluent.
- Drain field design parameters (Jensen 2012):
  - Delivery of effluent is proposed through drip emitters over 500,000 square feet ($ft^{2)}$ drain field, including developed and reserve areas, and internal areas of uneven topography.
- Wetlands are located approximately 600 feet east of the LOSS.
- Background water quality appears to have low total dissolved solids (e.g., TDS <200 milligrams per Liter [mg/L]), is of magnesium bicarbonate type, and is reducing (e.g., ammonia, iron, and manganese are present).
- The unsaturated vadose zone between ground surface and the water table is approximately 100 feet thick and is comprised of fine to medium-grained sand with silt laminae increasing with depth and rare peat laminae.
- Four drinking water wells are located within a quarter mile of the LOSS.
  - No impact from operation of a LOSS is predicted to three of these wells located to the northeast and northwest of the LOSS because the water table aquifer underlying the LOSS does not extend to these areas (Port Gamble community, Waggoner and Thompson wells).
  - The Pittman Well is located approximately 600 feet west of the LOSS. It is planned that this well will also serve a second residence in the future.

A field data collection program was undertaken to characterize the hydrogeology of the site. Seven monitoring wells and four piezometers were installed. Water quality samples were collected and three transducers installed to record groundwater levels.

Findings of the Hydrogeologic Report include:

- The stratigraphy consists of (from surface to depth):
  - Discontinuous compacted sand with sparse gravel up to 14 feet thick at ground surface (~300 feet above mean sea level [ft amsl]). This compacted sand is interpreted to be sandy till, appears to have relatively low permeability (recent precipitation ponds in the bottom of pits) and is overlain by approximately 3 feet to 5 feet of a loose, permeable weathered sandy horizon.
  - Fine-grained to medium-grained sand extends from ground surface, or from under the compacted sandy till, to approximately 190 ft amsl. This sand is a fining downward sequence with increasing silt lamina at greater depth.
  - Minor peaty organic material is occasionally present in the sand profile, which may reduce predicted nitrate concentrations.
  - Massive and laminated silt greater than 30 feet thick extends below approximately 190 feet amsl.
- Groundwater conditions are:
  - The vadose zone is on the order of 100 feet thick under the LOSS footprint.
  - Horizons above silt lamina concentrations within the vadose zone are moist.
  - The water table is usually immediately above the contact between the overlying sand layer and underlying silt layer, at approximately 100 feet below ground surface under the LOSS area.
  - Groundwater flow in the water table aquifer is radially from the southeast corner of the LOSS area, flowing west, north and east.
  - The water table aquifer is interpreted to discharge where the lower contact of the sand aquifer with the underlying silt intercepts ground surface. This occurs at approximately elevation 180-200 feet amsl, and was observed in the following areas:
    - Wetland D to the east of the LOSS area, where naturally occurring disperse seeps were observed (individually less than 5 gpm).
    - Stream 3 to the northeast, where naturally occurring discharge was observed (45 gpm).
    - Possibly to the southwest where natural discharge was observed.
    - No natural discharges were observed to the north or northwest of the LOSS footprint.

DOH has indicated they will set the maximum increase of nitrate at the property boundary of 5 mg/L. Treating effluent prior to discharge to the LOSS to a total nitrogen concentration of 8 mg/L total nitrogen results in a predicted total nitrogen concentration at the property boundary of less than 5 mg/L.

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1.0 INTRODUCTION AND BACKGROUND

Olympic Property Group, LLC (OPG) is developing a Large On-site Sewage System (LOSS) to receive treated wastewater from the Port Gamble community, thereby eliminating a current wastewater discharge to the Hood Canal. Conversion of the Port Gamble marine discharge includes: 1) discharge of treated wastewater to the LOSS drain field; followed by, 2) gradual replacement of the collection system to reduce groundwater inflow.

Current average wastewater discharges from the Port Gamble community are on the order of 8,000 to 27,000 gallons per day (gpd). A peak historical flow of 81,000 gpd is attributed to groundwater inflow (Jensen 2012). Gradual replacement of the collection system will reduce groundwater inflow. The LOSS will be designed for 100,000 gpd capacity and will be permitted by the Washington Department of Health (DOH). This report provides a Site Risk Survey (SRS; pursuant to WAC 246-272B-3200) and a Hydrogeological Report (HGR; pursuant to WAC 246-272B-3300) for the proposed site, in support of fulfilling DOH permitting requirements.

1.1 Previous Work

Several studies have been completed to date in support of the LOSS permitting, including: 1) baseline site conditions; 2) geotechnical feasibility; and, 3) predesign information to identify requirements for LOSS design. These studies and some selected findings are presented below.

- Zipper Zeman Associates, Inc. (Zipper Zeman 2005) described the upland area as mantled by low-permeability till, covered by a thin veneer of fine sand and local pockets of silt, peat, and compressible soils. They also identified steep and potentially unstable slopes in the greater project area.
- Zipper Zeman (2007) describe the results from test pits across the upland area close to the planned LOSS location as encountering till, locally covered with recessional outwash. Seeps in the pits were interpreted to reflect perched groundwater conditions on top of the till.
- Terracon Consultants, Inc. (Terracon) (2012) completed test pits throughout the proposed LOSS area. The average thickness of topsoil, sand, and weathered till were reported as 0.55 feet, 1.4 feet, and 2.1 feet, respectively.
- Jensen Engineering Inc. (Jenson 2012) submitted a report in fulfillment of WAC 296-272B-03000 (Site review – Predesign report). Site slope is 5 to 20% to the north and a bit to the east (some 30% slopes to be avoided). Additional test pits were completed across the drain field. Average depth to unweathered till was reported as approximately 4 feet. A predesign of the LOSS assumes no treatment beyond a septic tank, and 3 feet vertical separation between drip irrigation emitters and the water table. The drain field soils consist of Type 3 loamy sand. Preliminary design of the drain field consists of three lobes, totaling approximately 500,000 square feet (ft^2) with a loading rate of 0.6 gallons per day per square foot (gpd/ft^2).
- Terracon (2013) installed six groundwater monitoring wells between 4 feet and 7 feet below ground surface (bgs) to characterize winter groundwater conditions. Only one well encountered groundwater over the period of record (January 29 to April 11, 2012), in which water levels fluctuated between 2.5 to 4.2 feet bgs.

- DOH (2013a; Appendix C) provided a Site Approval letter to Jon Rose dated May 24, 2013. This letter determine that water level data, soil, and site information are consistent with the conceptual treatment design; and approves proceeding to preparation of a hydrogeological report (i.e., this report).

- DOH (2014; Appendix C) provided a hydrogeology report review letter Jon Rose dated January 28, 2014. This letter requested clarifications in the report, which are provided in this revised report, and said the maximum increase of nitrate at the property boundary will set at 5 mg/L.

1.2 Authorization, Relationships and Limitations

This work is conducted under contract with OPG signed on July 2, 2013. The work was conducted in close collaboration and coordination with the following:

- Nancy Darling, Washington DOH.
- Al Fure, Triad Associates, Inc. (Triad), prime consultant to OPG.
- David Jensen, Jensen Engineering Inc., engineering waste water drain field design.

This work was conducted according to standard professional practices usual to the time and place**.**

2.0 SITE RISK SURVEY

2.1 Design Flow and Waste Strength

Under current conditions, the Port Gamble community is served by a community sewer collection system that feeds a sewage treatment plant that discharges to Hood Canal. Representative average monthly flow from the Port Gamble Wastewater Treatment Plant is 13,000 gpd (Table 1). Peak flows of 81,000 gpd have occurred, and are caused by significant groundwater infiltration into the leaky sewer collection system. The existing collection system capacity is limited by infiltration of groundwater into the pipes.

Development of the proposed LOSS system would be implemented in two phases. Phase I would entail the establishment of a new treatment facility and septic tanks in the vicinity of the existing treatment facility, establishment of a new upland LOSS drain field with a dosing chamber, and abandonment of the existing outfall to Port Gamble Bay. In general, the Phase I system would use the existing collection pipe system to direct sewage to the new treatment facility. The treated effluent would then be pumped via new lines to the proposed dosing chamber and drain field.

Phase II would include the gradual replacement of the existing sewer collection pipe system with new collection pipes. The new pipes would substantially reduce the level of groundwater infiltration into the pipes compared to current conditions, thereby increasing the capacity and efficiency of the system.

The design flow rate for the LOSS is 100,000 gpd. This will accommodate baseline (8,000 to 27,000 gpd) and peak flows (81,000 gpd) from the existing Port Gamble system. As the existing collection system is upgraded and peak inflows reduced, the LOSS will be able to accommodate new flows from new planned development.

The waste strength will primarily be residential in nature. All non-residential connections will be evaluated prior to connection to the collection system, and will receive additional treatment at the source before delivery to the waste water collection system as necessary. A maximum Biological Demand (BOD) of 240 milligrams per Liter (mg/L), a maximum Total Suspended Solids of 140 mg/L, and a maximum Oils and Grease of 25 mg/L are anticipated after the primary treatment at the proposed new treatment facility (Jensen 2012).

2.2 Physical Characteristics of the Primary and Reserve Drainfield Site

This section describes physical properties of the proposed LOSS site (Figures 1 and 2). The proposed drainfield site includes a 50% reserve area and encompasses approximately 500,000 square feet (ft^2). Vegetation ranges from forestland to logged meadow. In general, the site slopes downward from the

southwest to northeast between 5 and 20%, with some swale areas having slopes up to 30%. Jensen (2012) identified the topsoil as Type 3 Loamy, ranging in thickness from approximately 3 to 6 feet.

Information from 11 monitoring wells and 34 test pits installed throughout the drainfield site indicate that compact glacial till occurs on topographic highs and is underlain by a thick sequence of very fine to medium sand with interfingering silt lenses (Appendix B). Glacial tills and silt lenses create localized perching conditions that may serve as potential restrictive layers within the proposed drainfield site. The hydrogeologic setting is described further in Section 3.0.

2.3 Sensitive or Critical Areas

This section identifies the location of the proposed drain field in relation to sensitive or critical areas designated by local, state, or federal agencies.

2.3.1 Critical Aquifer Recharge Area

The Kitsap County (County) Critical Areas Ordinance identifies the proposed drainfield site as being in a Category II Critical Aquifer Recharge Area, known as an Aquifer Recharge Area of Concern (ARAC) on the basis of highly permeable surficial Ragnar/Poulsbo soils. The National Conservation Resource Service (NRCS) lists depth to groundwater as ranging from 1 to 2.5 feet in the proposed area, however, information from onsite wells indicate that actual depth to groundwater is much greater under the proposed LOSS (i.e., 75 to 120 feet bgs).

If an operation takes place within an Aquifer Recharge Area of Concern that poses a potential threat to groundwater, a hydrogeologic report is required to address potential impacts to groundwater and surface water quality (County Ordinance 18.16.615). A LOSS is considered to be a potential threat to groundwater in this area. A hydrogeologic report is presented in Section 3.

2.3.2 Sole Source Aquifer

The proposed LOSS site is located within Environmental Protection Agency (EPA) Region 10. EPA does not list any sole source aquifers in the vicinity of the proposed drainfield.

2.3.3 Wellhead Protection Areas

Spatial data for wellhead protection areas (WHPA) was obtained from DOH (Figure 2). The data identified one WHPA within the proposed site. This WHPA was assigned by DOH for a Group A Water System (ID number 68650; Source Number 01) which corresponds to a groundwater spring that was previously used by Port Gamble and has been inactive since June 18, 1991. Examination of DOH source data indicates that this source was incorrectly georeferenced in the database and is actually located approximately 2,000 feet southeast of the site.

Four drinking water wells were identified in the immediate vicinity of the LOSS:

- Port Gamble Community Well (~1,000 feet northeast of the LOSS)
- Waggoner Well (~700 feet north of the LOSS)
- Thompson Well (~1,200 feet northwest of the LOSS)
- Pittman Well (~600 feet west of the LOSS)

Logs for each of these wells are included in Appendix A, and the hydrostratigraphic setting between these wells and the LOSS site is further discussed in Section 3. The water table aquifer underlying the LOSS footprint is interpreted to not extend to the locations of the first three wells.

The Port Gamble community well is located approximately 1,000 feet northeast of the LOSS site at an elevation of approximately 180 feet above mean sea level (ft amsl). This well is completed at a depth of over 500 feet bgs, and is located on the other side of a topographic valley that intercepts groundwater discharging from the LOSS site (road seep – Figure 2). Therefore, groundwater from the water table at the LOSS location cannot migrate to the well site. Additionally, the depth of the well provides an additional measure of protection.

The Waggoner well log shows the stratigraphy at that location as consisting of low permeability clay from near ground surface (4 feet bgs) to over 200 feet depth. The stratigraphy is different from that at the LOSS local, thereby affirming the interpretation that the water table aquifer at the LOSS local does not extend to the Waggoner well local.

The wellhead of the Thompson well is approximately 200 feet lower than the LOSS site and is screened at more than 100 feet below mean sea level. The water table at the LOSS is approximately 200 feet above mean sea level. Therefore, no hydraulic connection is interpreted to exist between the LOSS site and the Thompson well.

The well located at 3435 NE Nine Boulder Drive, approximately 600 feet west of the proposed drainfield boundary, currently serves one residence and is planned to serve a second residence in the future. The groundwater elevation in this well is similar to the elevation of the water table encountered under the LOSS footprint. Closer assessment of this well is provided in Section 3.0 of this report.

2.3.4 Marine Recovery Area

The LOSS is located approximately half a mile from the shores of Hood Canal. Groundwater receiving effluent is expected to discharge where the base of the aquifer intersects ground surface at an elevation of approximately 180-200 feet above sea level. This includes discharging to the wetland complex east of the LOSS site, and other surface water drainages in which denitrification is expected to occur. Nitrate is a

parameter of concern in relation to impacts to marine waters. Consequently, no impacts to Marine Recovery Areas (MRA) are anticipated within the scope of this project.

2.3.5 100-year Floodplain

The proposed drainfield is located at an elevation approximately 300 ft amsl. In the Port Gamble Area, land surface elevations greater than 10 ft amsl are not considered to be within the 100-year floodplain.

2.4 Sensitive Lands or Resources within One-Half Mile of the Drainfield

This section identifies the sensitive lands or resources within a half mile of the perimeter of the proposed LOSS drainfield site.

2.4.1 Wetlands

Several wetlands are located near the proposed drainfield site (GeoEngineers 2013; Figure 2). The western boundaries of the wetlands are located within approximately 600 feet east of the proposed site, in a relatively flat area down-gradient of the drainfield. Triad has provided the locations of wetlands (Figure 1). These areas are not likely to be directly impacted by LOSS construction activities because the construction site is located approximately 600 feet to the west of the wetlands. Consistent with Kitsap County Code 19.200.220, buffers are delineated around wetlands to ensure that disturbance is avoided (GeoEngineers 2013).

2.4.2 Surface Water

There is a small north-flowing perennial stream 1,000 feet east of the drainfield site, approximately parallel to the change in slope (GeoEngineers 2013). The stream flows through a small (approximately 7,000 ft^2) pond before draining to Puget Sound. This pond was historically a source of potable water for the community of Port Gamble. The headwaters of Stream 3 are located approximately 600 feet northeast of the LOSS. A natural base flow of 45 gallons per minute (gpm) was measured October 26, 2013 by Al Fure (Triad Associates, Inc.).

2.4.3 Fish Hatcheries

The Port Gamble S'Klallam Tribe operates the Little Boston Salmon Hatchery at the mouth of Little Boston Creek and the Port Gamble Coho Salmon Net Pens at the northern end of Port Gamble Bay. There are no other fish hatchery operations known within close vicinity of the LOSS site. It is unlikely LOSS effluent will impact fish hatchery operations because the LOSS site is greater than half a mile from these operations.

2.4.4 Shellfish Growing Areas

Shellfish growing areas are sensitive to dissolved nitrogen compounds that are present in wastewater. The current Port Gamble wastewater discharge to Hood Canal causes closures of shellfish harvest beds. The proposed redirecting of treated wastewater from its current discharge to Hood Canal, to the LOSS, will improve near shore marine water quality and habitat and potentially allow reopening of shellfish beds to harvest. The LOSS will discharge effluent to a large unsaturated zone to groundwater, which may then discharge to wetlands and surface water, which will then flow over half a mile to marine waters. This process provides numerous points that will further attenuate dissolved nitrogen compounds. Shellfish growing areas are not anticipated to be negatively affected by LOSS operation.

2.4.5 Water Recreation Areas

There are no water recreation areas within a half mile of the proposed drainfield site. Salisbury Point State Park is approximately half a mile from the LOSS site. However, as described in the description of shellfish growing areas in the preceding section, no impacts from LOSS operation on recreational waters are predicted.

2.5 Hydrogeologic Conditions

This section describes the general hydrogeologic conditions of the drainfield site. More details of the site hydrogeology are presented in Section 3.0. The data obtained from site investigations is generally consistent with published geologic maps, where the site is underlain by Quaternary glacial sediments of the Vashon Drift and advance outwash. However, whereas previous mapping shows extensive till cover (USGS 2009), till was found to be present only over portions of the LOSS site (Figures 3 and 4). All incidences of till were on topographic highs. The rest of the site is covered with sand and silt that is interpreted to be advance outwash sand that is older and underlying the till. Where present, the till is up to 10 feet thick and is overlain by a 4-foot to 5-foot veneer of weathered sandy till.

Wells installed at the LOSS revealed that the water table aquifer is a thick (approximately 40 to >100 feet thick) very fine to medium-grained sand unit that contains sparse subrounded to subangular gravels of varying lithology (i.e. quartz, granite, basalt) with thin silt laminae (approximately 0.1 to 1.0 feet thick). This water table aquifer is underlain by a massive silt to an unknown depth (>30 feet thick). The water table aquifer is interpreted to be advance glacial outwash. Specific hydrogeologic parameters are discussed in the following sections.

2.5.1 Interpretation of Well Logs

Eleven wells (including four piezometers) were installed at the LOSS from August through October 2013 as detailed in Section 3.0 (Figure 2; Appendix A). Well identification and location information is included as Table 2, and well construction information and water levels is included as Table 3.

Off-site well logs were also reviewed to assess lateral continuity. Aerial imagery shows three buildings within approximately 1,000 feet from the proposed drainfield boundary, plus the Port Gamble Community well. Tentative correlations of four of these sites with well logs were made using associated tax parcel numbers and street addresses, and are included in Appendix A. These wells include:

- Port Gamble Community Well
- Waggoner Well
- Thompson Well
- Pittman Well

The stratigraphy of the first three of these wells could not be correlated to the stratigraphy at the LOSS site. This indicates discontinuous stratigraphy and no apparent hydrogeologic correlation with the water table at the LOSS site. Water levels in these first three wells are more than 100 feet lower than the water table aquifer at the proposed LOSS site.

The Pittman well shows stratigraphy similar to that encountered under the LOSS, including a surficial till unit 26 feet thick and a depth to water of over 100 feet below ground surface. This well log is incorporated into the conceptual model of the hydrogeology of the site in Section 3.0.

Wells farther from the LOSS site indicate shallow weathered glacial till near ground surface, underlain by unweathered glacial till in some places up to 150 feet thick. Advance outwash underlies the glacial till to depths in some places exceeding 300 feet. Undifferentiated silt and sand underlie the advance outwash to an unknown depth. There is some discrepancy in the thickness of units presented when comparing onsite to offsite logs.

2.5.2 Depth to Groundwater and Flow Direction

Water level data from onsite wells is present in Table 3. Groundwater elevation contours in Figure 2 show a water level mound/divide centered on the southeast corner of the proposed LOSS footprint. Groundwater flow is radial from this mound, and likely travels in the advance outwash sand along the contact with the underlying massive silt until in intersects ground surface. Wetlands and springs are expected where the water table intersects ground surface, such as Stream 3 and wetlands D, G and H to the east and northeast of the proposed LOSS.

2.5.3 Vadose Zone Characteristics

The vadose zone has been characterized through excavation of test pits and installation of monitoring wells. Test pit logs and location information are included in Appendix B. The test pits within the drainfield were completed at depths ranging from 4 to 11 feet in what was mostly interpreted to be sandy glacial till (Appendix B; Terracon 2012). The near surface sediments were logged as silty sand to sand and had an

average hydraulic conductivity of 70 feet per day (ft/d; Table 7). No evidence of perched groundwater was found during excavation, which took place in mid-July, 2012.

Terracon (2013) completed six shallow monitoring wells within the vadose zone to identify if perching conditions exist or may arise during the wet season. Completion depths ranged from 4 to 7 feet. Water was present in one well (TP-16; Appendix B), with water levels ranging from 2.5 to 4.5 feet bgs (303 to 305 ft amsl) from January to April 2013. TP-16 is located at the eastern edge of the site, in an area of glacial till. Localized till may be responsible for perching of groundwater during the rainy season in the area surrounding TP-16.

2.5.4 Groundwater Quality

Field parameters and lab water quality results from eleven new monitoring wells and the Pittman Well are presented in Table 4 and discussed in Section 3.0 below. In addition, water quality data was obtained from DOH Sentry Database for the Community of Port Gamble water system. This includes the current drinking water source that is a deep well (Table 5), and groundwater springs used prior to 1991 located south and east of the site that is assumed to be representative of shallow groundwater in the area (Table 6).

Port Gamble Bay is listed on Ecology's 303 (d) list for impaired waters. Of particular importance are exceedances of fecal coliform in 2003 which may be due in part to the wastewater outfall from the Port Gamble Community. Treated LOSS effluent will eventually discharge to Puget Sound in Port Gamble Bay after infiltrating through a thick vadose zone (e.g., 100 feet), and discharging to wetlands. Beyond the treatment provided by the proposed new treatment facility, the following attenuation processes are expected to occur:

- The thick vadose zone will result in additional nitrification.
- The fine sand of the aquifer material will provide additional attenuation of pathogens.
- Discharge to wetlands and streams will remove additional nitrogen through denitrification.

2.5.5 Nitrate Screening Balance

A nitrate screening balance was completed according to DOH guidelines for Level 1 Nitrate Balance for Large Onsite Septic Systems (DOH 2013b; Appendix C).

2.5.5.1 Background Nitrate Concentration

Baseline nitrate data was obtained from the DOH Sentry database for the Port Gamble Community water system. This database includes data from inactive groundwater springs (Table 6) with low to absent nitrate in groundwater. Because ambient geochemical conditions in the aquifer are reducing (e.g., iron, manganese and ammonia are present) a zero concentration of background nitrate is assumed.

The default value for nitrate in precipitation used 0.24 mg/L (all references to nitrate concentrations in this report are as N). The National Atmospheric Deposition Program estimates annual nitrate loading of 1 to 2 kilograms/hectare in the Kitsap Peninsula area, which equates to 0.1 to 0.2 mg/L, given the average annual precipitation of 33 inches in the Port Gamble area (Golder 2002).

2.5.5.2 Wastewater Nitrogen

Wastewater is currently treated at the Port Gamble waste water treatment plant. No measured influent nitrogen values are available. Therefore the default value of 60 mg/L recommended by DOH for the nitrate screening balance is used.

2.5.5.3 Aquifer Properties

Hydraulic conductivity (K; 7 ft/d) was averaged from seven slug tests conducted on monitoring wells (Table 8). Groundwater recharge for the Port Gamble Sub-basin is estimated to be 13.2 inches per year (Golder 2002). Saturated aquifer thickness was averaged from monitoring well logs as 11 feet. This represents a seasonal low water table, and may be higher at other times of the year (e.g., the water table may be higher by several feet, and will not substantively reduce the vertical thickness of the unsaturated zone, which is approximately 100 feet). A water level elevation change of 20 feet between the 220-foot and 200-foot elevation contours across the LOSS footprint that are separated by approximately 800 feet indicates a hydraulic gradient of approximately 0.025 (Figure 2).

2.5.5.4 Nitrogen Screening Balance Results and Discussion

DOH said they will set the maximum increase of nitrate at the property boundary at 5 mg/L (DOH 2014; Appendix C).

The nitrate screening balance spreadsheet tool provided by DOH estimates groundwater nitrate concentrations at the edge of the drain field (“point of compliance”), and at a down gradient property boundary (“alternate point of compliance”). The nitrate screening balance assumes a simple, planar groundwater flow regime with flow occurring in one direction and conversion of all nitrogen to nitrate. The distance to the property boundary is assumed to be 10 feet, representing with the setback of the LOSS from the property boundary. Treatment of wastewater to a total nitrogen concentration of 7.7 mg/L resulted in a groundwater nitrate value at the property boundary alternate point of compliance of 5 mg/L (Appendix C).

The groundwater flow pattern at the Port Gamble Upland LOSS is radial from a groundwater mound high immediately east of the LOSS footprint. Recharge from the LOSS may affect the groundwater flow pattern and shift the groundwater mound high to the west. This would result in some of the recharged effluent to flow east to where groundwater discharges at seeps to the wetlands approximately 600 feet east from the LOSS boundary. The wetlands are expected to provide additional denitrification in

groundwater that discharges to the wetlands (Wilhelm and others 1996; Lowrance and others 1995). However, denitrification in wetlands is not assumed for compliance purposes.

2.5.6 Potential Hydraulic Continuity to Surface Water

Groundwater seeps exist northeast and east of the LOSS site (Figure 2). Approximately 45 gpm was measured in the north branch of Stream 3, approximately 650 feet northeast of the LOSS site, flowing into Wetland E. A spring was also observed in Wetland D, east of the LOSS. These wetlands eventually drain to Machias Creek. The elevation of all of these seeps is approximately 185-195 feet amsl, which is coincident with the elevation of the stratigraphic contact between the advance outwash sands at the LOSS site and the underlying silt. The seepage front along the east from Stream 3 to wetlands D is approximately 2,000 feet long. Recharge from the LOSS is estimated at 70 gpm (100,000 gpd). Approximately 50% of this recharge (35 gpm) may discharge to wetlands and streams to the east of the LOSS. GeoEngineers (2014) does not anticipate negative impacts from this seepage on wetlands. No groundwater seeps were observed in a reconnaissance of topographic slopes to the north and northwest of the LOSS site.

Pathogens are expected to be present in the treated effluent that is delivered to the LOSS. Where the unsaturated zone is thick and the movement of water slow, the time taken to reach the water table is usually long enough for most pathogens to die off (Morris 2010). Most pathogens die off within 50 days of entering the ground (Morris 2010), while some may last up to 150 days (Sugden 2006). The velocity of groundwater under the proposed LOSS site is estimated to be 1 foot per day (assuming K = 7 ft/d; i = 0.025; and, porosity [n] = 0.20; v = Ki/n). Therefore, a groundwater travel time of approximately 2 years is estimated for groundwater from under the LOSS to discharge to the wetlands, which is located approximately 600 feet east of the proposed LOSS. Additional travel time will occur through the unsaturated vadose zone. There is no regulatory standard for required travel time in the subsurface, and effective attenuation of pathogens is expected to occur in the subsurface before discharging to wetlands or surface water.

3.0 HYDROGEOLOGIC REPORT

This section describes the conceptual model of the general hydrogeologic conditions at the proposed drainfield site and down-gradient areas.

3.1 Conceptual Model

Test pits and monitoring wells installed across the LOSS footprint encountered isolated patches of sandy till on topographic highs, and areas in topographic lows and slopes where till is absent. Where the till is present a 4-5 foot thick veneer of weathered sandy till covers the till. Underlying the till is a thick (approximately 100 feet), fine- to medium-grained permeable sand with silt lamina. Where the till is absent, the medium-grained sand strata underlying the till is exposed. Effluent delivered to till areas will infiltrate vertically through the weathered till to the top of the unweathered till, and then migrate laterally downslope along the top of the unweathered till to areas where the till is absent and where infiltration to greater depths will occur.

The surficial sand is relatively permeable with an average hydraulic conductivity of 6 feet per day (ft/d) calculated from grain size analyses (Table 7). Slug test values from monitoring wells completed in the lower part of the advance outwash sand averaged hydraulic conductivity of 7 ft/d (Table 8).

There is approximately 100 feet of unsaturated vadose zone. Full oxidation of nitrogen to nitrate is expected. Peat was observed in LOSS MW-3, MW-5, MW-6, and MW-7 and may result in some denitrification of nitrate. The contact between the sand and the underlying silt is at approximately 180-200 ft amsl, which is coincident with western extents of wetlands to the northeast and east of the LOSS (Figure 2). Groundwater is believed to flow along this contact to this approximate topographic line. The high water level elevation measured in LOSS-MW-5 results in a groundwater flow map that indicates radial flow from that point.

Most flow is expected to be along the top of the silt in the advance outwash sand. Minimal vertical downward flow is expected through the underlying silt due to its thickness and permeability of more than two orders of magnitude lower than that of the overlying advance outwash sand (i.e., average silt of 0.03 ft/d in MW-1 and piezometers completed in silt; Table 8).

Almost all natural recharge occurring on site is assumed to discharge to surface waters, with very minor amounts recharging to deeper portions of the aquifer system. Recharge over the area between the crest of the groundwater mound (Figure 2) and discharge points at Stream 3 and Wetlands D, G and H along the 190 feet amsl topographic contour amounts to 146 gpm. This is consistent with observed discharge of 45 gpm at Stream 3 and isolated seeps of several gallons per minute. This observation suggests that the groundwater nitrate concentrations may be lower than estimated by the nitrate screening balance as a result of dilution with natural groundwater flow.

3.2 Groundwater Quality

Field parameters (i.e. temperature, pH, alkalinity as $CaCO_3$, and electrical conductivity) and lab results (i.e. electrical conductivity, Ca^{2+}, Cl^-, Fe^{2+}, Mg^{2+}, Mn^{2+}, NO_3^-, K^+, Na^+, SO_4^{2-}) from water quality analyses are presented in Table 4 (Appendix E). Water quality results are plotted on piper diagrams (Figure 5) and stiff plots (Figure 6) to visualize general background water quality type and characteristics. Drilling was conducted in three distinct phases: monitoring wells LOSS-MW-1 through LOSS-MW-3; monitoring wells LOSS-MW-4 through LOSS-MW-7; and piezometers LOSS-P1 through LOSS-P4. Differences in water quality between the two sets of monitoring wells may reflect the addition of water during installation of the second set of monitoring wells and influences of the bentonite seal. Resampling of the wells in the future is recommended if the data is to be used for regulatory compliance purposes.

3.3 Monitoring Well Installation

Cascade Drilling, L.P. (Cascade) was contracted to install monitoring wells. Monitoring wells were installed with a MiniSonic drill rig. The monitoring wells will also be used for long-term monitoring of groundwater elevation and water quality.

A Golder Associates Inc. (Golder) hydrogeologist was onsite August 19 through 22, 2013 to document Cascade drilling activities, log cuttings, provide input regarding three well completions, and conduct slug tests at LOSS MW-1, -2, and -3. The Golder hydrogeologist was onsite September 3 through 5, 2013 to measure water levels, install data logging pressure transducers, perform additional slug tests, and to collect field parameters and water quality samples from each well. The Golder hydrogeologist was onsite September 25, 2013 to measure water levels, download data logging pressure transducers, and to perform another slug test at MW-3. Golder personnel were also onsite October 21 through 31, 2013 to hand auger, log cuttings, install four shallow piezometers, perform slug tests, and to collect field parameters and water quality samples at LOSS P-1, -2, -3, and -4. During this period, Golder personnel also documented Cascade drilling activities, logged cuttings, provided input regarding four well completions, measured water levels, conducted slug tests, and collected field parameters and water quality samples at LOSS MW-4, -5, -6, and -7.

A survey of LOSS MW-1, -2, and -3 was completed on Friday, September 13, 2013 by Triad. Another survey of LOSS MW-4, -5, -6, -7 and P-1, -2, -3, and -4 was completed on Thursday, October 31, 2013 by Triad. Monitoring well identification and location information is included in Table 2 and shown in Figure 1.

Monitoring wells (2-inch, PVC), were installed in 6-inch boreholes. Formation samples were collected at 5-foot intervals and logged by the onsite hydrogeologist. Monitoring well borehole geologic logs and well completion diagrams are provided in Appendix A. Based on borehole geologic logs, site lithology consists predominantly of very fine to medium sands interfingered with thin silt lenses. Compact glacial tills were

observed overlying the sands at MW-2, -3, -4. Massive silt layers of silt were observed underlying the sands in LOSS MW-1, -2, -5, and -6. Bedrock was not encountered in the boreholes.

Monitoring well construction information is summarized in Table 3. Monitoring wells were constructed with 15 to 25-foot segments of 10-slot PVC screen (0.010 inch openings). Threaded 2-inch diameter PVC pipe extends from the top of the well screen to approximately 2 to 3 feet above ground surface at each well. An engineered filter pack consisting of 10-20 mesh Colorado silica sand was placed around the well screen to a level of approximately 2 to 4 feet above and below the screen extents, with exceptions noted below. Filter pack was placed concurrent with the removal (pull-back) of the temporary drill casing and measured with a sounding tape to ensure placement around the screen without bridging. A surface seal consisting of hydrated 3/8-inch bentonite chips was emplaced from the top of the filter pack to 3 feet bgs as the temporary drill casing was removed from the borehole and then filled with concrete to ground surface. At the surface the PVC stick-up is contained within a yellow painted steel casing set in 2 by 2-foot concrete pads that are surrounded by three 3-foot yellow-painted steel bollards.

In some instances, Cascade pulled the PVC casing above the intended set depth due to over-packing the drill casing with filter pack material (i.e., MW-1, -2, -3, and -5) during drill casing removal. In other instances, the PVC casing settled below the intended depth due to liquefaction created by sonic vibrations during drill casing removal (i.e., MW-4 and -7). At MW-7, 50 feet of 6-inch casing was temporarily lost in the borehole due to joint break during casing removal, and so the borehole was overdrilled with an 8-inch casing to retrieve the lost casing and to reset the well. It is likely that the well screen may have been compromised by bentonite due to inadequate refuse removal following the first unsuccessful attempt to set the well in the 6-inch borehole.

3.4 Hydraulic Testing

The wells contained water following installation, and so the onsite hydrogeologist conducted slug tests to estimate the hydraulic properties of the unconsolidated material adjacent to the screened intervals. Water levels in the wells were monitored in 30-second intervals for 20-minutes following removal of 63 cubic inches (in^3) of water via a disposable bailer. Following the slug tests, the wells were hand-developed with the bailer by purging approximately 6 gallons (3 well volumes) from each well. MW-1 was bailed dry during this period. Turbidity was not reduced.

Slug testing data were analyzed using the Hvorslev method (Hvorslev 1951) to estimate hydraulic conductivity (K) of the aquifer. Hydraulic conductivity estimates fall within the range of published hydraulic conductivity values for unconsolidated silty to silty sand aquifers (Freeze and Cherry 1979). Curve matching plots for both analysis methods are presented in Appendix D and analysis results are summarized in Table 8.

3.5 Water Level Monitoring

Data logging pressure transducers (15-minute interval) were installed September 10, 2013 per Table 9 to document long-term trends in groundwater level fluctuations. Because MW-1 is in a confined aquifer, it was relocated to MW-5 on November 26, 2013, and the time of all transducers was reset for Pacific Standard Time. The barometric monitor was placed inside the monument of MW-1 and remains there at this time. Depth to groundwater and groundwater elevations are listed in Table 10.

A plot of long-term water level trends at MW-1, -2, and -3 is provided as Figure 7, which shows a slight decrease in water level over the period of record despite precipitation during this period. Precipitation records are from Bremerton airport (up to October 31, 2013) and the Bremerton fire station (from November 1, 2013).

The lack of response of groundwater levels to precipitation suggests there is a lag time for precipitation to recharge the water table aquifer. Figures 8 through 10 show plots of barometric pressure plotted against long-term water level elevation that is corrected for barometric pressure. Monitoring well MW-1 shows strong correlation with barometric response. This information coupled with borehole lithology suggests that the massive silt logged at the bottom of MW-1 is a significant confining layer and a barrier (aquitard) to vertical flow.

4.0 CLOSING

Thank you for this opportunity to be of service.

GOLDER ASSOCIATES INC.

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5.0 REFERENCES

Department of Health (DOH). 2013a. Site Approval letter to Jon Rose dated May 24, 2013 (Project Number 2012-035).

DOH. 2013b. Publication #337-069 (Revised October 2013) Level 1 Nitrate Balance Instructions for Large On-site Sewage Systems.

DOH. 2014. Port Gamble – Hydrogeology Report. Letter from Nancy Darling to Jon Rose of Olympic Property Group January 28, 2014.

Department of Natural Resources (DNR). 2007. Washington DNR Hydrography (HYDRO) for Kitsap County.

Freeze, R.A. and J.A. Cherry. 1979. Groundwater. Prentice-Hall, Inc. Englewood Cliffs, New Jersey.

GeoEngineers. 2013. Technical Discipline Report: Plants, Animal and Wetlands. Prepared for Pope Resources.

GeoEngineers. 2014. Revised Evaluation of Impacts to Water Quantity on Wetlands; Port Gamble Large On-site Sewage System Memorandum. Prepared for Olympic Property Group I, LLC. February 28, 2014.

Golder Associates Inc. (Golder). 2002. Kitsap Basin (WRIA 15) Watershed Planning Level 1 Assessment. Prepared for Kitsap County.

Hvorslev, M.J. 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engineers, U.S. Army, Vicksburg, Mississippi, pp. 1-50.

Jensen Engineering Inc. (Jenson). 2012. Port Gamble Large On-Site Sewage Disposal System Predesign Report. September 2012.

Kasenow, M. 2002. Determination of Hydraulic Conductivity from Grain Size Analysis. Water Resources Publications, pp. 53-70.

Lowrance, R., G. Vellidis and R.K. Hubbard. 1995. Denitrification in a Restored Riparian Forest Wetland. Journal of Environmental Quality 24(5): 808-815.

Morris, B. 2010. Pathogens and Groundwater. Review for the United Kingdom Groundwater Forum.

Natural Resources Conservation Service (NRCS) Soil Classification System (SCS). 2012. Custom Soil Resource Report for Kitsap County Area, Washington, Port Gamble.

Sugden, S. 2006. The Microbiological Contamination of Water Supplies. Well Fact Sheet. Downloaded 7/1/2013 from http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/Contamination.htm

Terracon Consultants, Inc. (Terracon). 2012. Geotechnical Feasibility Evaluation: Port Gamble Upland LOSS. September.

Terracon. 2013. Groundwater Monitoring Summary: Port Gamble Upland LOSS.

Tchobanoglous, G., F.L. Burton and Metcalf and Eddy, Inc. 1991. Wastewater Engineering: Treatment Disposal and Reuse. McGraw-Hill Book Co., Inc. New York, New York. pp. 1334.

United States Geologic Survey (USGS). 2009. Surficial Geology of the Kitsap Peninsula. Open-File Report 2009-1033 Version 1.0, Sheets 1 and 2.

Wilhelm, S.R., S.L. Schiff and W., D. Robertson. 1996. Biogeochemical Evolution of Domestic Waste Water in Septic Systems: 2 Application of Conceptual Model in Sandy Aquifers. Groundwater, Vol. 34, No.5.

Zipper Zeman Associates, Inc. (Zipper Zeman). 2005. Geotechnical Feasibility Report: Baseline Site Conditions Study.

Zipper Zeman. 2007. Geotechnical Pre-Design Report: Forested Upland Study.

TABLES

Table 1: Port Gamble Wastewater Treatment Plant Average Monthly Flows, MGD

Month	2001	2002	2003	2004 †	2005	2006	2007	2008	2009	2010
January	0.008	0.018	0.031	0.029	0.011	0.03	0.02	0.019	0.013	0.027
February	0.007	0.02	0.021	0.027	0.016	0.015	0.013	0.012	0.012	0.021
March †	0.008	0.018	0.033	0.013	0.011	0.017	0.018	0.01	0.015	0.017
April	0.013	0.011	0.022	0.008	0.017	0.013	0.013	0.012	0.015	--
May	0.013	0.01	0.018	0.007	0.012	0.01	0.01	0.009	0.01	0.016
June	0.014	0.012	0.013	0.011	0.013	0.011	0.008	0.01	0.008	0.015
July	0.013	0.013	0.013	0.009	0.013	0.01	0.009	0.011	0.006	0.009
August	0.014	0.011	0.013	0.007	0.012	0.01	0.008	0.009	0.006	0.012
September	0.011	0.01	0.013	0.009	0.013	0.009	0.008	0.008	0.008	0.01
October	0.01	0.006	0.018	0.009	0.008	0.008	0.009	0.008	0.007	0.012
November	0.023	0.007	0.024	0.008	0.011	0.024	0.011	0.011	0.027	0.017
December	0.022	0.016	0.029	0.014	0.022	0.026	0.027	0.012	0.018	--
Annual Average	0.013	0.013	0.021	0.013	0.013	0.015	0.013	0.011	0.012	
Total annual water use (gallons)	4,381,209	4,036,624	3,621,564	4,121,269	5,053,322	5,076,457	4,627,124	--		
Total annual rainfall (inches)	39.6	29.2	39.2	36.0	35.0	42.4	34.3			

Notes:

-- Data not available

† Manholes repaired March 2004

Pre-repair flows

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Table 2: Well Identification and Location Information

OPG Well ID	Date Installed	Ecology Well ID	Northing	Easting	Top of PVC casing elevation (ft amsl)	PVC casing stick-up (ft ags)
LOSS MW-1	8/20/2013	BHN-761	314467.56	1206721.69	289.03	2.25
LOSS MW-2	8/21/2013	BHN-762	314306.42	1206908.99	315.26	2.39
LOSS MW-3	8/22/2013	BHN-763	314218.83	1206696.26	296.87	2.38
LOSS MW-4	10/28/2013	BHN-786	313806.86	1206562.49	341.7	2.64
LOSS MW-5	10/29/2013	BHN-785	314053.73	1207410.78	246.83	2.54
LOSS MW-6	10/30/2013	BHN-783	314901.64	1207277.75	238.48	2.93
LOSS MW-7	10/24/2013	BHN-784	314886.51	1206539.87	292.44	2.96
LOSS P-1	10/25/2013	na	314452.26	1207673.98	185.21	2.16
LOSS P-2	10/24/2013		314328.77	1207544.28	216.28	2.42
LOSS P-3	10/24/2013		314226.71	1207567.37	216.3	2.18
LOSS P-4	10/25/2013		314137.56	1207564.74	215.69	1.96
Pittman	10/31/2002	AES 249	314418.971	1205900.7	330.62	~1

Notes:

Coordinates are in Washington State Plane NAD83 (Horizontal) and NAVDAT88 (Vertical)

n/a = Not analyzed

ft amsl = feet above mean sea level

ft ags = feet above ground surface

Table 3: Well Construction Information and Water Levels

OPG Well ID	Borehole Depth (ft bgs)	Screen (ft bgs)	Filter Pack (ft bgs)	Water Level (ft btoc)	Water Level (ft amsl)
LOSS MW-1	90	52.5 - 77.5	52.2 - 82.7	77.41 [1]	211.62 [1]
LOSS MW-2	120	80.2 - 100.2	82.7 – 110.0	95.39 [1]	219.87 [1]
LOSS MW-3	90	68.4 - 83.4	67.2 – 90.0	77.72 [1]	219.15 [1]
LOSS MW-4	130	112.0 – 132.0	108.0 – 128.0	122.80 [2]	218.90 [2]
LOSS MW-5	60	18.0 – 38.0	16.0 – 42.0	26.66 [2]	220.17 [2]
LOSS MW-6	55	34.0 – 44.0	31.0 – 46.0	43.83 [2]	194.65 [2]
LOSS MW-7	110	87.5 – 102.5	82.0 – 101.0	94.13 [2]	198.31 [2]
LOSS P-1	9	2.8 – 7.8	2.0 – 9.0	5.01 [3]	180.20 [3]
LOSS P-2	9	2.6 – 7.6	2.0 – 9.0	6.22 [3]	210.06 [3]
LOSS P-3	9	2.8 – 7.8	2.0 – 9.0	7.60 [3]	208.70 [3]
LOSS P-4	9	3.0 – 8.0	2.0 – 9.0	4.61 [3]	211.08 [3]
Pittman [4]	175	170-175	None (0.004-inch screen)	132.9 [4]	197.72 [4]

Notes:

[1] October 21, 2013

[2] October 31, 2013

[3] October 30, 2013

[4] November 26, 2013

ft bgs = feet below ground surface

ft btoc = feet below top of casing

ft amsl = feet above mean sea level

Table 4: Groundwater Quality Data

	Site	Units	MW-1	MW-2	MW-3	MW-4[3]	MW-5[3]	MW-6	MW-7[3]	P-1	P-2[3]	P-3[3]	P-4[3]	Pittman
	Date (2013)	MM/DD	9/10			10/31	10/30	10/31			10/30			11/26
	Time	hh:mm	16:46	16:20	15:45	14:55	18:10	10:34	13:40	9:10	14:00	15:00	16:30	13:10
Field Data	Temperature	°C	14.8	13.5	14	11.56	10.26	11.54	10.55	12.46	13.28	13.27	11.46	10.9
Field Data	pH	SU	7.49	7.52	7.87	8.07	6.89	7.32	8.06	6.88	6.51	6.75	6.22	7.61
Field Data	Alkalinity (as CaCO3)[1]	mg/L	112	132	104	92	119	138	189	78	52	48	48	61
Field Data	Electrical Conductivity	µS/cm	254.8	234	168	213	263	311	348	171	80	131	104	91.6
Lab Data	Electrical Conductivity at 25°C	µS/cm	238	223	136	222	297	331	360	156	70.7	129	99.7	200
Lab Data	Sodium	mg/L	7.27	10.2	6.94	24	45.6	59.7	85.8	8.79	4.61	6.1	7.65	5.2
Lab Data	Potassium	mg/L	1.74	2.46	1.45	1.9	2.02	2.31	4.15	2.77	0.657	0.831	1.17	1.7
Lab Data	Calcium	mg/L	17.3	14.7	8.74	12.8	11	11.4	12.8	15.7	5.19	7.51	5.88	25.9
Lab Data	Magnesium	mg/L	15.2	12.5	6.32	5.59	3.74	3.18	12.3	5.62	3.26	6.03	3.45	12
Lab Data	Iron	mg/L	0.38	0.077	0.193	0.299	0.396	0.139	31.9	0.0373	0.106	0.155	0.519	<0.06
Lab Data	Manganese	mg/L	0.247	0.383	0.265	0.726	0.871	0.0586	0.601	0.0398	0.0105	0.0032	0.0084	0.011
Lab Data	Chloride	mg/L	5.85	4.48	1.28	3.21	7.26	9.66	9.95	1.12	1.12	2.25	1.8	5.4
Lab Data	Ammonia (as N)	mg/L	n/a			0.105	0.196	0.181	0.085	0.143	0.086	0.076	0.069	<0.05
Lab Data	Nitrate (as N)	mg/L	<0.01			0.03	0.04	0.04	<0.01	0.13	0.07	2.88	0.97	0.13
Lab Data	Sulfate	mg/L	20.9	15.5	10.3	17.7	5.43	4.6	5.34	1.31	2.27	4.79	6.23	19
Calculated	Charge Balance Error (CBE) [4]	%	1%	-7%	-20%	6%	12%	14%	31%	11%	-11%	0%	-4%	24%
Calculated	TDS	mg/L	128.20	128.16	90.54	96.58	101.52	113.44	188.27	71.68	43.83	52.97	48.21	99.65

Notes:

[1] Determined using Hach Alkinity kit. Method: add Phenolpthalein and Bromcresol powder to 100 mL sample and titrate with 1.6N H2SO4 until color change from green to pink.

[2] Field alkalinity adjusted to achieve CBE <5%.

[3] Alkalinity sample field filtered with 0.45 micron filter to improve visual determination of color change.

[4] CBE calculated with field alkalinity (CBE = ((Total Cation meq/L - Total Anion meq/L) / (Total Cation meq/L + Total Anion meq/L))*100%).

°C = degrees Celsius SU = standard unit

mg/L = milligrams per liter µS/cm = microsiemens per centimeter

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Table 5: DOH Water Quality Results for Water System 00323 (Port Gamble well)

Analyte	3/1/1995	9/9/1996	8/4/1998	6/20/2000	8/1/2001	12/27/2002 to 10/11/2011
ARSENIC	<0.01	NO DATA	<0.005	NO DATA	<0.005	NO DATA
BARIUM	<0.1		<0.01		<0.1	
CADMIUM	<0.002		<0.0005		<0.001	
CHROMIUM	<0.01		<0.005		<0.01	
IRON	<0.1		<0.05		<0.1	
LEAD	<0.002		<0.001		<0.002	
MANGANESE	<0.01		0.03		0.01	
MERCURY	<0.0005		<0.0002		0.0008	
SELENIUM	<0.005		<0.005		<0.005	
SILVER	<0.01		<0.0005		<0.01	
SODIUM	40		41.4		39.1	
HARDNESS	61		57.7		60	
Conductivity (Umhos/cm)	276		281		275	
TURBIDITY (NTU)	0.3		0.24		0.13	
COLOR (CU)	<5		15		<5	
FLUORIDE	<0.2		0.2		<0.2	
NITRATE	<0.5	0.1	<0.1	0.6	<0.1	<0.5
CHLORIDE	5	NO DATA	3.92	NO DATA	<5	NO DATA
COPPER	<0.2		<0.005		<0.2	
ZINC	<0.2		<0.005		<0.2	
BERYLLIUM	<0.003		<0.0005		<0.003	
NICKEL	<0.04		<0.04		<0.04	
ANTIMONY	<0.005		<0.005		<0.005	
THALLIUM	<0.002		<0.002		<0.002	
NITRITE-N	<0.5		<0.01		<0.01	
CYANIDE	<0.05				<0.05	
Total Nitrate + Nitrite					<0.5	

Table 6: DOH Water Quality Results for Water System 68650 (decommissioned springs)

Analyte	10/13/1987	8/16/1984	6/13/1983	11/14/1981
ARSENIC	<0.01	<0.01	NO DATA	<0.01
BARIUM	<0.25	<0.25		<0.25
CADMIUM	<0.002	<0.002		<0.002
CHROMIUM	<0.01	<0.01		<0.01
IRON	<0.1	0.06	0.69	0.06
LEAD	<0.01	<0.01	NO DATA	<0.01
MANGANESE	<0.01	0.022	0.205	<0.01
MERCURY	<0.0005	0.0005	NO DATA	0.0005
SELENIUM	<0.005	<0.003		<0.005
SILVER	<0.01	<0.01		<0.01
SODIUM	5	5		5
HARDNESS	50	55		NO DATA
CONDUCTIVITY	160	150		140
TURBIDITY	0.3	0.3		0.2
COLOR	<5	<5		25
FLUORIDE	<0.2	<0.2		<0.2
NITRATE-N	<0.2	0.2		0.4
CHLORIDE	<5	5		<5

Table 7: Hydraulic Conductivity Calculated from Grain Size Analysis

Site	USCS Classification	Lithology[1]	Hydraulic Conductivity Range (cm/sec)[2]	Hydraulic Conductivity	
				(cm/sec)	(ft/day)
TP-1	Silty Sand (SM)	Weathered Till	2.5E-4 to 2.5E-3	1.7E-03	4.8
TP-5	Silty Sand (SM)	Sandy Till	1.4E-4 to 4E-3[4]	7.5E-4[4]	2.1
TP-20	Sand (SM)		5.4E-4 to 1E-3	1.4E-03	4.0
TP-31	Silty Sand (SM)		6.9E-4 to 6.5E-2	5.2E-03	14.7
TP-4*	Silty Sand (SM)	Recessional Outwash	1.6E-3 to 3.0E-3[4]	2.2E-3[4]	6.2
TP-4*	Sand (SP)		4.0E-4 to 3.2E-3	1.1E-3	3.1
TP-9*	Sand (SP)		3.7E-4 to 3.0E-3	1.1E-3	3.1
TP-24*	Silty Sand (SM)	Weathered Till	6.3E-4 to 1.2E-3[4]	8.6E-4[4]	2.4
TP-28*	Sand (SP)	Advance Outwash	1.8E-3 to 1.5 E-2	4.3E-3	12.2
Average				2E-03	5.9

Notes:

* Grain size analysis performed by Zipper Zeman Associates, 2006. All other analysis by Terracon, 2012.

[1] Lithologic interpretations from Terracon, 2012.

[2] Range in conductivity of applicable equations for hydraulic conductivity (e.g., Barr, Kozeny-Carmen, Pavchich, and Sauerbrei).

[3] Geometric mean conductivity from applicable equations.

[4] Applicable equations limited to Barr and Kozeny-Carmen due to increased percentage of fines.

ft/day = feet per day

cm/sec = centimeters per second

Table 8: Hydraulic Conductivity Calculated from Slug Tests

OPG Well ID	Date of Slug Test	Lithology Tested	Hydraulic Conductivity	
			(ft/day)	(cm/sec)
LOSS MW-1	9/10/2013	SILT	0.044	1.60E-05
LOSS MW-2	9/10/2013	Silty SAND	20	6.90E-03
LOSS MW-3	9/25/2013		3.6	1.30E-03
LOSS MW-4	10/31/2013		20	7.00E-03
LOSS MW-5	10/31/2013		0.42	1.50E-04
LOSS MW-6	10/31/2013		3.1	1.10E-03
LOSS MW-7	10/31/2013		1.6	5.80E-04
LOSS P-1	10/31/2013	SILT	0.027	9.50E-06
LOSS P-2	10/30/2013	Silty SAND	0.32	1.10E-04
LOSS P-3	10/30/2013	SILT	0.018	6.20E-06
LOSS P-4	10/30/2013	Sandy SILT	0.022	7.80E-06
Average		SAND	7	2.45E-03
		SILT	0.03	9.88E-06

Notes:
ft/day = feet per day
cm/sec = centimeters per second

Table 9: Long-term Monitoring Pressure Transducer Inventory

Serial Number	Range (psi)	Cable Length (feet)	Location	
			9/10/2013 to 11/26/2013	11/26/2013 to present
21330007	15 (barometric monitor)	n/a	LOSS-MW-1	
21327069	30	95	LOSS-MW-1	LOSS-MW-5
21335021		125	LOSS-MW-2	
21335020		95	LOSS-MW-3	

Notes:

All sensors are model INW PT2X

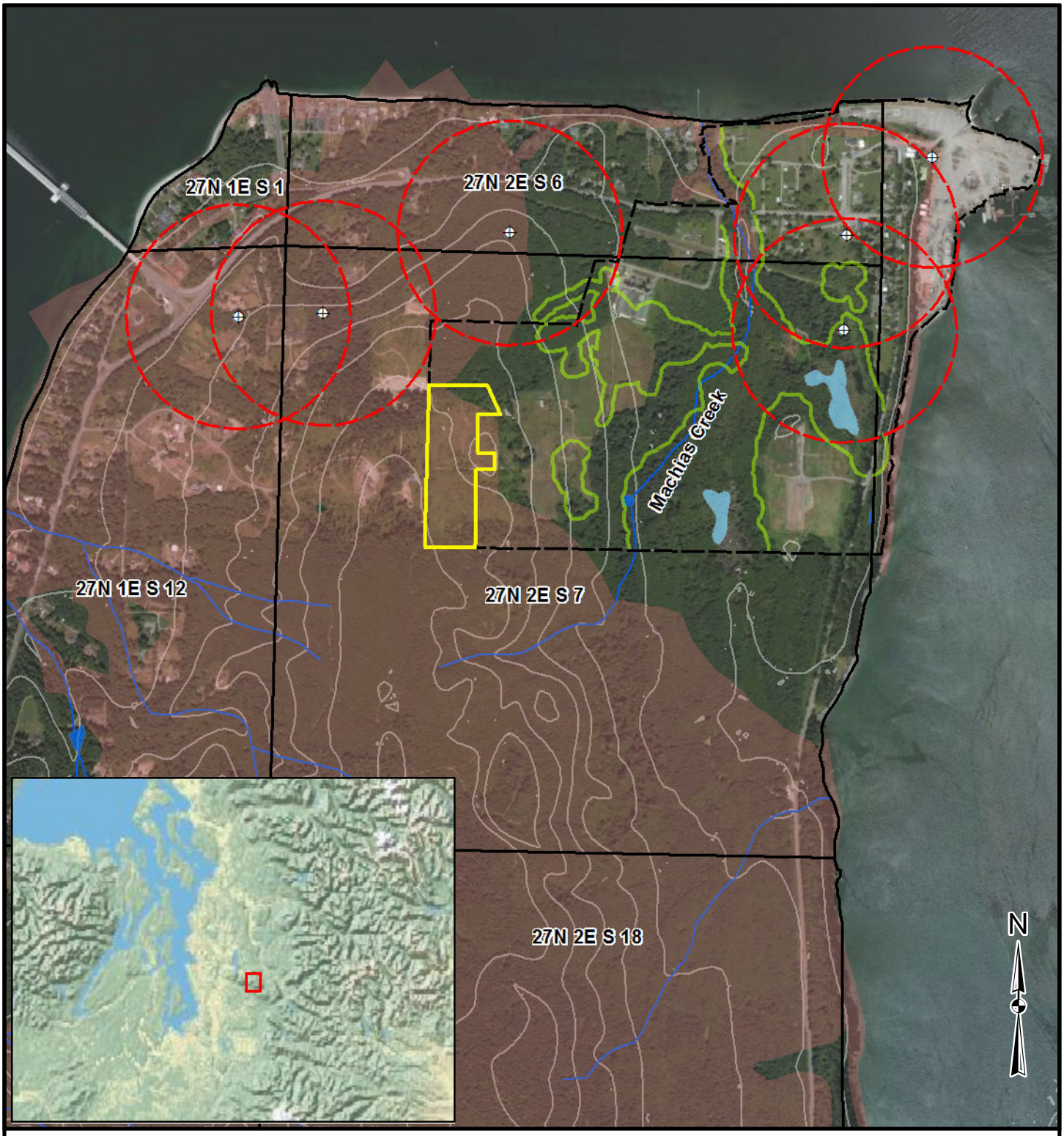
psi = pounds per square inch

Table 10: Depth to Water and Water Level Elevations

OPG Well ID		10/31/2002	22-Aug-13	9-Sep-13	10-Sep-13	25-Sep-13	21-Oct-13	30-Oct-13	31-Oct-13	26-Nov-13
	Date Installed	**Depth to Water** (feet below top of casing)								
LOSS MW-1	8/20/2013		76.76	76.95	76.80	77.07	77.41			77.84
LOSS MW-2	8/21/2013		94.94	95.16	95.14	95.24	95.39			
LOSS MW-3	8/22/2013		77.10	77.49	77.49	77.59	77.72			77.85
LOSS MW-4	10/28/2013								122.80	122.82
LOSS MW-5	10/29/2013								26.66	26.72
LOSS MW-6	10/30/2013								43.83	43.91
LOSS MW-7	10/24/2013								94.13	95.74
LOSS P-1	10/25/2013							5.01		
LOSS P-2	10/24/2013							6.22		
LOSS P-3								7.60		
LOSS P-4	10/25/2013							4.61		
Pittman	10/31/2002	136								132.90
	Top of Casing Elevation	**Water Elevation**								
	(ft amsl; NAVDAT88)									
LOSS MW-1	289.03		212.27	212.08	212.23	211.96	211.62			211.19
LOSS MW-2	315.26		220.32	220.10	220.12	220.02	219.87			
LOSS MW-3	296.87		219.77	219.38	219.38	219.28	219.15			219.02
LOSS MW-4	341.70								218.90	218.88
LOSS MW-5	246.83								220.17	220.11
LOSS MW-6	238.48								194.65	194.57
LOSS MW-7	292.44								198.31	196.70
LOSS P-1	185.21							180.20		
LOSS P-2	216.28							210.06		
LOSS P-3	216.30							208.70		
LOSS P-4	215.69							211.08		
Pittman	330.62	194.62								197.72

Note: ft amsl = feet above mean sea level

FIGURES



LEGEND

- Source Well
- Wellhead Protection Area
- Hydric Soil Buffer Area
- Township Range Section
- Category II CARA

Hydrologic Features

- Pond
- Freshwater Forested/Shrub Wetland
- Stream/River
- 50 ft Contour

NOTES

1.) HYDRIC SOIL BUFFERS DELINEATED BY TRIAD ASSOCIATES
2.) WELLHEAD PROTECTION AREAS ASSIGNED BY WA DOH
3.) SOURCE WELLS INCLUDE GROUP A AND GROUP B SYSTEMS

REFERENCES

1.) WASHINGTON DEPARTMENT OF NATURAL RESOURCES
2.) WA DEPT. OF HEALTH OFFICE OF DRINKING WATER
3.) BING MAPS

1,250 0 1,250
Feet

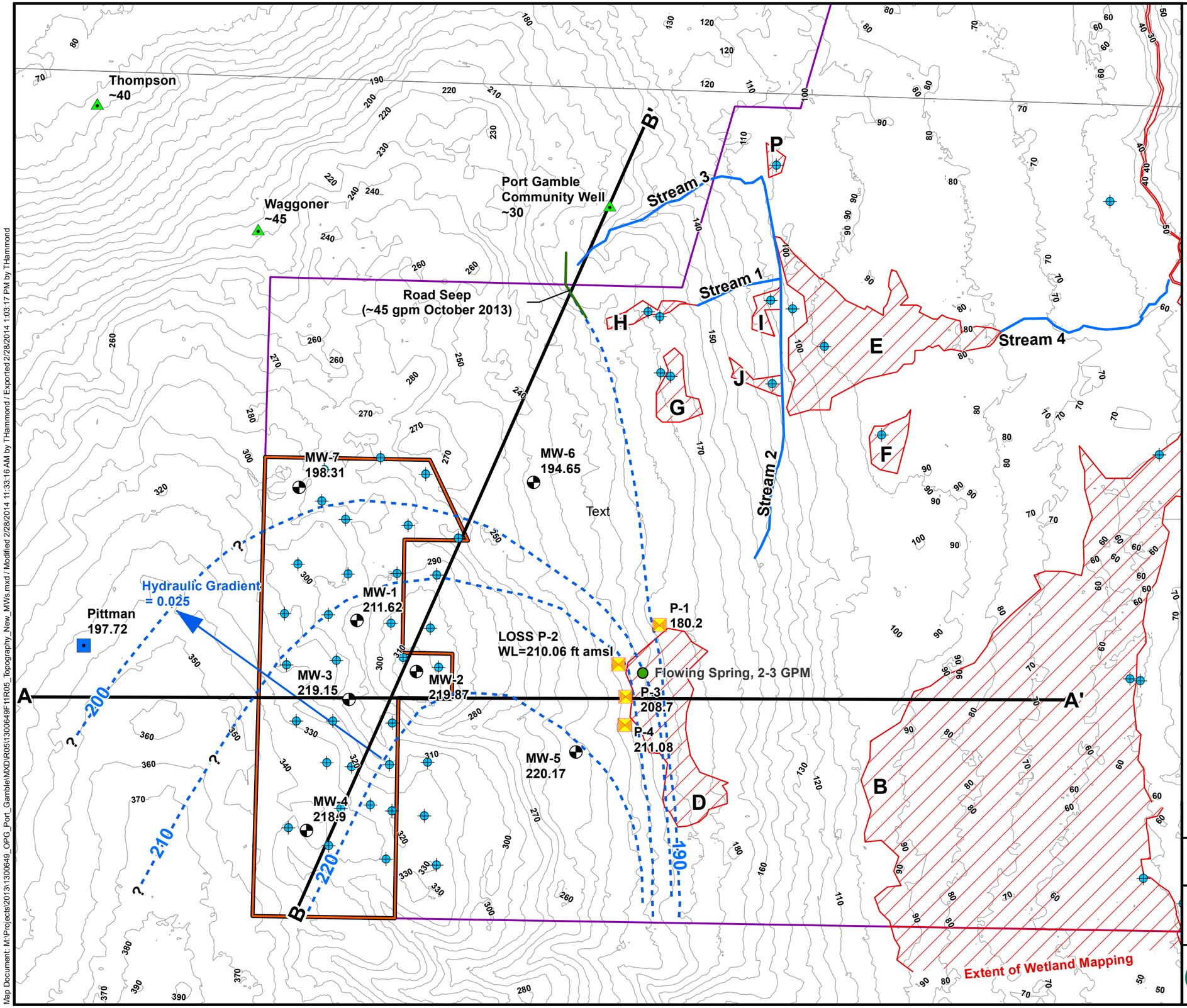
PROJECT
OLYMPIC PROPERTY GROUP
PORT GAMBLE LOSS (1300649)
KITSAP COUNTY, WASHINGTON

TITLE
LOCATION MAP AND SENSITIVE AREAS

Golder Associates

PROJECT NO. 1300649			FILE No. 1300649F013R03_CriticalAreas.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 3
GIS	BVJ	7 Jan. 2014	
CHECK	CP	7 Jan. 2014	**FIGURE: 1**
REVIEW	JJ	7 Jan. 2014	

Map Document: M:\Projects\2013\1300649_OPG_Port_Gamble\MXD\R03\1300649F013R03_CriticalAreas.mxd / Modified 1/7/2014 2:57:07 PM by BVang-Johnson / Exported 1/7/2014 3:10:13 PM by BVang-Johnson



LEGEND

- MW-1 211.62 — Monitoring Well and Groundwater Elevation ft amsl
- P-1 180.2 — Piezometer and Groundwater Elevation ft amsl
- Pittman — Domestic Well (surveyed)
- Thompson — Domestic Well (not surveyed, location approximate)
- Test Pit
- Spring
- Road Seep
- Groundwater Elevation Contour
- A A' — Cross Section Location
- Wetland
- Stream
- Proposed Drainfield Area
- Property Boundary
- Contour (10 ft)

REFERENCES

1.) PUGET SOUND LIDAR CONSORTIUM (TOPOGRAPHY)
2.) TRIAD ASSOCIATES (PITS, WETLANDS, LOSS LAYOUT, PROPERTY BOUNDARY, STREAMS, WELLS, PIEZOMETERS)
3.) COORDINATE SYSTEM: NAD 1983 StatePlane Washington North FIPS 4601 Feet

N

300 0 300 Feet

PROJECT
OLYMPIC PROPERTY GROUP
PORT GAMBLE LOSS (1300649)
KITSAP COUNTY, WASHINGTON

TITLE
SITE MAP

Golder Associates

PROJECT NO. 1300649			1300649F11R05_Topography_New_MWs.mxd
DESIGN	-	-	SCALE: AS SHOWN REV. 5
GIS	TH	7 Jan. 2014	**FIGURE: 2**
CHECK	TH	28 Feb. 2014	
REVIEW	CP	28 Feb. 2014	

Map Document: M:\Projects\2013\1300649_OPG_Port_Gamble\MXD\R05\1300649F11R05_Topography_New_MWs.mxd / Modified 2/28/2014 11:33:16 AM by THammond / Exported 2/28/2014 1:03:17 PM by THammond

WEST

EAST

ELEVATION (FEET MSL)

400
350
300
250
200
150
100
50
0

LOSS FOOTPRINT

B

PITTMAN WELL

HARDPAN

SANDBOUND WITH ROCKS

SAND WITH ROCKS

SILT SANDY

SAND WITH ROCKS

SILTY SAND

FINE SAND

SILT

LOSS MW-3

LOSS MW-2

SAND / SILT SAND

SAND W/ SILT LENSES

SILT

SAND

SILT

SAND

SILTY SAND

SAND

SILT

219.15

219.15

LOSS MW-5

LOSS P-3

WETLAND

SAND

SILT

220.17

208.7

WETLAND

EXPLANATION

LOSS MW-3

MONITORING WELL AND DESIGNATION

SILT

219.15

GROUNDWATER ELEVATION

SAND

SCREENED INTERVAL

GEOLOGIC CONTACT

SPRING/SEEP

0 150 300 450

SCALE FEET

SCALE 1" = 300'
VERT. SCALE 1:60

A
3

CROSS-SECTION A-A'

PROJECT

OLYMPIC PROPERTY GROUP
COMPILATION AND REVIEW OF DATA
PORT GAMBLE, WA.

TITLE

CROSS SECTION A-A'

Golder Associates

PROJECT No.		1300649.004	FILE No.	13006-49-004-001
DESIGN	CM	2013-11-18	SCALE	AS SHOWN
CADD	ACF	2013-11-18	FIGURE	
CHECK	MK	2013-11-18		3
REVIEW	CP	2013-11-18		

SOUTH

NORTH

LOSS FOOTPRINT

LOSS MW-4

LOSS MW-3

LOSS MW-2

LOSS MW-1
(PROJECTED 90' E)

LOSS MW-7
(PROJECTED 250' E)

LOSS MW-6
(PROJECTED 65' W)

A

SAND
SILT
SAND W/
SILT LENSES
218.90
SAND /
SANDY SILT
SILT
219.15
SAND
SAND
SILTY
SAND
219.87
SAND W/
SILT LENSES
SILT
SAND
SAND
SILT
211.62
SILT
(VARIES)
198.31
SAND W/
SILT LENSES
SAND
194.65
SILT
SEEP @ 190' amsl
(~45 gpm OCT. 2013)
STREAM 3
PORT GAMBLE
WELL
SILTY
CLAY
SANDY
SILT
SILT
FINE SAND
AND SILT
SCREENED
438-448 ft.bgs.
TD 452 ft.bgs.

ELEVATION (FEET MSL)

400
350
300
250
200
150
100
50
0
-50
-100

SCALE 1" = 300'
VERT. SCALE 1:60

B
4

CROSS-SECTION B-B'

EXPLANATION

LOSS MW-3

MONITORING WELL AND DESIGNATION

SILT
219.15
GROUNDWATER ELEVATION

SAND
SCREENED INTERVAL

GEOLOGIC CONTACT

SPRING/SEEP

0 150 300 450
SCALE FEET

PROJECT
OLYMPIC PROPERTY GROUP
COMPILATION AND REVIEW OF DATA
PORT GAMBLE, WA.

TITLE
CROSS SECTION B-B'

Golder Associates

PROJECT No.		1300649.004	FILE No.	13006-49-004-001
DESIGN	CM	2013-11-18	SCALE	AS SHOWN
CADD	ACF	2013-11-18	FIGURE	
CHECK	MK	2013-11-18		4
REVIEW	CP	2013-11-18		

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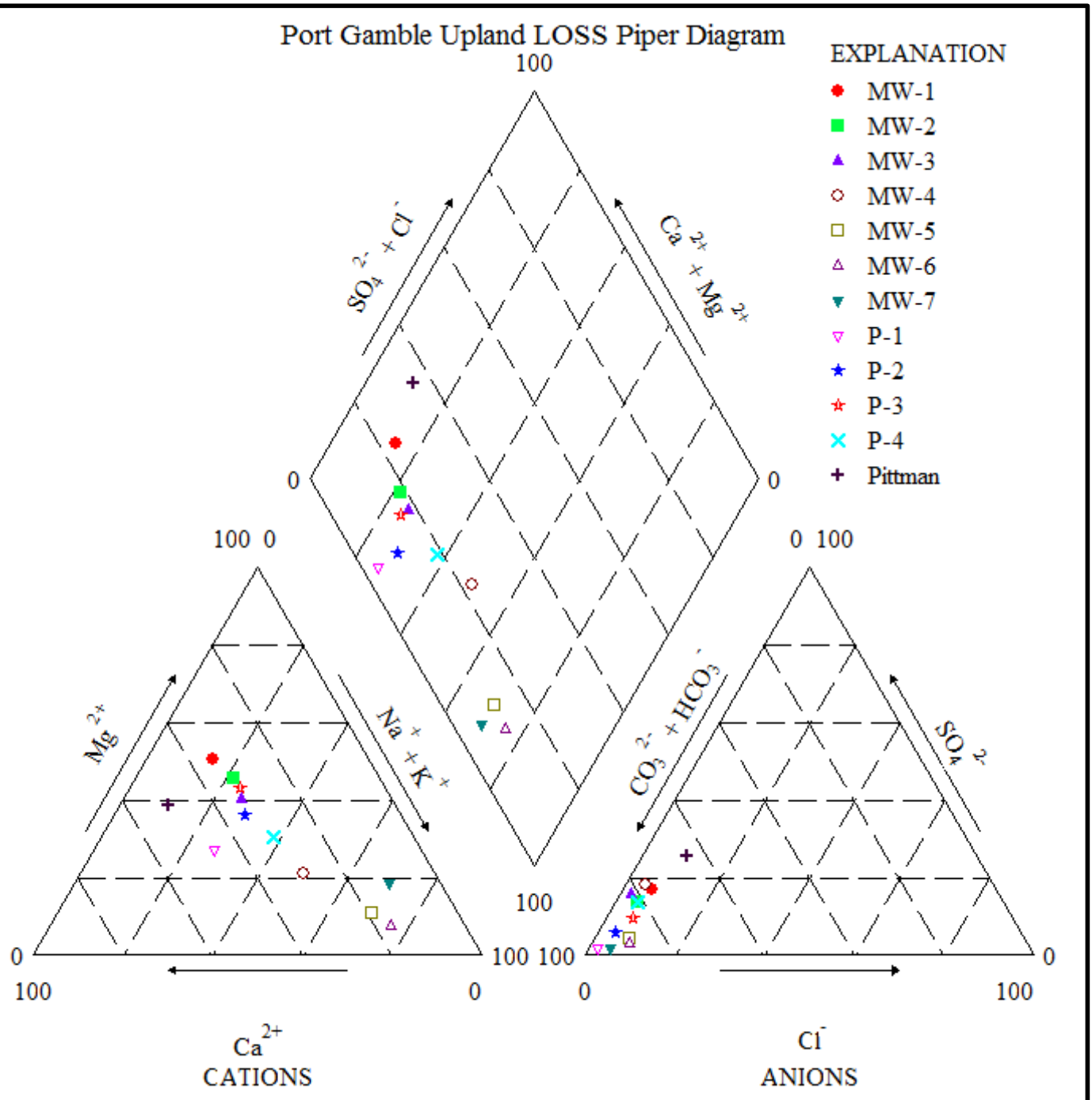


Golder Associates

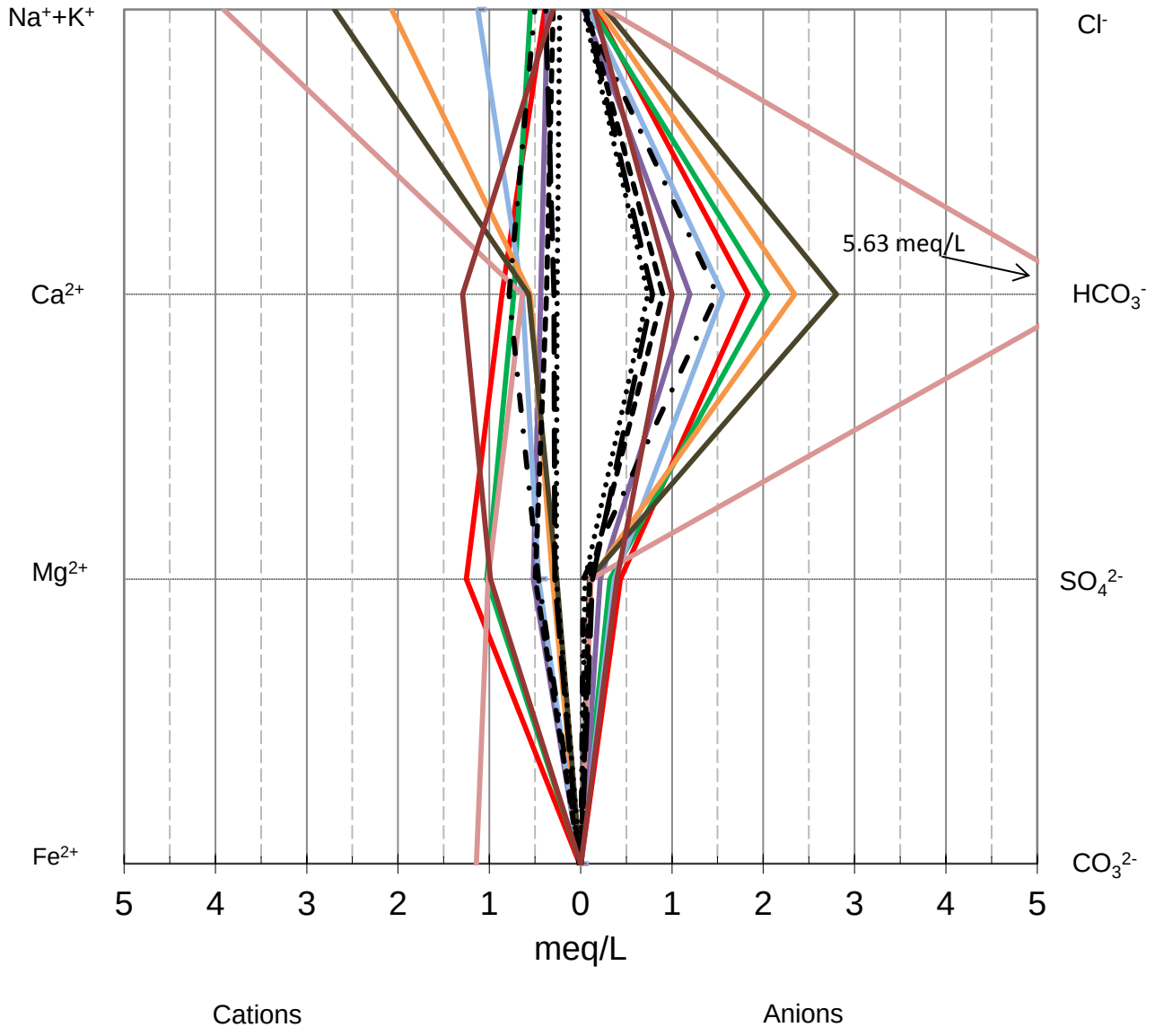
FIGURE **5**

PIPER DIAGRAM

Port Gamble Upland LOSS

1300649.004

Port Gamble Upland LOSS Stiff Diagrams



LEGEND

MW-1 MW-2 MW-3 MW-4

MW-5 MW-6 MW-7 P-1

P-2 P-3 P-4 Pittman

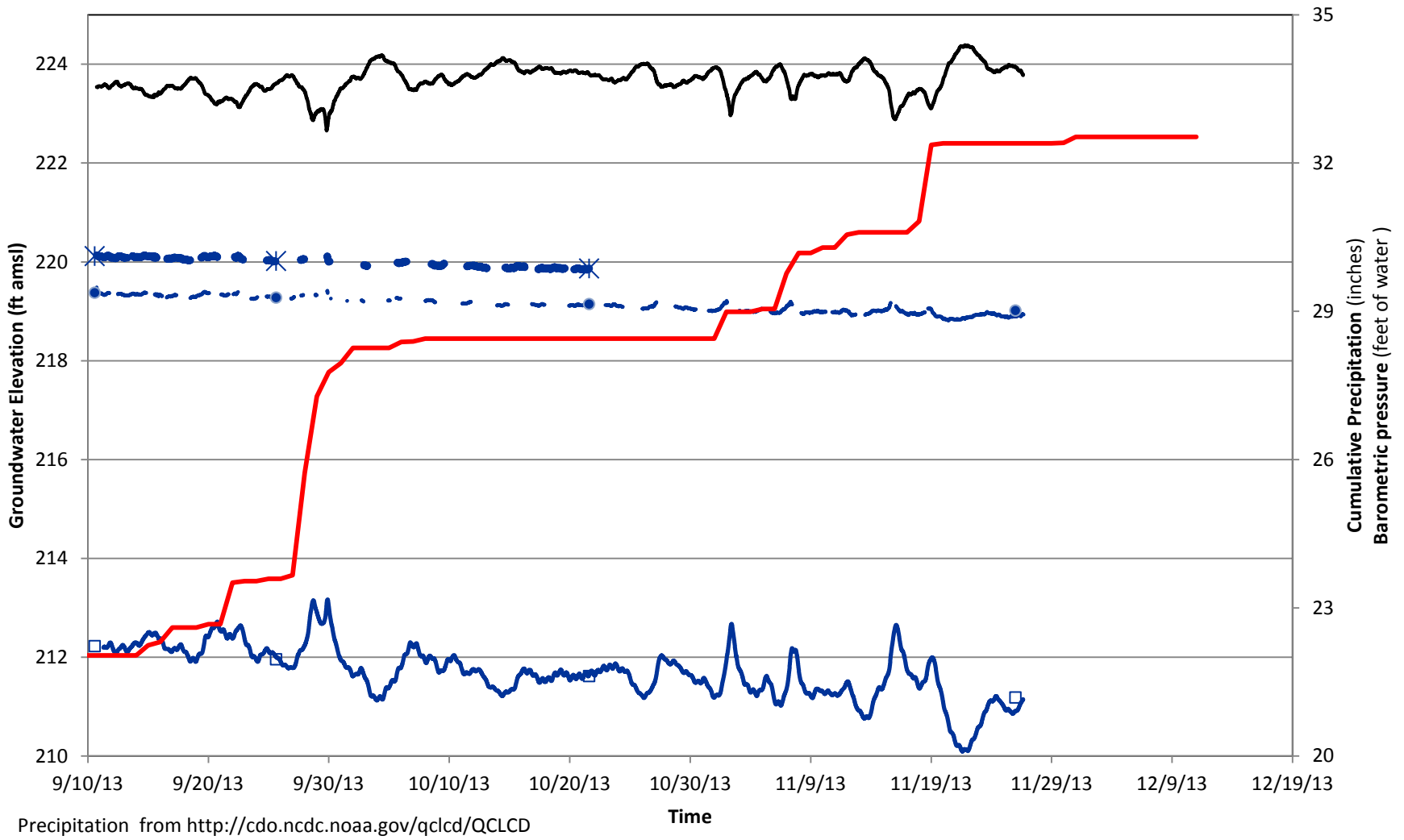
Golder Associates

FIGURE **6**

STIFF PLOT

Port Gamble Upland LOSS

1300649.004

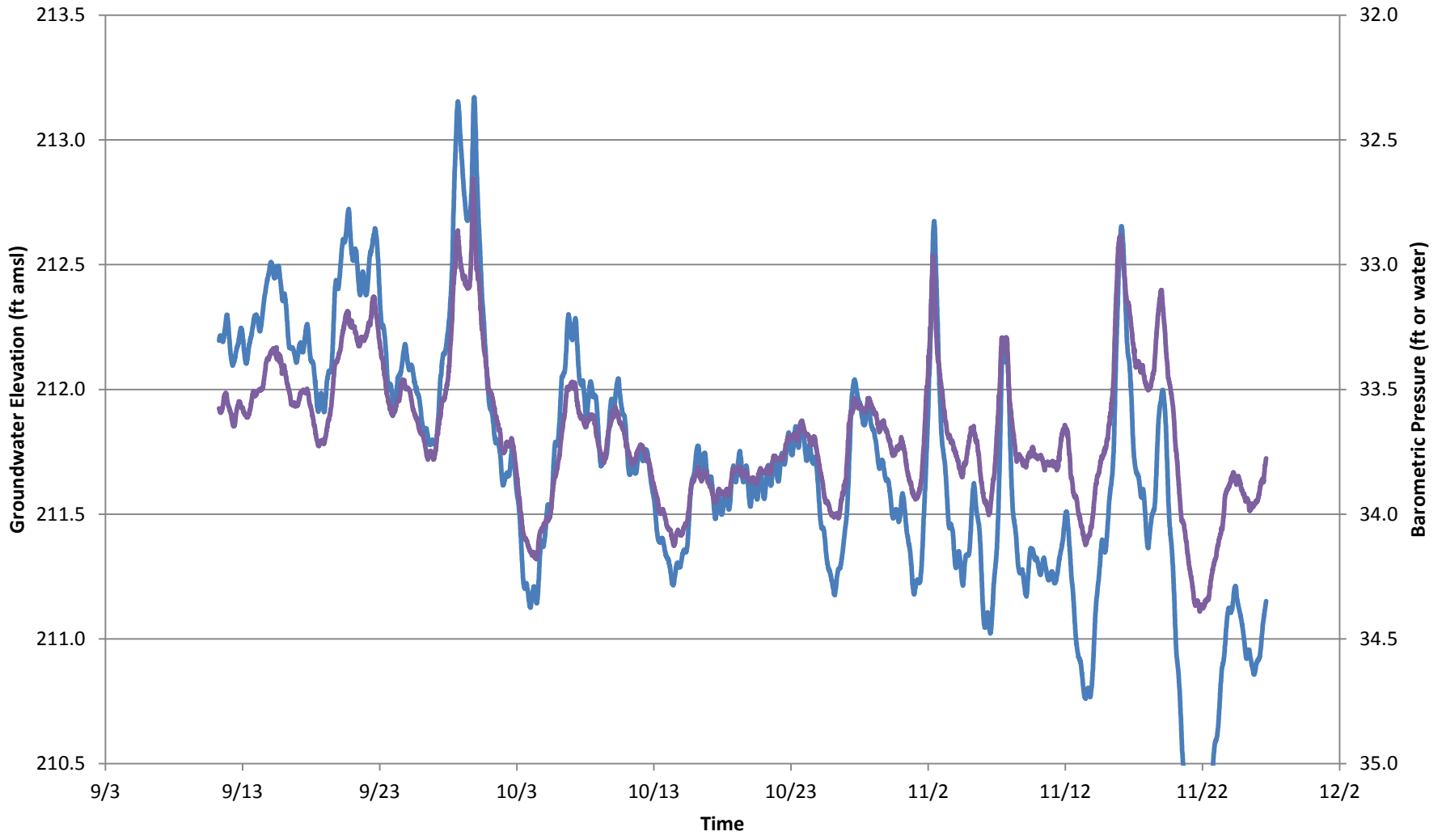


Golder Associates

Figure 7

WATER LEVEL PLOTS

Port Gamble Upland LOSS



LEGEND

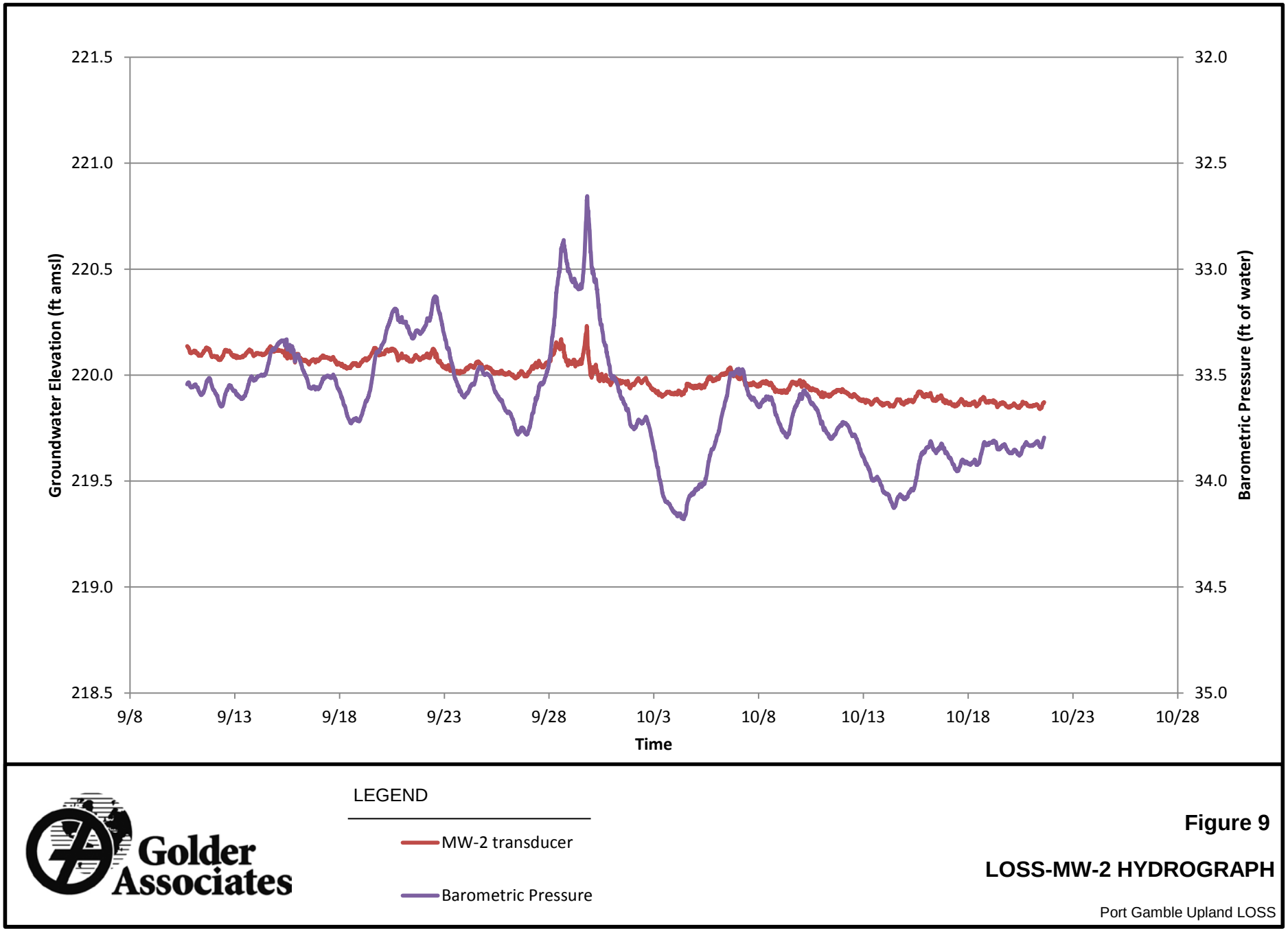
MW-1 transducer

Barometric Pressure

Figure 8

LOSS-MW-1 HYDROGRAPH

Port Gamble Upland LOSS

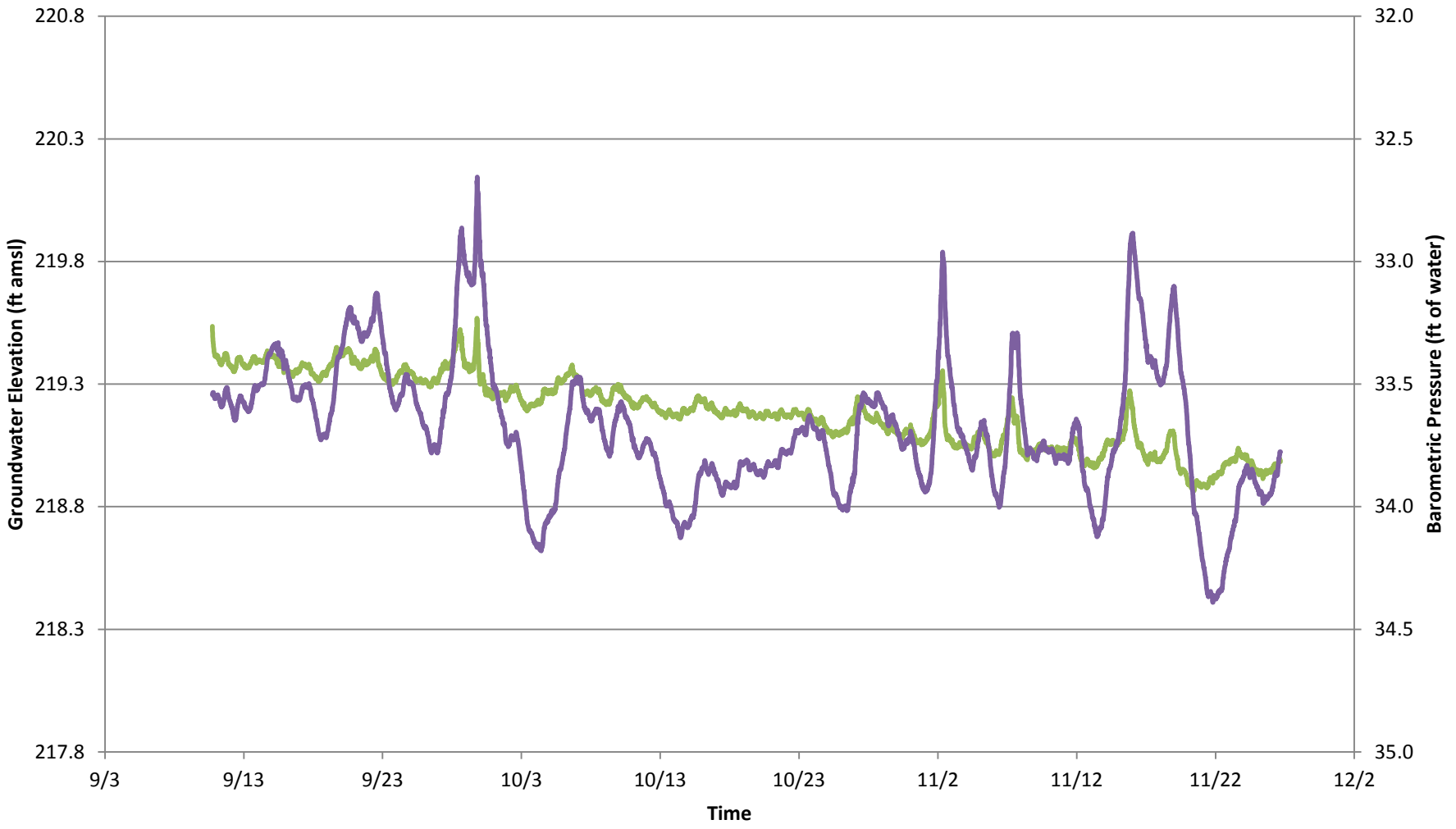


Golder Associates

Figure 9

LOSS-MW-2 HYDROGRAPH

Port Gamble Upland LOSS



LEGEND

MW-3 transducer

Barometric Pressure

Figure 10

LOSS-MW-3 HYDROGRAPH

Port Gamble Upland LOSS

APPENDIX A
WELL LOGS

Pittman Well

Waggoner Well

Port Gamble Community Well

Thompson Well

LOSS Monitoring Wells 1 thru 7

123333

Pittman Well

27-2E. 7F

File Orig & First Copy - Dept of Ecology
Second Copy - Owner, Third Copy - Driller

WATER WELL REPORT
State of Washington

Start Card No W153760
Unique Well ID AES249
Water Right Permit No

(1) OWNER Name KURT WAGGONER Address P O BOX 118 KINGSTON WA 98346 Page 1 of
(2) LOCATION OF WELL County KITSAP SE 1/4 NW 1/4 Sec 7 T 27 N R 2E
(2a) STREET ADDRESS OF WELL (or nearest address) BABCOCK ST OFF HWY 3 TAX# 072702-2- WA

(3) PROPOSED USE DOMESTIC Owner Well ID
(4) Type of work NEW WELL
Method CABLE

(5) DIMENSIONS Diameter of well 6 inches
Drilled 175 feet Depth of completed well 175 ft

(6) CONSTRUCTION DETAILS
Casing instld 6 " Diam from 0 ft to 170 ft
Welded X " Diam from ft to ft
Liner _ " Diam from ft to ft
Threaded _

Perforations Yes _ No X
Type of perforator used
Size of perforations in by in
perforations from ft to in
perforations from ft to in
perforations from ft to in

Screens Yes X No _
Manufacturer's Name JOHNSON
Type STAINLESS Model No SUPER
Diam 6 Slot size 4 from 170 ft to 175 ft
Diam Slot size from ft to ft

Gravel packed Yes _ No X Size of gravel
Gravel placed from ft to ft

Surface seal Yes X No _ To what depth? 23 ft
Material used in seal BENTONITE
Did any strata contain unusable water? Yes _ No X
Type of water? Depth of strata
Method of sealing strata off

(7) PUMP Manufacturer's Name STA RITE
Type SUBMERSIBLE H P 2

(8) WATER LEVELS Surface elev above mean sea level 300 ft
Static level 136 ft below top of well Date 10/31/02
Artesian pressure lbs per sq in Date
Artesian pressure is controlled by

(9) WELL TESTS Pump test made? YES By whom? DRILLER
Yield 15 gal /min with 16 ft drawdown after 3 hrs
Yield 0 gal /min with ft drawdown after hrs
Yield 0 gal /min with ft drawdown after hrs
Recovery data

Time	Wtr Lvl	Time	Wtr Lvl	Time	Wtr Lvl
5 00	152	5 01	143-6	5 02	140
5 03	138-2	5 04	137-4	5 05	137

Date of test 10/31/02
Bailer test 18 gal/min with 17 ft drawdown after 3 hr
Airtest 0 gal/min with stem set at ft for hrs
Artesian flow 0 gal/min Date
Temperature of water Was chemical analysis made? YES

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION

Material		From	To
LOAM SANDY	BROWN	0	3
HARDPAN ROCKY MILD	BROWN	3	26
SAND BOUND W/ ROCKS	BROWN	26	78
SAND W/ ROCKS	BROWN	78	91
SILT SANDY	BROWN	91	120
SAND W/ ROCKS	BROWN	120	157
SAND BOUND SILTY FINE	BROWN	157	166
SAND FINE	BROWN	166	173
SAND FINE	GRAY	173	175
SILT COMPACT	GRAY	175	

RECEIVED
NOV 13 2002
DEPT OF ECOLOGY

Work Started 10/25/02 Completed 10/31/02

WELL CONSTRUCTOR CERTIFICATION
I constructed and/or accept responsibility for construction this well and its compliance with all Washington well construction standards Materials used and the information report above are true to my best knowledge and belief
Name CRABTREE DRILLING CO
Address 33349 Eglon Road NE Kingston WA 98346
(Signed) B L Crabtree License No 1443
(Well Driller)
Contractor's Registration No 09702 Date 11/08
Based on form ECL 050-1-20 (2/93)**f-1329- by Speed Systems C

409837 Waggoner Well 27-2E-7D

WATER WELL REPORT

Original & 1st copy – Ecology, 2nd copy – owner, 3rd copy – driller

DEPARTMENT OF ECOLOGY State of Washington

Construction/Decommission *("x" in circle)*

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

CURRENT

Notice of Intent No. W269974

Unique Ecology Well ID Tag No. BAT995

Water Right Permit No. N/A

Property Owner Name KURT WAGGONER

Well Street Address NE STATE HWY 104

City PORT GAMBLE County KITSAP

Location NW1/4-1/4 NW1/4 Sec 7 Twn 27 R 2E EWM ☒ Or WWM ☐

(s, t, r Still REQUIRED)

Lat/Long Lat Deg ____ Lat Min/Sec ____ Long Deg ____ Long Min/Sec ____

Tax Parcel No. (Required) 072702-2-025-2003

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other ____

TYPE OF WORK: Owner's number of well (if more than one) ____

☒ New well ☐ Reconditioned *Method:* ☐ Dug ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 600 ft. Depth of completed well 439 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6 " Diam. from +1 ft. to 419.10 ft. ☐ Liner installed ____ " Diam. from ____ ft. to ____ ft. ☐ Threaded ____ " Diam. From ____ ft. to ____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used ____

SIZE of perfs ____ in. by ____ in. and no. of perfs ____ from ____ ft. to ____ ft.

Screens: ☒ Yes ☐ No ☐ K-Pac Location ____

Manufacturer's Name FJ

Type PVC Model No. ____

Diam. 5 Slot size 10 from 399 ft. to 439 ft.

Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel/Filter packed: ☒ Yes ☐ No Size of gravel/sand 20/40

Materials placed from 417 ft. to 439 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.

Material used in seal BENTONITE

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? ____ Depth of strata ____

Method of sealing strata off ____

PUMP: Manufacturer's Name GOULDS 10LS15

Type: SUBMERSIBLE H.P. 1 1/2

WATER LEVELS: Land-surface elevation above mean sea level ____ ft.

Static level 177 ft. below top of well Date 4/18/11

Artesian pressure ____ lbs. per square inch Date ____

Artesian water is controlled by ____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level

Was a pump test made? ☒ Yes ☐ No If yes, by whom? GRESHAM

Yield: 16.5 gal./min. with 49.9 ft. drawdown after 1+ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Yield: ____ gal./min. with ____ ft. drawdown after ____ hrs.

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
30MIN	189.6				

Date of test 4/18/11

Bailer test ____ gal./min. with ____ ft. drawdown after ____ hrs.

Airtest 10 gal./min. with stem set at 208 ft. for 1 hrs.

Artesian flow ____ g.p.m. Date ____

Temperature of water ____ Was a chemical analysis made? ☒ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
BROWN SAND	0	4
BROWN SANDY CLAY	4	92
BLUE CLAY	92	204
BLUE SILTY SAND W/CLAY	204	211
BLUE CLAY	211	418
FINE SAND & SILT,	418	
LAYERED W/CLAY, H20		439

RECEIVED MAY 03 2011 WATER RESOURCES - NWRO

Start Date 03/29/11 Completed Date 4/04/11

WELL CONSTRUCTION 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.

☒ Driller ☐ Engineer ☐ Trainee Name (print) CRAIG A. GRESHAM

Driller/Engineer/Trainee Signature ____

Driller or trainee License No. 0761

IF TRAINEE: Driller's License No: ____

Driller's Signature ____

Drilling Company GRESHAM WELL DRILLING INC

Address P O BOX 1600

City, State, Zip POULSBO , WA, 98370-0195

Contractor's Registration No. GRESHWD055BC Date 4/25/11

File Original and First Copy with the Division of Water Resources
Second Copy — Owner's Copy
Third Copy — Driller's Copy

27/2E-7Q2

Port Gamble Community Well

INTENT Application No. 026478

Permit No. .....

(1) OWNER: Name Pope & Talbot, Inc. Address P.O. Box 217 Port Gamble, Wa. 98364

(2) LOCATION OF WELL: County KITSAP NE ¼ NE ¼ NW ¼ Sec. 7 T. 27 N., R. 2E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic ☐ Industrial ☐ Municipal ☒
Irrigation ☐ Test Well ☐ Other ☐

(4) TYPE OF WORK: Owner's number of well (if more than one) .... #2
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☒ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 12 inches.
Drilled 452 ft. Depth of completed well 448 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 12 " Diam. from 0 ft. to 440 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☐ " Diam. from ft. to ft.

Perforations: Yes ☐ 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.

Screens: Yes ☒ No ☐
Manufacturer's Name
Type SS Model No.
Diam. 6 PS Slot size 40 from 438 ft. to 448 ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☒ No ☐ Size of gravel: 8 x 12
Gravel placed from 415 ft. to 451 ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? Depth of strata
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 152.5 ft. below top of well Date 4/23/90
Artesian pressure lbs. per square inch Date
Artesian water is controlled by (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is amount water level is lowered below static level
Was a pump test made? Yes ☒ No ☐ If yes, by whom? BURT
Yield: 50 gal./min. with 134.7 ft. drawdown after 24 hrs.
" " " "
" " " "

Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
10 min	222.9	140	185.0		
20	209.5	180	182.3		
60	197.1				

Date of test 4/23, 24/90
Bailer test gal./min. with ft. drawdown after hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes ☒ No ☐

(10) WELL LOG:
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 of formation.

MATERIAL	FROM	TO
Brn silty sand	0	10
Gray silty clay	10	118
" sandy silt	118	142
Organic silt	142	144
Gray silt, sand, some pebbles	144	185
Gray v.f. sand & silt	185	323
Cemented sand	323	325
Silt, varying layers clayey to sandy. Basalt boulder at 397	325	440
Gravel w/ silt layers	440	442
F to med sand w/ some gravel. Grades finer downwards	442	447
Silty fine sand	447	450
Till	450	452
LOG PREPARED BY		
ROBINSON & NOBLE, INC		
GROUND WATER GEOLOGISTS		
J.K. Noble 5/7/90		

RECEIVED
MAY 14 1990
DEPT OF ECOLOGY

Work started 3/7/90, 19.... Completed 5/24, 19.90

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Burt Drilling Co.
(Person, firm, or corporation) (Type or print)

Address Poulsbo, WA

[Signed] George Burt
(Well Driller)

License No. 0048 Date 5-9, 19.90

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—(Rev. 2-66)—2-66—5M. 4516.

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

115754

WATER WELL REPORT

ECOLOGY Original & 1st copy Ecology 2nd copy owner 3rd copy driller

Thompson Well

Construction/Decommission (x in circle)
- (X) Construction
- ( ) Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* _____

CURRENT Notice of Intent No W131469

Unique Ecology Well ID Tag No AHB414

Water Right Permit No _____

Property Owner Name STEVE THOMPSON

Well Street Address STATE HWY 104

City POULSBO County KITSAP

Location NW 1/4- 1/4 NW 1/4 Sec 7 Twn 27 R 2E EWM or WWM *circle one*

Lat/Long (s,t,r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____

Tax Parcel No 072702-2-009-2003

PROPOSED USE (X) Domestic ( ) Industrial ( ) Municipal ( ) DeWater ( ) Irrigation ( ) Test Well ( ) Other _____

TYPE OF WORK Owner's number of well (if more than one) _____

(X) New Well ( ) Reconditioned *Method* ( ) Dug ( ) Bored ( ) Driven ( ) Deepened (X) Cable ( ) Rotary ( ) Jetted

DIMENSIONS Diameter of well 6 inches drilled 212 ft. Depth of completed well 212 ft.

CONSTRUCTION DETAILS

Casing Installed: (X) Welded 6 Diam from +1 ft to 202 ft; ( ) Liner installed _____ Diam from _____ ft to _____ ft; ( ) Threaded _____ Diam from _____ ft to _____ ft

Perforations ( ) Yes (X) No

Type of perforator used _____

SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens (X) Yes ( ) No ( ) K Pac Location TOP

Manufacturer's Name WESCO

Type STAINLESS STEEL Model No _____

Diam 6 Slot Size 8 from 202 ft to 207 ft

Diam 6 Slot Size 10 from 207 ft to 212 ft

Gravel/Filter packed ( ) Yes (X) No ( ) Size of gravel/sand _____

Materials placed from _____ ft to _____ ft

Surface Seal (X) Yes ( ) No To what depth? 18 ft

Materials used in seal BENTONITE

Did any strata contain unusable water? ( ) Yes (X) No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP Manufacturer's Name GOULDS

Type SUBMERSIBLE 18LS15 H P 1½

WATER LEVELS Land surface elevation above mean sea level _____ ft

Static level 41 ft below top of well Date 6/14/02

Artesian pressure _____ lbs per square inch Date _____

Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level

Was a pump test made? (X) Yes ( ) No If yes by whom? GRESHAM

Yield 21 gal /min with 83 ft drawdown after 1+ hrs

Yield _____ gal./min with _____ ft drawdown after _____ hrs

Yield _____ gal /min with _____ ft drawdown after _____ hrs

Recovery data (time taken as zero when pump turned off)(water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
FULL RECOVERY IN 18 MIN					
Date of test 6/14/02					

Bailer test 22 gal /min with 86 ft drawdown after 1 hrs

Airtest _____ gal./min with stem set at _____ ft for _____ hrs

Artesian flow _____ g p m Date _____

Temperature of water _____ Was a chemical analysis made? (X) Yes ( ) No

CONSTRUCTION OR DECOMMISSION PROCEDURE

Formation Describe by color character size of material and structure and the kind and nature of the material in each stratum penetrated with at least one entry for each change of information Indicate all water encountered (USE ADDITIONAL SHEETS IF NECESSARY)

MATERIAL	FROM	TO
OVERBURDEN	0	1
BROWN SANDY HARDPAN	1	47
BROWN SILTY FINE SAND	47	51
BROWN SANDY SILTY CLAY	51	58
BROWN FINE SAND	58	62
BROWN SANDY SILT	62	66
GRAY SANDY SILT	66	78
GRAY SILTY CLAY	78	105
GRAY SILT	105	125
GRAY SILTY CLAY	125	184
GRAY SILTY SANDY CLAY	184	202
GRAY SAND, SILT, H20	202	205
GRAY GRAVELLY CLAY	205	206
GRAY SAND, GRAVEL, H20	206	208
GRAY SAND, H20	208	211
GRAY SANDY CLAY	211	212

RECEIVED
JUL 03 2002
DEPT OF ECOLOGY

Start Date 6/05/02 Completed Date 6/11/02

WELL CONSTRUCTION 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

(X) Driller ( ) Engineer ( ) Trainee Name (Print) CRAIG A GRESHAM

Driller/Engineer/Trainee Signature _____

Driller or Trainee License No 0761

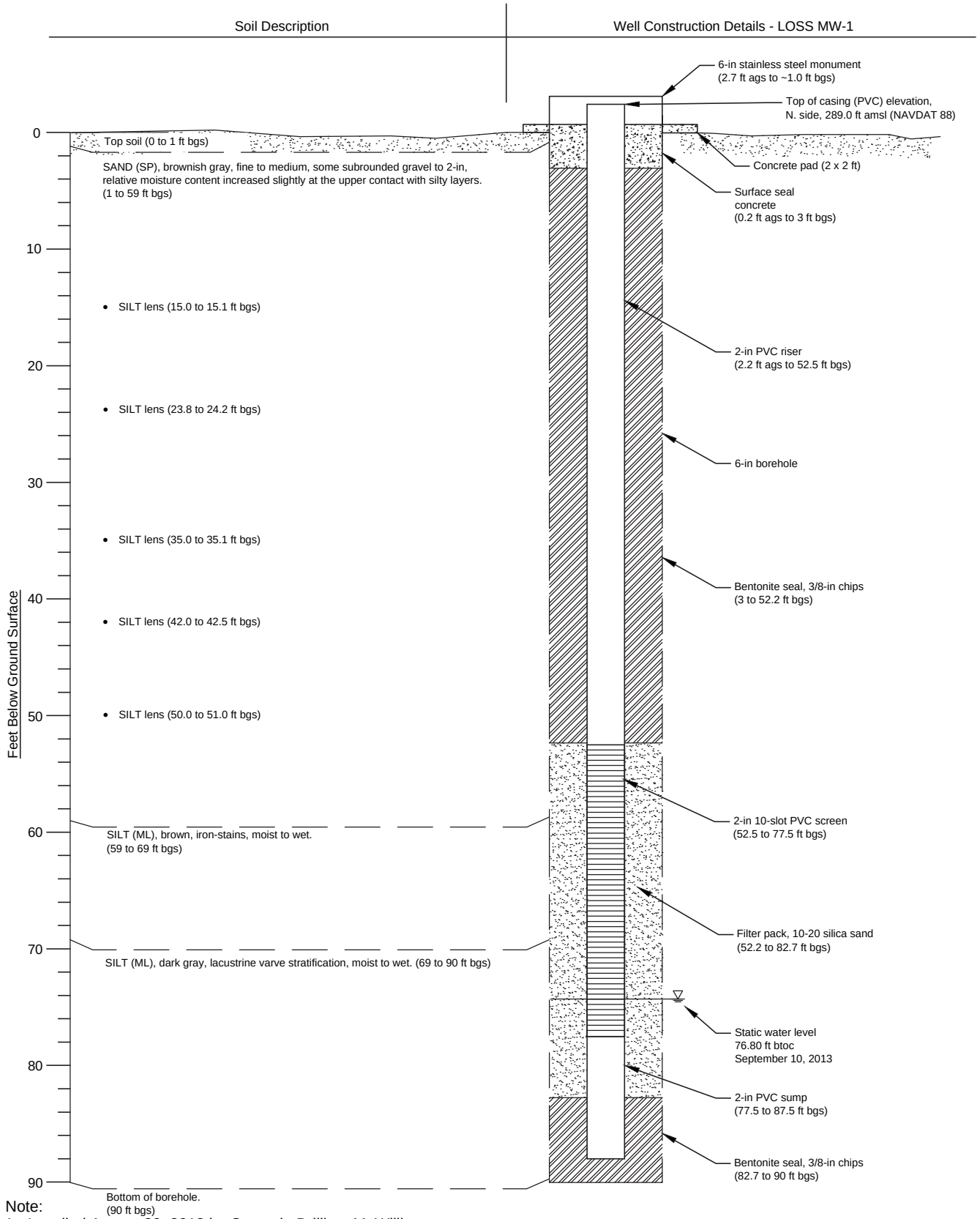
Drilling Company GRESHAM WELL DRILLING INC

Address P O BOX 1600

City State Zip POULSBO, WA 98370

Contractor's Registration No GRESHWD055BC Date 6/20/02

If trainee, licensed driller's Signature and License no _____



Note:

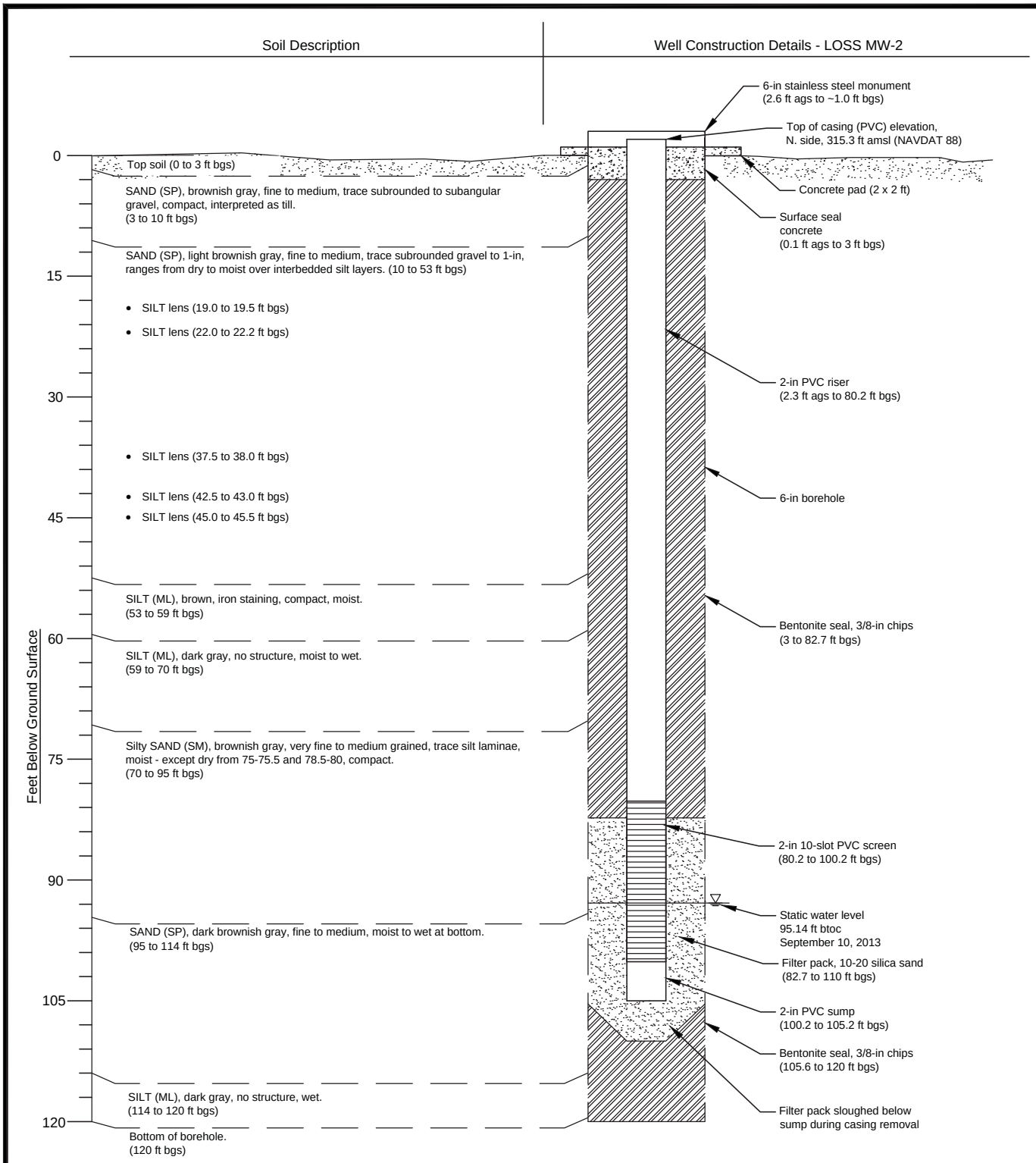
1. Installed August 20, 2013 by Cascade Drilling, M. Williams
2. WA Dept. of Ecology ID BHN-761
3. Logged by J. Gerst
4. Well casing pulled up approximately 2.5 ft from intended depth of 90 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
7. 314467.56N 1206721.69E (WA State Plane North Zone; NAD 83)

FIGURE **A-1**

LOSS MW-1 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates



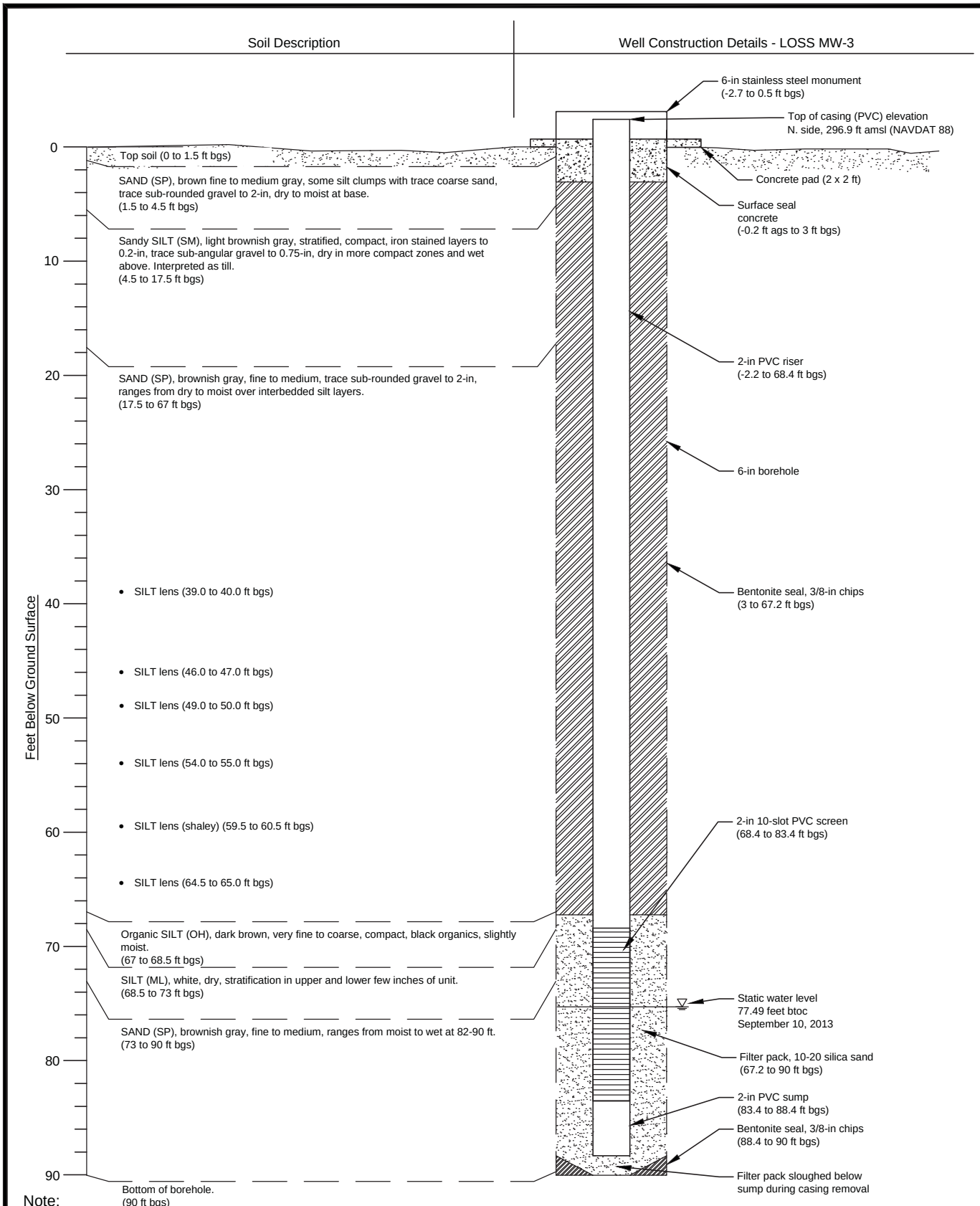
Note:
1. Installed August 21, 2013 by Cascade Drilling, M. Williams
2. WA Dept. of Ecology ID BHN-762
3. Logged by J. Gerst
4. Well casing pulled up approximately 5 ft from intended depth of 110 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
7. 314306.42N 1206908.99E (WA State Plane North Zone; NAD 83)

FIGURE **A-2**

LOSS MW-2 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates



Note:

1. Installed August 22, 2013 by Cascade Drilling, M. Williams
2. WA Dept. of Ecology ID BHN-763
3. Logged by J. Gerst
4. Well casing pulled up approximately 1.6 ft from intended depth of 90 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
7. 314218.83N 1206696.26E (WA State Plane North Zone; NAD 83)

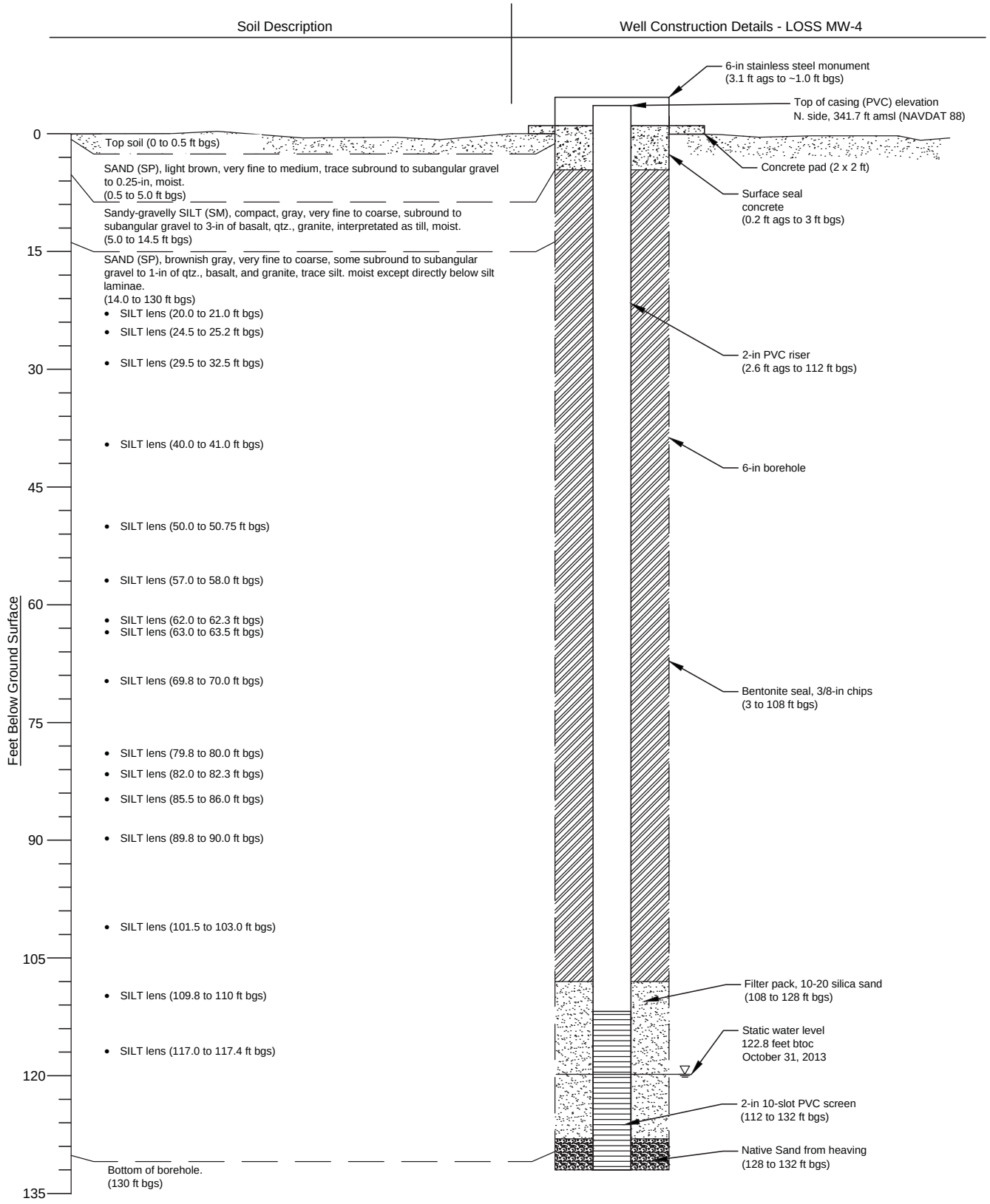
FIGURE **A-3**

LOSS MW-3 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates

C:\Users\CRaeburn\Desktop\CAD - working folder\Port Gamble\Port Gamble Loss MWells_v0.3.dwg | FIGURE 3 - LOSS MW-3 | Mod: 11/11/2013, 15:51 | Plotted: 11/11/2013, 15:52 | CRaeburn



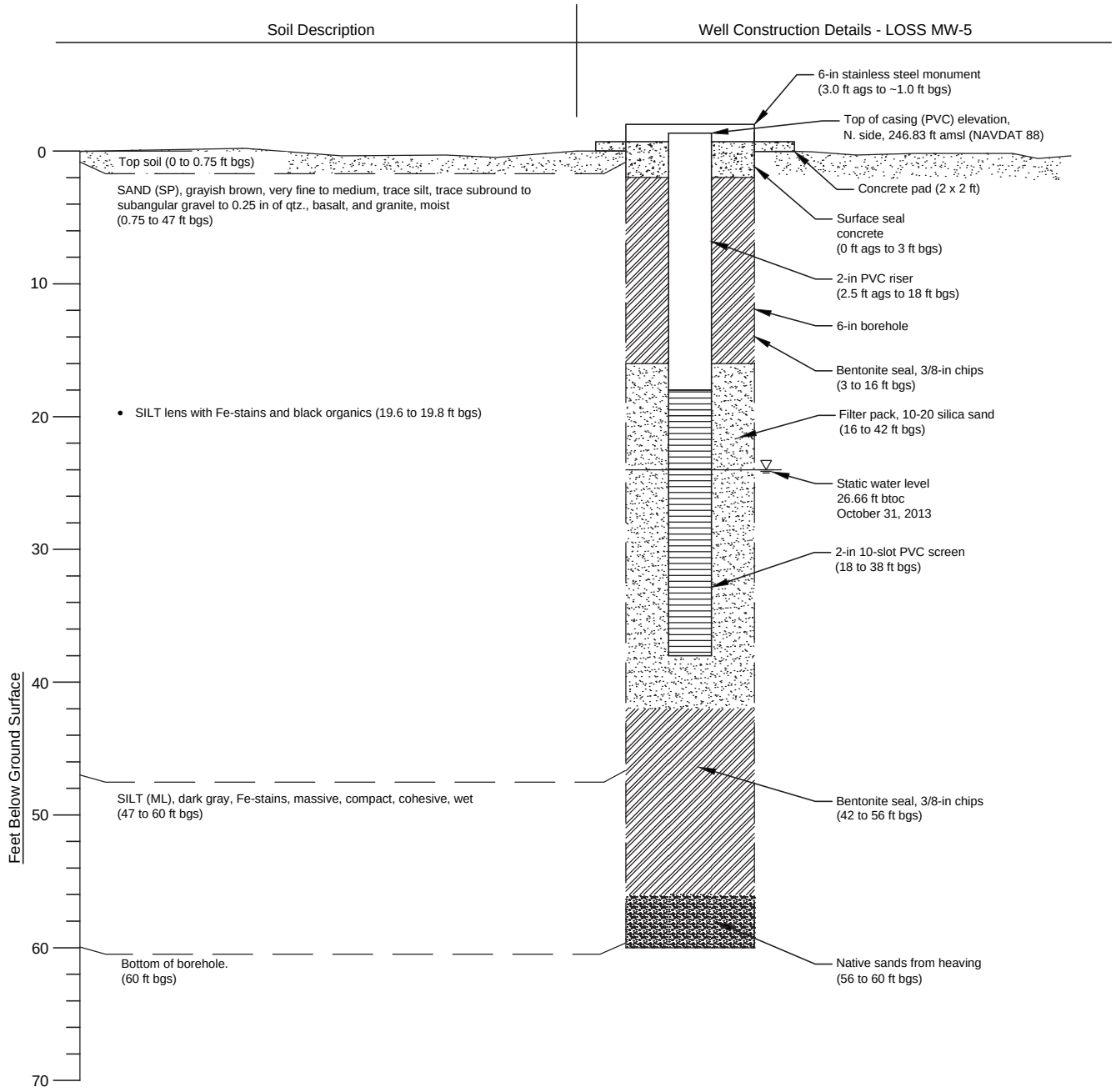
Note:
1. Installed October 28, 2013 by Cascade Drilling, J. Charlton
2. WA Dept. of Ecology ID BHN-786
3. Logged by J. Gerst
4. Well casing settled 4 ft below intended depth of 128 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
7. 313806.86N 1206562.49E (WA State Plane North Zone; NAD 83)

FIGURE **A-4**

LOSS MW-4 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates



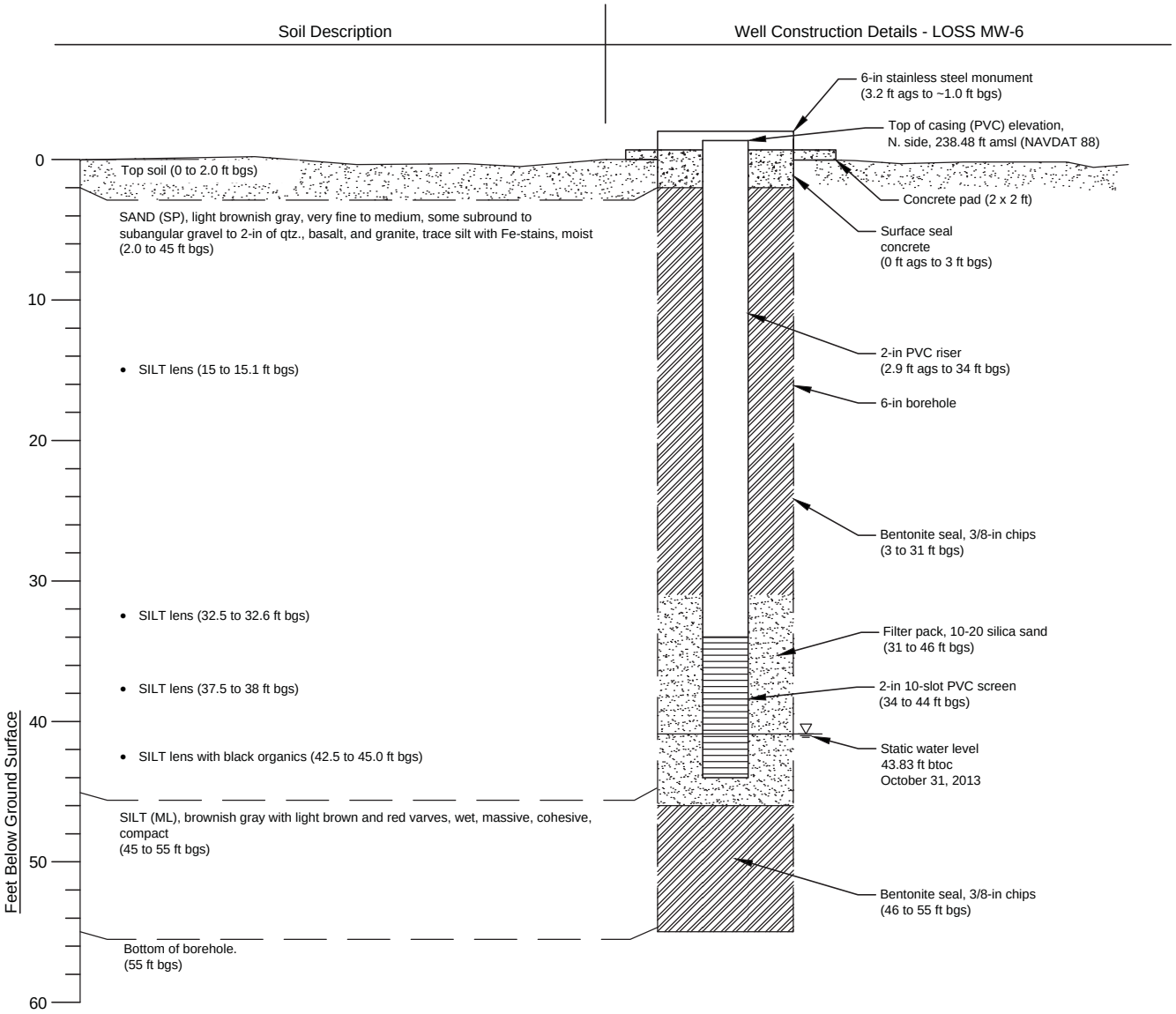
Note:
1. Installed October 29, 2013 by Cascade Drilling, J. Charlton
2. WA Dept. of Ecology ID BHN-785
3. Logged by J. Gerst
4. Well casing pulled up approximately 2 ft from intended depth of 40 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
7. 314053.73N 1207410.78E (WA State Plane North Zone; NAD 83)

FIGURE **A-5**

LOSS MW-5 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates



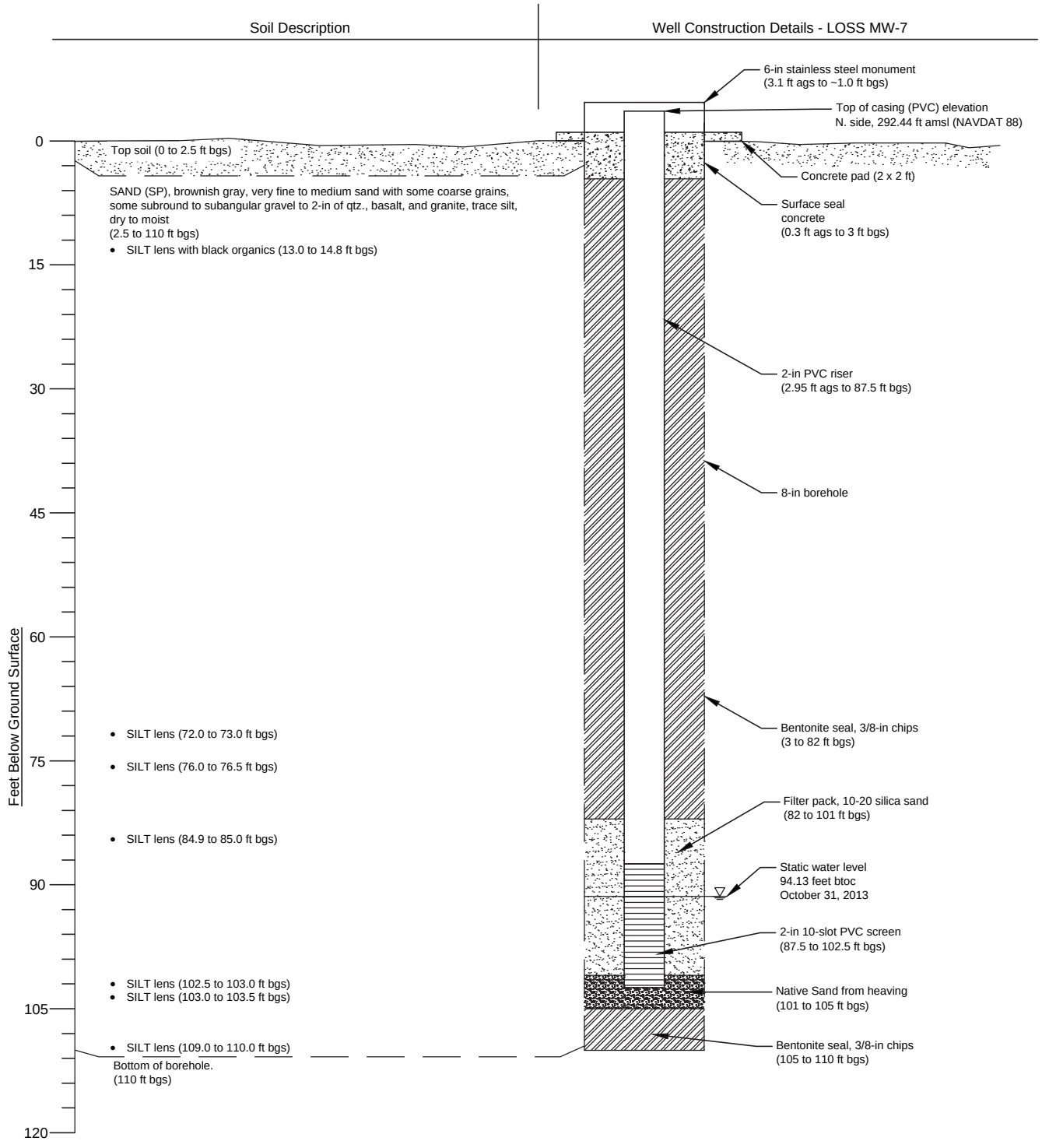
Note:
1. Installed October 30, 2013 by Cascade Drilling, J. Charlton
2. WA Dept. of Ecology ID BHN-783
3. Logged by J. Gerst
4. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
5. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
6. 314901.64N 1207277.75E (WA State Plane North Zone; NAD 83)

FIGURE **A-6**

LOSS MW-6 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates



Note:
1. Installed October 24, 2013 by Cascade Drilling, J. Charlton
2. WA Dept. of Ecology ID BHN-784
3. Logged by J. Gerst
4. Well casing settled 2.5 ft below intended depth of 100 ft bgs during casing removal
5. See attached Golder adapted USDA Unified Soil Classification System for soil descriptions
6. 6-in Sonic casing lost due to joint break during casing removal. Borehole over-drilled with 8-in casing to retrieve lost casing and to reset well.
7. Well screen compromised by bentonite due to inadequate removal following first unsuccessful attempt to set well.
8. WA T27N, R2E, S07, SE$\frac{1}{4}$, NW$\frac{1}{4}$
9. 314886.51N 1206539.87E (WA State Plane North Zone; NAD 83)

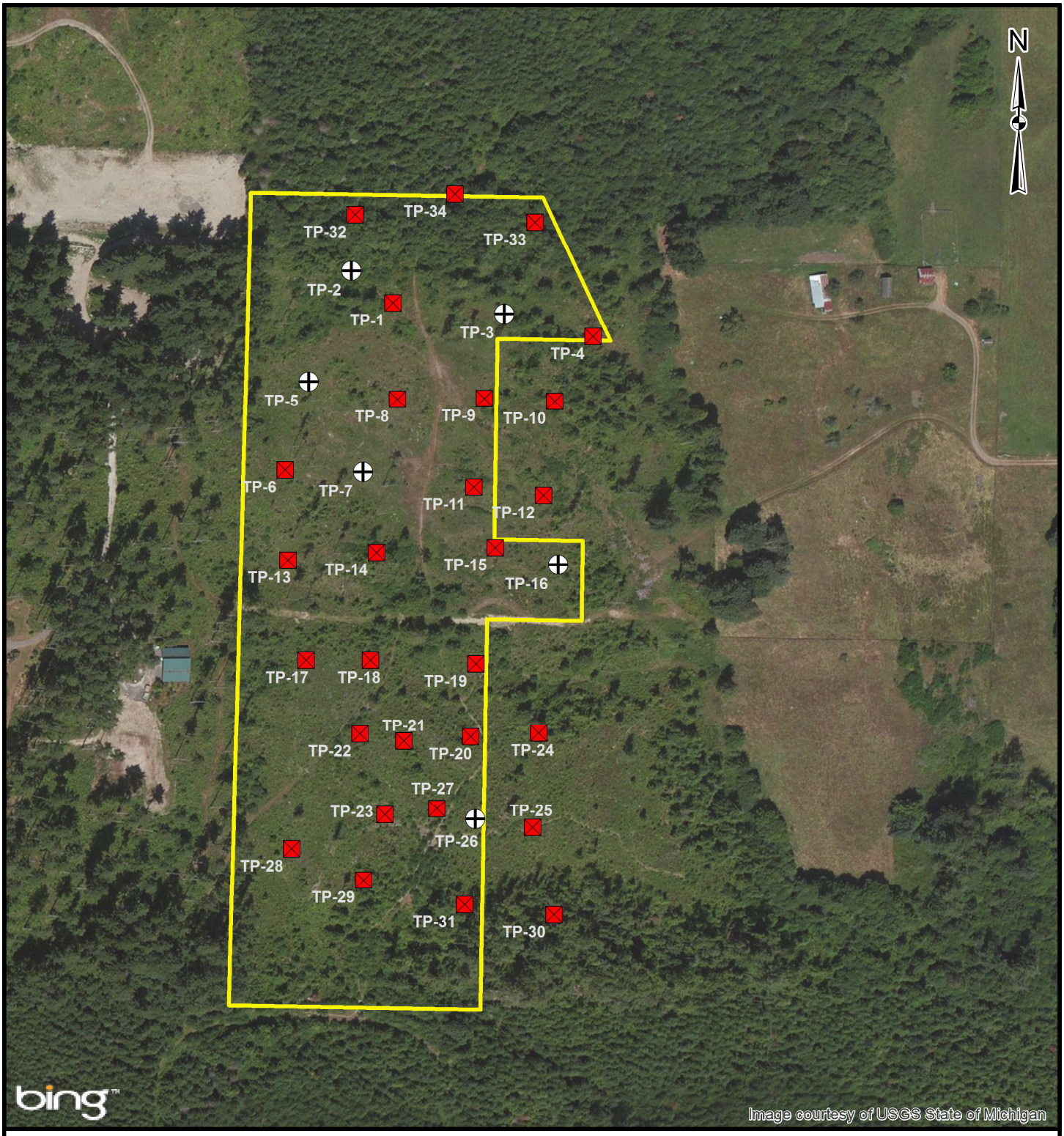
FIGURE **A-7**

LOSS MW-7 AS-BUILT SCHEMATIC

PROJECT 1300649 / OPG / PORT GAMBLE UPLAND LOSS / WA

Golder Associates

APPENDIX B
TEST PIT LOCATIONS AND LOGS



LEGEND

- Test Pit
- Test Pit with Piezometer Installed
- Proposed Drainfields

NOTES

REFERENCES

1.) TEST PIT LOCATIONS AND DRAINFIELD BOUNDARY PROVIDED BY TRIAD ASSOCIATES
2.) COORDINATE SYSTEM: NAD 1983 StatePlane Washington

250 0 250
Feet

REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RVW
0						

OLYMPIC PROPERTY GROUP
PORT GAMBLE LOSS (1300649)
ISLAND COUNTY, WA

TEST PIT LOCATIONS

Golder Associates

PROJECT NO. 001-1001			FILE: 1300649F013_TestPit_Locations_AA.mxd
DESIGN	AA	13 Nov. 2013	SCALE: AS SHOWN REV. 0
GIS	AA	15 Nov. 2013	
CHECK	XXX	13 Nov. 2012	FIGURE: B-1
REVIEW	XXX	13 Nov. 2012	

Map Document: M:\Projects\2013\1300649_OPG_Port_Gamble\MXD\1300649F013_TestPit_Locations_AA.mxd / Modified 11/15/2013 1:40:27 PM by AAustreng / Exported 11/15/2013 1:49:25 PM by AAustreng

Terracon

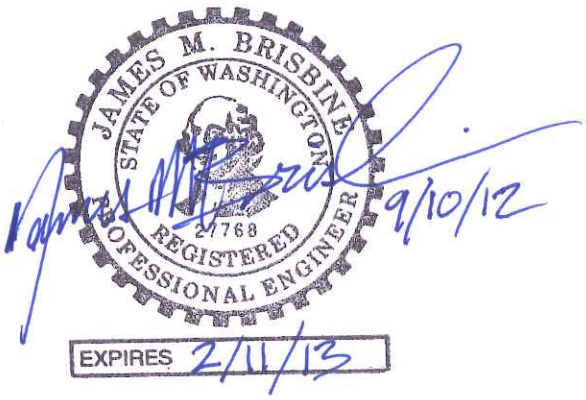
MEMORANDUM

September 10, 2012

To: Brian Hansen & Al Fure
Triad Associates

From: James M. Brisbine, P.E.

RE: **GEOTECHNICAL FEASIBILITY EVALUATION**
Port Gamble Upland LOSS
Kitsap County, Washington
Terracon Project No. 81125065



This memo briefly presents our geotechnical observations, findings, and conclusions regarding the feasibility of constructing a Large On-Site Septic System (LOSS) in the upland area southwest of Port Gamble. We understand that the LOSS would consist of a shallow drainfield receiving controlled volumes of residential-strength (or better) effluent from numerous nearby single-family residences.

SUBSURFACE CONDITIONS

On July 10 & 11, 2012, a Terracon geologist observed the excavation of 34 exploratory test pits advanced across the site, extending to depths ranging from about 4 to 11 feet below ground surface. These test pits revealed a fairly uniform soil sequence comprising a surficial duff and topsoil layer over an upper recessional sand layer over a weathered till layer over unweathered glacial till. All test pits were terminated in the glacial till deposit. None of the test pits encountered groundwater at the time of digging, but we anticipate that perched groundwater likely forms atop the glacial till horizon during the wet season. The following table summarizes the near-surface soil conditions observed within each test pit.

Soil Layer	Typical Composition	Typical Density	Observed Thickness (feet)		
			Min.	Ave.	Max.
Duff / Topsoil	Sand & Silt with organics	Soft / Loose	0.5	0.55	0.7
Upper Sand	Silty Sand	Loose to Medium Dense	1.2	1.4	1.7
Weathered Till	Silty Sand with gravel	Medium Dense	1.2	2.1	3.0
Glacial Till	Silty Sand with gravel	Dense to Very Dense	--	--	>7

CONCLUSIONS

In our opinion, based on the above-described subsurface conditions, the proposed construction of a LOSS at the project site appears to be geotechnically feasible. We infer that the upper sand layer and underlying weathered till layer will provide moderate percolation rates for effluent infiltration and dispersal, and both of these layers were observed to be laterally extensive. As part of subsequent design-phase work, additional field evaluations should be performed to quantify percolation rates and seasonal groundwater levels within the LOSS area.

TEST PIT LOG NO. TP-1

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8					S-1				12			
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till)												
	Scattered roots to 3 feet												
	4.3					S-2							15
	SILTY SAND (SM), with trace gravel, gray, dense, moist, (Sandy Glacial Till)	5											
	10.0					S-3							
	Test Pit Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method: Trackhoe

Abandonment Method: Trackhoe

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes: All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-2

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8					S-1							
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till)												
	Scattered roots to 5 feet, moderate roots to 3 feet												
	4.2					S-2							
	SILTY SAND (SM), with trace gravel, gray, dense, moist, (Sandy Glacial Till)	5											
	10.0					S-3							
	Test Pit Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-3

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.9					S-1							
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet												
	4.2 **SILTY SAND (SM)**, with trace gravel, gray, very dense, moist, (Sandy Glacial Till)	5											
	5.7 ***Test Pit Terminated at 5.7 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-4

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.6 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	2.2 **SILTY SAND (SM)**, with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet												
	4.8 **SILTY SAND (SM)**, with trace gravel, gray, dense to very dense, moist, (Sandy Glacial Till)	5											
	10.0					S-1							
	Test Pit Terminated at 10 Feet	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-5

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.7												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet 5.0	5											
	SILTY SAND (SM), with trace gravel, gray, very dense, moist, (Sandy Glacial Till) 8.0					S-1				8			45
	Test Pit Terminated at 8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-6

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.7												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet 3.5												
	SILTY GRAVELLY SAND (SM), with trace gravel, gray, very dense, moist, (Sandy Glacial Till) 5.0												
	Test Pit Terminated at 5 Feet	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-7

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.6												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.1												
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet 4.0												
	SILTY SAND (SM), with gravel, gray, very dense, moist, (Sandy Glacial Till)	5											
	11.0	10				S-1							
	Test Pit Terminated at 11 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-8

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.7												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet 4.2												
	SILTY SAND (SM), with gravel, gray, very dense, moist, (Sandy Glacial Till) 5.5	5											
	Test Pit Terminated at 5.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-9

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet 4.2												
	SILTY SAND (SM), with gravel, gray, dense, moist, (Sandy Glacial Till)	5											
	11.0	10				S-1							
	Test Pit Terminated at 11 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-10

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.6												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 1.8												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) 3.0 Scattered roots to 3 feet												
	SILTY GRAVELLY SAND (SM), gray, very dense, moist, (Sandy Glacial Till) 3.8												
	Test Pit Terminated at 3.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-11

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.7												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0					S-1							
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet 4.0												
	SILTY GRAVELLY SAND (SM), gray, very dense, moist, (Sandy Glacial Till) 5.0												
	Test Pit Terminated at 5 Feet	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-12

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.6												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet 3.5												
	SILTY SAND (SM), with gravel, gray, very dense, moist, (Sandy Glacial Till) 5.5	5											
	Test Pit Terminated at 5.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-13

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	2.0 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3.5 feet												
	4.0 **SILTY SAND (SM)**, with gravel, gray, very dense, moist, (Sandy Glacial Till)	5											
	10.5	10				S-1							
	Test Pit Terminated at 10.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon

21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-14

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet												
	4.2 **SILTY SAND (SM)**, with gravel, gray, very dense, moist, (Sandy Glacial Till)					S-1							
	5.0 ***Test Pit Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-15

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 4.5 feet												
	4.3 **SILTY SAND (SM)**, with gravel, gray, very dense, moist, (Sandy Glacial Till)	5											
	10.0 ***Test Pit Terminated at 10 Feet***	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-16

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	2.0 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	3.8 **SILTY GRAVELLY SAND (SM)**, gray, very dense, moist, (Sandy Glacial Till)												
	4.8 ***Test Pit Terminated at 4.8 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-17

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	Forest Duff, Topsoil 0.6												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.1												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet 4.1												
	SILTY SAND (SM), with gravel, gray, dense to very dense, moist, (Sandy Glacial Till) 5.3	5											
	Test Pit Terminated at 5.3 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-18

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till)												
	3.0 **SILTY GRAVELLY SAND (SM)**, gray, very dense, moist, (Very Hard Glacial Till)												
	3.8 Moderate roots to 2 feet, scattered roots to 3 feet												
	Test Pit Terminated at 3.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-19

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist					S-1							
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3.5 feet												
	4.0 **SILTY SAND (SM)**, with gravel, gray, dense, moist, (Sandy Glacial Till)												
	5.0 ***Test Pit Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-20

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist 2.0												
	SAND (SM), with silt, trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3.5 feet 5.0	5											
	SAND (SM), with silt and gravel, gray, dense, moist, (Sandy Glacial Till)												
	9.5					S-1				11			6
	Test Pit Terminated at 9.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/10/2012 | Test Pit Completed: 7/10/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-21

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist												
	2.2 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet					S-1							
	4.0 **SILTY SAND (SM)**, with gravel, gray, dense, moist, (Sandy Glacial Till)												
	5.0 ***Test Pit Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-22

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 6 feet												
	4.2 **SILTY SAND (SM)**, with gravel, gray, dense, moist, (Sandy Glacial Till)	5											
						S-1							
	10.0 ***Test Pit Terminated at 10 Feet***	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-23

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet 3.8					S-1							
	SILTY SAND (SM), with gravel, gray, dense, moist, (Sandy Glacial Till) 4.8												
	Test Pit Terminated at 4.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-24

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.6 **Forest Duff**, Topsoil												
	2.0 **SILTY SAND (SM)**, with trace gravel, tan-brown, loose to medium dense, moist												
	4.0 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	4.8 **SILTY SAND (SM)**, with gravel, gray, dense to very dense, moist, (Glacial Till)					S-1							
	Test Pit Terminated at 4.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-25

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 1.8												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Scattered roots to 3 feet 4.0												
	SILTY SAND (SM), with gravel, gray, very dense, moist, (Very Dense Glacial Till) 5.2	5											
	Test Pit Terminated at 5.2 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-26

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist					S-1							
	2.2 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	3.8 **SAND (SM)**, with silt, gravel, gray, very dense, moist, (Sandy Glacial Till)												
	Gravelly zone from 6-7 feet	5											
		10				S-2							
	11.0 ***Test Pit Terminated at 11 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-27

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist												
	1.8 **SILTY SAND (SM)**, with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	3.8 **SILTY SAND (SM)**, with gravel, gray, dense, moist, (Sandy Glacial Till)												
	5.0 ***Test Pit Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-28

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	2.0 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	4.0 **SAND (SM)**, with silt, gravel, gray, dense to very dense, moist, (Sandy Glacial Till)	5											
						S-1							
	10.0 ***Test Pit Terminated at 10 Feet***	10											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-29

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose, moist												
	2.0					S-1							
	SILTY SAND (SM), with trace gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3.5 feet												
	4.0 **SILTY SAND (SM)**, with gravel, gray, dense to very dense, moist, (Sandy Glacial Till)												
	5.0 ***Test Pit Terminated at 5 Feet***	5											

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-30

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	4.0 **SILTY SAND (SM)**, with gravel, gray, very dense, moist, (Very Dense Glacial Till)	5				S-1							
	7.0 ***Test Pit Terminated at 7 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-31

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet					S-1				8			9
	4.0 **SILTY SAND (SM)**, with gravel, gray, dense, moist, (Sandy Glacial Till) 4.8												
	Test Pit Terminated at 4.8 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-32

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist 2.0												
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3.5 feet 4.2												
	SILTY SAND (SM), with gravel, gray, dense, moist, (Sandy Glacial Till) 5.5	5											
	Test Pit Terminated at 5.5 Feet												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

Notes:
All test pit locations selected by Jensen Engineering, Inc.

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-33

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	2.0					S-1							
	SILTY SAND (SM), with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 3 feet												
	3.8					S-2							
	SILTY SAND (SM), with gravel, gray, dense, moist, (Sandy Glacial Till)												
	4.8 ***Test Pit Terminated at 4.8 Feet***												

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon

21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

TEST PIT LOG NO. TP-34

PROJECT: Port Gamble Upland LOSS Site

CLIENT: Olympic Property Group, LLC

SITE: Port Gamble, Washington

GRAPHIC LOG	LOCATION / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	SAMPLE NUMBER	STRENGTH TEST: TEST TYPE	STRENGTH TEST: COMPRESSIVE STRENGTH	STRENGTH TEST: STRAIN (%)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS: LL-PL-PI	Percent Fines
	0.5 **Forest Duff**, Topsoil												
	SILTY SAND (SM), with trace gravel, tan-brown, loose to medium dense, moist												
	1.8 **SILTY SAND (SM)**, with gravel, brown-gray with mottling, medium dense, moist, (Weathered Glacial Till) Moderate roots to 2 feet, scattered roots to 4 feet												
	3.8 **SAND (SM)**, with silt, gravel, gray, dense, moist, (Sandy Glacial Till)	5				S-1							
	9.5 ***Test Pit Terminated at 9.5 Feet***					S-2							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:

Abandonment Method:

WATER LEVEL OBSERVATIONS

No groundwater seepage observed

No observed caving

Notes:

All test pit locations selected by Jensen Engineering, Inc.

Terracon
21905 64th Ave. W, Suite 100
Mountlake Terrace, Washington

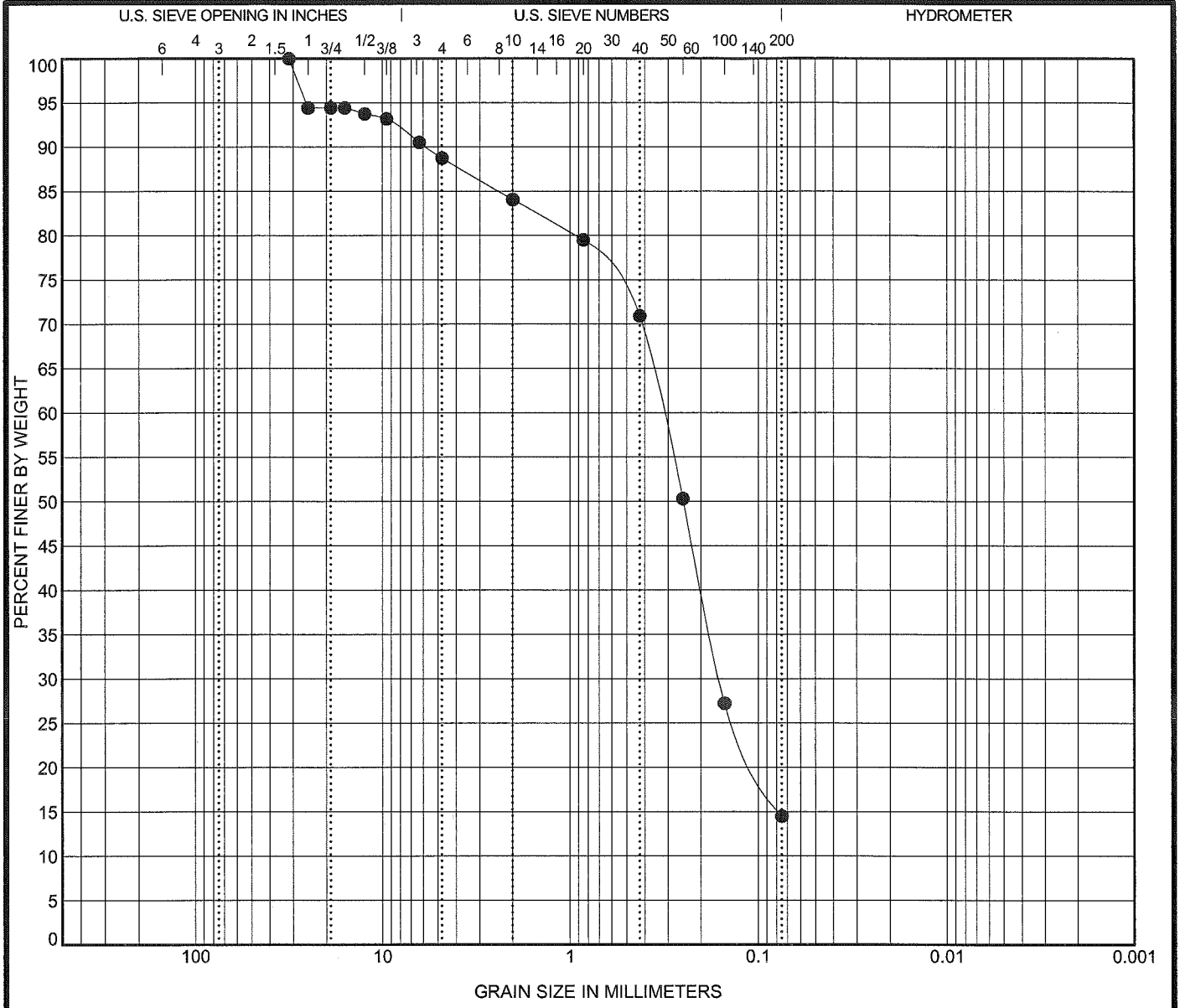
Test Pit Started: 7/11/2012 | Test Pit Completed: 7/11/2012

Excavator: Seton Const. | Operator:

Project No.: 81125065

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	TP-1	3.5						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-1	3.5	31.5	0.321	0.159		11.2	74.2	14.5	

PROJECT: Port Gamble Upland

SITE: Port Gamble Millsite
Port Gamble, Washington

Terracon
21905 64th Ave. W., Suite 100
Mountlake Terrace, Washington

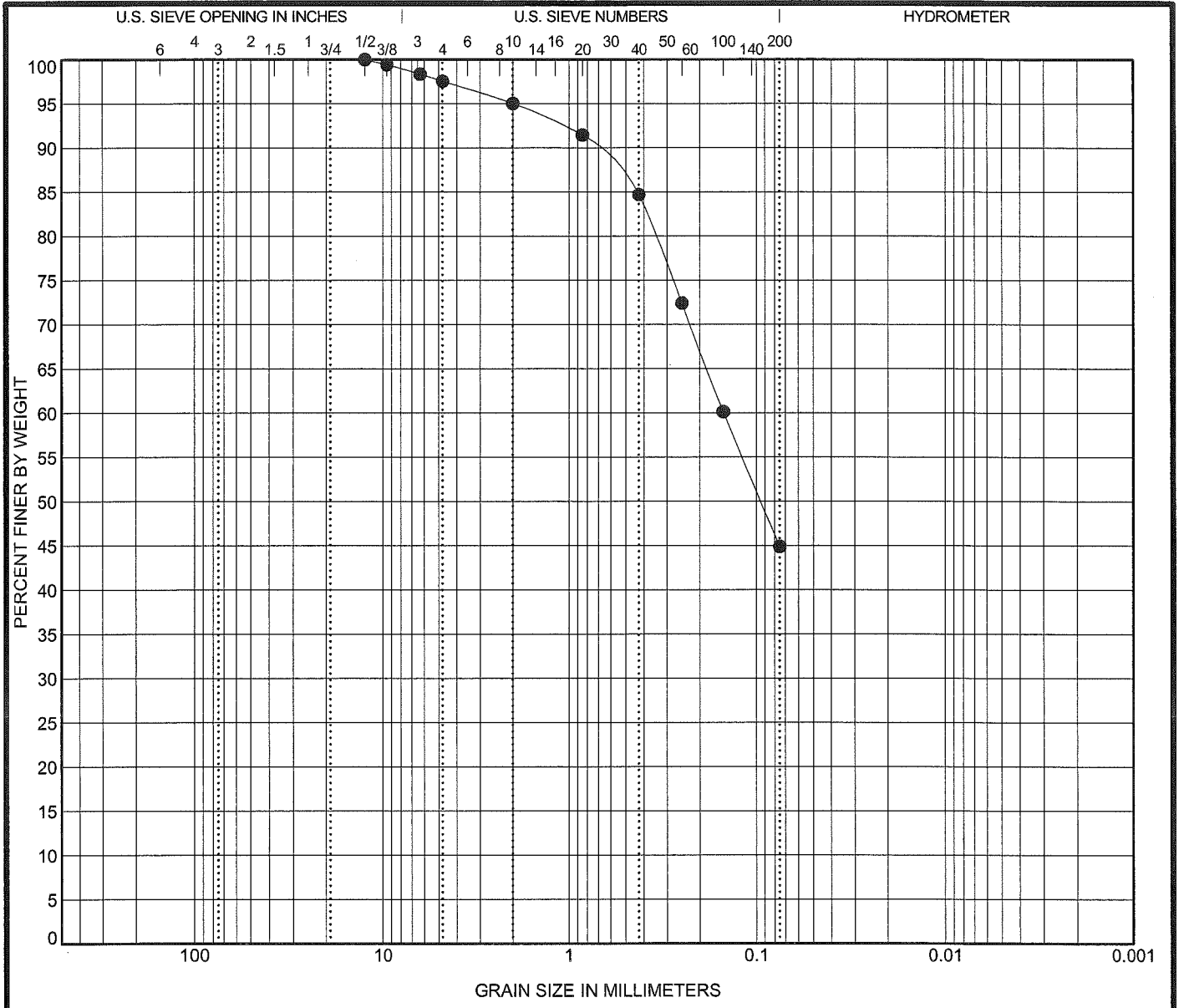
PROJECT NUMBER: 81125065

CLIENT: Olympic Properety Group, LLC

GRAIN SIZE: USCS-2 81125065, TEST PIT LOGS, 7-17-12.GPJ TERRACON2012.GDT 7/18/12

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	TP-5	7.5						

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-5	7.5	12.5	0.149			2.4	52.7	44.9	

PROJECT: Port Gamble Upland

SITE: Port Gamble Millsite
Port Gamble, Washington

Terracon
21905 64th Ave. W., Suite 100
Mountlake Terrace, Washington

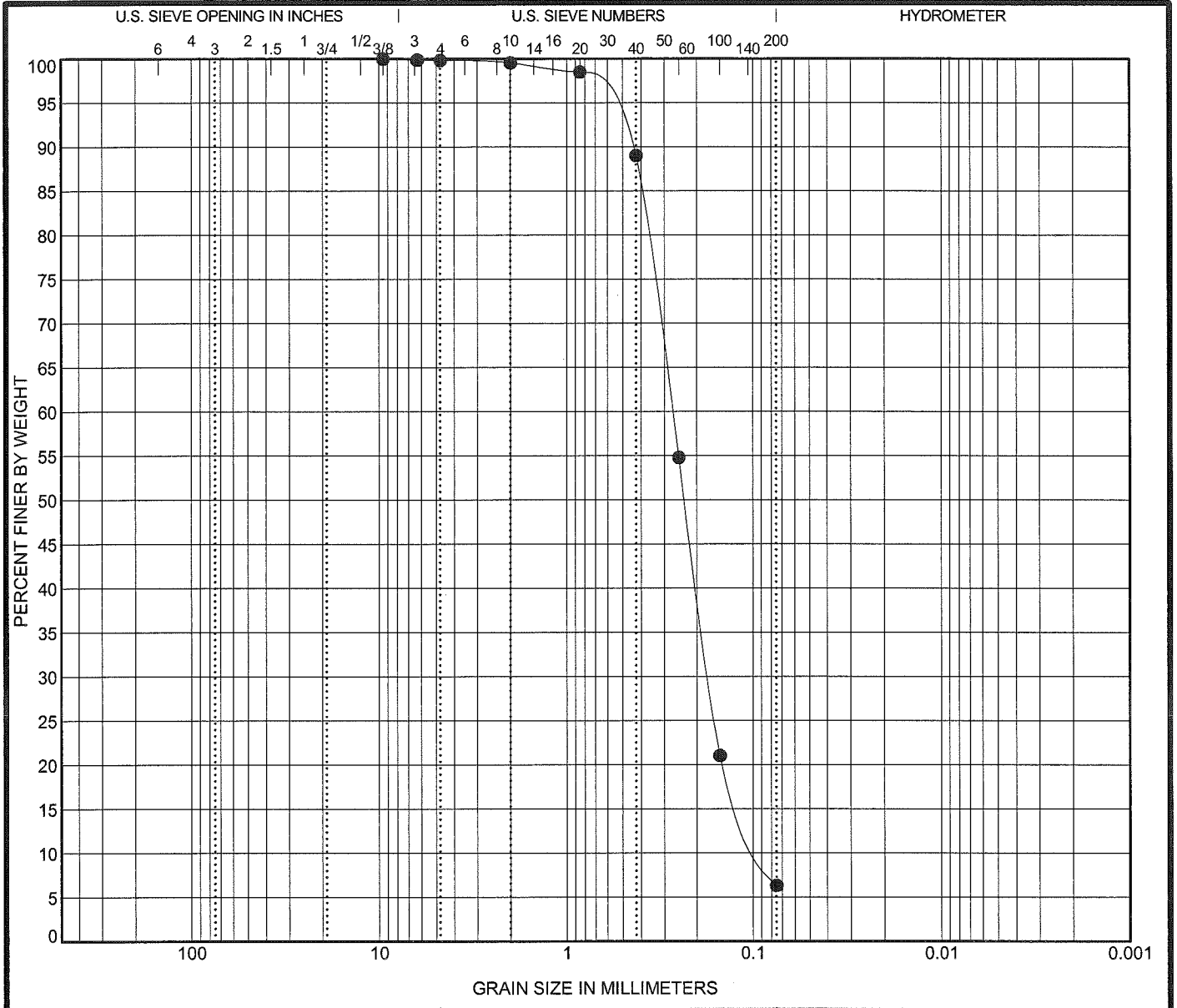
PROJECT NUMBER: 81125065

CLIENT: Olympic Properety Group, LLC

GRAIN SIZE: USCS-2 81125065. TEST PIT LOGS. 7-17-12.GPJ TERRACON2012.GDT 7/18/12

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	TP-20	9.0					1.22	3.04

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-20	9.0	9.5	0.271	0.172	0.089	0.2	93.5	6.3	

PROJECT: Port Gamble Upland

SITE: Port Gamble Millsite
Port Gamble, Washington

Terracon
21905 64th Ave. W., Suite 100
Mountlake Terrace, Washington

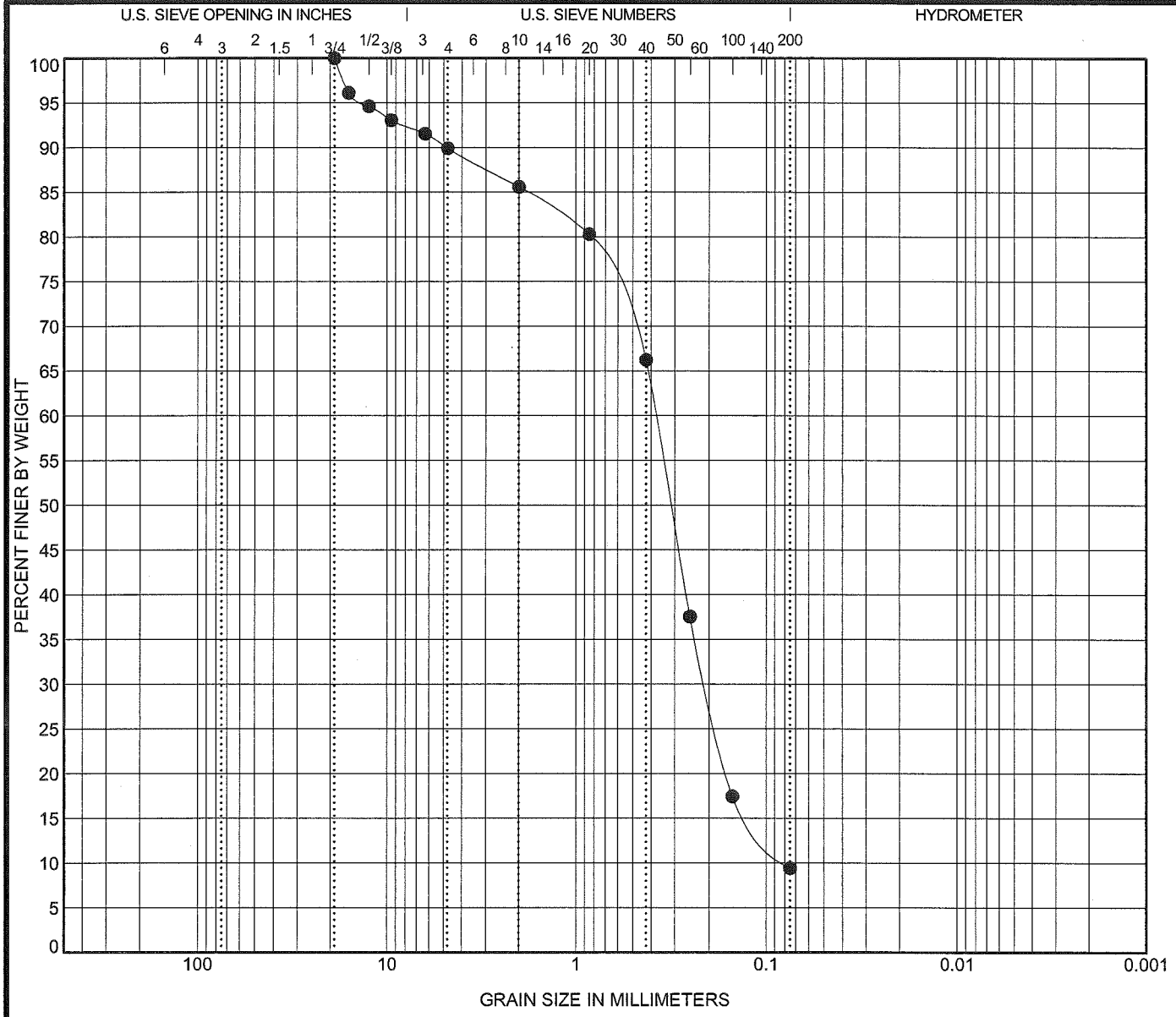
PROJECT NUMBER: 81125065

CLIENT: Olympic Properety Group, LLC

GRAIN SIZE: USCS-2 81125065 TEST PIT LOGS 7-17-12.GPJ TERRACON2012.GDT 7/18/12

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		USCS Classification	LL	PL	PI	Cc	Cu
●	TP-31	3.0					1.43	4.81

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	TP-31	3.0	19	0.379	0.206	0.079	10.1	80.5	9.4	

PROJECT: Port Gamble Upland

SITE: Port Gamble Millsite
Port Gamble, Washington

Terracon
21905 64th Ave. W., Suite 100
Mountlake Terrace, Washington

PROJECT NUMBER: 81125065

CLIENT: Olympic Properety Group, LLC

GRAIN SIZE: USCS-2 81125065, TEST PIT LOGS, 7-17-12.GPJ TERRACON2012.GDT 7/18/12

APPENDIX C
NITRATE SCREENING BALANCE

Department of Health (DOH). 2013a. Site Approval letter to Jon Rose dated May 24, 2013 (Project Number 2012-035).

DOH. 2014. Port Gamble – Hydrogeology Report. Letter from Nancy Darling to Jon Rose of Olympic Property Group January 28, 2014.

DOH. 2013b. Publication #337-069 (Revised October 2013) Level 1 Nitrate Balance Instructions for Large On-site Sewage Systems.

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE OF SHELLFISH AND WATER PROTECTION
PO Box 47824 • Olympia, Washington 98504-7824
(360) 236-3330 • TDD Relay Service: 1-800-833-6388

May 24, 2013

John Rose, President
Pope Resources
14245 Tenth Avenue NE
Poulsbo, Washington 98370

Subject: Proposed Port Gamble Large On-site Sewage System (LOSS), Project Number 2012-035, Site Approval, Kitsap County

Dear Mr. Rose,

We have reviewed the winter water table study submitted by your engineer. We've determined that the soil and site information, including the study data, is consistent with the conceptual treatment design.

You are approved to proceed to the next step: submit a hydrogeology report to address the fate and transport of the effluent in the drainfield area.

Prior to commencing work on that submittal, your engineer or hydrogeologist should contact Nancy Darling at 360-236-3040 or nancy.darling@doh.wa.gov to discuss the scope of the study.

Your system's required treatment level will be determine after the review of the hydrogeology report.

Here are the drainfield design parameters, based on our review:

- The hydraulic loading rate to the drainfield shall be no greater than 0.6 gallons per day per square foot.
- Soil depth in the proposed drainfield area is between 45 and 60 inches of Soil Types 3 and 4.
- The drainfield shall not be installed in areas of over 30% slope and areas surrounding soil logs 6, 16, 18, and 22.
- Dripfields must be designed in accordance with WAC 246-272B-06650 Table 7: Maximum Daily Emitter Discharge Rates.

If you have any questions please contact Kay Rottell at 360-236-3318 or katherine.rottell@doh.wa.gov.

Sincerely,

Denise Lahmann

Denise Lahmann, P.E.
LOSS Engineering Supervisor

cc: David Jensen, P.E. Jensen Engineering
Kathy Taylor, Department of Ecology
John Felder, P.E. Department of Natural Resources
Bill Whitely, P.E., Kitsap PUD
Kay Rottell, E.I.T., DOH
Kitsap County Health District

STATE OF WASHINGTON
DEPARTMENT OF HEALTH
OFFICE of SHELLFISH and WATER PROTECTION
243 Israel Road SE • PO Box 47824 • Olympia, Washington 98504-7824
(360) 236-3330 • TDD Relay Services 1-800-833-6388

January 28, 2014

Jon Rose
Olympia Property Group
19950 7th Ave NE Suite 200
Poulsbo, WA 98370

Dear Mr. Rose,

Subject: Port Gamble - Hydrogeology Report

Thank you for submitting the hydrogeology report for the proposed Port Gamble Large On-Site System (LOSS) dated January 10, 2013. In general, the report and its findings are acceptable. Golder Associates did an excellent job of characterizing the hydrogeological parameters required for the nitrate balance.

Several parameters in the nitrate balance need additional supporting data. Please provide the following:

1. A discussion on how the primary drainfield area was determined. It seems large for a 100,000 gpd system in sandy soils.
2. The supporting calculations for the groundwater gradient.
3. Influent samples to support a concentration less than 60 mg/L.
4. I recommend you also take a second look at the recharge rate (seemed low) and the aquifer thickness (you can use an average annual thickness).

The Department of Health's (DOH) goal is to keep nitrate increases at the property boundary to less than 2.0 mg/L. The characteristics of the aquifer under your site make that difficult to achieve. For your LOSS, DOH will set the maximum increase of nitrate at the property boundary at 5.0 mg/L.

The hydrogeology report discussed the use of wetlands for treatment. We cannot approve the use of wetlands as part of the nitrogen treatment because the report did <u>not</u> show the following:

1. All the effluent will flow east into the wetlands.
2. The wetlands can reduce the nitrogen in the effluent to 5 mg/L or less.
3. The streams would not have a measureable nitrate impact greater than 10 mg/L.

In my professional opinion, it will be difficult (and costly) to show all effluent flows to the east. Please note that even if the above information was provided, DOH would only allow the natural wetlands to provide a part, not all, of the denitrification treatment.

Also, please provide a discussion with supporting data showing that the 100,000 gpd of wastewater will not have a negative impact simply from that amount of effluent being added to the hydrologic system. Golder Associates mentioned this might be covered in an Environmental Impact Statement (EIS) which is close to completion. If so, please provide us a copy of the EIS.

If you have questions, please call Nancy Darling at 360.236.3040.

Sincerely,

Nancy Darling

Nancy Darling, LHG, CPSS
Wastewater Management Section
LOSS Program

Cc: Sue Allison, Olympia Property Group
Kay Rotelle, DOH
Denise Lahmann, DOH
Chris Pitre, Golder Associates
David Jensen, Jensen Engineering

WASHINGTON DEPARTMENT OF HEALTH
LEVEL 1 NITRATE BALANCE FOR LARGE ON-SITE SEWAGE SYSTEM 0.875
Prepared 2014-02-28 by Chris Pitre

Project name:	**Port Gamble Upland LOSS**			
Address, city and county:	**Port Gamble Upland**			
Completed by (name and title):	**Chris Pitre, Golder Associates**			
Date:	**2014-02-26**			
Input Values	**Factor**	**Units**	**Values**	**Information Source**
Nitrate concentration in precipitation	**N_R**	**mg/l as N**	**0.24**	Default. A better value is 0.11-0.22 jusing PRISM and NAPD data.
Total nitrogen concentration in wastewater	**N_W**	**mg/l**	**7.7**	Assumed treatment level to achieve a maximum of 5 mg/L of nitrate as nitrogen at the alternate point of compliance.
Soil denitrification	**d**	**unitless**	**0.1**	Default
Aquifer thickness	**b**	**ft**	**11**	Average saturated thickness at seasonal low period (Sept.-Oct. 2013).
Drainfield area	**A_D**	**ft^2**	**500,000**	Predesign Report (Jensen 2012). Half of the drainfield.
Distance from drainfield to property boundary	**D_{pb}**	**ft**	**10**	West boundary of the drain field is set back from the property boundary.
Aquifer width	**W_A**	**ft**	**1,500**	North-south drain field dimension. Predesign Report (Jensen 2012)
Aquifer hydraulic conductivity	**K**	**ft/day**	**7**	Average of sandy materials (6 monitoring wells and one piezometer).
Hydraulic gradient	**i**	**ft/ft**	**0.025**	Estimated from a groundwater elevation difference of 20 feet over a distance of 800 feet between the 220-foot and 200-foot water level contours (Figure 2).
Recharge	**R**	**in/yr**	**20.30**	Based on precipitation of 35.3 inches evapotranspiration of 15 inches (Golder 2002) and no observed runoff.
Nitrate concentration of upgradient ground water	**N_B**	**mg/l**	**0**	Sampling shows geochemical environment is too reducing for nitrate to be stable
Wastewater volume	**V_W**	**gpd**	**100,000**	Predesign Report (Jensen 2012) - daily flow design
Area between drainfield & property boundary	A_{RD}	ft^2	15,000	
Volume of recharge over drainfield	V_R	gpd	17,335	
Volume of infiltration from drainfield area	V_I	gpd	117,335	
Volume of discharge downgradient	V_{RD}	gpd	520	
Total volume of recharge	V_T	gpd	17,855	
Aquifer discharge	Q	gpd	21,600	**Equals ~15 gpm. This should be much higher because ~45 gpm was measured in stream to north (Oct. 2013), and that represents only a small portion of the total groundwater flow from the site. Greater dilution may occur.**
Total Nitrogen concentration from drainfield area	N_i	mg/l as N	5.94	
Downgradient ground water nitrogen concentration	N_{GW}	mg/l as N	5.01	
Downgradient ground water nitrogen concentration at property boundary	N_B	mg/l as N	5.00	
Output Values				
Groundwater nitrate value	**N_{GW}**	**mg/l as N**	**5.01**	**Point of Compliance (POC) (at drain field egde)**
Groundwater nitrate value	**$N_{GW\ ALT}$**	**mg/l as N**	**5.00**	**Alternative POC (at property boundary)**

Level 1 Nitrate Balance Instructions for Large On-site Sewage Systems

Instructions for Department of Health (DOH) Level 1 Nitrate Balance

DOH uses the Level 1 Nitrate Balance as a screening tool to identify LOSS which may have potential impacts to an unconfined or semi-confined surface aquifer. DOH may require a more comprehensive Nitrate Balance at sites where the Level 1 analysis indicates a potential moderate or significant impact to ground water. In general, a moderate impact is an increase greater than 2 mg/L above background. You can use the nitrate balance as a tool to understand the sensitivity of your LOSS on groundwater quality by varying values for effluent quality, effluent volume, and drainfield orientation. The equation used to build the Level 1 Nitrate Balance Excel spreadsheet is shown in Appendix A.

When you fill out the Nitrate Balance Excel spreadsheet use the most reliable site specific information you can find. Always list your information source on the spreadsheet or on a separate reference sheet if you need more room. Provide a copy of the information source or an on-line link to the source. Sources of information can include field measurements, pump test data, well logs, literature reviews, a local or regional study, and state or local databases. DOH will generally consider a nitrate balance supported by field measurements to be more reliable than one completed with literature values.

Based on the parameters you provide, the spread sheet will calculate the estimated nitrate concentration in the groundwater at the point of compliance. The default point of compliance is the downgradient edge of the drainfield. DOH may approve an alternative point of compliance up to but not exceeding the property boundary.

In your supporting information, identify and include all drainfields associated with the project or located on the property in the nitrate balance. One nitrate balance must be performed that includes all active drainfields unless the drainfields are separated by a groundwater boundary condition that would result in different points of compliance. For those cases, a separate nitrate balance should be performed for each drainfield.

As explained below, several parameters must be shown on a topographic map of 1:7200 scale or less. The parameters are drainfield area, point of compliance, alternative point of compliance (if applicable), aquifer width, hydraulic gradient, and the property boundary. The map MUST be readable at a printable size of 11”x17” or smaller**.** An example map is shown in Appendix B.

The nitrate balance(s) and supporting information can be submitted as a hard copy or electronically submitted as a PDF file.

For more information call 360.236.3040 or email Nancy.Darling@doh.wa.gov.

Level 1 Nitrate Balance Instructions for Large On-site Sewage Systems

Input values

Nitrate Concentration in Precipitation: Precipitation in Washington State contains a small amount of nitrates from both natural and man-made sources.

Instructions: Use the default value of 0.24 mg/L

Total Nitrogen Concentration in Wastewater: This is the concentration of total nitrogen in the effluent measured at the end of the pipe before it enters the drainfield. Residential strength effluent can range from 30 to 100 mg/L. High strength effluent, such as RV waste, can have total nitrogen concentrations greater than 500 mg/L.

Instructions: Use the default value of 60 mg/L for residential strength effluent. This value is for systems that do not have advanced treatment and are not treating high strength waste. Any value other then 60 mg/L must be supported by sampling data or a supporting reference.

Soil Denitrification: Denitrification in the soil can reduce the amount of nitrates that reach groundwater. Denitrification occurs when soil oxygen is depleted and the microbes must obtain oxygen from another source. Microbes obtain oxygen from soil compounds in the following general order: 0_2>$N0_3$->Mn^{+4}>Fe^{+3}>SO_4^{-2} >CO_2. The amount of denitrification is difficult to quantify and depends on several variables including soil carbon, soil moisture, soil temperature, and soil pH. In general, a coarse well drained soil will have less denitrification than a fine poorly drained soil.

Instructions: Use the default value of 10% denitrification. If you use a denitrification rate greater than 10%, you must provide site specific data or a supporting reference.

NOTE: The nitrate balance does not have a specific value for plant uptake. Some LOSS using shallow drip systems may qualify for an additional percent reduction in soil nitrates due to plant uptake. To qualify, your site must have a nutrient management plan that includes soil sampling and vegetation management. If you are taking a nitrate reduction for plant uptake, add the reduction to your denitrification value. Clearly identify which portion of the reduction is for plant uptake.

Aquifer Thickness: This value is used to calculate nitrate dilution in the upper-most aquifer through vertical mixing of the nitrate and groundwater.

Instructions: Use the default value of 20 feet or the actual aquifer thickness, whichever is less. Aquifer thickness can be estimated from a well log.

Drainfield Area: This is the area of the primary drainfield and does not include the reserve area except when part of the reserve area is being used. The area of the drainfield is used to calculate how much dilution is received from infiltrating precipitation (recharge). The down gradient edge of the drainfield is the default point of compliance (POC) for the nitrate concentration in groundwater.

Instructions: For a new LOSS, calculate the area of the primary drainfield based on the estimated drainfield size including the area between trenches. For an existing LOSS, field measure the area of the existing drainfield. Be sure to take credit if you use or plan to use 50% of the reserve area in addition to the primary ("150% of the primary"). Show the drainfield area on the nitrate balance map.

Distance from the drainfield to the property boundary: The LOSS owner may request an alternative POC and DOH may approve an alternative POC up to but not exceeding the property boundary. An alternative POC can sometimes help dilute the nitrate in the groundwater to an acceptable level. If there is a well, spring, or surface water before the property boundary, then use that point for the distance instead of the property boundary for the alternative POC.

Instructions: The nitrate balance must first always be calculated with a zero value for the distance to the property boundary. This allows the spreadsheet to calculate the POC at the downgradient edge of the drainfield. A second nitrate balance can then be completed for an alternative POC (if applicable) using the distance between the down gradient edge of the drainfield and the property boundary or other receptor such as a well, spring or surface water. Measure the distance in the direction of the groundwater flow. Show both the default POC at the edge of the drainfield and the alternate POC on the nitrate balance map.

Aquifer Width: The width of the aquifer is the width of the gross area of the drainfield (not the width of the property) perpendicular to the groundwater flow.

Instructions: Measure the primary drainfield perpendicular to the direction of groundwater flow. Similar to measuring the drainfield area, be sure to consider the additional width if you use or plan to use 50% of the reserve area. Place a dotted line on the nitrate balance map to show where you measured the drainfield width.

Hydraulic conductivity of aquifer (K): Hydraulic conductivity is a measurement of an aquifer's ability to transmit water. Hydraulic conductivities can range from greater than 10,000 ft/day to less than 1 ft/day. A well sorted gravel aquifer has high conductivity, whereas a poorly sorted sand aquifer has a lower conductivity. A high conductivity results in greater dilution and lower nitrate concentrations.

Instructions: Use the most site specific value available. Pump test or slug test data from a nearby well is preferred. Many public supply wells will have a pump test on record with the county that will contain a value for hydraulic conductivity. Other options include drawdown data on well logs from nearby wells, values in a technical report for the local area, or literature values for hydraulic conductivity based on

aquifer materials. The table below shows typical literature values. If you are using the table, follow these steps:

1. Based on a geotechnical report or the nearest well logs, determine the materials of the upper-most aquifer (this may not be the aquifer where the well is completed).

2. Find the materials on the table that best matches the well log description and select a K value in the mid to lower range for that material. Input K using ft/day.

Hydraulic Conductivity Table

K (cm/s)	10^{2}	10^{1}	10^{0}=1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}	10^{-7}	10^{-8}	10^{-9}	10^{-10}
K (ft/day)	10^{5}	10,000	1,000	100	10	1	0.1	0.01	0.001	0.0001	10^{-5}	10^{-6}	10^{-7}
Relative Permeability	Pervious				Semi-Pervious				Impervious				
Aquifer	Good					Poor			None				
Unconsolidated Sand & Gravel	Well Sorted Gravel		Well Sorted Sand or Sand & Gravel			Very Fine Sand, Silt, Loess, Loam							
Unconsolidated Clay & Organic					Peat		Layered Clay			Unweathered Clay			
Consolidated Rocks	Highly Fractured Rocks				Oil Reservoir Rocks			Fresh Sandstone		Fresh Limestone, Dolomite		Fresh Granite	

Modified from J. Bear, 1972

Hydraulic gradient: This is the "slope" of the groundwater. Hydraulic gradients are generally less than three percent. The gradient, hydraulic conductivity, width of the aquifer, and depth of the mixing zone determine the aquifer flow under the drainfield.

Instructions: Water table elevations may be found on a water table map if one is available or can be calculated using water table elevations from nearby wells. Use a default value of 0.001 if the gradient is unknown. Place an arrow on the nitrate balance map to show the direction of groundwater flow.

Level 1 Nitrate Balance Instructions for Large On-site Sewage Systems

Recharge: The rate of recharge is the amount of inches per year of rainfall that infiltrate into the ground surface. Recharge is a percentage of the annual precipitation. This value is converted to gallons per day (gpd) in the nitrate balance equation.

Instructions: Some counties have groundwater recharge rates available. Where recharge is unknown, use a default is 35% of annual rainfall in western Washington and 20% of annual rainfall in eastern Washington.

Nitrate concentration of up-gradient groundwater: This is the nitrate concentration upgradient of the primary drainfield.

Instructions: Use site specific groundwater quality data for this value. Provide two or more sample results from nearby wells preferably on or upgradient of the project property. The sample must come from the surface aquifer. If you are unable to get a sample, you may use recent data from nearby public drinking water wells, county records, or hydrogeology reports in the local area. If you know the name or location of the public water system you can find sample data at http://www.doh.wa.gov/ehp/dw/sentry.htm. If you use well data, show the location of the wells on the nitrate balance map.

Wastewater Volume: For a new LOSS, the volume of wastewater is the daily operating capacity of the LOSS. The operating capacity is the design flow without a peaking factor. Use actual flow volumes if you have an existing LOSS with a reliable history of flow monitoring.

Instructions: For a new LOSS, determine the daily operating capacity from the pre-design report. For an existing LOSS use flow data if available or estimate the flow using information in Section-06150 of WAC 246-272B (the LOSS rule).

Appendix A - Nitrogen Balance Equation

$$N_{GW} = \frac{\overbrace{(Q \times N_B)}^{\text{Upgradient}} + \overbrace{(V_W \times N_W(1-d))}^{\text{Effluent}} + \overbrace{(V_R \times N_r)}^{\text{Recharge}}}{Q + V_W + V_r}$$

N_{GW} = nitrate concentration in groundwater (mg/L) at the selected point of compliance

$Q = KibW_A\,(7.48)$

Q = aquifer flow (gallons/day)

i = gradient (ft/ft)

b =depth of mixing in Aquifer (feet)

W_A = width of aquifer (measured as width of drainfield) (feet)

N_B = background (upgradient) ground water nitrate concentration (mg/L)

V_W = volume of wastewater (gallons/day)

N_W = nitrogen concentration in wastewater (mg/L)

d = denitrification rate in soil and vadose zone (unitless)

$V_R = A_D \times R \times 0.0017$

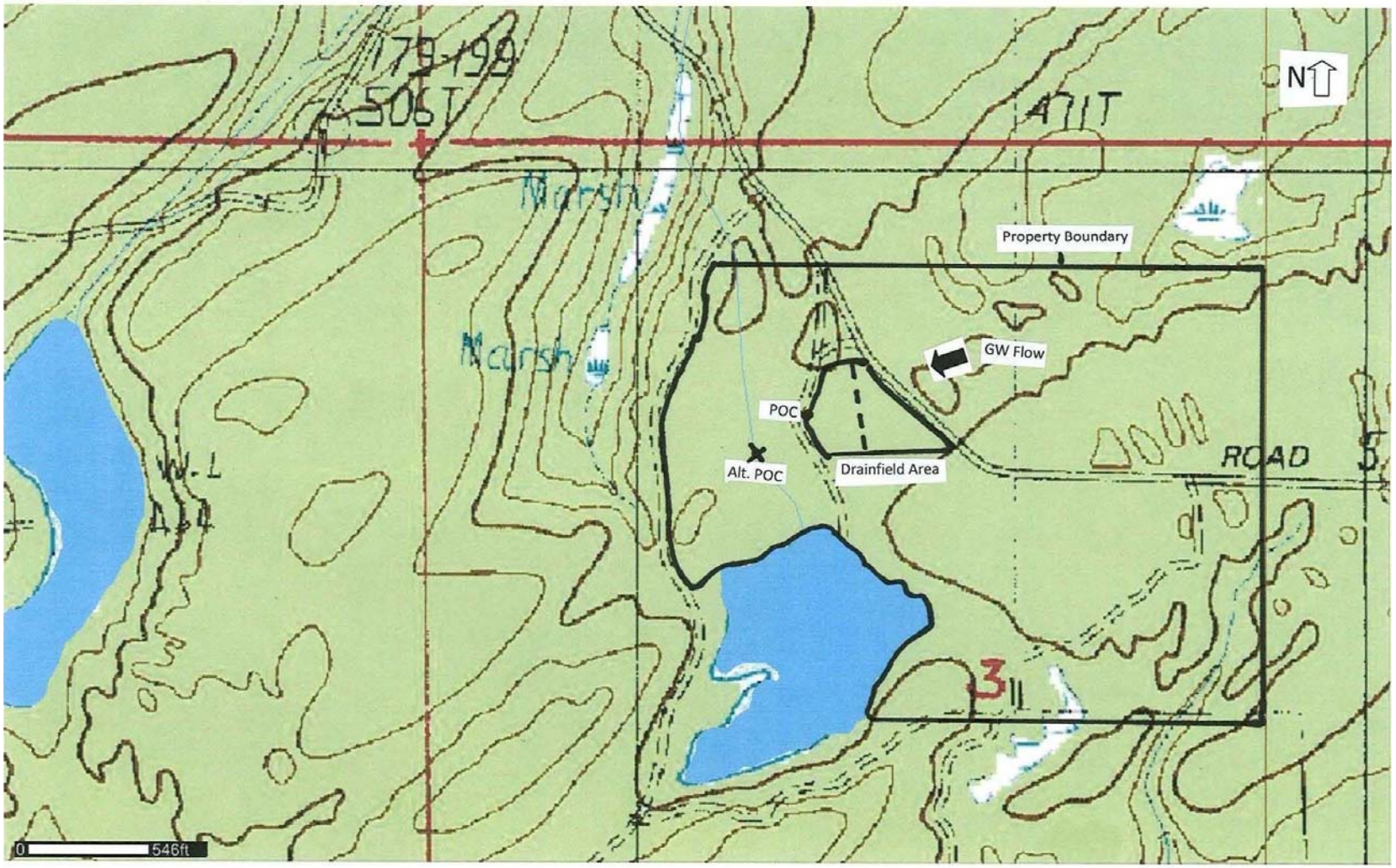
V_R = volume of recharge over drainfield (gallons/day)

A_D = area of drainfield (ft^2)

R = recharge (in/yr)

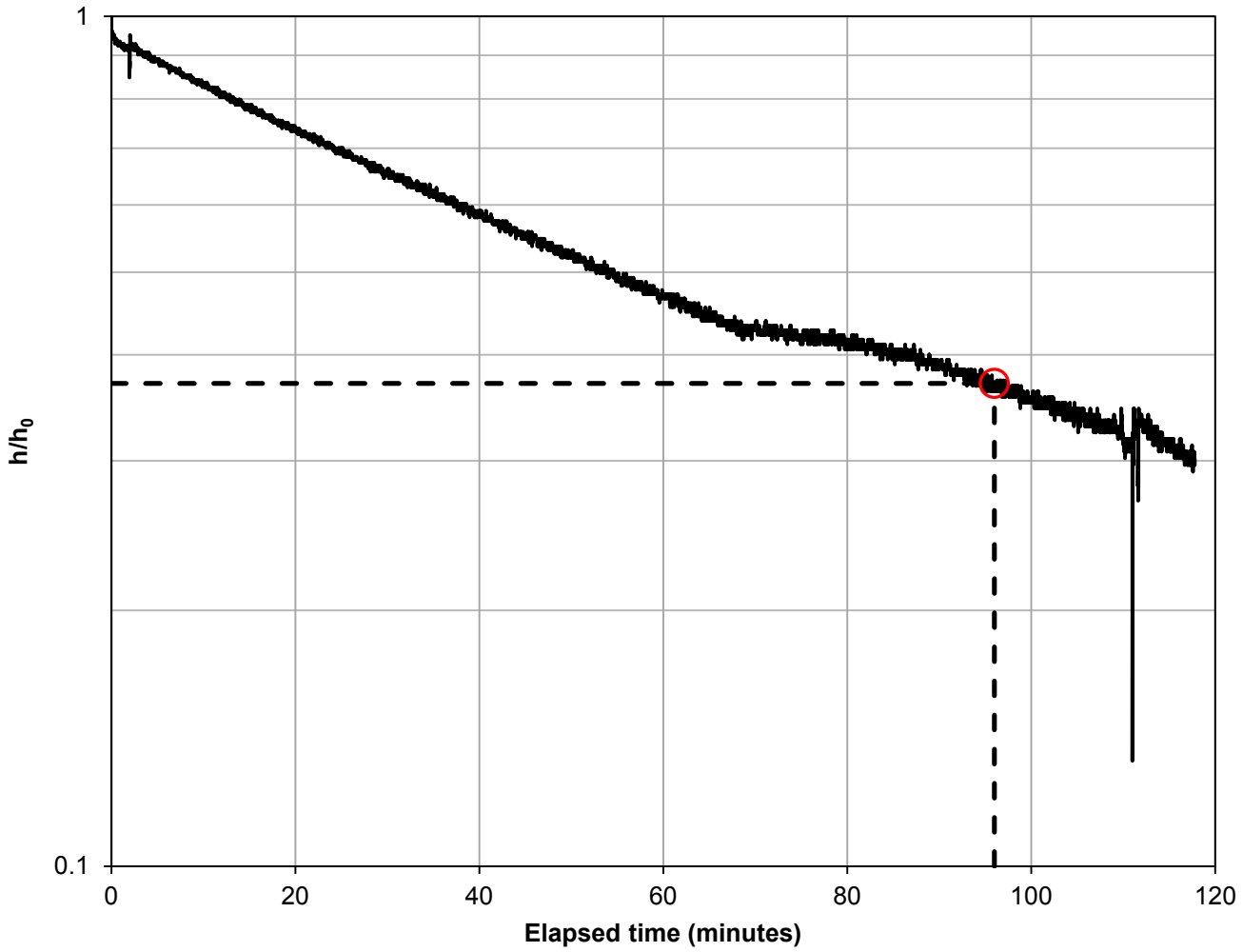
N_r = nitrate concentration in precipitation (mg/L)

Appendix B - Level One Nitrate Balance Sample Map



Darling's Acres Proposed LOSS 2/5/2011

APPENDIX D
AQUIFER PARAMETERS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.044 feet/day or
1.6E-05 cm/sec

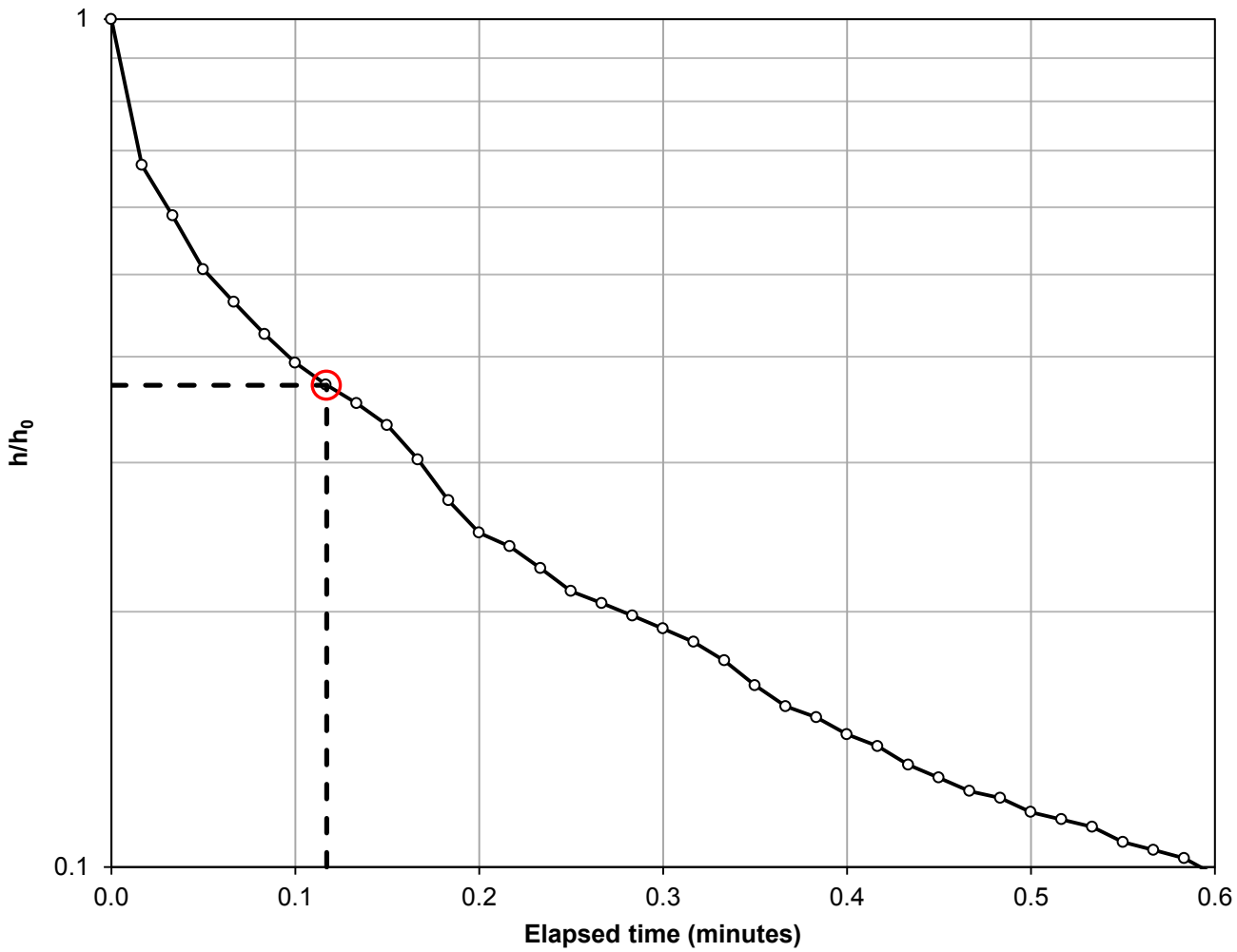
r = 0.083 feet
R = 0.250 feet
L_e = 2.9 feet
t_{37} = 96 minutes

Golder Associates

Figure D.1

LOSS MW-1 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 20 feet/day or
6.9E-03 cm/sec

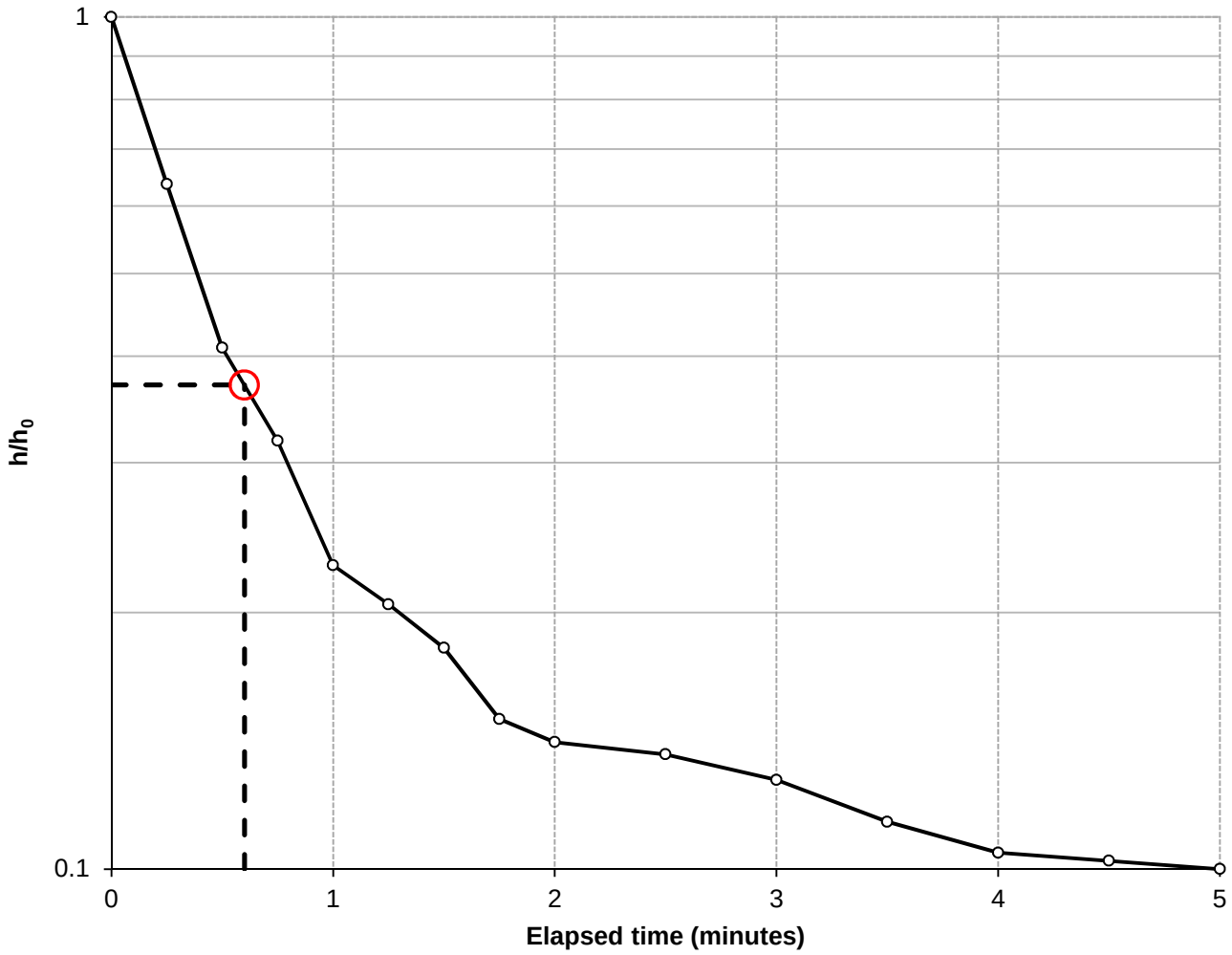
r = 0.083 feet
R = 0.250 feet
L_e = 7.4 feet
t_{37} = 0.12 minutes

Golder Associates

Figure D.2

LOSS MW-2 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 3.6 feet/day or
1.3E-03 cm/sec

r = 0.083 feet
R = 0.250 feet
L_e = 8.1 feet
t_{37} = 0.6 minutes

Golder Associates

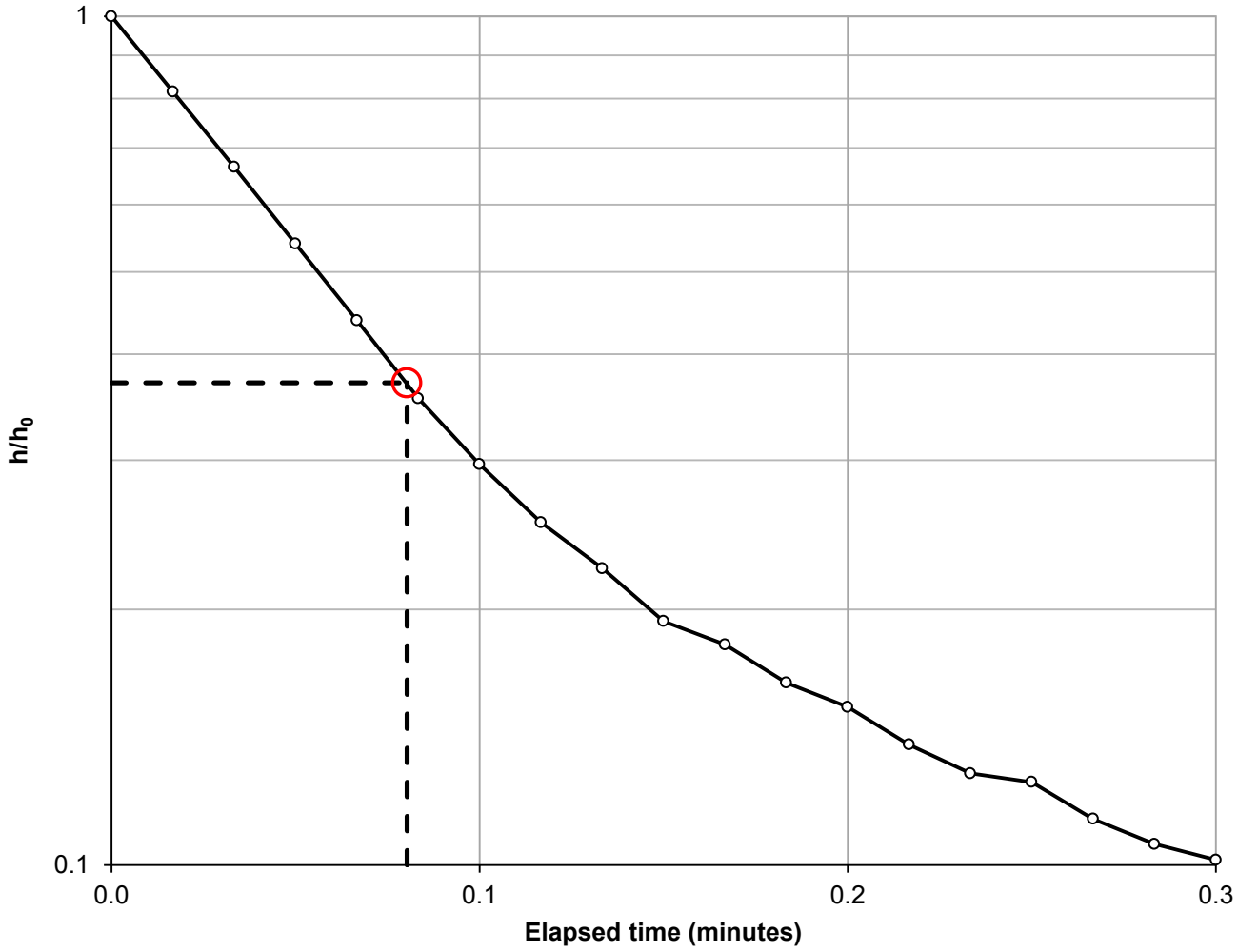
LEGEND

Test Data

FIGURE **D.3**

LOSS MW-3 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 20 feet/day or
7.0E-03 cm/sec

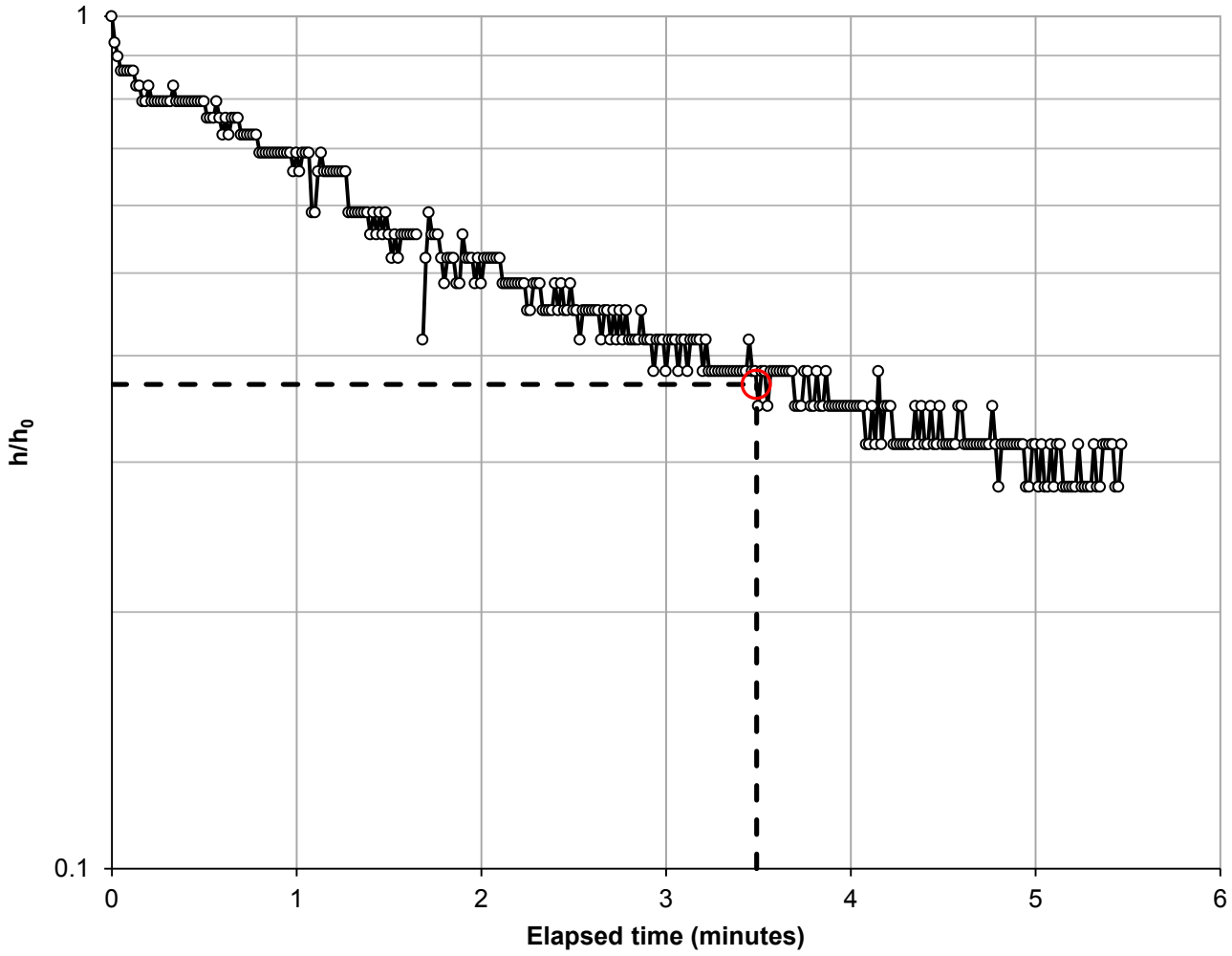
r = 0.083 feet
R = 0.250 feet
L_e = 12.1 feet
t_{37} = 0.0803 minutes

Golder Associates

Figure D.4

LOSS MW-4 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.42 feet/day or
1.5E-04 cm/sec

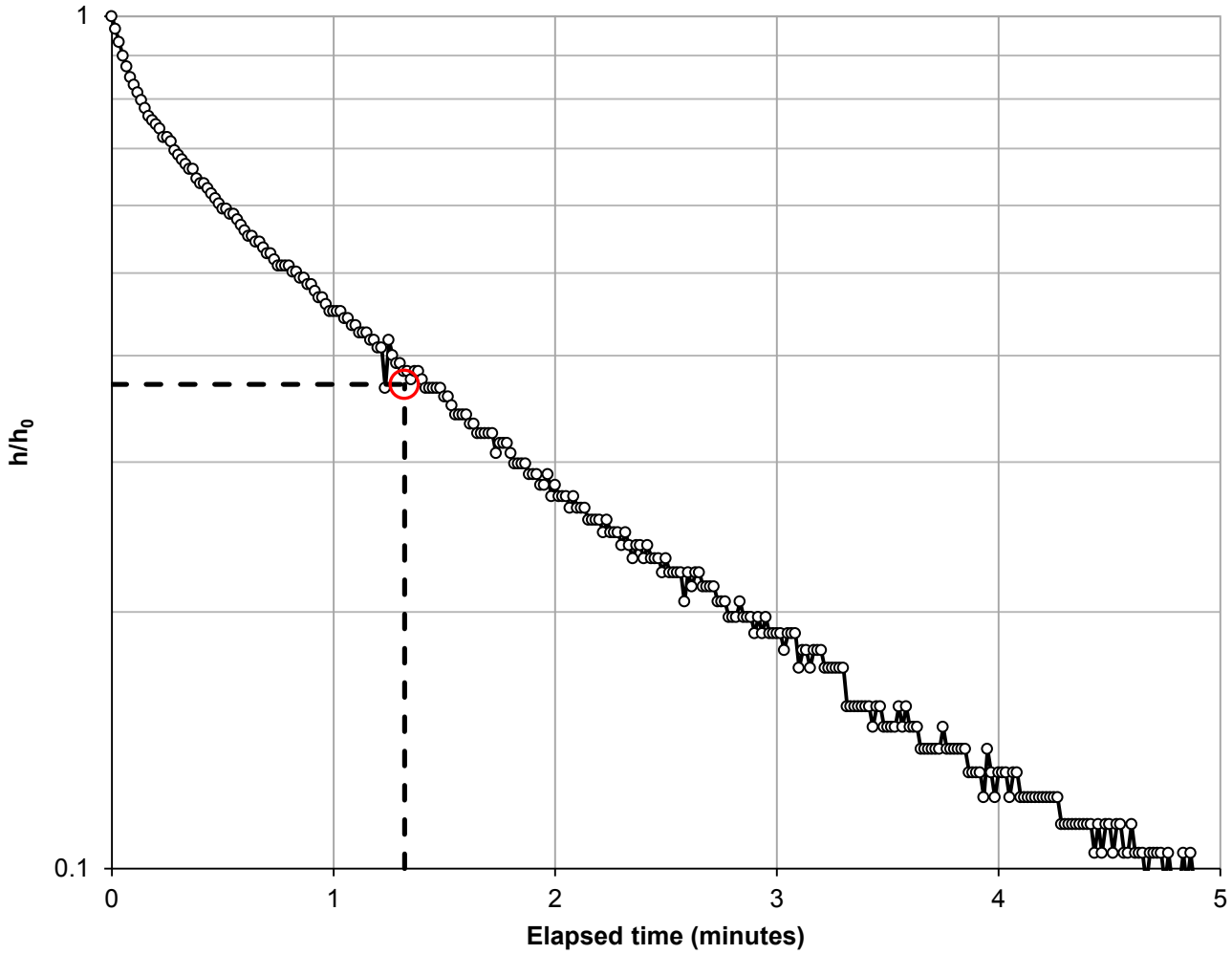
r = 0.083 feet
R = 0.250 feet
L_e = 13.8 feet
t_{37} = 3.49 minutes

Golder Associates

Figure D.5

LOSS MW-5 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 3.1 feet/day or
1.1E-03 cm/sec

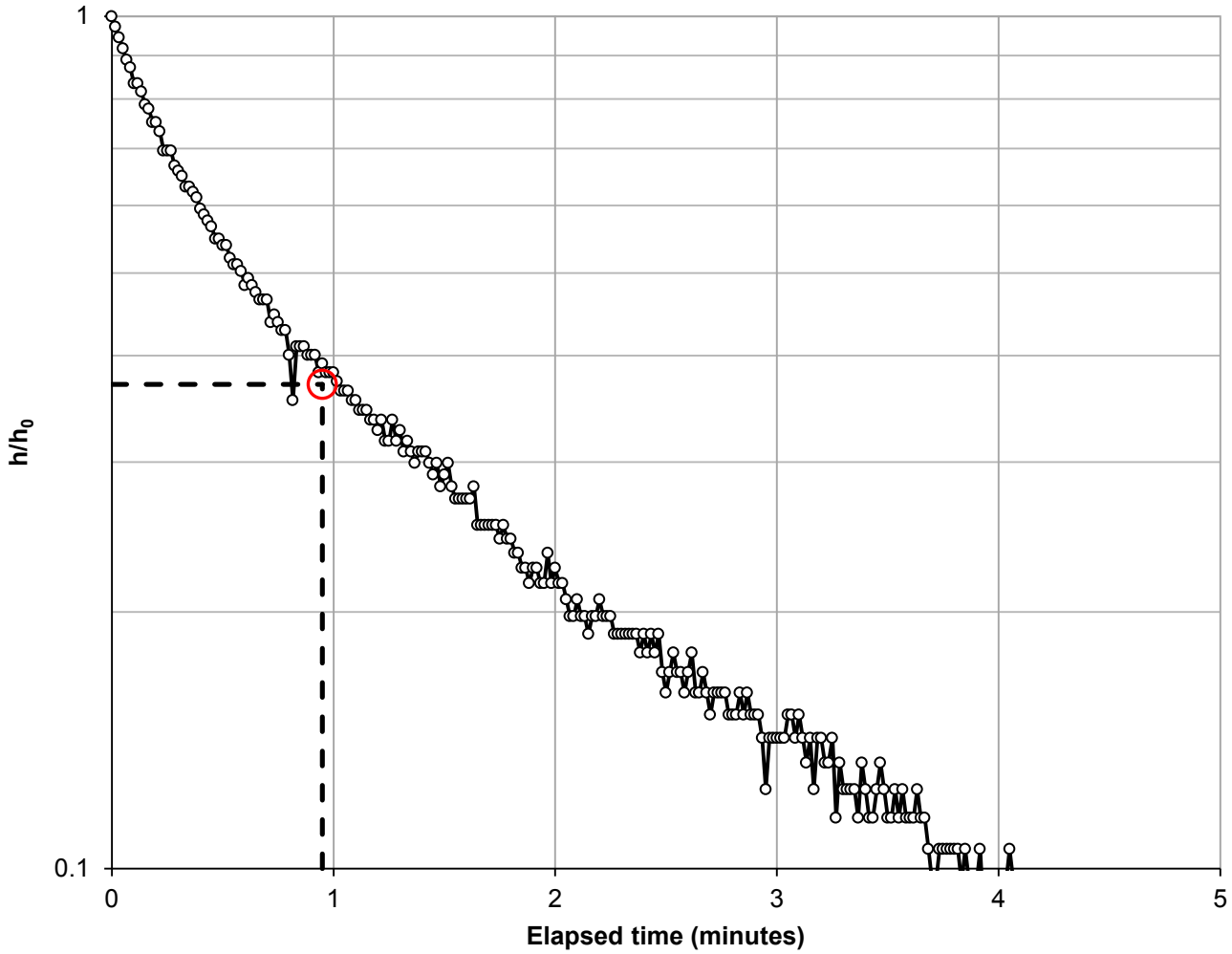
r = 0.083 feet
R = 0.250 feet
L_e = 3.03 feet
t_{37} = 1.3 minutes

Golder Associates

Figure D.6

LOSS MW-6 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 1.6 feet/day or
5.8E-04 cm/sec

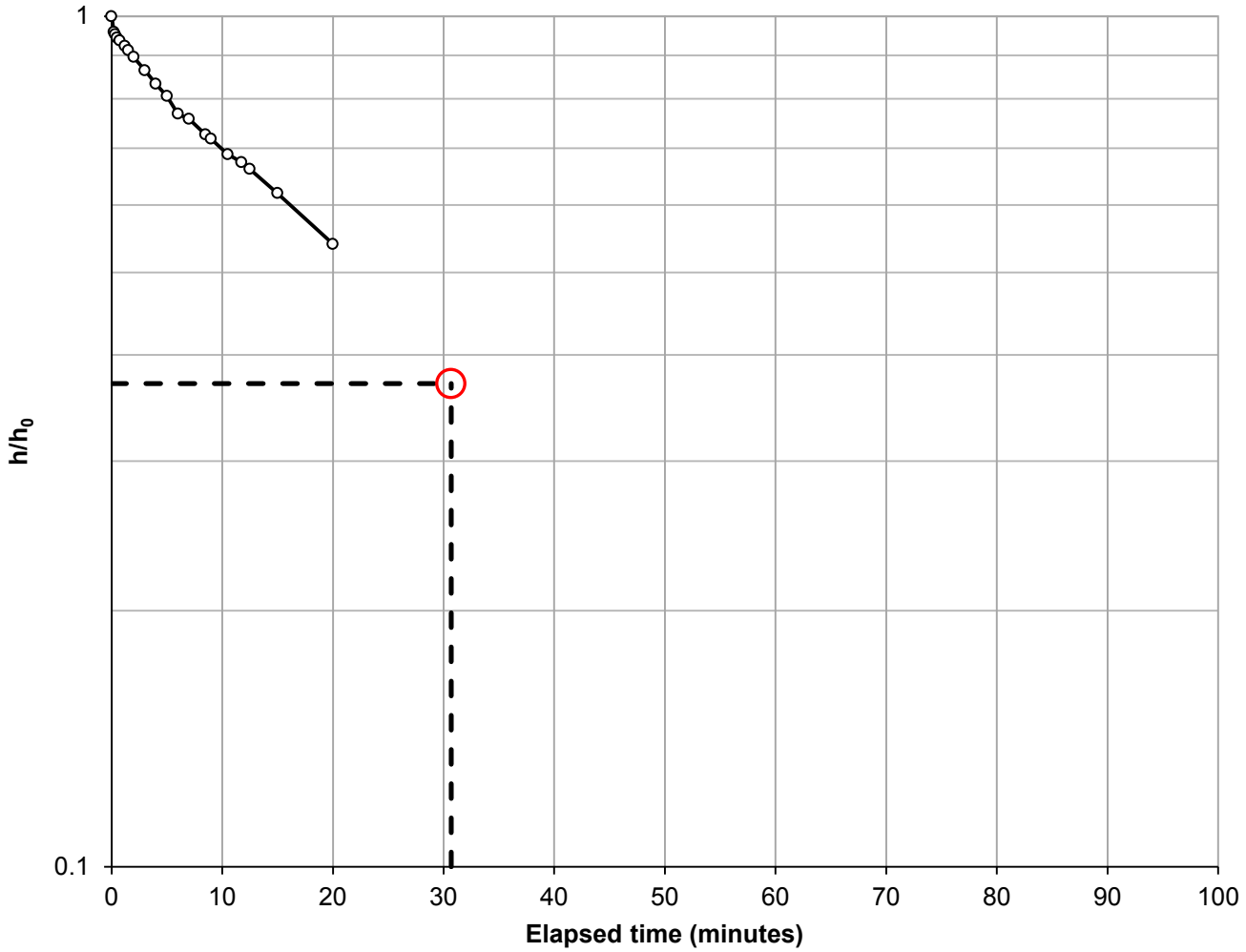
r = 0.083 feet
R = 0.333 feet
L_e = 11.32 feet
t_{37} = 1.0 minutes

Golder Associates

Figure D.7

LOSS MW-7 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.027 feet/day or
9.5E-06 cm/sec

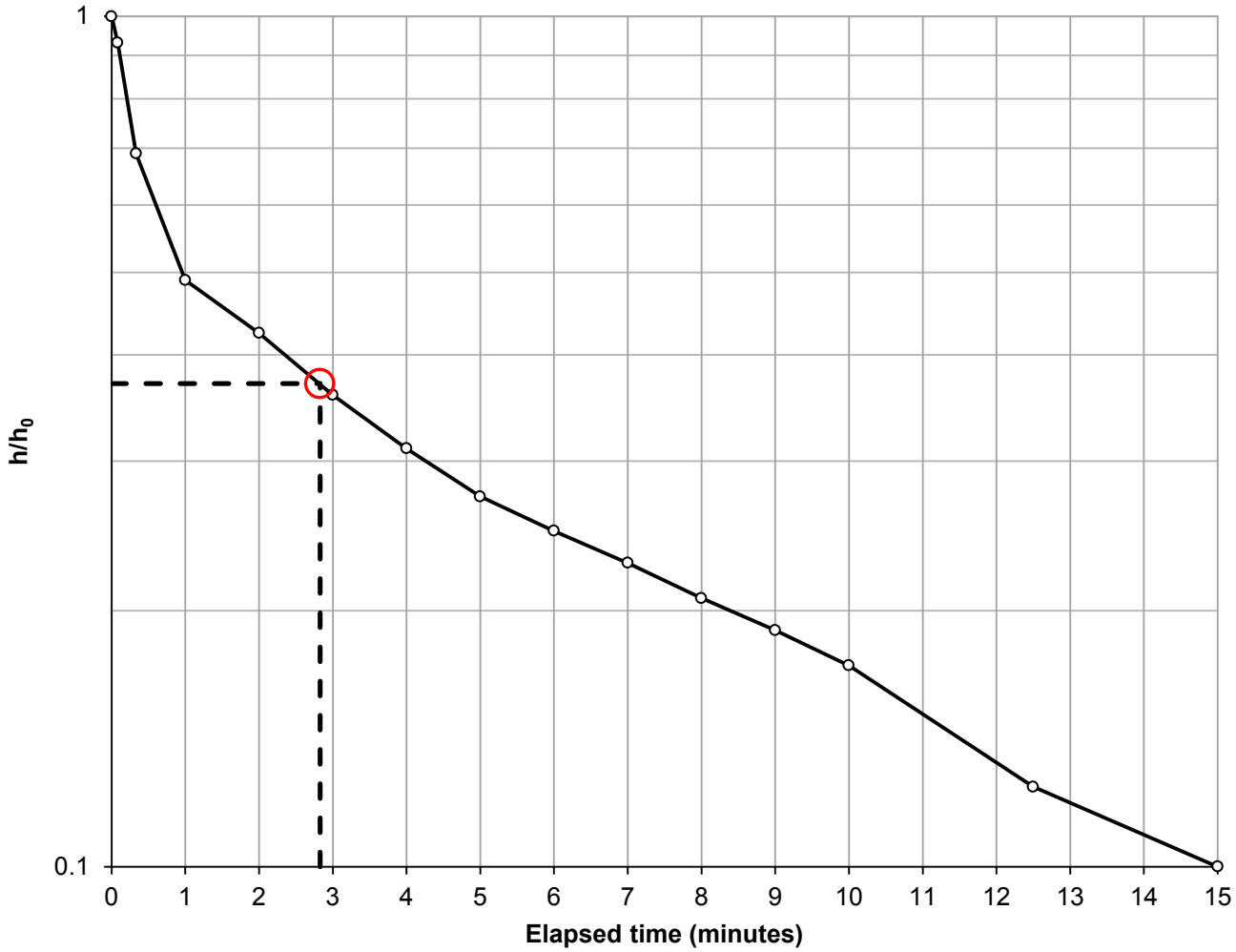
r = 0.036 feet
R = 0.125 feet
L_e = 4.0 feet
t_{37} = 30.7 minutes

Golder Associates

Figure D.8

LOSS P-1 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.32 feet/day or
1.1E-04 cm/sec

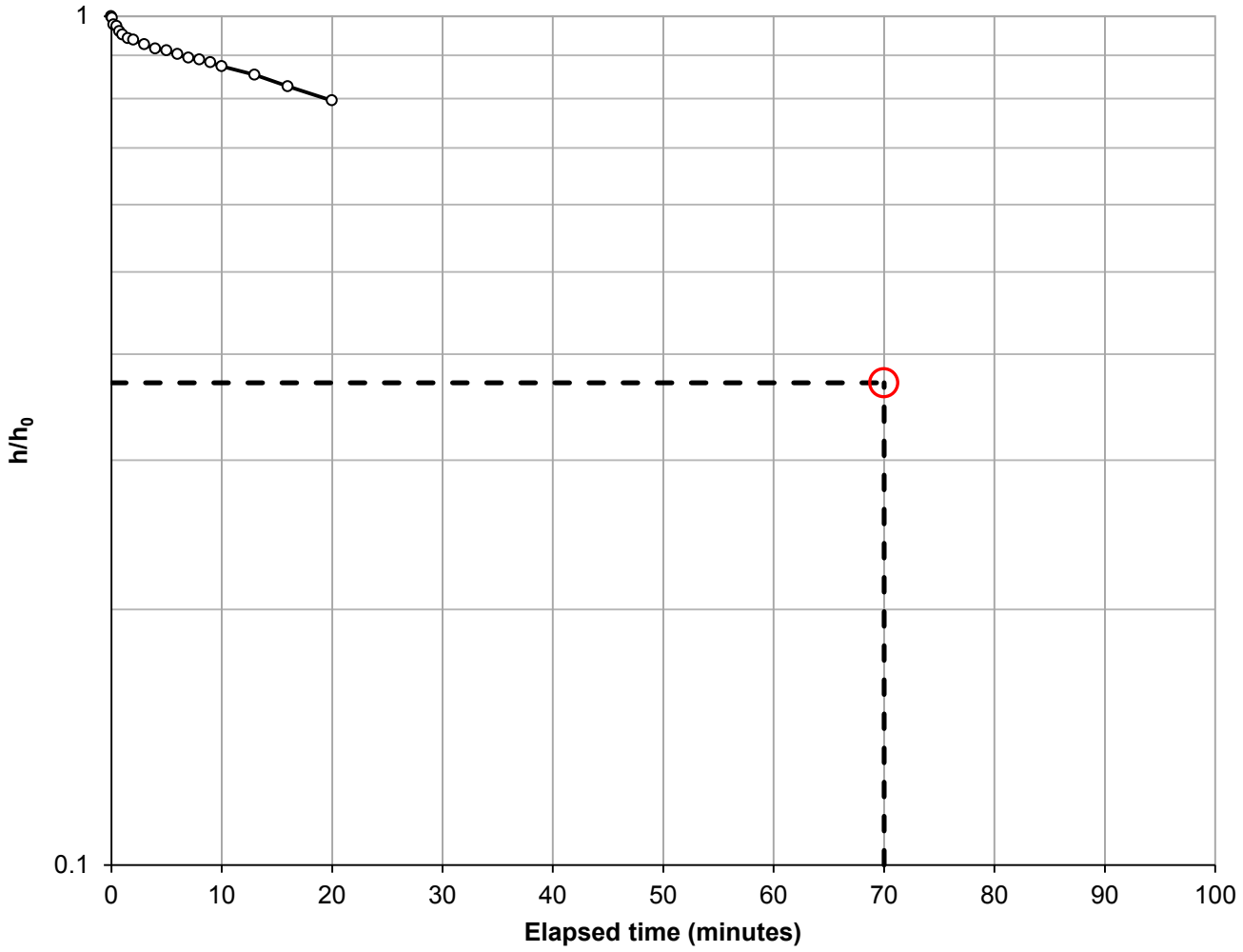
r = 0.036 feet
R = 0.125 feet
L_e = 3.6 feet
t_{37} = 2.8 minutes

Golder Associates

Figure D.9

LOSS P-2 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.018 feet/day or
6.2E-06 cm/sec

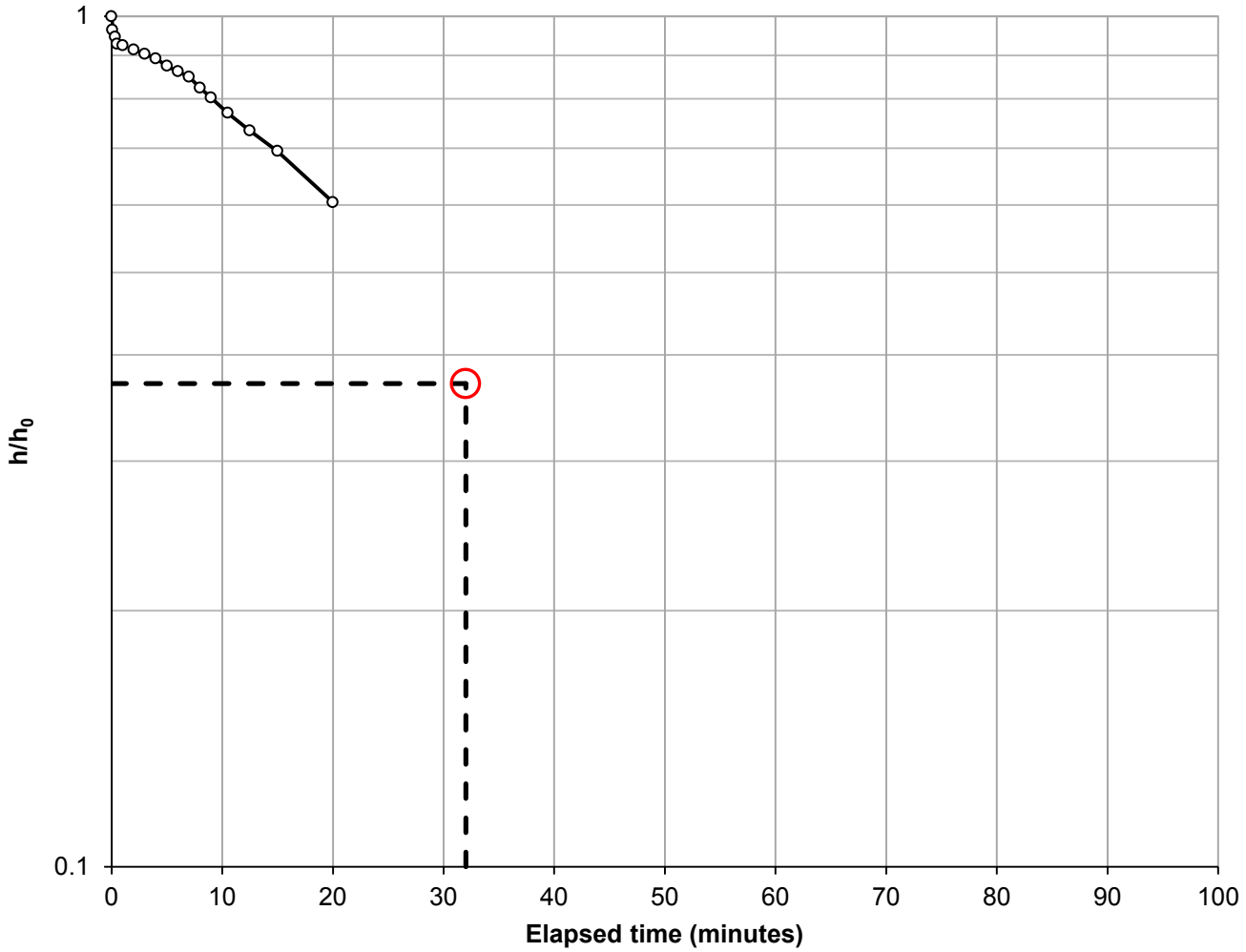
r = 0.036 feet
R = 0.125 feet
L_e = 2.25 feet
t_{37} = 70 minutes

Golder Associates

Figure D.10

LOSS P-3 SLUG TEST

Port Gamble Upland LOSS



Hvorslev Method

$K = r^2 \ln(L_e/R)/2L_e t_{37}$

K - hydraulic conductivity
r - radius of well casing
R - radius of filter pack
L_e - length of filter pack
t_{37} - time when $h/h_0 = 0.37$
h - displaced head
h_0 - initial displaced head

Falling-Head Test Analysis:

K = 0.022 feet/day or
7.8E-06 cm/sec

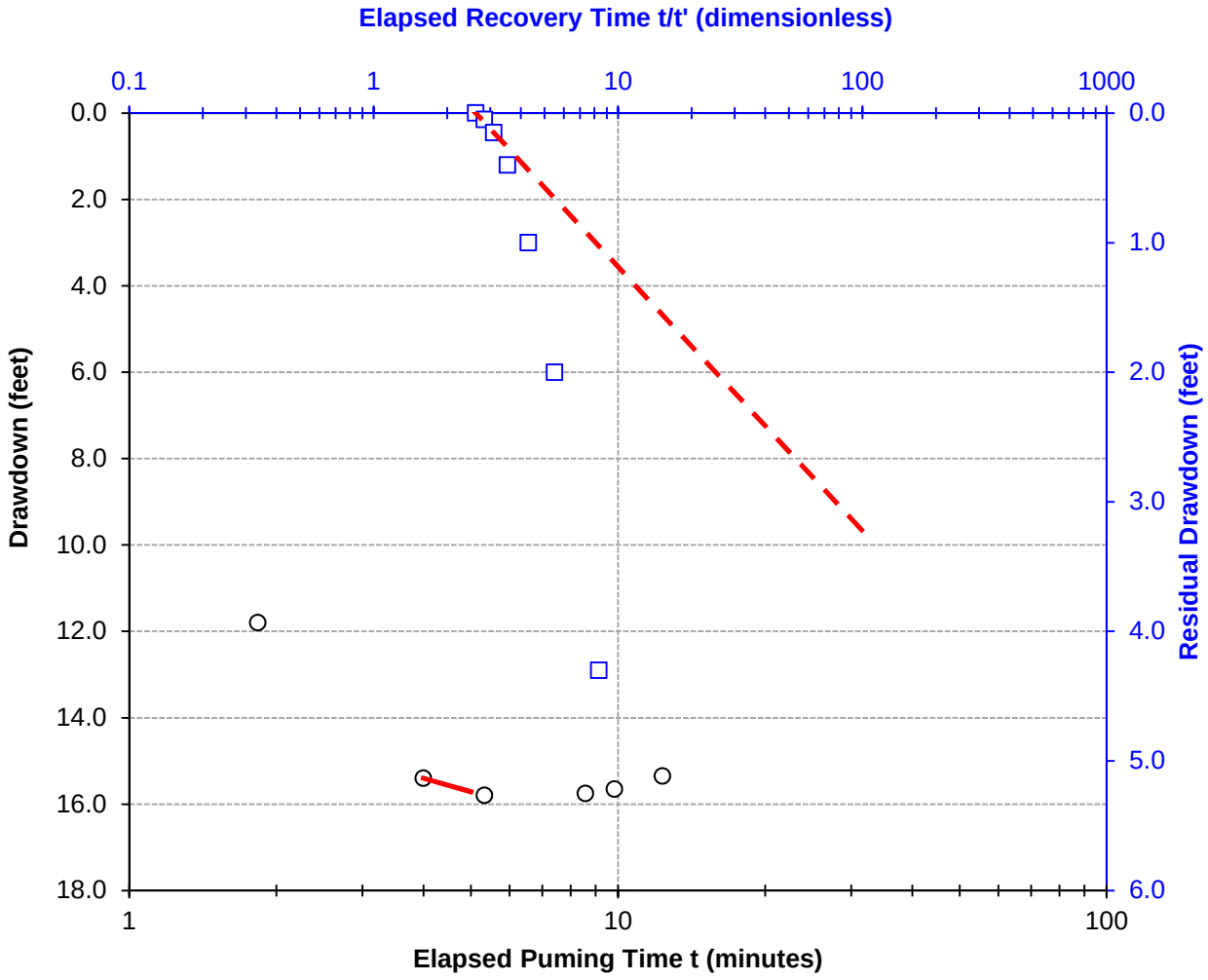
r = 0.036 feet
R = 0.125 feet
L_e = 4.98 feet
t_{37} = 32 minutes

Golder Associates

Figure D.11

LOSS P-4 SLUG TEST

Port Gamble Upland LOSS



Cooper-Jacob Solution (1946)

$$T = \frac{2.3Q}{4\pi s}$$

Where:
T is aquifer transmissivity [ft^2/day]
Q is pumping rate [ft^3/day]
s is drawdown per log cycle [ft]

Drawdown

T =	**160**	**ft^2/day**
Q =	2,807	ft^3/day
s =	3.20	ft per log cycle

Recovery

T =	**252**	**ft^2/day**
Q =	788	ft^3/day
s =	2.04	ft per log cycle

LEGEND

- Drawdown
- Drawdown Analysis
- Residual Drawdown
- Recovery Analysis

FIGURE **D.12**

PITTMAN WELL COOPER-JACOB ANALYSIS

Port Gamble Upland LOSS

13-00649

APPENDIX E
LABORATORY WATER QUALITY DATA

Report Number	Report Date	Contents
ALS Laboratory		
K1309407.01	10/10/2013	LOSS MW-1, -2, and -3 general water quality analyses
K1311873	11/6/2013	LOSS MW-4, -5, -6, and -7 & P-1, -2, -3, -4 general water quality analyses
K1312215	11/13/2013	LOSS MW-4, -5, -6, and -7 7 & P-1, -2, -3, -4 ammonia analyses
On-Site Environmental, Inc.		
1311-222	12/10/2013	Pittman Well

October 18, 2013

Analytical Report for Service Request No: K1309407
Revised Service Request No: K1309407.01

Jonathan Gerst, M.Sc
Golder Associates, Incorporated
9 Monroe Parkway, Suite 270
Lake Oswego, OR 97035

RE: Port Gamble Upland Loss/1300649

Dear Jonathan:

Enclosed is the revised report for the samples submitted to our laboratory on September 11, 2013. For your reference, these analyses have been assigned our service request number K1309407.

The report was revised to show MDLs per client request.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) 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 3364. You may also contact me via Email at Howard.Holmes@alsglobal.com.

Respectfully submitted,

REVISED
12:01 pm, Oct 18, 2013

ALS Group USA Corp. dba ALS Environmental

Howard Holmes
Project Manager

HH/rh

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
LOD	Limit of Detection
LOQ	Limit of Quantitation
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 as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
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 analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
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 or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

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 as defined by the DOD or NELAC standards.
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 estimated value.
J	The result is an estimated value.
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.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

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.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	4704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.caslab.com or at the accreditation bodies web site

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

ALS ENVIRONMENTAL

Client:	Golder Associates, Incorporated	**Service Request No.:**	K1309407
Project:	Port Gamble Upland Loss/ 1300649	**Date Received:**	09/11/13
Sample Matrix:	Water		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Laboratory Control Sample (LCS).

Sample Receipt

Three water samples were received for analysis at ALS Environmental on 09/11/13. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

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

Dissolved Metals

Matrix Spike Recovery Exceptions:
The control criteria for matrix spike recovery of Calcium for the Batch QC sample were not applicable. The analyzed concentration in the sample was significantly higher than the added spike concentration, preventing accurate evaluation of the spike recovery.

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

Approved by_____

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# K1307701

PAGE 1 OF 1 COC#

PROJECT NAME: Port Gamble Upland Loss
PROJECT NUMBER: 1300649
PROJECT MANAGER: Chris Pitre, c/o Jonathan Gerst
COMPANY NAME: Golder Assoc. Inc.
ADDRESS: 9 Monroe Pkwy Ste 270
CITY/STATE/ZIP: Lake Oswego, OR, 97035
E-MAIL ADDRESS: jgerst@golder.com
PHONE #: (503) 607-1820 FAX #
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Cyanide ☐	Hex-Chrom ☐	(circle) pH, Cond., Cl, SO4, PO4, F, NO2, NO3, BOD, TSS, TDS, Turb.	(circle) NH3-N, COD, TKN, TOC, DOC, NO2+NO3, T-Phos	TOX 9020 ☐	AOX 1650 ☐ 506 ☐	Alkalinity ☐ CO3 ☐ HCO3 ☐	Dioxins/Furans 1613 ☐ 8290 ☐	Dissolved Gases RSK 175 ☐ CO2 ☐ Methane ☐ Ethane ☐ Ethene ☐	Na, Ca, Mg, K, Fe, Mn, NO3, Cl, SO4, Fe	REMARKS
LOSS MW-1	9/10/13	1648		groundwater	2		✓								✓	
LOSS MW-2	9/10/13	1625		groundwater	2		✓								✓	
LOSS MW-3	9/10/13	1545		groundwater	2		✓								✓	

REPORT REQUIREMENTS

- ✓ I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ___ IV. Data Validation Report
- ✓ V. EDD

INVOICE INFORMATION

P.O. # 1300649
Bill To: Golder Assoc Inc

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
___ 5 day
___ Standard (15 working days)
___ Provide FAX Results
10-day TAT, no extra charge
Requested Report Date per HH

Circle which metals are to be analyzed:

Total 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

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

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: _____ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:
Analyze per email instructions to Howard H.

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:		RECEIVED BY:		RELINQUISHED BY:		RECEIVED BY:	
Signature	Date/Time 9/11/13	Signature	Date/Time 9/11/13 1100	Signature	Date/Time	Signature	Date/Time
Printed Name: Jonathan Gerst	Firm: Golder Assoc. Inc.	Printed Name	Firm: ALS	Printed Name	Firm	Printed Name	Firm

PC HA

Cooler Receipt and Preservation Form

Client / Project: Golder Assoc Service Request *K13* 09407

Received: 9/11/13 Opened: 9/11/13 By: BT Unloaded: 9/11/13 By: BT

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *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? front

   If present, were custody seals intact? (Y) N If present, were they signed and dated? (Y) N

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID (NA)	Tracking Number (NA)	Filed
1.9	2.0	0.3	0.4	+0.1	342			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* *Wet Ice* *Dry Ice* *Sleeves* _____ HA

5. Were custody papers properly filled out (ink, signed, etc.)?	NA	(Y)	N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.*	NA	(Y)	N
7. Were all sample labels complete (i.e analysis, preservation, etc.)?	NA	(Y)	N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.*	NA	(Y)	N
9. Were appropriate bottles/containers and volumes received for the tests indicated?	NA	(Y)	N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below*	NA	(Y)	N
11. Were VOA vials received without headspace? *Indicate in the table below.*	(NA)	Y	N
12. Was C12/Res negative?	(NA)	Y	N

Sample ID on Bottle	Sample ID on COC	Identified by:

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

Notes, Discrepancies, & Resolutions: Analytes not marked for metals - vac'd bttls

SHORT HOLD TIME

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	09/10/13
Sample Matrix:	Water	**Date Received:**	09/11/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Chloride

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
LOSS MW-1	K1309407-001	**5.85**	0.40	0.06	2	09/11/13 14:59	
LOSS MW-2	K1309407-002	**4.48**	0.40	0.06	2	09/11/13 15:15	
LOSS MW-3	K1309407-003	**1.28**	0.40	0.06	2	09/11/13 15:30	
Method Blank	K1309407-MB1	ND U	0.20	0.03	1	09/11/13 09:45	
Method Blank	K1309407-MB2	ND U	0.20	0.03	1	09/11/13 18:05	

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	09/11/13

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	KQ1310274-33	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample KQ1310274-33DUP Result	Average	RPD	RPD Limit
Chloride	300.0	0.40	0.06	3.06	3.02	3.04	1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Chloride

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	KQ1310274-33	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike KQ1310274-33MS			Duplicate Matrix Spike KQ1310274-33DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Chloride	3.06	13.1	10.0	101	13.0	10.0	100	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	09/11/13
Sample Matrix:	Water		

Lab Control Sample Summary
Chloride

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	357867

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1309407-LCS1	4.73	5.00	95	90-110
Lab Control Sample	K1309407-LCS2	4.76	5.00	95	90-110

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	09/10/13
Sample Matrix:	Water	**Date Received:**	09/11/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Nitrate as Nitrogen

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
LOSS MW-1	K1309407-001	ND U	0.10	0.01	2	09/11/13 14:59	
LOSS MW-2	K1309407-002	ND U	0.10	0.01	2	09/11/13 15:15	
LOSS MW-3	K1309407-003	ND U	0.10	0.01	2	09/11/13 15:30	
Method Blank	K1309407-MB1	ND U	0.050	0.005	1	09/11/13 09:45	
Method Blank	K1309407-MB2	ND U	0.050	0.005	1	09/11/13 18:05	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Duplicate Sample Summary
Nitrate as Nitrogen

Sample Name:	Lab Code:	MRL	MDL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
Batch QC	K1309409-001DUP	0.10	0.01	0.13	0.13	0.126	2	20	09/11/13
Batch QC	K1309410-001DUP	0.10	0.01	0.28	0.28	0.278	<1	20	09/11/13
Batch QC	K1309411-001DUP	0.10	0.01	0.25	0.25	0.252	<1	20	09/11/13
Batch QC	KQ1310274-33DUP	0.10	0.01	0.08	0.08	0.0774	2	20	09/11/13

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	K1309409-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike				Duplicate Matrix Spike					
		K1309409-001MS				K1309409-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.13	4.17	4.00	101	4.18	4.00	101	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	K1309410-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1309410-001MS			Duplicate Matrix Spike K1309410-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.28	4.37	4.00	102	4.38	4.00	103	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	K1309411-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1309411-001MS			Duplicate Matrix Spike K1309411-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.25	4.30	4.00	101	4.33	4.00	102	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	KQ1310274-33	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike KQ1310274-33MS			Duplicate Matrix Spike KQ1310274-33DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.08	10.2	10.0	101	10.2	10.0	101	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	09/11/13
Sample Matrix:	Water		

Lab Control Sample Summary
Nitrate as Nitrogen

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	357867

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1309407-LCS1	15.6	14.5	107	90-110

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	09/10/13
Sample Matrix:	Water	**Date Received:**	09/11/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Sulfate

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
LOSS MW-1	K1309407-001	**20.9**	1.0	0.1	10	09/12/13 03:32	
LOSS MW-2	K1309407-002	**15.5**	0.20	0.02	2	09/11/13 15:15	
LOSS MW-3	K1309407-003	**10.3**	0.20	0.02	2	09/11/13 15:30	
Method Blank	K1309407-MB1	ND U	0.10	0.01	1	09/11/13 09:45	
Method Blank	K1309407-MB2	ND U	0.10	0.01	1	09/11/13 18:05	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	09/11/13

Replicate Sample Summary

General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	KQ1310274-33	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample KQ1310274-33DUP Result	Average	RPD	RPD Limit
Sulfate	300.0	0.20	0.02	5.23	5.06	5.15	3	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	N/A
Sample Matrix:	Water	**Date Received:**	N/A
		Date Analyzed:	09/11/13

Duplicate Matrix Spike Summary
Sulfate

Sample Name:	Batch QC	**Units:**	mg/L
Lab Code:	KQ1310274-33	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike			Duplicate Matrix Spike					
		KQ1310274-33MS			KQ1310274-33DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfate	5.23	15.5	10.0	103	15.5	10.0	103	90-110	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	09/11/13
Sample Matrix:	Water		

Lab Control Sample Summary
Sulfate

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	357867

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1309407-LCS1	4.82	5.00	96	90-110
Lab Control Sample	K1309407-LCS2	4.79	5.00	96	90-110

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	09/10/13
Sample Matrix:	Water	**Date Received:**	09/11/13
Analysis Method:	SM 2510 B	**Units:**	uMHOS/cm
		Basis:	NA

Conductivity at 25 Degrees Celsius

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
LOSS MW-1	K1309407-001	**238**	2.0	0.4	1	09/26/13 17:55	
LOSS MW-2	K1309407-002	**223**	2.0	0.4	1	09/26/13 17:55	
LOSS MW-3	K1309407-003	**136**	2.0	0.4	1	09/26/13 17:55	
Method Blank	K1309407-MB1	**0.9 J**	2.0	0.4	1	09/26/13 17:55	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	09/26/13

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	uMHOS/cm
Lab Code:	K1310117-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample K1310117-001DUP Result	Average	RPD	RPD Limit
Conductivity at 25 Degrees Celsius	SM 2510 B	2.0	0.4	1260	1250	1260	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	09/26/13
Sample Matrix:	Water		

Lab Control Sample Summary
Conductivity at 25 Degrees Celsius

Analysis Method:	SM 2510 B	**Units:**	uMHOS/cm
		Basis:	NA
		Analysis Lot:	360481

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1309407-LCS1	327	330	99	86-113

ALS Group USA, Corp.
dba ALS Environmental

- Cover Page -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project Name: Port Gamble Upland Loss
Project No.: 1300649

Service Request: K1309407

Sample Name:	Lab Code:
LOSS MW-1	K1309407-001
LOSS MW-2	K1309407-002
LOSS MW-3	K1309407-003
Method Blank	K1309407-MB
Batch QC1LD	K1309536-001D
Batch QC1LS	K1309536-001S

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project No.:	1300649	**Date Collected:**	09/10/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	09/11/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: **LOSS MW-1** **Lab Code:** **K1309407-001**

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	09/17/13	09/18/13	17300		
Iron	6010C	20.0	3.0	1.0	09/17/13	09/18/13	380		
Magnesium	6010C	5.0	0.3	1.0	09/17/13	09/18/13	15200		
Manganese	6010C	1.00	0.07	1.0	09/17/13	09/18/13	247		
Potassium	6010C	200	60.0	1.0	09/17/13	09/18/13	1740		
Sodium	6010C	200	20.0	1.0	09/17/13	09/18/13	7270		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project No.:	1300649	**Date Collected:**	09/10/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	09/11/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: LOSS MW-2 **Lab Code:** K1309407-002

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	09/17/13	09/18/13	14700		
Iron	6010C	20.0	3.0	1.0	09/17/13	09/18/13	76.5		
Magnesium	6010C	5.0	0.3	1.0	09/17/13	09/18/13	12500		
Manganese	6010C	1.00	0.07	1.0	09/17/13	09/18/13	383		
Potassium	6010C	200	60.0	1.0	09/17/13	09/18/13	2460		
Sodium	6010C	200	20.0	1.0	09/17/13	09/18/13	10200		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1309407
Project No.:	1300649	**Date Collected:**	09/10/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	09/11/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: **LOSS MW-3** **Lab Code:** **K1309407-003**

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	09/17/13	09/18/13	8740		
Iron	6010C	20.0	3.0	1.0	09/17/13	09/18/13	193		
Magnesium	6010C	5.0	0.3	1.0	09/17/13	09/18/13	6320		
Manganese	6010C	1.00	0.07	1.0	09/17/13	09/18/13	265		
Potassium	6010C	200	60.0	1.0	09/17/13	09/18/13	1450		
Sodium	6010C	200	20.0	1.0	09/17/13	09/18/13	6940		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Service Request: K1309407
Project No.: 1300649
Date Collected:
Project Name: Port Gamble Upland Loss
Date Received:
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: Method Blank
Lab Code: K1309407-MB

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	09/17/13	09/18/13	0.9	U	
Iron	6010C	20.0	3.0	1.0	09/17/13	09/18/13	3.0	U	
Magnesium	6010C	5.0	0.3	1.0	09/17/13	09/18/13	0.3	J	
Manganese	6010C	1.00	0.07	1.0	09/17/13	09/18/13	0.07	U	
Potassium	6010C	200	60.0	1.0	09/17/13	09/18/13	60.0	U	
Sodium	6010C	200	20.0	1.0	09/17/13	09/18/13	20.0	U	

Comments:

Metals
- 5A -
SPIKE SAMPLE RECOVERY

Client: Golder Associates, Incorporated **Service Request:** K1309407

Project No.: 1300649 **Units:** UG/L

Project Name: Port Gamble Upland Loss **Basis:** NA

Matrix: WATER

Sample Name: Batch QC1LS **Lab Code:** K1309536-001S

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Calcium		68800		59800		10000.00	90.0		6010C
Iron		22500		21600		1000.00	90.0		6010C
Magnesium	75 - 125	21100		10800		10000.00	103.0		6010C
Manganese	75 - 125	928		452		500.00	95.2		6010C
Potassium	75 - 125	25200		14600		10000.00	106.0		6010C
Sodium	75 - 125	10800		465		10000.00	103.4		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Metals

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DUPLICATES

Client: Golder Associates, Incorporated **Service Request:** K1309407

Project No.: 1300649 **Units:** UG/L

Project Name: Port Gamble Upland Loss **Basis:** NA

Matrix: WATER

Sample Name: Batch QC1LD **Lab Code:** K1309536-001D

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Calcium	20	59800		61700		3.1		6010C
Iron	20	21600		22300		3.2		6010C
Magnesium	20	10800		11000		1.8		6010C
Manganese	20	452		466		3.1		6010C
Potassium	20	14600		15100		3.4		6010C
Sodium		465		453		2.6		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

Metals

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LABORATORY CONTROL SAMPLE

Client: Golder Associates, Incorporated **Service Request:** K1309407

Project No.: 1300649

Project Name: Port Gamble Upland Loss

Aqueous LCS Source: Inorganic Ventures **Solid LCS Source:**

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Calcium	12500	12600	100.8					
Iron	2500	2530	101.2					
Magnesium	12500	12600	100.8					
Manganese	1250	1240	99.2					
Potassium	12500	12500	100.0					
Sodium	12500	12400	99.2					

November 6, 2013 Analytical Report for Service Request No: K1311873

Jonathan Gerst, M.Sc
Golder Associates, Incorporated
9 Monroe Parkway, Suite 270
Lake Oswego, OR 97035

RE: Port Gamble Upland Loss/1300649

Dear Jonathan:

Enclosed are the results of the samples submitted to our laboratory on November 01, 2013. For your reference, these analyses have been assigned our service request number K1311873.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) 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 3364. You may also contact me via Email at Howard.Holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Howard Holmes
Project Manager

HH/ln

ADDRESS 1317 S. 13th Avenue, Kelso, WA 98626 USA | PHONE +1 360 577 7222 | FAX +1 360 636 1068
ALS Group USA, Corp. Part of the ALS Group An ALS Limited Company

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
LOD	Limit of Detection
LOQ	Limit of Quantitation
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 as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
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 analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
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 or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

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 as defined by the DOD or NELAC standards.
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 estimated value.
J	The result is an estimated value.
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.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

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.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	4704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.caslab.com or at the accreditation bodies web site

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

CHAIN OF CUSTODY

ALS Environmental

1317 South 13th Ave., Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

SR# L1311573

PAGE 1 OF 1 COC#

PROJECT NAME: Port Gamble Uplands LOSS
PROJECT NUMBER: 1300649
PROJECT MANAGER: Chris Pitre
COMPANY NAME: Golder Associates
ADDRESS: 9 Monroe Pkwy Ste 270
CITY/STATE/ZIP: Lake Oswego, OR
E-MAIL ADDRESS: jgerst@golder.com
PHONE #: 503-307-1772 FAX:
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total or Dissolved (See List below)	Cyanide☐ Hex-Chrom☐	(circle) pH, Cond., Turb., Alk., BOD, TSS, TDS, Turb. PO_4	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ CO_2☐ Methane☐ Ethane☐ Ethene☐			REMARKS
P-1	10/31	0930		GW	2								✓		✓									
P-2	10/30	1306		GW	2								✓		✓									
P-3	10/30	1500		GW	2								✓		✓									
P-4	10/30	1710		GW	2								✓		✓									
MW-4	10/31	1455		GW	2								✓		✓									
MW-5	10/30	1810		GW	2								✓		✓									
MW-6	10/31	10:34		GW	2								✓		✓									
MW-7	10/31	1340		GW	2								✓		✓									

REPORT REQUIREMENTS

___ I. Routine Report: Method Blank, Surrogate, as required
___ II. Report Dup., MS, MSD as required
___ III. CLP Like Summary (no raw data)
✓ IV. Data Validation Report
✓ V. EDD

INVOICE INFORMATION

P.O. # 1300649
Bill To: Golder

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr.
✓ 5 day 3 is better
___ Standard (15 working days)
___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total 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

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

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ___ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Analyze per correspondence w/ H. Holmes

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: [signature]	Signature:	Signature:
Date/Time: 10/31 8:08PM	Date/Time: 10/1 11/1/13 0800	Date/Time:	Date/Time:
Printed Name: Jonathan Gerst	Printed Name: Les Kennedy	Printed Name:	Printed Name:
Firm: Golder	Firm: ALS	Firm:	Firm:

PC HC

Cooler Receipt and Preservation Form

Client / Project: Golder Associates Service Request *K13* 11873

Received: 10/31/13 Opened: 11/1/13 By: MC Unloaded: 11/1/13 By: MC

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *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

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID (NA)	Tracking Number (NA)	Filed
4.1	4.1	1.5	1.5	0	333			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* (*Wet Ice*) *Dry Ice* *Sleeves* _____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA (Y) N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time
					SHORT HOLD TIME					

Notes, Discrepancies, & Resolutions: _____

Page _____ *of* _____

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dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/1/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Chloride

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
P-1	K1311873-001	**1.12**	0.40	0.06	2	11/01/13 10:41	
P-2	K1311873-002	**1.12**	0.40	0.06	2	11/01/13 09:40	
P-3	K1311873-003	**2.25**	0.40	0.06	2	11/01/13 09:56	
P-4	K1311873-004	**1.80**	0.40	0.06	2	11/01/13 10:11	
MW-4	K1311873-005	**3.21**	0.40	0.06	2	11/01/13 10:57	
MW-5	K1311873-006	**7.26**	0.40	0.06	2	11/01/13 10:26	
MW-6	K1311873-007	**9.66**	0.40	0.06	2	11/01/13 11:12	
MW-7	K1311873-008	**9.95**	0.40	0.06	2	11/01/13 11:28	
Method Blank	K1311873-MB	ND U	0.20	0.03	1	11/01/13 07:17	

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Duplicate Sample Summary
Chloride

Sample Name:	Lab Code:	MRL	MDL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
P-1	K1311873-001DUP	0.40	0.06	1.12	1.13	1.12	<1	20	11/01/13
P-2	K1311873-002DUP	0.40	0.06	1.12	1.12	1.12	<1	20	11/01/13

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Chloride

Sample Name:	P-1	**Units:**	mg/L
Lab Code:	K1311873-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1311873-001MS			Duplicate Matrix Spike K1311873-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Chloride	1.12	4.92	4.00	95	4.96	4.00	96	90-110	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Chloride

Sample Name:	P-2	**Units:**	mg/L
Lab Code:	K1311873-002	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1311873-002MS			Duplicate Matrix Spike K1311873-002DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Chloride	1.12	4.97	4.00	96	4.99	4.00	97	90-110	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	11/01/13
Sample Matrix:	Water		

Lab Control Sample Summary
Chloride

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	366226

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1311873-LCS	4.57	5.00	91	90-110

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/1/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Nitrate as Nitrogen

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
P-1	K1311873-001	**0.13**	0.10	0.01	2	11/01/13 10:41	
P-2	K1311873-002	**0.07 J**	0.10	0.01	2	11/01/13 09:40	
P-3	K1311873-003	**2.88**	0.10	0.01	2	11/01/13 09:56	
P-4	K1311873-004	**0.97**	0.10	0.01	2	11/01/13 10:11	
MW-4	K1311873-005	**0.03 J**	0.10	0.01	2	11/01/13 10:57	
MW-5	K1311873-006	**0.04 J**	0.10	0.01	2	11/01/13 10:26	
MW-6	K1311873-007	**0.04 J**	0.10	0.01	2	11/01/13 11:12	
MW-7	K1311873-008	ND U	0.10	0.01	2	11/01/13 11:28	
Method Blank	K1311873-MB	ND U	0.050	0.005	1	11/01/13 07:17	

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QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Duplicate Sample Summary
Nitrate as Nitrogen

Sample Name:	Lab Code:	MRL	MDL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
P-1	K1311873-001DUP	0.10	0.01	0.13	0.13	0.130	<1	20	11/01/13
P-2	K1311873-002DUP	0.10	0.01	0.07	0.07	0.0683	1	20	11/01/13

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	P-1	**Units:**	mg/L
Lab Code:	K1311873-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1311873-001MS			Duplicate Matrix Spike K1311873-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.13	3.93	4.00	95	4.01	4.00	97	90-110	2	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Nitrate as Nitrogen

Sample Name:	P-2	**Units:**	mg/L
Lab Code:	K1311873-002	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike			Duplicate Matrix Spike					
		K1311873-002MS			K1311873-002DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Nitrate as Nitrogen	0.07	3.94	4.00	97	3.92	4.00	96	90-110	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	11/01/13
Sample Matrix:	Water		

Lab Control Sample Summary
Nitrate as Nitrogen

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	366226

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1311873-LCS	15.1	14.5	104	90-110

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/1/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Sulfate

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
P-1	K1311873-001	**1.31**	0.20	0.02	2	11/01/13 10:41	
P-2	K1311873-002	**2.27**	0.20	0.02	2	11/01/13 09:40	
P-3	K1311873-003	**4.79**	0.20	0.02	2	11/01/13 09:56	
P-4	K1311873-004	**6.23**	0.20	0.02	2	11/01/13 10:11	
MW-4	K1311873-005	**17.7**	0.20	0.02	2	11/01/13 10:57	
MW-5	K1311873-006	**5.43**	0.20	0.02	2	11/01/13 10:26	
MW-6	K1311873-007	**4.60**	0.20	0.02	2	11/01/13 11:12	
MW-7	K1311873-008	**5.34**	0.20	0.02	2	11/01/13 11:28	
Method Blank	K1311873-MB	ND U	0.10	0.01	1	11/01/13 07:17	

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QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA

Duplicate Sample Summary
Sulfate

Sample Name:	Lab Code:	MRL	MDL	Sample Result	Duplicate Result	Average	RPD	RPD Limit	Date Analyzed
P-1	K1311873-001DUP	0.20	0.02	1.31	1.32	1.32	<1	20	11/01/13
P-2	K1311873-002DUP	0.20	0.02	2.27	2.20	2.23	3	20	11/01/13

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ALS Group USA, Corp.
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QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Sulfate

Sample Name:	P-1	**Units:**	mg/L
Lab Code:	K1311873-001	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1311873-001MS			Duplicate Matrix Spike K1311873-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfate	1.31	5.47	4.00	104	5.52	4.00	105	90-110	<1	20

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dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/1/13

Duplicate Matrix Spike Summary
Sulfate

Sample Name:	P-2	**Units:**	mg/L
Lab Code:	K1311873-002	**Basis:**	NA
Analysis Method:	300.0		

		Matrix Spike K1311873-002MS			Duplicate Matrix Spike K1311873-002DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Sulfate	2.27	6.49	4.00	106	6.52	4.00	106	90-110	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	11/01/13
Sample Matrix:	Water		

Lab Control Sample Summary
Sulfate

Analysis Method:	300.0	**Units:**	mg/L
		Basis:	NA
		Analysis Lot:	366226

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1311873-LCS	4.76	5.00	95	90-110

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/30/13 - 10/31/13
Sample Matrix:	Water	**Date Received:**	11/1/13
Analysis Method:	SM 2510 B	**Units:**	uMHOS/cm
		Basis:	NA

Conductivity at 25 Degrees Celsius

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Q
P-1	K1311873-001	**156**	2.0	0.4	1	11/05/13 13:50	
P-2	K1311873-002	**70.7**	2.0	0.4	1	11/05/13 13:50	
P-3	K1311873-003	**129**	2.0	0.4	1	11/05/13 13:50	
P-4	K1311873-004	**99.7**	2.0	0.4	1	11/05/13 13:50	
MW-4	K1311873-005	**222**	2.0	0.4	1	11/05/13 13:50	
MW-5	K1311873-006	**297**	2.0	0.4	1	11/05/13 13:50	
MW-6	K1311873-007	**331**	2.0	0.4	1	11/05/13 13:50	
MW-7	K1311873-008	**360**	2.0	0.4	1	11/05/13 13:50	
Method Blank	K1311873-MB	**1.0**	2.0	0.4	1	11/05/13 13:50	**J**

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QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	NA
Sample Matrix:	Water	**Date Received:**	NA
		Date Analyzed:	11/05/13

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	Batch QC	**Units:**	uMHOS/cm
Lab Code:	K1311973-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample K1311973-001DUP Result	Average	RPD	RPD Limit
Conductivity at 25 Degrees Celsius	SM 2510 B	2.0	0.4	36.1	36.2	36.1	<1	20

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ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	11/05/13
Sample Matrix:	Water		

Lab Control Sample Summary
Conductivity at 25 Degrees Celsius

Analysis Method:	SM 2510 B	**Units:**	uMHOS/cm
		Basis:	NA
		Analysis Lot:	366830

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1311873-LCS	334	330	101	86-113

ALS Group USA, Corp.
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- Cover Page -
INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project Name: Port Gamble Upland Loss
Project No.: 1300649

Service Request: K1311873

Sample Name:	Lab Code:
P-1	K1311873-001DISS
P-1D	K1311873-001DISSD
P-1S	K1311873-001DISSS
P-2	K1311873-002DISS
P-3	K1311873-003DISS
P-4	K1311873-004DISS
MW-4	K1311873-005DISS
MW-5	K1311873-006DISS
MW-6	K1311873-007DISS
MW-7	K1311873-008DISS
Method Blank	K1311873-MB

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project No.: 1300649
Project Name: Port Gamble Upland Loss
Matrix: WATER

Service Request: K1311873
Date Collected: 10/31/13
Date Received: 11/01/13
Units: ug/L
Basis: NA

Sample Name: P-1
Lab Code: K1311873-001DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	15700		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	37.3		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	5620		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	39.8		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	2770		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	8790		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project No.:	1300649	**Date Collected:**	10/30/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	11/01/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: P-2 **Lab Code:** K1311873-002DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	5190		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	106		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	3260		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	10.5		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	657		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	4610		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project No.: 1300649
Project Name: Port Gamble Upland Loss
Matrix: WATER

Service Request: K1311873
Date Collected: 10/30/13
Date Received: 11/01/13
Units: ug/L
Basis: NA

Sample Name: P-3
Lab Code: K1311873-003DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	7510		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	155		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	6030		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	3.20		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	831		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	6100		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project No.:	1300649	**Date Collected:**	10/30/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	11/01/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: P-4 **Lab Code:** K1311873-004DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	5880		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	519		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	3450		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	8.40		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	1170		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	7650		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project No.: 1300649
Project Name: Port Gamble Upland Loss
Matrix: WATER

Service Request: K1311873
Date Collected: 10/31/13
Date Received: 11/01/13
Units: ug/L
Basis: NA

Sample Name: MW-4
Lab Code: K1311873-005DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	12800		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	299		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	5590		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	72.6		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	1900		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	24000		

Comments:

Metals

- 1 -

INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Service Request: K1311873
Project No.: 1300649
Date Collected: 10/30/13
Project Name: Port Gamble Upland Loss
Date Received: 11/01/13
Matrix: WATER
Units: ug/L
Basis: NA

Sample Name: MW-5
Lab Code: K1311873-006DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	11000		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	396		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	3740		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	87.1		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	2020		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	45600		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated
Project No.: 1300649
Project Name: Port Gamble Upland Loss
Matrix: WATER

Service Request: K1311873
Date Collected: 10/31/13
Date Received: 11/01/13
Units: ug/L
Basis: NA

Sample Name: MW-6
Lab Code: K1311873-007DISS

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	11400		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	139		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	3180		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	58.6		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	2310		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	59700		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client:	Golder Associates, Incorporated	**Service Request:**	K1311873
Project No.:	1300649	**Date Collected:**	10/31/13
Project Name:	Port Gamble Upland Loss	**Date Received:**	11/01/13
Matrix:	WATER	**Units:**	ug/L
		Basis:	NA

Sample Name: **MW-7** **Lab Code:** **K1311873-008DISS**

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	12800		
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	31900		
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	12300		
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	601		
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	4150		
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	85800		

Comments:

Metals

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INORGANIC ANALYSIS DATA PACKAGE

Client: Golder Associates, Incorporated **Service Request:** K1311873

Project No.: 1300649 **Date Collected:**

Project Name: Port Gamble Upland Loss **Date Received:**

Matrix: WATER **Units:** ug/L

Basis: NA

Sample Name: **Method Blank** **Lab Code:** **K1311873-MB**

Analyte	Analysis Method	MRL	MDL	Dilution Factor	Date Extracted	Date Analyzed	Result	C	Q
Calcium	6010C	20.0	0.9	1.0	11/02/13	11/04/13	0.9	U	
Iron	6010C	20.0	3.0	1.0	11/02/13	11/04/13	3.0	U	
Magnesium	6010C	5.0	0.3	1.0	11/02/13	11/04/13	0.3	U	
Manganese	6010C	1.00	0.07	1.0	11/02/13	11/04/13	0.07	U	
Potassium	6010C	200	60.0	1.0	11/02/13	11/04/13	60.0	U	
Sodium	6010C	200	20.0	1.0	11/02/13	11/04/13	20.0	U	

Comments:

Metals
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SPIKE SAMPLE RECOVERY

Client: Golder Associates, Incorporated **Service Request:** K1311873

Project No.: 1300649 **Units:** UG/L

Project Name: Port Gamble Upland Loss **Basis:** NA

Matrix: WATER

Sample Name: P-1S **Lab Code:** K1311873-001DISSS

Analyte	Control Limit %R	Spike Result	C	Sample Result	C	Spike Added	%R	Q	Method
Calcium	75 - 125	25500		15700		10000.00	98.0		6010C
Iron	75 - 125	1030		37.3		1000.00	99.3		6010C
Magnesium	75 - 125	16400		5620		10000.00	107.8		6010C
Manganese	75 - 125	518		39.8		500.00	95.6		6010C
Potassium	75 - 125	12900		2770		10000.00	101.3		6010C
Sodium	75 - 125	19200		8790		10000.00	104.1		6010C

An empty field in the Control Limit column indicates the control limit is not applicable

Metals

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DUPLICATES

Client: Golder Associates, Incorporated **Service Request:** K1311873

Project No.: 1300649 **Units:** UG/L

Project Name: Port Gamble Upland Loss **Basis:** NA

Matrix: WATER

Sample Name: P-1D **Lab Code:** K1311873-001DISSD

Analyte	Control Limit	Sample (S)	C	Duplicate (D)	C	RPD	Q	Method
Calcium	20	15700		15900		1.3		6010C
Iron		37.3		38.6		3.4		6010C
Magnesium	20	5620		5660		0.7		6010C
Manganese	20	39.8		40.3		1.2		6010C
Potassium	20	2770		2810		1.4		6010C
Sodium	20	8790		8980		2.1		6010C

An empty field in the Control Limit column indicates the control limit is not applicable.

Metals

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LABORATORY CONTROL SAMPLE

Client: Golder Associates, Incorporated **Service Request:** K1311873

Project No.: 1300649

Project Name: Port Gamble Upland Loss

Aqueous LCS Source: Inorganic Ventures **Solid LCS Source:**

Analyte	Aqueous (ug/L)			Solid (mg/kg)				
	True	Found	%R	True	Found	C	Limits	%R
Calcium	12500	12300	98.4					
Iron	2500	2430	97.2					
Magnesium	12500	12500	100.0					
Manganese	1250	1210	96.8					
Potassium	12500	12100	96.8					
Sodium	12500	12600	100.8					

November 13, 2013 Analytical Report for Service Request No: K1312215

Jonathan Gerst, M.Sc
Golder Associates, Incorporated
9 Monroe Parkway, Suite 270
Lake Oswego, OR 97035

RE: Port Gamble Upland Loss/1300649

Dear Jonathan:

Enclosed are the results of the samples submitted to our laboratory on November 01, 2013. For your reference, these analyses have been assigned our service request number K1312215.

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at www.alsglobal.com. All results are intended to be considered in their entirety, and ALS Group USA Corp. dba ALS Environmental (ALS) 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 3364. You may also contact me via Email at Howard.Holmes@alsglobal.com.

Respectfully submitted,

ALS Group USA Corp. dba ALS Environmental

Howard Holmes
Project Manager

HH/mj

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
LOD	Limit of Detection
LOQ	Limit of Quantitation
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 as defined by the DOD or NELAC standards.
E	The result is an estimate amount because the value exceeded the instrument calibration range.
J	The result is an estimated value.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.
H	The holding time for this test is immediately following sample collection. The samples were analyzed as soon as possible after receipt by the laboratory.

Metals Data Qualifiers

#	The control limit criteria is not applicable. See case narrative.
J	The result is an estimated value.
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 analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
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 or LOQ/LOD is elevated due to a matrix interference.
X	See case narrative.
+	The correlation coefficient for the MSA is less than 0.995.
Q	See case narrative. One or more quality control criteria was outside the limits.

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 as defined by the DOD or NELAC standards.
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 estimated value.
J	The result is an estimated value.
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.
U	The analyte was analyzed for, but was not detected ("Non-detect") at or above the MRL/MDL. *DOD-QSM 4.2 definition* : Analyte was not detected and is reported as less than the LOD or as defined by the project. The detection limit is adjusted for dilution.
i	The MRL/MDL or LOQ/LOD is elevated due to a chromatographic interference.
X	See case narrative.
Q	See case narrative. One or more quality control criteria was outside the limits.

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.

ALS Group USA Corp. dba ALS Environmental (ALS) - Kelso
State Certifications, Accreditations, and Licenses

Agency	Web Site	Number
Alaska DEC UST	http://dec.alaska.gov/applications/eh/ehllabreports/USTLabs.aspx	UST-040
Arizona DHS	http://www.azdhs.gov/lab/license/env.htm	AZ0339
Arkansas - DEQ	http://www.adeq.state.ar.us/techsvs/labcert.htm	88-0637
California DHS (ELAP)	http://www.cdph.ca.gov/certlic/labs/Pages/ELAP.aspx	2286
DOD ELAP	http://www.denix.osd.mil/edqw/Accreditation/AccreditedLabs.cfm	L12-28
Florida DOH	http://www.doh.state.fl.us/lab/EnvLabCert/WaterCert.htm	E87412
Georgia DNR	http://www.gaepd.org/Documents/techguide_pcb.html#cel	881
Hawaii DOH	Not available	-
Idaho DHW	http://www.healthandwelfare.idaho.gov/Health/Labs/CertificationDrinkingWaterLabs/tabid/1833/Default.aspx	-
Indiana DOH	http://www.in.gov/isdh/24859.htm	C-WA-01
ISO 17025	http://www.pjlabs.com/	L12-27
Louisiana DEQ	http://www.deq.louisiana.gov/portal/DIVISIONS/PublicParticipationandPermitSupport/LouisianaLaboratoryAccreditationProgram.aspx	3016
Maine DHS	Not available	WA0035
Michigan DEQ	http://www.michigan.gov/deq/0,1607,7-135-3307_4131_4156---,00.html	9949
Minnesota DOH	http://www.health.state.mn.us/accreditation	053-999-368
Montana DPHHS	http://www.dphhs.mt.gov/publichealth/	CERT0047
Nevada DEP	http://ndep.nv.gov/bsdw/labservice.htm	WA35
New Jersey DEP	http://www.nj.gov/dep/oqa/	WA005
North Carolina DWQ	http://www.dwqlab.org/	605
Oklahoma DEQ	http://www.deq.state.ok.us/CSDnew/labcert.htm	9801
Oregon – DEQ (NELAP)	http://public.health.oregon.gov/LaboratoryServices/EnvironmentalLaboratoryAccreditation/Pages/index.aspx	WA200001
South Carolina DHEC	http://www.scdhec.gov/environment/envserv/	61002
Texas CEQ	http://www.tceq.texas.gov/field/qa/env_lab_accreditation.html	4704427-08-TX
Washington DOE	http://www.ecy.wa.gov/programs/eap/labs/lab-accreditation.html	C1203
Wisconsin DNR	http://dnr.wi.gov/	998386840
Wyoming (EPA Region 8)	http://www.epa.gov/region8/water/dwhome/wyomingdi.html	-
Kelso Laboratory Website	www.alsglobal.com	NA

Analyses were performed according to our laboratory's NELAP-approved quality assurance program. A complete listing of specific NELAP-certified analytes, can be found in the certification section at www.caslab.com or at the accreditation bodies web site

Please refer to the certification and/or accreditation body's web site if samples are submitted for compliance purposes. The states highlighted above, require the analysis be listed on the state certification if used for compliance purposes and if the method/anlayte is offered by that state.

ALS ENVIRONMENTAL

Client:	Golder Associates, Incorporated	**Service Request No.:**	K1312215
Project:	Port Gamble Upland Loss/1300649	**Date Received:**	11/01/13
Sample Matrix:	Water		

Case Narrative

All analyses were performed consistent with the quality assurance program of ALS Environmental. This report contains analytical results for samples designated for Tier II data deliverables. When appropriate to the method, method blank results have been reported with each analytical test. Additional quality control analyses reported herein include: Laboratory Duplicate (DUP), Matrix Spike (MS), and Laboratory Control Sample (LCS).

Sample Receipt

Eight water samples were received for analysis at ALS Environmental on 11/01/13. The samples were received in good condition and consistent with the accompanying chain of custody form. The samples were stored in a refrigerator at 4ºC upon receipt at the laboratory.

General Chemistry Parameters

Ammonia as Nitrogen by Standard Method 4500-NH3 E:
The Relative Percent Difference (RPD) criterion for the replicate analysis in sample P-1 was 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.

Sample notes
Samples preserved with nitric acid instead of sulfuric acid were analyzed for ammonia with no apparent adverse affects.

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

Approved by_____

ALS Environmental

CHAIN OF CUSTODY

K1312215 SR# ~~K1311575~~

1317 South 13th Ave . Kelso, WA 98626 | 360.577.7222 | 800.695.7222 | 360.636.1068 (fax)

PAGE 1 OF 1 COC#

PROJECT NAME: Port Gamble Uplands LOSS
PROJECT NUMBER: 1300649
PROJECT MANAGER: Chris Pitre
COMPANY NAME: Golder Associates
ADDRESS: 9 Monroe Pkwy Ste 220
CITY/STATE/ZIP: Lake Oswego, OR
E-MAIL ADDRESS: ~~Contact~~ jgerst@golder.com
PHONE #: 503-397-1721 FAX:
SAMPLER'S SIGNATURE:

SAMPLE I.D.	DATE	TIME	LAB I.D.	MATRIX	NUMBER OF CONTAINERS	Semivolatile Organics by GC/MS 625☐ 8270☐ 8270LL☐ SIM PAH☐	Volatile Organics 624☐ 8260☐ 8021☐ BTEX☐	Hydrocarbons (*see below) Gas☐ Diesel☐ Oil☐	Oil & Grease/TRPH 1664 HEM☐ 1664 SGT☐	PCBs Aroclors☐ Congeners☐	Pesticides/Herbicides 608☐ 8081☐ 8141☐ 8151☐	Chlorophenolics - 8151M Tri☐ Tetra☐ PCP☐	Metals, Total & Dissolved (See List below)	Cyanide☐	Hex. Chrom☐ (circle) DH, Cond, TOC, TSS, TDS, Turb, PO_4	(circle) NH_3-N, COD, TKN, TOC, DOC, NO_2+NO_3, T-Phos	TOX 9020☐ AOX 1650☐ 506☐	Alkalinity☐ CO_3☐ HCO_3☐	Dioxins/Furans 1613☐ 8290☐	Dissolved Gases RSK 175☐ Methane☐ Ethane☐ Ethene☐ CO_2☐	Ammonia added on 11-7-13 ttz	REMARKS
P-1	10/31	0930		GW	2								✓		✓							X		
P-2	10/30	1306		GW	2								✓		✓							X		
P-3	10/30	1500		GW	2								✓		✓							X		
P-4	10/30	1710		GW	2								✓		✓							X		
MW-4	10/31	1455		GW	2								✓		✓							X		
MW-5	10/30	1810		GW	2								✓		✓							X		
MW-6	10/31	10:34		GW	2								✓		✓							X		
MW-7	10/31	1340		GW	2								✓		✓							X		

REPORT REQUIREMENTS

- ✓ I. Routine Report: Method Blank, Surrogate, as required
- ___ II. Report Dup., MS, MSD as required
- ___ III. CLP Like Summary (no raw data)
- ✓ IV. Data Validation Report
- ✓ V. EDD

INVOICE INFORMATION

P.O. # 1300649
Bill To: Golder

TURNAROUND REQUIREMENTS

___ 24 hr. ___ 48 hr
✓ 5 day 3 is better
___ Standard (15 working days)
___ Provide FAX Results

Requested Report Date

Circle which metals are to be analyzed:

Total 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

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

*INDICATE STATE HYDROCARBON PROCEDURE: AK CA WI NORTHWEST OTHER: ___ (CIRCLE ONE)

SPECIAL INSTRUCTIONS/COMMENTS:

Analyze per correspondence w/ H. Holmes

☐ Sample Shipment contains USDA regulated soil samples (check box if applicable)

RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY:	RECEIVED BY:
Signature: [signature]	Signature: [signature]	Signature:	Signature:
Date/Time: 10/31 8:08PM	Date/Time: ~~10/~~ 11/1/13 0900	Date/Time:	Date/Time:
Printed Name: Jonathan Gerst	Printed Name: Les Kennedy	Printed Name:	Printed Name:
Firm: Golder	Firm: ALS	Firm:	Firm:

PC 42

Cooler Receipt and Preservation Form K1312215

Client / Project: Golder Associates Service Request ~~K13~~ 1312215

Received: 10/31/13 Opened: 11/1/13 By: MM Unloaded: 11/1/13 By: MM

1. Samples were received via? *Mail* *Fed Ex* *UPS* *DHL* *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

Raw Cooler Temp	Corrected Cooler Temp	Raw Temp Blank	Corrected Temp Blank	Corr. Factor	Thermometer ID	Cooler/COC ID (NA)	Tracking Number (NA)	Filed
4.1	4.1	1.5	1.5	0	333			

4. Packing material: *Inserts* *Baggies* *Bubble Wrap* *Gel Packs* (*Wet Ice*) *Dry Ice* *Sleeves*_____
5. Were custody papers properly filled out (ink, signed, etc.)? NA (Y) N
6. Did all bottles arrive in good condition (unbroken)? *Indicate in the table below.* NA (Y) N
7. Were all sample labels complete (i.e analysis, preservation, etc.)? NA (Y) N
8. Did all sample labels and tags agree with custody papers? *Indicate major discrepancies in the table on page 2.* NA (Y) N
9. Were appropriate bottles/containers and volumes received for the tests indicated? NA (Y) N
10. Were the pH-preserved bottles (*see SMO GEN SOP*) received at the appropriate pH? *Indicate in the table below* NA (Y) N
11. Were VOA vials received without headspace? *Indicate in the table below.* (NA) Y N
12. Was C12/Res negative? (NA) Y N

Sample ID on Bottle	Sample ID on COC	Identified by:

Sample ID	Bottle Count Bottle Type	Out of Temp	Head-space	Broke	pH	Reagent	Volume added	Reagent Lot Number	Initials	Time
						SHORT HOLD TIME				

*Notes, Discrepancies, & Resolutions:*_____

ALS Group USA, Corp.
dba ALS Environmental

Analytical Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1312215
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/1/13
Analysis Method:	SM 4500-NH3 E	**Units:**	mg/L
Prep Method:	SM 4500-NH3B	**Basis:**	NA

Ammonia as Nitrogen

Sample Name	Lab Code	Result	MRL	MDL	Dil.	Date Analyzed	Date Extracted	Q
P-1	K1312215-001	**0.143**	0.063	-	1.25	11/11/13 12:30	11/11/13	
P-2	K1312215-002	**0.086**	0.063	-	1.25	11/11/13 12:30	11/11/13	
P-3	K1312215-003	**0.076**	0.063	-	1.25	11/11/13 12:30	11/11/13	
P-4	K1312215-004	**0.069**	0.063	-	1.25	11/11/13 12:30	11/11/13	
MW-4	K1312215-005	**0.105**	0.063	-	1.25	11/11/13 12:30	11/11/13	
MW-5	K1312215-006	**0.196**	0.063	-	1.25	11/11/13 12:30	11/11/13	
MW-6	K1312215-007	**0.181**	0.063	-	1.25	11/11/13 12:30	11/11/13	
MW-7	K1312215-008	**0.085**	0.063	-	1.25	11/11/13 12:30	11/11/13	
Method Blank	K1312215-MB	ND U	0.063	-	1.25	11/11/13 12:30	11/11/13	

ALS Group USA, Corp.

dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1312215
Project	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/11/13

Replicate Sample Summary
General Chemistry Parameters

Sample Name:	P-1	**Units:**	mg/L
Lab Code:	K1312215-001	**Basis:**	NA

Analyte Name	Analysis Method	MRL	MDL	Sample Result	Duplicate Sample K1312215-001DUP Result	Average	RPD	RPD Limit
Ammonia as Nitrogen	SM 4500-NH3 E	0.063	-	0.143	0.201	0.172	34 *	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1312215
Project:	Port Gamble Upland Loss/1300649	**Date Collected:**	10/31/13
Sample Matrix:	Water	**Date Received:**	11/01/13
		Date Analyzed:	11/11/13
		Date Extracted:	11/11/13

Duplicate Matrix Spike Summary
Ammonia as Nitrogen

Sample Name:	P-1	**Units:**	mg/L
Lab Code:	K1312215-001	**Basis:**	NA
Analysis Method:	SM 4500-NH3 E		
Prep Method:	SM 4500-NH3B		

		Matrix Spike K1312215-001MS			Duplicate Matrix Spike K1312215-001DMS					
Analyte Name	**Sample Result**	**Result**	**Spike Amount**	**% Rec**	**Result**	**Spike Amount**	**% Rec**	**% Rec Limits**	**RPD**	**RPD Limit**
Ammonia as Nitrogen	0.143	10.9	10.0	108	11.0	10.0	108	75-125	<1	20

Results flagged with an asterisk (*) indicate values outside control criteria.

Results flagged with a pound (#) indicate the control criteria is not applicable.

Percent recoveries and relative percent differences (RPD) are determined by the software using values in the calculation which have not been rounded.

ALS Group USA, Corp.
dba ALS Environmental

QA/QC Report

Client:	Golder Associates, Incorporated	**Service Request:**	K1312215
Project:	Port Gamble Upland Loss/1300649	**Date Analyzed:**	11/11/13
Sample Matrix:	Water	**Date Extracted:**	11/11/13

Lab Control Sample Summary
Ammonia as Nitrogen

Analysis Method:	SM 4500-NH3 E	**Units:**	mg/L
Prep Method:	SM 4500-NH3B	**Basis:**	NA
		Analysis Lot:	367821

Sample Name	Lab Code	Result	Spike Amount	% Rec	% Rec Limits
Lab Control Sample	K1312215-LCS	10.0	9.56	105	85-115

OnSite Environmental Inc.

14648 NE 95th Street, Redmond, WA 98052 • (425) 883-3881

December 10, 2013

Chris Pitre
Golder Associates Inc.
18300 NE Union Hill Road
Suite 200
Redmond, WA 98052-3333

Re: Analytical Data for Project 1300649-007
Laboratory Reference No. 1311-222

Dear Chris:

Enclosed are the analytical results and associated quality control data for samples submitted on November 27, 2013.

The standard policy of OnSite Environmental, Inc. is to store your samples for 30 days from the date of receipt. If you require longer storage, please contact the laboratory.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning the data, or need additional information, please feel free to call me.

Sincerely,

David Baumeister
Project Manager

Enclosures

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

Case Narrative

Samples were collected on November 26, 2013 and received by the laboratory on November 27, 2013. They were maintained at the laboratory at a temperature of 2°C to 6°C.

General QA/QC issues associated with the analytical data enclosed in this laboratory report will be indicated with a reference to a comment or explanation on the Data Qualifier page. More complex and involved QA/QC issues will be discussed in detail below.

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

DISSOLVED METALS
EPA 6010C

Matrix: Water
Units: ug/L (ppb)

Analyte	Result	PQL	EPA Method	Date Prepared	Date Analyzed	Flags
Lab ID:	11-222-01					
Client ID:	**Pitman Well**					
Calcium	**12000**	1100	6010C		12-2-13	
Iron	**ND**	56	6010C		12-2-13	
Magnesium	**12000**	1100	6010C		12-2-13	
Manganese	**23**	11	6010C		12-2-13	
Potassium	**1700**	1100	6010C		12-2-13	
Sodium	**5200**	1100	6010C		12-2-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

DISSOLVED METALS
EPA 6010C
METHOD BLANK QUALITY CONTROL

Date Analyzed: 12-2-13

Matrix: Water
Units: ug/L (ppb)

Lab ID: MB1202D1

Analyte	Method	Result	PQL
Calcium	6010C	**ND**	1100
Iron	6010C	**ND**	56
Magnesium	6010C	**ND**	1100
Manganese	6010C	**ND**	11
Potassium	6010C	**ND**	1100
Sodium	6010C	**ND**	1100

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

DISSOLVED METALS
EPA 6010C
DUPLICATE QUALITY CONTROL

Date Analyzed: 12-2-13

Matrix: Water
Units: ug/L (ppb)

Lab ID: 11-200-01

Analyte	Sample Result	Duplicate Result	RPD	PQL	Flags
Calcium	**25900.0**	**25900**	0	1100	
Iron	**ND**	**ND**	NA	56	
Magnesium	**11000.0**	**11000**	0	1100	
Manganese	**ND**	**ND**	NA	11	
Potassium	**1580.0**	**1480**	6	1100	
Sodium	**2100.0**	**2090**	0	1100	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

DISSOLVED METALS
EPA 6010C
MS/MSD QUALITY CONTROL

Date Analyzed: 12-2-13

Matrix: Water
Units: ug/L (ppb)

Lab ID: 11-200-01

Analyte	Spike Level	MS	Percent Recovery	MSD	Percent Recovery	RPD	Flags
Calcium	22200	**44900**	86	**45300**	87	1	
Iron	22200	**20400**	92	**20200**	91	1	
Magnesium	22200	**31200**	91	**31200**	91	0	
Manganese	1110	**1150**	104	**1160**	104	1	
Potassium	22200	**22400**	94	**22400**	94	0	
Sodium	22200	**21700**	88	**21500**	87	1	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

NITRATE (as Nitrogen)
EPA 353.2

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**Pitman Well**					
Laboratory ID:	11-222-01					
Nitrate	**0.13**	0.050	EPA 353.2	12-2-13	12-2-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

NITRATE (as Nitrogen)
EPA 353.2
QUALITY CONTROL

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB1202W1					
Nitrate	**ND**	0.050	EPA 353.2	12-2-13	12-2-13	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	11-222-01								
	ORIG	DUP							
Nitrate	**0.134**	**0.126**	NA	NA	NA	NA	6	16	
MATRIX SPIKE									
Laboratory ID:	11-222-01								
	MS		MS		MS				
Nitrate	**2.26**		2.00	0.134	106	84-119	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB1202W1								
	SB		SB		SB				
Nitrate	**2.10**		2.00	NA	105	86-114	NA	NA	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

AMMONIA (as Nitrogen)
SM 4500-NH_3 D

Matrix: Water
Units: mg NH3-N/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**Pitman Well**					
Laboratory ID:	11-222-01					
Ammonia	**ND**	0.050	SM 4500-NH3 D	12-3-13	12-3-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

AMMONIA (as Nitrogen)
SM 4500-NH_3 D
QUALITY CONTROL

Matrix: Water
Units: mg NH3-N/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB1203W1					
Ammonia	**ND**	0.050	SM 4500-NH3 D	12-3-13	12-3-13	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	11-175-01								
	ORIG	DUP							
Ammonia	**ND**	**ND**	NA	NA	NA	NA	NA	11	
MATRIX SPIKE									
Laboratory ID:	11-175-01								
	MS		MS		MS				
Ammonia	**4.47**		5.00	ND	89	83-100	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB1203W1								
	SB		SB		SB				
Ammonia	**4.53**		5.00	NA	91	86-99	NA	NA	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

SULFATE
ASTM D516-07

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**Pitman Well**					
Laboratory ID:	11-222-01					
Sulfate	**19**	5.0	ASTM D516-07	12-5-13	12-5-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

SULFATE
ASTM D516-07
QUALITY CONTROL

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB1205W1					
Sulfate	**ND**	5.0	ASTM D516-07	12-5-13	12-5-13	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	11-218-01								
	ORIG	DUP							
Sulfate	**84.3**	**91.6**	NA	NA	NA	NA	8	10	
MATRIX SPIKE									
Laboratory ID:	11-218-01								
	MS		MS		MS				
Sulfate	**186**		100	84.3	102	82-123	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB1205W1								
	SB		SB		SB				
Sulfate	**9.79**		10.0	NA	98	91-114	NA	NA	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

CONDUCTIVITY
EPA 120.1

Matrix: Water
Units: Micro-mho

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**Pitman Well**					
Laboratory ID:	11-222-01					
Conductivity	**200**	2.0	EPA 120.1	11-27-13	11-27-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

CONDUCTIVITY
EPA 120.1
QUALITY CONTROL

Matrix: Water
Units: Micro-mho

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	11-222-01								
	ORIG	DUP							
Conductivity	**195**	**195**	NA	NA	NA	NA	0		

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

CHLORIDE
SM 4500-Cl E

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
Client ID:	**Pitman Well**					
Laboratory ID:	11-222-01					
Chloride	**5.4**	2.0	SM 4500-Cl E	12-5-13	12-5-13	

Date of Report: December 10, 2013
Samples Submitted: November 27, 2013
Laboratory Reference: 1311-222
Project: 1300649-007

CHLORIDE
SM 4500-Cl E
QUALITY CONTROL

Matrix: Water
Units: mg/L

Analyte	Result	PQL	Method	Date Prepared	Date Analyzed	Flags
METHOD BLANK						
Laboratory ID:	MB1205W1					
Chloride	**ND**	2.0	SM 4500-Cl E	12-5-13	12-5-13	

Analyte	Result		Spike Level	Source Result	Percent Recovery	Recovery Limits	RPD	RPD Limit	Flags
DUPLICATE									
Laboratory ID:	11-222-01								
	ORIG	DUP							
Chloride	**5.40**	**5.09**	NA	NA	NA	NA	6	11	
MATRIX SPIKE									
Laboratory ID:	11-222-01								
	MS		MS		MS				
Chloride	**58.9**		50.0	5.40	107	94-126	NA	NA	
SPIKE BLANK									
Laboratory ID:	SB1205W1								
	SB		SB		SB				
Chloride	**52.0**		50.0	NA	104	94-124	NA	NA	

OnSite Environmental Inc.

Data Qualifiers and Abbreviations

A - Due to a high sample concentration, the amount spiked is insufficient for meaningful MS/MSD recovery data.

B - The analyte indicated was also found in the blank sample.

C - The duplicate RPD is outside control limits due to high result variability when analyte concentrations are within five times the quantitation limit.

E - The value reported exceeds the quantitation range and is an estimate.

F - Surrogate recovery data is not available due to the high concentration of coeluting target compounds.

H - The analyte indicated is a common laboratory solvent and may have been introduced during sample preparation, and be impacting the sample result.

I - Compound recovery is outside of the control limits.

J - The value reported was below the practical quantitation limit. The value is an estimate.

K - Sample duplicate RPD is outside control limits due to sample inhomogeneity. The sample was re-extracted and re-analyzed with similar results.

L - The RPD is outside of the control limits.

M - Hydrocarbons in the gasoline range are impacting the diesel range result.

M1 - Hydrocarbons in the gasoline range (toluene-napthalene) are present in the sample.

N - Hydrocarbons in the lube oil range are impacting the diesel range result.

N1 - Hydrocarbons in diesel range are impacting lube oil range results.

O - Hydrocarbons indicative of heavier fuels are present in the sample and are impacting the gasoline result.

P - The RPD of the detected concentrations between the two columns is greater than 40.

Q - Surrogate recovery is outside of the control limits.

S - Surrogate recovery data is not available due to the necessary dilution of the sample.

T - The sample chromatogram is not similar to a typical _____.

U - The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

U1 - The practical quantitation limit is elevated due to interferences present in the sample.

V - Matrix Spike/Matrix Spike Duplicate recoveries are outside control limits due to matrix effects.

W - Matrix Spike/Matrix Spike Duplicate RPD are outside control limits due to matrix effects.

X - Sample extract treated with a mercury cleanup procedure.

X1- Sample extract treated with a Sulfuric acid/Silica gel cleanup procedure.

Y - The calibration verification for this analyte exceeded the 20% drift specified in method 8260C, and therefore the reported result should be considered an estimate. The overall performance of the calibration verification standard met the acceptance criteria of the method.

Z -

ND - Not Detected at PQL
PQL - Practical Quantitation Limit
RPD - Relative Percent Difference

Chain of Custody

Page 1 of 1

OnSite Environmental Inc.
Analytical Laboratory Testing Services
14648 NE 95th Street • Redmond, WA 98052
Phone: (425) 883-3881 • www.onsite-env.com

Company: Golder
Project Number: 1300649-007
Project Name: Port Gamble LOSS
Project Manager: Chris Pitre
Sampled by: A. Austreng

Turnaround Request (in working days)

(Check One)

- ☐ Same Day
- ☐ 1 Day
- ☐ 2 Days
- ☐ 3 Days
- ☒ Standard (7 Days) (TPH analysis 5 Days)
- ☐ _____ (other)

Laboratory Number: 11-222

Lab ID	Sample Identification	Date Sampled	Time Sampled	Matrix	Number of Containers	NWTPH-HCID	NWTPH-Gx/BTEX	NWTPH-Gx	NWTPH-Dx	Volatiles 8260C	Halogenated Volatiles 8260C	Semivolatiles 8270D/SIM (with low-level PAHs)	PAHs 8270D/SIM (low-level)	PCBs 8082A	Organochlorine Pesticides 8081B	Organophosphorus Pesticides 8270D/SIM	Chlorinated Acid Herbicides 8151A	Total RCRA Metals/ MTCA Metals (circle one)	TCLP Metals	HEM (oil and grease) 1664A	Dissolved Metals (see comments)	Nitrate as N	Ammonia as N	Sulfate	Specific Conductance		% Moisture
1	Pitman Well	11/26/13	1310	H_2O	4																X	X	X	X	X		

	Signature	Company	Date	Time
Relinquished		Golder	11/27/13	0920
Received		COE	11/27/13	0920
Relinquished				
Received				
Relinquished				
Received				

Comments/Special Instructions

- Bottle w/ HNO_3 preservative is field-filtered. Please analyze for the following:
Na, K, Ca, Mg, Fe, Mn, Cl

Reviewed/Date

Reviewed/Date

Chromatograms with final report ☐

Data Package: Level III ☐ Level IV ☐

Electronic Data Deliverables (EDDs) ☐ _____

Established in 1960, Golder Associates is a global, employee-owned organization that helps clients find sustainable solutions to the challenges of finite resources, energy and water supply and management, waste management, urbanization, and climate change. We provide a wide range of independent consulting, design, and construction services in our specialist areas of earth, environment, and energy. By building strong relationships and meeting the needs of clients, our people have created one of the most trusted professional services organizations in the world.

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Golder Associates

Engineering Earth's Development, Preserving Earth's Integrity

GeoEngineers

1101 South Fawcett Avenue, Suite 200, Tacoma, Washington 98402, Telephone: 253.383.4940 www.geoengineers.com

Memorandum

To:	Sue Allison/Olympic Property Group I, LLC
From:	Fiona McNair and Lisa Berntsen
Date:	February 28, 2014
File:	2378-044-03
Subject:	REVISED - Evaluation of Impacts to Water Quantity on Wetlands Port Gamble Large On-Site Sewage System Port Gamble, Washington

GeoEngineers, Inc. (GeoEngineers) has read and reviewed the Port Gamble Upland Large On-Site Sewage System (LOSS) report prepared by Golder Associates (2014) for Olympic Property Group (OPG) and corresponded with Al Fure of Triad and others of the design team multiple times about the alternatives and revised treatment scenarios. The question currently posed to GeoEngineers has to do with the potential impact of added effluent volume on wetlands and streams north, east and south of the proposed LOSS. This is based upon siting the LOSS in the proposed footprint bordering the western property boundary and treating the effluent prior to its reaching the drainfield to protect an off-site drinking water well and on-site wetlands and streams. Much of this is described in the Golder report (2014).

Currently, the existing Port Gamble wastewater treatment plant discharges treated effluent into Hood Canal, which has caused water quality problems in the past, including shellfish closures (Golder, 2014). The proposed LOSS will receive effluent from the redeveloped area, and the treatment plant discharge will be decommissioned, thus eliminating potential water quality impacts to Hood Canal from the wastewater treatment plant discharges.

Septic system effluent treated to meet Washington State Department of Health standards will enter the environment through perforated pipes within the drainfield. The primary pollutants of concern in septic tanks are metals, polycyclic aromatic hydrocarbons (PAHs), nutrients (e.g., nitrogen and phosphorus) and microbes/pathogens. The effluent from the septic system will be treated for nutrients prior to it being released to the drainfield. The focus of this memo is the potential for impacts of increased effluent volume on the adjacent wetlands and streams.

The LOSS configuration as identified in the Site Risk Survey and Hydrogeologic Report describes a flow of effluent from the northern quadrant of the system in a 'radial' pattern with the majority of the new effluent flowing to the north and east. The three wetlands (D, G and H) immediately east of the LOSS footprint location are approximately 600 feet from the edge of the drainfield and are at, or immediately below, the groundwater level (approximately 195 to 210 feet) where seeps emerge from the slope. A seep north and east of the LOSS footprint location flows at a rate of 45 gallons per minute (gpm) (0.01 cubic feet per second [cfs]). Much of this flow is captured by Stream 3 located immediately northeast of this seep (GeoEngineers, 2013). Another seep, identified within Wetland D has a flow measured at 2 to 3 gpm (Golder, 2014). Based on calculations made for the LOSS footprint location, flows along the eastern boundary are anticipated to be 35 gpm extending across an aquifer width of 2,000 feet for an average flow rate of 0.02 gpm per linear foot of aquifer (Golder, 2014).

FLOW ATTENUATION BY ADJACENT WETLANDS, STREAMS AND RIPARIAN AREAS

Impacts from Increased Flow Rates/Hydrology Impacts

As described in the Golder (2014) report the closest distance of the LOSS to wetlands and streams is 600 feet to the east. Based on calculations made for the LOSS footprint location, flows along the eastern boundary are anticipated to be 35 gpm extending across an aquifer width of 2,000 feet for an average flow rate of 0.02 gpm per linear foot of aquifer (Golder, 2014). Recall, that under the radial flow not all the LOSS volume will be directed to the east. Some volume will flow north and west. Under current conditions, a seep along the eastern slope flows into Wetland D at a rate of 2 to 3 gpm (Golder, 2014) and groundwater surfaces at numerous locations along the eastern slope at lower flow rates than the seep into Wetland D. Flow rates of these seeps have not been measured; however, based on field observations it is assumed these seeps flow at approximately 25 to 50 percent of the Wetland D seep (e.g., 0.5 to 1.5 gpm), then an increase in flow of 0.02 gpm per linear foot of aquifer would represent an increase in flow rate of 0.06 to 4 percent across the eastern slope. This increase in water supply to the adjacent wetlands and streams is not anticipated to result in negative impacts both because the increase would be relatively small and the increase would be spread across a large area and the adjacent landscape is extensive, and undeveloped. The increase in hydrologic inputs may cause a small expansion of adjacent wetlands (spatially) and would likely result in a minor increase in the frequency and duration of saturation and/or inundation. The seep northeast of the LOSS footprint flowing at a rate of 45 gpm would experience a 0.05 percent increase in flow, which is an insignificant amount especially considering that Stream 3 flows into adjacent wetlands, which absorb and moderate its flows. Within the project area and to the extent of the property line, wetland habitat was not identified, west of the LOSS. Therefore there will be no onsite hydrology impacts west of the LOSS.

CONCLUSIONS

Anticipated flows from the LOSS drainfield effluent are at a flow rate of 0.02 gpm per linear foot across the aquifer. Based on calculations made for the proposed LOSS footprint location, flows along the eastern boundary are anticipated to be 35 gpm extending across an aquifer width of 2,000 feet for an average flow rate of 0.02 gpm per linear foot of aquifer (Golder, 2014). Under current conditions, measured seeps north and east of the LOSS flows at rates of 2 to 3 gpm (Wetland D), 45 gpm (Stream 3) (Golder, 2014) and 0.5 to 1.5 gpm (assumed range of flows across the eastern slope). The anticipated increase in flow from the LOSS facility of 0.02 gpm per linear foot of aquifer, represents an increase of 0.05, 0.65, 1, 1.35, and 4 percent for the five seep rates listed above. This increase in supply of water to the adjacent wetlands and streams is not anticipated to result in negative impacts because the increase is relatively small and it would be spread across a large forested and undeveloped area. The increase in hydrologic inputs may cause minor increases in the frequency and duration of saturation and/or inundation and some expansion of adjacent wetlands. However, the minor increase in flow would not be anticipated to result in significant impacts.

LIMITATIONS

We have prepared this memorandum for Olympic Property Group for the proposed Port Gamble Property Large On-Site Sewage System. Olympic Property Group may distribute copies of this report to its contractors, authorized agents and regulatory agencies as may be required for the project.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of wetland science in this area at the time this report was prepared. The conclusions, recommendations and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty, express or implied, applies to our services and this report.

REFERENCES

Camargo, J.A. and Alonso, A. (2007), "Inorganic nitrogen pollution in aquatic ecosystems: causes and consequences." 2007, http://www.eoearth.org/view/article/153841.

Camargo, J.A. and Alonso, A. (2006), "Ecological and toxicological effects of inorganic nitrogen pollution in aquatic ecosystems: A global assessment," in Environment International 32, 2006, pp. 831–849.

GeoEngineers, Inc. (2013), Report to Pope Resources, "Wetland and Stream Delineation Report, Port Gamble Redevelopment Plan, Kitsap County, Washington," GEI File No. 2378-044-02, January 8, 2013.

Golder Associates, Inc. (2014), Report to Olympic Property Group I, LLC February 28, 2014. "Port Gamble Upland Loss Site Risk Survey and Hyrdrogeologic Report. Revised. DOH #2012-035."

FM:LAB:tt:lc