SW WELL 1A REPORT

THE CITY OF YELM SOUTHWEST WELL 1A DEVELOPMENT REPORT

Drilling, Well Construction and Testing

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EXECUTIVE SUMMARY

A new water well (SW Well 1A; Ecology Well Tag No. ALM 113) was constructed and tested in the Tahoma Terra area west of Yelm in Thurston County, Washington to evaluate the area as a potential new source for groundwater development. Testing has shown that Yelm has installed a very successful new water supply well capable of producing high quality water at yields two to three times greater than expected. Formation samples, water quality, and water level response during aquifer testing indicate that SW Well 1A is completed in the deeper portion of the regional aquifer system (the TQu unit), and development of the groundwater appears feasible.

This report describes results from the SW Well 1A drilling, well construction, and testing program. The major conclusions and recommendations are summarized in the sections below.

Well Construction

The drilling and testing program for SW Well 1A began in April 2010 and was completed in October 2010. The well is located in SE¼, SE¼, Section 23, T17N, R1E W.M. Well construction information is summarized below:

- Well casing diameter and depth: 12-inch to 367.5 feet below ground surface (ft bgs);
- Well depth: 633 ft bgs;
- Well seal diameter and depth: 16-inch to 327.7 ft bgs;
- Well screen assembly: An 8-inch pipe-size screen assembly extends from 349 to 633 ft bgs. The top of the screen assembly consists of 20-ft of 8-inch blank steel riser pipe, which includes a 5-ft pressure relief screen (from 352 to 357 ft bgs) that is positioned within the 12-inch production casing. The screen assembly consists of three screened sections placed in the intervals 369 to 437 ft bgs, 487 to 547 ft bgs, and 611 to 625 ft bgs. The screen sections are separated by 8-inch blank steel pipe. The bottom of the screen assembly includes 8-ft of an 8-inch steel casing tailpipe from 633 to 625 ft bgs;
- Well screen: 8-inch diameter pipe-size, stainless steel, “V-wire” wrap, 35-slot (0.035-inch slot size) Johnson well screen;
- Filter pack: 10-20 Colorado silica sand extending from 353 to 633 ft bgs;
- Screen design capacity: 2,700 gpm;
- Static water level: 102.5 ft bgs; and
- Aquifer source: Confined, unconsolidated and undifferentiated deposits of the TQu unit.

Aquifer Testing

The aquifer testing program at SW Well 1A included step-rate and constant-rate aquifer tests. A step-rate test was conducted at pumping rates of 750, 1,300 and 1,800 gpm. Total drawdown of approximately 29.1, 49.6, and 68.2 feet were observed, equating to short-term specific capacity values of 25.8, 26.2, and

26.4 gpm/ft, respectively. The slight increases in specific capacity suggest that the well continued to develop during testing.

A constant-rate aquifer test including baseline and recovery monitoring was conducted over a 14 day period from September 29 to October 13, 2010. The pumping portion of the aquifer test was conducted at a constant pumping rate of 2,100 gallons per minute for a period of nearly 73 hours, which resulted in a maximum drawdown of approximately 82.3 feet. The specific capacity at the end of the test was 25.5 gpm/ft. The efficiency of SW Well 1A is estimated at 93 percent.

The water level in SW Well 1A post-pumping was projected to recover to pre-test water levels (i.e., water level recovery trends toward zero residual drawdown at $t/t' = 1$). The recovery response curve indicates that recovery was affected by a linear negative aquifer boundary condition. The presence of the boundary was not apparent on either the specific capacity or pumping response curves and does not appear to have accelerated drawdown in or limited flow to the well during pumping. The aquifer's hydraulic response to pumping indicates a well confined aquifer with no apparent evidence of leakance.

Transmissivity estimates of the TQu in the vicinity of SW Well 1A ranged between 42,400 and 58,900 gpd/ft. The geometric mean transmissivity equated to 47,827 gpd/ft. Storativity was estimated to be 2.0×10^{-4}, consistent with typical confined aquifer coefficients.

An observation well network consisting of 10 private domestic wells, municipal test wells, and piezometers were monitored (in addition to SW Well 1A) as part of the testing program. No hydraulic response to pumping SW Well 1A was apparent in any of the observation wells monitored. Consequently, groundwater development from the SW Well 1A is not expected to result in significant impacts to existing groundwater users or nearby surface water features. Response to planned future pumping is evaluated in Yelm's Mitigation Plan to support water right permitting.

Water Quality

Groundwater from SW Well 1A was cold, clear, odorless, and was noted to have a slight metallic/mineral taste. Analytical results show that:

- No volatile organic compounds, synthetic organic compounds, herbicides, or hydrogen sulfide were detected;
- The only inorganic constituent having a concentration above its regulatory criteria was manganese. The manganese concentration of 0.15 mg/L is at a level three times the recommended secondary (aesthetic) limit of 0.05 mg/L. Although a manganese concentration at this level is likely to cause staining, it does not pose a risk to human health or the environment;
- The total coliform result of 2 MPN/100 mL suggests the presence of coliform bacteria (other than fecal coliform and *E. coli* because these were not detected). The sample was

collected before the well was disinfected and it is most likely that the result is due to a sampling circumstance or condition and is not representative of source water quality;

- Radon was detected at 234 pCi/L, below the proposed federal drinking water criteria of 300 pCi/L; and
- The chemical signature of groundwater from SW Well 1A is most consistent with groundwater from the deeper, regional TQu flow regime.

Recommendations

Based on the results of the drilling and testing program at SW Well 1A, Golder recommends the following:

- As part of the finished design, the well should be equipped with the following:
  - Two water level access pipes for long-term water level monitoring; and
  - A filter pack fill tube to allow placement of additional filter pack as it may settle over time.
- Static water levels, pumping rates, and pumping volumes should be monitored on a regular basis to track usage, seasonal water level fluctuations, and well performance;
- Based on a projected pumping water level of 186 ft bgs at a rate of 2,100 gpm, the pump intake should be set to a depth of 266 feet bgs;
- Repeat bacteriological samples should be collected as part of the source approval process to validate the coliform presence result;
- Track radon concentrations once the well is online for production to assess whether they change over time. Additionally, the City may consider integrating (or reserving space for) a radon treatment system as part of planned treatment facilities to avoid the addition of infrastructure after the facility has been constructed;
- Treatment would likely be required for manganese to maintain the delivered water aesthetic quality and prevent scaling in the City's piping and distribution system;
- Complete the conditions outlined in Thurston County Public Health and Social Services Department's Well Site Inspection Application Report (project # 2010100450) as part of the WAC 246-290 requirements for new drinking water source approval;
- Submit water system plans and specifications to the Washington State Department of Health Office of Drinking Water; and
- Complete and submit a SW Well 1A wellhead protection plan.

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1.0 INTRODUCTION

The City of Yelm (City) has constructed and tested a new water supply well (SW Well 1A; Well Tag No. ALM 113) to explore the potential of developing new groundwater sources from a portion of the aquifer system that would lessen the effects of pumping on local surface water features. Currently, the City's municipal water is supplied by two relatively shallow wells in downtown Yelm. Developing a groundwater supply from deeper portions of the aquifer system would allow the City to meet increasing demands for water while minimizing impacts of the withdrawals.

The City has drilled at tested three test wells in 1994 (North, South, and West Test Wells) and one test well in 2005 (SW Well 1). These wells identified a deep, permeable aquifer that appeared to be more regional in nature than the aquifer supporting the downtown wells. The City decided to drill and install a new test/production well to assess this deep aquifer supply closer to the City's existing infrastructure.

Well construction began in April 2010 and testing was completed in October 2010. The drilling and testing program described in this report was conducted in accordance with the Washington State Department of Ecology's preliminary drilling and testing permit and was designed to:

- Explore the potential for withdrawing water from a deeper supply source near Yelm;
- Characterize aquifer properties in the immediate vicinity of the test/production well;
- Evaluate potential production capacity;
- Assess potential impacts to existing groundwater users and surface water bodies; and
- Characterize water quality of the targeted supply source.

1.1 Site Location

SW Well 1A is located in the Tahoma Terra area west of downtown Yelm in Thurston County, Washington. The site is located in SE¼, SE¼, Section 23, T17N, R1E W.M. (Figure 1). The ground surface elevation is approximately 381 ft above the National Geodetic Vertical Datum of 1929 (ft NGVD29). The well is located near Thompson Creek, which is tributary to the Nisqually River.

2.0 HYDROGEOLOGIC SETTING

The Yelm area is situated in the south-central portion of the Puget Sound Lowland. The Puget Sound Lowland is a north-south-oriented basin that has experienced repeated deposition, erosion and reworking of geologic sediments during glacial and interglacial periods. The repeated glacial advances and retreats covered the area with layered, unconsolidated glacial and non-glacial deposits. The most recent glacial advance into the Yelm area took place approximately 13,500 to 15,000 years ago and is known as the Vashon Stade of the Fraser Glaciation.

Extensive geologic studies of Thurston County and the Yelm area were conducted by Mundorff et al. (1955), Wallace and Molenaar (1961) and Noble and Wallace (1966), with more recent investigations conducted by Drost et al. (1998), Drost et al. (1999), and Robinson and Noble (2001). The glacial geohydrologic units known to exist within this area of Thurston County from the surface downward include:

- Recessional Outwash (Qvr);
- Till (Qvt);
- Advance Outwash (Qva);
- Kitsap Formation (Qf);
- Salmon Springs(?) Drift (Qc);
- Unconsolidated and undifferentiated deposits (TQu); and
- Bedrock (Tb).

The primary water-bearing units include the Qva, Qc, and TQu. The till (Qvt) and Kitsap Formation (Qf) units are typically composed of low-permeability, fine-grained sediments and act as confining layers for deeper groundwater flow systems. The TQu unit contains both aquifers and confining layers (Drost et al., 1999). A table summarizing the lithologic and hydrologic characteristics of each unit is presented in Table 1 (adapted from Drost et al., 1999). The hydrostratigraphic units (as interpreted from area well logs) are illustrated on geologic cross-sections shown on Figures 2 and 3 (cross-section locations, well locations, and area well logs are included in Appendix A; adapted from Golder, 2009). A brief description of each unit is provided in the subsections below.

2.1 Recessional Outwash (Qvr)

The recessional outwash deposits (Qvr) blanket most of Yelm east of the Thurston Highlands. The sediments were deposited by meltwater streams discharging from the glacier as it retreated from the Yelm area. With the exception of alluvial sands and gravels found along many of the local streams, the recessional outwash is the youngest geologic deposit in the study area. The Qvr sediments are composed primarily of sand and gravel. Area well logs indicate the thickness to range between 10 and 50

feet (Appendix A). The Qvr unit is generally too thin to support groundwater supply wells along the western margin of Yelm Prairie; most wells in the area are completed in the deeper, more transmissive Qva aquifer.

2.2 Till (Qvt)

An unsorted mixture of rock debris known as glacial till (Qvt) underlies the Qvr unit and confines groundwater in the deeper Qva. The till was picked up and transported by the glacier as it advanced into the area and was deposited over the Qva. The Qvt deposits are generally composed of a mixture of sands, gravels, cobbles, and boulders within a compacted matrix of silt and clay. Drillers commonly refer to these deposits as “hardpan”, “cemented”, or “clay boulder”. The Qvt unit is found at depth throughout the Yelm area and is exposed at the surface west of Yelm forming the eastern portion of the Thurston Highlands. The thickness generally ranges between 35 and 80 feet (Appendix A), and is known to exceed 100 feet in areas west and southwest of Yelm (Drost et al., 1999). The Qvt unit is considered a confining bed (i.e., aquitard) and its cemented conditions limit its water transmitting capacity.

2.3 Advance Outwash (Qva)

The advance outwash deposits (Qva) lie beneath and are confined by the overlying Qvt till. The Qva sediments were carried and deposited by meltwater streams discharging from the glacier as it advanced into the Yelm area. The Qva is a relatively permeable aquifer unit in the area consisting generally of gravel in a matrix of sand with some sand lenses. The Qva is widespread throughout the subsurface ranging in thickness between 15 and 85 ft (Appendix A), and is the primary source for domestic and municipal water supplies in the Yelm area.

2.4 Kitsap Formation (Qf)

The Kitsap Formation is a low-permeability, fine-grained confining layer that separates the overlying Qva unit from the deeper Qc and TQu units. The Qf unit is composed predominately of clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits and minor amounts of peat and wood. The Qf unit is extensive throughout the Yelm area and its thickness generally ranges between approximately 25 and 80 feet (Appendix A).

2.5 Salmon Springs(?) Drift

Below the Qf is the Salmon Springs(?) Drift unit (Qc). The Qc unit consists mainly of coarse-grained sand and gravel is characterized by its oxidized red or brown staining (i.e., iron-oxides). This unit is referred to as the Salmon Springs(?) Drift by Noble and Wallace (1966) because its stratigraphic relationships mapped in Thurston County are similar to the Salmon Springs Drift type-section mapped in Pierce County and north of Tacoma, WA. The Qc unit is extensive throughout the Yelm area and its thickness typically

ranges between 15 and 50 feet (Appendix A). Groundwater in the Qc is confined by the overlying Qf unit and is a supply source for some wells.

2.6 Unconsolidated and Undifferentiated Deposits (TQu)

Unconsolidated and undifferentiated deposits of the TQu underlie the Qc unit. The TQu consists of glacial and non-glacial sediments of clay, silt, sand, and gravel, and is known to consist of layers of fine-grained confining beds and coarse-grained aquifer units (Drost et al., 1999). The TQu is widespread throughout the region, but its thickness and groundwater development capacity is not well known. The TQu is the target aquifer for SW Well 1A

2.7 Bedrock (Tb)

The deepest geohydrologic unit in the Yelm area is the consolidated bedrock (Tb). The bedrock unit consists of sedimentary claystone, siltstone and sandstone and igneous bodies of andesite and basalt. The Tb unit is known to contain some water in fractures and joints, but is considered an unreliable source due to low yields and poor water quality (Drost et al., 1998).

2.8 Groundwater

Groundwater in the Yelm area is derived from two different flow systems: shallow and deep. The shallow groundwater system consists primarily of the advance outwash (Qva) deposits, whereas the deeper, regional groundwater system consists of the older glacial deposits identified as the Salmon Springs(?) Drift (Qc) and unconsolidated and undifferentiated deposits of the TQu. Studies conducted by Robinson and Noble (1995 and 2001) indicate that the groundwater elevation and flow direction of the deeper system are different from those in the shallow system beneath Yelm. Groundwater within the shallow system generally flows in a northerly direction across Yelm Prairie toward the Nisqually River, whereas groundwater in the deeper system moves northwest away from the Nisqually River toward Olympia, WA. The TQu unit was the target aquifer source for the SW Well 1A due to its depth, confined nature, and reduced potential for interference with shallow groundwater resources in the area.

3.0 WELL DRILLING, CONSTRUCTION AND COMPLETION

SW Well 1A was drilled and tested between April and October 2010 by the E&I Rotary group of Boart Longyear (Boart) of Sherwood, Oregon. Drill cuttings characterization and construction oversight was provided by Golder Associates Inc. (Golder). This section provides information on well construction and design.

3.1 Well Drilling

SW Well 1A was drilled to a depth of 800 feet below ground surface (ft bgs) using dual-rotary (air) drilling methods. The deepest production zone target by this well occurred at 629 ft bgs, so the lower section of the borehole was backfilled with neat cement in accordance with WAC 173-160 from 800 to 650 ft bgs. Pea gravel was placed from 650 to 633 ft bgs to form a base for the screen assembly. The final depth of the completed well is 633 ft.

The SW Well 1A borehole advanced through the glacial geohydrologic units described above. The hydrostratigraphy, hydrogeologic characteristics, and thicknesses observed at SW Well 1A are summarized below. The geologic log for SW Well 1A is provided in Appendix B:

- **Recessional Outwash (Qvr)** – The Qvr unit is present between the depths of 0 and 25 ft bgs and consisted mainly of sand and silt;
- **Till (Qvt)** – The Qvt unit consisted predominately of cemented, fine-to-coarse sand and gravel with silt and cobbles, and is approximately 145 ft thick (25 to 170 ft bgs);
- **Advance Outwash (Qva)** – The Qva unit is roughly 49 ft thick (170 to 219 ft bgs) and consisted mainly of sand with gravel and silt;
- **Kitsap Formation (Qf)** – The Qf unit consisted of both silt and clay with organics and fine-to-coarse sand with silt, gravel and cobbles, and is approximately 21 ft thick (219 and 240 ft bgs);
- **Salmon Springs(?) Drift (Qc)** – The Qc unit is roughly 60 ft thick (240 and 300 ft bgs) and consisted predominately of sand with gravel (stained reddish brown) and silt; and
- **Unconsolidated and undifferentiated deposits (TQu)** – SW Well 1A is completed within the coarse-grained, water-bearing layers of the TQu. The coarse-grained layers consisted predominately of fine-to-coarse sand with some gravel, while the fine-grained layers generally consist of silt and clay with some fine sand. The SW Well 1A borehole encountered relatively thick zones of heaving sand within the TQu. The TQu unit at SW Well 1A is at least 500 ft thick (from 300 ft bgs to the total explored drilling depth of 800 ft bgs). The total thickness however, remains unknown because bedrock was not encountered within the exploratory drilling depth.

3.2 Well Design

The well is completed with a 16-inch neat cement surface seal to a depth of 327.7 ft bgs, which extends approximately 27.7 ft into the TQu unit. Approximately 4.3 ft of 20-40 filter pack sand was placed below the seal to prevent downward migration of cement as it was placed. The well is cased with 12-inch steel production casing that extends from approximately 2 feet above ground surface (ft ags) to a depth of

367.5 ft bgs. Three water bearing zones were identified based on formation samples and air-lift tests conducted during drilling (a fourth water bearing zone was encountered below 650 ft bgs, but was not screened due to the presence of a strong hydrogen sulfide odor). Grain size distributions of the samples were used to design the appropriate filter pack gradation and well screen slot size. The geologic log, as-built diagram, and water well report for SW Well 1A are included in Appendix B.

An 8-inch pipe-size screen assembly extends from 349 to 633 ft bgs. The top of the screen assembly consists of 20-ft of 8-inch blank steel riser pipe, which includes a 5-ft pressure relief screen (from 352 to 357 ft bgs) that is positioned within the 12-inch production casing. The screen assembly consists of three screened sections. The screen sections were placed in the intervals 369 to 437 ft bgs, 487 to 547 ft bgs, and 611 to 625 ft bgs. Each screen section consists of 8-inch pipe-size stainless steel, "V-wire" wrap 35-slot (0.035-inch slot size) well screen. The screen sections are separated by 8-inch blank steel pipe. The bottom of the screen assembly includes 8-ft of an 8-inch steel casing tailpipe from 633 to 625 ft bgs. Steel bands were used as casing guides to centralize the screen assembly in the borehole. The centralizers were welded to the solid casing (blank) sections of the assembly at 120-degree spacing. The annular space between the screen assembly and production casing and borehole is filled with 10-20 Colorado silica sand filter pack. The filter pack extends from 353 to 633 ft bgs.

The design capacity of the well screen based on manufacturer specifications (transmitting capacity of 19 gpm/ft of screen at a recommended entrance velocity of 0.1 ft/sec) is approximately 2,700 gpm.

3.3 Well Development

Well development techniques included isolation surging with simultaneous air-lift pumping and application of a liquid polymer dispersant. Surging and airlifting were conducted initially to stabilize the filter pack as the sand was placed and the screen sections exposed. The surge tool was equipped with two, 7.5-inch rubber discs at each end (7-ft separation) to isolate separate screen sections during development. Sand production during development was monitored using an Imhoff cone and each screened interval was developed until the sand content was <5 mL sand per L water and turbidity values were <5 NTU.

After the initial development was complete and filter pack stabilized, a phosphate-free dispersant (Aqua-Clear®) was added to the well to break up fine-grained material from the producing formation and filter pack that may have been emplaced during drilling or construction. The dispersant was jetted into each screen section, allowed to sit overnight and removed using airlift pumping. After the dispersant was removed, the well was further developed using the isolation surge tool and simultaneous airlift pumping until the sand content was < 5 mL sand per L water, turbidity was <5 NTU and field water quality parameters stabilized.

3.4 Well Video

A video survey of SW Well 1A was conducted by Water Well Developing and Surveys of Umatilla, Oregon on September 17, 2010. The video was completed to ensure proper construction and completion of the well after it was installed and developed. Results of the survey confirmed that the:

- Production casing, casing welds, and well screen assembly were intact with no apparent defects in construction; and
- The well and screen assembly were constructed and positioned as designed.

3.5 Alignment and Plumbness Testing

Alignment and plumbness testing was conducted to assess whether the well was straight and plumb. An alignment test was conducted prior to screen installation by running a 40-ft cylindrical dummy (two well casing lengths) with 11.5-inch rings attached at each end throughout the entire length of the borehole. The dummy freely passed the entire length of the 633-ft borehole indicating the well was in alignment.

A plumbness test was conducted after installation of the screen assembly. The plumbness test was completed by deploying a 3 ft plummet with two 11.75-in outer diameter plates attached to each end. The plummet was positioned in the center of the casing and lowered at 10-ft intervals recording the displacement of the plummet from the center of the casing. The total displacement to the top of the screen assembly was 0.39 inches indicating the well is plumb and straight and within acceptable tolerance limits as specified by AWWA A100-06 standards (i.e., two-thirds the well's inside diameter per 100 feet). Results of the plumbness test are provided in Appendix B.

3.6 Well Disinfection

After aquifer testing was completed and the test pump removed, the well was disinfected in accordance with the requirements of WAC 173-160-331 and ANSI/AWWA C654 using Multi-Chlor (12.5% sodium hypochlorite). The well was disinfected by pumping a concentrated disinfection solution through a 3-inch pipe into the water bearing zones to provide a chlorine residual of approximately 50 mg/L. The sodium hypochlorite solution was agitated using airlift pumping to circulate the chlorinated water in the well. The chlorinated water was then pumped from the well until no residual chlorine was detected. The chlorinated water was neutralized with sodium sulfate prior to discharge to the onsite pond.

4.0 AQUIFER TESTING

The aquifer testing program at SW Well 1A included step-rate and constant-rate aquifer tests. A step-rate test was performed to evaluate well production and assess potential pumping rates for the constant-rate test. The constant-rate test was conducted to characterize local hydraulic properties of the TQu and assess potential hydraulic response at nearby wells and surface water features. This section describes the aquifer testing approach and results, including (1) test design and monitoring approach, (2) estimates of TQu hydraulic properties, (3) evaluations of well performance, production capacity, and well efficiency, and (4) observed hydraulic response in observation wells.

4.1 Approach

The aquifer testing program was conducted according to Ecology's superseding preliminary permit requirements to drill and test SW Well 1A and followed the recommended procedures outlined in Appendix E of the Washington State Department of Health (DOH) Water System Design Manual (DOH #331-123, 2001). Descriptions of the pumping system, discharge location, monitoring procedures, and observation well network are provided in the subsections below.

4.1.1 Pumping System

Boart installed a 7-stage Goulds 12FRHC turbine pump to conduct the aquifer tests. The test pump was powered by a 950 horsepower Cummins QSK23 engine. The engine was equipped with a variable speed drive, which controlled the rotational speed of the engine and the pumping rate from the well. The pumping rate from the well was also controlled by a gate valve at the wellhead.

The test pump was installed on an 8-inch pump column, and the intake was set at approximately 350 ft bgs. The outside diameter of the 7-stage bowl assembly was 11 inches. The remaining annular space between the bowl assembly and the 12-inch production casing was too small to accommodate a foot-valve and prevented its installation. Ecology was notified and waived the foot-valve requirement (Golder, 2010; Gallagher, M., Washington State Department of Ecology, personal communication, September 27, 2010). A check-valve was installed at the surface near the wellhead to prevent backflow from discharge piping.

The discharge rate for the pumping test was measured using a newly calibrated McCrometer flow meter with instantaneous flow rate indicator and volumetric totalizer. Meter calibration was verified in the field and adjusted to match flow rates measured simultaneously using an orifice weir.

Two PVC drop tubes were installed in the well to allow for the installation of a pressure transducer and to obtain manual water-level measurements.

4.1.2 Conveyance of Pumped Water

Water generated during aquifer testing was conveyed from the well through a 10-inch pipe to a natural, dry depression located approximately 4,200 feet southwest of the well (Figure 4). Because the well is sealed with neat cement to a depth of 327.7 ft bgs and completed in a confined aquifer, water discharged to the depression at this distance had little potential to recharge the production zone and hydraulically affect the results of the test, and no evidence of artificial recharge to the aquifer was observed in the test data (Section 4.3).

4.1.3 Water Level Monitoring

Water levels in each well were recorded using newly calibrated pressure transducers or manually using electronic water-level indicators. Manual water-level measurements were collected regularly at all wells to supplement and validate the high-frequency transducer data. Manual water level measurements were recorded to the nearest hundredth of a foot (0.01 ft).

4.1.4 Barometric Pressure and Precipitation Monitoring

A sensor was dedicated for barometric pressure monitoring to correct the transducer data, if needed. Transducer data from the pumping and observation wells were corrected for barometric pressure effects using barometric pressure and the barometric efficiency of each well. The barometric efficiencies were estimated by evaluating the change in water level in the well compared to the change in barometric pressure over the same period using baseline data collected prior to conducting the aquifer tests. The estimated barometric efficiencies for each well are provided in Table 2.

Daily precipitation totals were obtained from a local weather station (Weather Underground Station ID: KWALACEY1) maintained approximately one mile southeast of SW Well 1A (Lat: 46.936° N; Long: -122.614° W; elev: 345 ft).

4.1.5 Observation Well Network

A total of 11 wells (including SW Well 1A) were monitored as part of the aquifer testing program. The network of wells consisted of piezometers, private domestic wells, and municipal test wells. Information for each well is provided in Table 2 and their locations shown on Figure 4. Available boring logs and construction diagrams are included in Appendix C. A brief summary of each observation well is provided below:

- **SW Well 1A** – Municipal water-supply test well completed in the TQu to a depth of 633 ft bgs (see Section 3.0 for details on well construction and completion).
- **Thompson Creek Monitoring Well** – Shallow monitoring well drilled to a depth of 17 ft bgs (315.8 ft NGVD29). The well is located adjacent to Thompson Creek approximately 1,855 ft east of SW Well 1A, and is screened in the Qvr just above the base of the Qvt from 11 to 16 ft bgs (321.8 to 316.8 ft NGVD29). The well was used as a monitoring

location during the constant-rate pump test to evaluate the potential for hydraulic response in the shallow aquifer in connection with the creek;

- **P18** – Piezometer drilled to a depth of 56 ft bgs (322.7 ft NGVD29). The piezometer is located approximately 1,978 ft northwest of SW Well 1A and is screened in the Qva from 45 to 56 ft bgs (333.4 to 322.9 ft NGVD29);
- **Baker Well** – Domestic well drilled to a depth of 85 ft bgs (260 ft NGVD29). The well is located approximately 2,174 ft northeast of SW Well 1A, and is completed in the Qva at a depth of 84 ft bgs (261 ft NGVD29). The well was completed without a well screen or casing perforations;
- **P2** – Piezometer drilled to a depth of 59 ft bgs (315.4 ft NGVD29). The piezometer is located approximately 2,441 ft southwest of SW Well 1A and is believed to be screened in the Qvt from 49 to 59.5 ft bgs (325.4 to 314.9 ft NGVD29);
- **Purvis Well** – Domestic well drilled to a depth of 155 ft bgs (227 ft NGVD29). The well is located approximately 2,733 ft northeast of SW Well 1A, and is completed in the Qc at a depth of 155 ft bgs (227 ft NGVD29). The well was completed without a well screen or casing perforations;
- **P3** – Piezometer drilled to a depth of 61.2 ft bgs (341.2 ft NGVD29). The piezometer is located approximately 3,887 ft southwest of SW Well 1A and is screened in the Qvr from 50.6 to 61.2 ft bgs (351.8 to 341.2 ft NGVD29);
- **North Test Well (NTW)** – Exploratory water-supply test well drilled to a depth of 240 ft bgs (453.9 ft NGVD29). The test well is located approximately 6,309 ft southwest of SW Well 1A, and is perforated in the TQu from 195 to 225 ft bgs (258.9 to 228.9 ft NGVD29);
- **South Test Well (STW)** – Exploratory water-supply test well drilled to a depth of 260 ft bgs (194.5 ft NGVD29). The test well is located approximately 8,393 ft southwest of SW Well 1A, and is perforated in the TQu from 195 to 237 ft bgs (259.5 to 217.5 ft NGVD29) and 247 to 254 ft bgs (207.5 to 200.5 ft NGVD29);
- **West Test Well (WTW)** – Exploratory water-supply test well drilled to a depth of 290 ft bgs (152.2 ft NGVD29). The test well is located approximately 10,326 ft southwest of SW Well 1A, and is perforated in the TQu from 230 to 245 ft bgs (212.2 to 197.2 ft NGVD29) and 247 to 254 ft bgs (177.2 to 157.2 ft NGVD29); and
- **SW Well 1** – Exploratory water-supply test well drilled to a depth of 410 ft bgs (32.1 ft NGVD29). The test well is located approximately 10,394 ft southwest of SW Well 1A, and is screened in the TQu from 337 to 352 ft bgs (105.1 to 90.1 ft NGVD29), 359 to 375 ft bgs (83.1 to 67.1 ft NGVD29) and 390 to 399 ft bgs (52.1 to 43.1 ft NGVD29).

4.2 Step-Rate Test

The step-rate test was conducted on September 23, 2010 to evaluate well production and select the pumping rate for the constant-rate pumping test. A hydrograph showing the pumping water level is provided in Figure 5. The well was pumped for three steps at respective rates of 750, 1,300 and 1,800 gpm. Each step rate was maintained for a minimum of 90 minutes as pumping water levels stabilized before increasing the production rate. Small rate adjustments were necessary during the early portions of the first step to maintain a constant pumping rate. The depth to water prior to testing was 88.5 ft bgs. Field data sheets are provided in Appendix D. Electronic data files and tables are provided in Attachment A.

The test results showed specific capacity to be very similar amongst steps and that it increased slightly at each step in pumping rate. Total drawdown of approximately 29.1, 49.6, and 68.2 feet were observed in the pumping well for each of the respective pumping rates equating to short-term specific capacity values of 25.8, 26.2, and 26.4 gpm/ft, respectively. The observed trend is opposite of what is expected because turbulent well losses increase as a function of pumping rate causing well performance and specific capacity to decrease. The slightly increasing trend is an indication that the well was continuing to develop as it was pumped at rates far exceeding those used during the initial development. The amount of specific capacity increase lessened with each step, indicating that specific capacity was stabilizing.

The pre-testing static water level was likely not representative of the actual water level in the aquifer due to water added to the system during drilling to control heaving sands encountered in the production zones, incomplete hydraulic connection with the aquifer due to partial development, and water added to lubricate bearings immediately prior to pumping. This was confirmed by full projected recovery in response to the constant rate test. Over 0.8 million gallons (MG) was added to the borehole (Ray, S., City of Yelm, personal communication, November 2010), which likely resulted in some localized pressure increases in poorly connected aquifer layers. Approximately 0.4 MG of water was discharged during the step-rate test.

Well production and aquifer parameters were estimated from the step-rate test results using the Birsoy and Summers (1980) and Eden and Hazel (1973) analytical solutions available in the Aquifer^{Win32} software package (ESI, 2003). Results of the analyses are shown in Figures 6 and 7 and summarized in Table 3.

Aquifer transmissivity and storativity were estimated using the Birsoy and Summers (1980) analytical solution. Figure 6A shows the pattern of drawdown in terms of s/Q versus log-adjusted pumpage time (β) for each of the three steps. The test results for each step conform to ideal conditions and plot along the same straight line of slope $\Delta(s/Q)$. This indicates that factors such as continued well development and the presence of hydrologic boundaries did not affect conformity with ideal conditions and the test results are valid for estimating transmissivity and storativity. Results of the analysis indicate that the TQu in the vicinity of SW Well 1A has a transmissivity of approximately 48,000 gpd/ft and a storativity of 2.0×10^{-4} (Table 3). The storativity value is consistent with values for confined aquifers (generally range from 1×10^{-3} to 1×10^{-5}).

Figure 6B compares drawdown observed during the step-rate test with drawdown predicted by the Birsoy and Summers (1980) solution. The predicted values are consistent with those observed indicating the validity of the analytical solution.

Aquifer transmissivity was estimated using the Eden and Hazel (1973) analytical solution. Figure 7A shows drawdown versus the product of yield and log-adjusted pumpage time (*H*) for each of the three steps. Using the slope of linear regression lines optimized to best-fit the test results equates to a TQu transmissivity in the vicinity of SW Well 1A of approximately 58,900 gpd/ft.

Figure 7B also compares predicted drawdown versus pumping rate to drawdown assuming a 100 percent efficient borehole. The comparable values indicate that turbulent well losses are low and the well is highly efficient. The well is estimated to be 93 percent efficient (as presented in Section 4.4).

Figure 7C compares drawdown observed during the step-rate test with drawdown predicted by the Eden and Hazel (1973) solution. The predicted values are consistent with those observed indicating the validity of the analytical solution.

The Eden and Hazel (1973) analytical solution was also used to estimate well production. Drawdown predicted by the solution for various pumping rates is shown in Figure 7B. Results of the analysis show that drawdown is predicted to be approximately 100 feet at a pumping rate equivalent to the design capacity of the well screen (2,700 gpm). This rate could likely be sustained for the constant-rate pumping test assuming no flow-limiting boundary conditions are encountered during the test that would cause the pumping water level to exceed available drawdown. The total drawdown available was 219 feet (based on a pump intake depth of 350 feet bgs, static water level of 88.5 feet bgs, and 40 feet of pump submergence). Although it appears that the well is capable of producing higher pumping rates, rates exceeding the design capacity of the well will result in entrance velocities that exceed the recommended well design criteria of 0.1 ft/sec and could increase the likelihood for incrustation or corrosion of the well screen (Driscoll, 1986).

4.3 Constant-Rate Test

A three-day, constant-rate pumping test was performed at SW Well 1A beginning on October 6, 2010. The test was composed of three phases spanning approximately 14 days: baseline water-level monitoring, pumping, and recovery water-level monitoring. Results from each testing phase are presented and discussed in the subsections below. Field data sheets are provided in Appendix D. Electronic data files and tables are provided in Attachment A.

4.3.1 Barometric Pressure and Precipitation

Precipitation and barometric pressure observed during the testing period are presented in Figure 8. Barometric pressure ranged between approximately 33.0 and 33.9 ft of water (ft H2O). The overall general barometric pressure trend was gradually increasing throughout most of the testing period. Transient periods of decline were observed on the overall trend during the latter portion of baseline and early pumping phases and during the latter portion of recovery.

Little to no precipitation events occurred during the eight days leading up to the pumping period. Minor precipitation events took place during the pumping and recovery phases. Each event totaled 0.4 inches or less. A total of 0.85 inches were recorded during the testing period.

4.3.2 Baseline Monitoring

Baseline monitoring began a minimum of seven days prior to pumping to assess background hydrogeologic conditions and pre-existing groundwater-level trends. The baseline water-level trends for SW Well 1A and the observation wells are presented in Figures 9 through 16. The following pre-test groundwater level trends were observed:

- Relatively stable trends were observed in SW Well 1A, SW Well 1, WTW, NTW, and STW (Figures 9 and 14 through 16). As a result, no antecedent trend corrections were necessary to evaluate the potential hydraulic response to pumping or to characterize aquifer properties;
- Decreasing trends were observed at the Thompson Creek, P2, and P3 monitoring wells (Figures 10 and 12). The water level in the Thompson Creek monitoring well was flashy, rising and falling in response to intermittent precipitation events, but the overall trend was decreasing throughout the testing period. The water level in P2 decreased at a relatively faster rate than P3. P3 is completed in the recessional outwash unit (Qvr) while P2 is completed in the underlying low-permeability till (Qvt). The slower rate of water-level decline in P3 is likely related to the underlying till layer impeding the downward migration of groundwater within the overlying Qvr and becoming perched atop the Qvt;
- A decreasing water level trend was observed in P18 during baseline monitoring. A measurement collected on 10/6/2010 8:45 AM before pumping began indicated that the well was dry. This well continued to be monitored as part of the aquifer testing program and all subsequent observations indicated a dry well; and
- Water level trends in the Baker and Purvis domestic wells (Figures 11 and 13) appear moderately stable, but no trends or response can be discerned. During non-pumping periods, the apparent static water levels vary by approximately four feet in the Baker Well (49 to 53 ft bgs) and approximately three feet in the Purvis Well (83 to 86 ft bgs) depending upon frequency of use. Pumping water levels approached depths of 70 ft bgs in the Baker Well and 110 ft bgs in the Purvis Well. Baseline data show several periods when pumping in these wells is frequent enough that water levels do not fully recover from the previous pumping event before pumping begins again causing periods of progressive drawdown.

4.3.3 Pumping Phase

Pumping began at 2:35 PM on October 6, 2010, and continued until 3:05 PM on October 9, 2010 for a total pumping time of approximately 73 hours. Totalizer volume measurements were consistent with instantaneous flow readings, and indicated that the average discharge rate was approximately 2,100 gpm throughout the test. Small flow adjustments were necessary during early portions of the pumping period to maintain a constant pumping rate as water was conveyed to the Thurston Highlands discharge site and pipe flows were adjusted. A total of approximately 9 MG of water was discharged during the test. Hydrographs of SW Well 1A and the observation wells during the pumping phase of the constant-rate test are shown in Figures 9 through 16.

4.3.3.1 SW Well 1A

Figure 9 shows the hydrograph for SW Well 1A during the pumping phase of the constant-rate test. The static water level immediately prior to pumping was 102.5 feet bgs. After pumping began, the water level dropped rapidly and began to stabilize toward a depth of approximately 180 feet bgs. During the last five hours of pumping, the absolute change in water level ranged between 0.03 and 0.09 ft and was below Ecology's stability target of 0.1 ft/hr for at least four hours (Figure 17). A maximum drawdown of approximately 82.2 feet (water level of 184.7 feet bgs) was observed by the end of the pumping period, indicating a specific capacity of 25.5 gpm/ft after approximately 73 hours of pumping at 2,100 gpm (Figure 18). After the constant-rate test was complete, Boart began the mechanical process of shutting down the pumping system, which included opening a series of vacuum relief valves along the discharge pipeline to prevent pipe collapse and ramping down the pump motor before shutoff.

Small rate adjustments were necessary during the first 150 minutes pumping to maintain a constant rate as test water was conveyed to the Thurston Highlands discharge location. To assist in the evaluation of the aquifer's hydraulic response to pumping SW Well 1A during this period, a plot of specific capacity versus elapsed pumping time was constructed to normalize drawdown with respect to pumping rate (Figure 18). The plot shows no apparent aquifer boundary conditions.

Aquifer transmissivity was estimated using the Theis (1935) analytical solution available in the Aquifer^{win32} software package (ESI, 2003). Figure 19A presents a log-log plot of drawdown versus elapsed pumping time at SW Well 1A superimposed on the non-equilibrium Theis type-curve for a fully confined aquifer. The observed response is an excellent match of the type-curve indicating a confined aquifer response with no apparent evidence of leakance or hydraulic boundary conditions. Results of the analysis indicate that the TQu in the vicinity of SW Well 1A has a transmissivity of approximately 42,400 gpd/ft (Table 3). Drawdown predicted by the Theis (1935) solution is consistent with the observed response indicating the validity of the analytical solution (Figure 19B).

The hydraulic response to pumping and aquifer transmissivity of the TQu in the vicinity of SW Well 1A was also estimated using the Cooper-Jacob (Cooper and Jacob, 1946; Jacob, 1950) straight-line method. A semi-log plot of drawdown versus elapsed pumping time (Figure 20) shows the rate of drawdown to be relatively consistent throughout the test with the exception of some small rate adjustments within the early portion of the test. No hydraulic boundary effects were apparent during the test. Results of the analysis indicate a transmissivity of 43,650 gpd/ft (Table 3) and is consistent with TQu transmissivity estimated using the Theis (1935) solution.

4.3.3.2 Observation Network Wells

No apparent hydraulic response to pumping SW Well 1A was observed in the observation well network:

- **Thompson Creek Monitoring Well** – The water level exhibited fluctuations in response to precipitation events, but continued a declining trend consistent with the baseline period. No evidence of decline due to pumping is apparent (Figure 10);
- **P18** – This well was dry before pumping began and remained dry during the pumping and recovery periods;
- **Baker Well and Purvis Wells** – There was no apparent response to pumping SW Well 1A at these two domestic wells (Figures 11 and 13). The water levels observed in these wells during the pumping and recovery periods behaved similarly as those observed during baseline monitoring, including response to barometric pressure changes. In addition to response to barometric pressure variability, the Purvis well exhibits increased pumping frequency and duration relative to the baseline monitoring period. No response to pumping SW Well 1A are apparent;
- **P2 and P3** – The water level trends in these wells were declining throughout baseline monitoring and continued to decline at similar rates throughout the pumping and recovery periods (Figure 12). No response to pumping was apparent at these wells; and
- **SW Well 1 and the North, South and West Test Wells –** The stable water level trends observed in these wells during baseline monitoring continued on similar trends throughout the pumping and recovery periods and no evidence of decline due to pumping SW Well 1A is apparent (Figures 14 through 16).

4.3.4 Recovery Phase

Recovery monitoring began at the termination of the pumping period and continued until 1:00 PM on October 13, 2010. Figure 9 shows recovery phase in context of the entire constant-rate test, and Figure 20 shows a more detailed analysis. SW Well 1A recovered to within 75 percent of the pre-test water level after approximately 40 minutes. At the end of the recovery phase, the water level had risen to 107.8 ft bgs, approximately 5.3 ft below its pre-test level of 102.5 ft bgs. The recovery trend shown on the hydrograph indicates that the water level is projected to continue to rise after monitoring stopped.

Assuming theoretical idealized aquifer conditions (no leakance, no boundaries, and homogeneity), the water level in a well will recover to the pre-test static level following the termination of pumping. If other hydrogeologic conditions influence the aquifer's hydraulic response (e.g., recharge to the aquifer, variations in aquifer permeability, pumping of other wells, and/or the presence of aquifer boundaries within the radius of influence of the well), a different (though diagnostic) recovery response will occur. Figure 21 presents the recovery analysis for SW Well 1A using the Theis (1946) method. This recovery analysis is performed by plotting residual drawdown (drawdown remaining in the well after pumping has stopped) against the logarithm of the ratio of time since pumping started (t) and time since pumping stopped (t'). This ratio of time is dimensionless, and is referred to as t/t'. Under ideal aquifer conditions (uniform confined aquifer of infinite extent), the recovery data should trend toward zero residual drawdown at $t/t' = 1$.

The plot shows three recovery segments representing: (1) an early recovery response during the first four minutes after pumping stopped ($t/t' > 1{,}000$), (2) a transition period between four and 230 minutes after pumping stopped (t/t' between 1,000 and 20), and (3) a late recovery response for the remaining 5,445

minutes of recovery (*t/t'* less than 20). If residual drawdown is still apparent at *t/t'* = 1, then water was removed from storage within the aquifer because the aquifer has a limited extent, thus indicating that the aquifer was de-watered or depressurized (the volume of water pumped was significant relative to the volume available from storage and natural recharge). This response did not occur at SW Well 1A indicating that the recharge to the aquifer appears capable of sustaining the withdrawal represented by this test.

The early recovery response resulted from pump column storage (relatively small volume of water contained in the pump column added to the system after pumping stopped) and the mechanical process of shutting down the pumping system. The large pump diameter required to achieve the target test rate precluded installation of a check-valve to prevent water in the pump column (above the pumping water level) from re-entering the well casing. After the early recovery response stabilized, the water level begins recovering at a relatively constant rate until approximately *t/t'* = 10. During the latter portion of the transition period, the rate of recovery begins to increase and trending toward zero residual drawdown at *t/t'*= 1. The shape of the late recovery response curve is concave upward indicating that recovery was affected by a linear barrier boundary (Hargis, 1979). The presence of the barrier boundary was not apparent on either the specific capacity or pumping response curves and could have been masked by the small changes in pumping rate necessary during the early portion of the test to maintain a constant pumping rate. The presence of the barrier boundary does not appear to have accelerated drawdown in or limited flow to the well and likely represents a change in transmissivity at distance.

Since the recovery response was influenced by pump column storage and barrier boundary effects, aquifer transmissivity was not estimated with the recovery data. The TQu transmissivity estimates derived from step-rate and constant-rate pumping analyses are considered most representative of actual conditions in the vicinity of SW Well 1A (Table 3).

4.4 Well Efficiency

The efficiency of SW Well 1A was estimated using an empirical relationship between transmissivity and specific capacity. This empirical relationship is described in Driscoll (1986), and can be used to estimate well efficiency through the ratio of the actual specific capacity to the theoretical specific capacity. The theoretical specific capacity (defined as the estimated transmissivity divided by 2,000) is 23.9 gpm/ft when using a transmissivity of 47,827 gpd/ft. The actual specific capacity calculated after the three-day pumping period was 25.5 gpm/ft. The ratio of the actual to theoretical specific capacity indicates that the SW Well 1A has an efficiency of approximately 93 percent.

4.5 Well Yield

The City intends to operate SW Well 1A at a maximum instantaneous pumping rate of 2,100 gpm. The constant-rate test results were used to estimate pumping water levels and pump intake depth settings under the expected operating conditions, using the following values and assumptions:

- Specific capacity of 25.5 gpm/ft;
- Expected operating production capacity of 2,100 gpm;
- Static water level = 103 ft bgs;
- Assumed allowance for pump submergence = 40 ft;
- Assumed allowance for seasonal groundwater fluctuations = 20 ft; and
- Buffer of 20 ft to accommodate uncertainty.

Based on the above values and assumptions, the estimated pumping water level will be approximately 186 ft bgs, representing 83 feet of drawdown (compared to fall 2010 static water levels). Actual available drawdown is approximately 167 ft.

Factoring in allowances for pump submergence, seasonal groundwater level fluctuations, and accommodations for uncertainty, the estimated pump intake depth setting should be 266 ft bgs. These estimates assume that aquifer characteristics will be stable over time/distance during long-term pumping and no significant boundary conditions exist that may reduce available drawdown.

4.6 Groundwater Development Impact Assessment

Because the well withdraws water from a deep well-confined portion of the aquifer system, and results from the aquifer test conducted to assess this system did not result in observable response in nearby wells, pumping at SW Well 1A is not expected to result in significant impact to existing groundwater users or nearby surface water features. Most, if not all, of the groundwater users in the Yelm area utilize the Qva and Qc aquifer units as a groundwater supply source since these are shallower and therefore more accessible than the TQu. The only wells known to be completed within the TQu unit in the Yelm area are the City's test wells (NTW, STW, WTW, and SW Well 1) shown on Figure 4. The nearest TQu well is the NTW located approximately 1.2 miles southwest of SW Well 1A, and no response to pumping was observed at that location.

Based on the confined nature of the TQu and the 327.7-ft seal depth, no significant hydraulic response in the overlying units is expected. It is possible that measurable response could eventually be observed, though the upward propagation of hydraulic effects from pumping will clearly be limited by the overlying low-permeability confining Qf and Qvt units, and the magnitude of any future response is expected to be small. Since no response was observed, future response cannot be extrapolated from these results. As

no response was observed in overlying aquifer units or at the Thompson Creek observation well, impacts to nearby surface water features are expected to be minor as well.

5.0 WATER QUALITY

Water quality monitoring was included as part of the SW Well 1A testing program. Groundwater quality samples were collected from SW Well 1 and SW Well 1A and submitted to Washington State certified drinking water laboratories for analysis. Field water quality measurements for pH, temperature, specific conductance, turbidity, oxidation-reduction potential (ORP), and dissolved oxygen (DO) were also obtained as part of the testing program. Field water quality data sheets and laboratory test results for the sample suites are included in Appendices D and E.

5.1 SW Well 1

Ecology's superseding preliminary permit to drill and test SW Well 1A included a requirement that at least one TQu observation well be monitored for water quality during aquifer testing. However, pumping an observation well during the test (to ensure the sample was representative) would cause unwanted hydraulic interference, possibly invalidating test interpretation. Consequently, the well was not pumped, and a sample was collected from the well using a small disposable bailer during the pumping portion of the aquifer test. This sample was measured for field characteristics only because it is unlikely to be representative of actual water quality conditions in the aquifer. Those compliance-driven measurements are included below:

- pH: 9.2
- Temperature: n/a
- Specific conductance: 209 µS/cm
- Dissolved oxygen: 3.9 mg/L
- ORP: -75.4 mV

To provide Ecology with a comparable (though not in time) sample from the deeper portion of the aquifer system at a second well, a sample was collected from SW Well 1 and analyzed for a suite of general chemistry and field parameters to characterize water quality during the drilling phase of the project. The samples were collected on May 19, 2010 after approximately 7,800 gallons (~5 well volumes) had been pumped from the well.

Test America was contracted to perform the water quality analyses. Summary reports, which include the results, analytical methods used and their associated method detection limits, and quality control results provided by the laboratory, are included in Appendix E-1. The final field parameter values measured at the end of the sampling event are summarized below:

- pH: 6.2
- Temperature: 9.8 ^{o}C (49.6 ^{o}F)
- Specific conductance: 110 µS/cm

- Dissolved oxygen: 3.0 mg/L
- ORP: 183 mV

These results are considered representative of TQu water quality, though over a mile from SW Well 1A.

Laboratory test results show that water quality from SW Well 1 meets all Primary Maximum Contaminant Levels (MCLs) for the drinking water analytes tested. The groundwater is moderately hard with a hardness of 67 mg/L as $CaCO_3$. Aesthetically, groundwater from SW Well 1 was cold, clear, odorless, and had a slight metallic/mineral taste.

Laboratory test results also show that iron, manganese, and pH exceed their respective Secondary MCLs (SMCL), and that iron and manganese are mostly in insoluble form. Total iron and manganese concentrations were 1.2 and 0.14 mg/L, respectively. For comparison, dissolved iron and manganese concentrations were 0.05 and 0.02 mg/L. The secondary MCLs for iron and manganese are 0.3 and 0.05 mg/L. Manganese and iron levels above the SMCL do not pose a risk to human health or the environment. The SMCL for manganese is provided as a recommendation for aesthetic quality only. Elevated concentrations of iron and manganese may affect the flavor and color of water, cause staining, or result in buildup in pipelines, pressure tanks, water heaters and water softeners. Groundwater from SW Well 1 is slightly acidic (pH of 6.2) and is slightly outside of the secondary MCL pH range of 6.5 to 8.5. Low pH levels may affect taste and corrosivity.

The composition of groundwater from SW Well 1 was compared to water quality results from previous studies conducted in Yelm and Thurston County to evaluate its source. The Piper diagram illustrated in Figure 22 plots water compositions from samples of different wells in the Yelm area (Site No. 465625122361701 17N/02E-19N01 and 465637122352805 17N/02E-19J05; USGS, 2010) and median water chemistries of the regional geologic units as presented by the U.S. Geological Survey (USGS; Table 6 in Drost et al., 1998). The tight grouping indicates that groundwater throughout the study area is similar in composition and chemistry type, and can generally be classified as a calcium/magnesium-bicarbonate type. The similarity in chemical signature suggests that groundwater throughout the study area is likely of the same origin (from infiltration of precipitation) and that the various glacial hydrogeologic units are generally similar in mineralogic composition. Water composition of the regional bedrock formation (Tb) is set apart from the cluster due to lower levels of magnesium and higher levels of sodium and potassium.

While groundwater quality in Thurston County is quite similar amongst the various hydrogeologic units, groundwater from the deeper system can be distinguished from shallower sources. The Stiff diagrams presented in Figure 23 compares the ionic composition of SW Well 1 with the same nearby wells and hydrogeologic units as shown in Figure 22. Groundwater from SW Well 1 has a chemical signature that is

more similar to characteristic signatures of the deeper aquifer systems (Qc and TQu) rather than the shallow system (Qvr, Qvt, and Qva). The differences are most attributed to the deeper units having slightly elevated concentrations of calcium, sodium, potassium, bicarbonate, silica, iron, and manganese (Drost et al., 1998). In addition, the shallow USGS wells in Yelm also exhibit a lower dissolved solids concentration and proportionally lower magnesium concentrations than other samples (Figure 23) indicating that groundwater in Yelm is somewhat younger than groundwater from deeper sources in the study area, and that they can be distinguished chemically. The relatively low ionic composition of the USGS wells suggests a low residence time, and is consistent with the shallow aquifer system in Yelm, in contrast to the deeper, confined system with higher ion concentrations. The hydrostratigraphic relationships apparent in the SW Well 1 well log (Appendix C) are consistent with those previously published for the area indicating that the well is completed in, and obtains water from, the TQu unit. The lithologic characteristics and water quality similarities indicate that the source aquifer for SW Well 1 is from the deeper, regional groundwater flow regime of the TQu.

5.2 SW Well 1A

A suite of water quality samples and field parameters were collected from SW Well 1A to assess drinking water quality and evaluate the source. The samples were collected at the end of the aquifer testing period and submitted to Edge Analytical, Inc. for analyses. Field parameters monitored during the pumping phase are summarized below:

- pH: 7.5
- Temperature: 11.3 ^{o}C (52.3 ^{o}F)
- Turbidity: 0.8 NTU
- Specific conductance: 176 µS/cm
- Dissolved oxygen: 0.4 mg/L
- ORP: -60.2 mV

The groundwater samples were analyzed for water-quality constituents required for new source approvals in the State of Washington. Analytes tested included (1) physical parameters, (2) volatile and synthetic organic compounds, (3) inorganic compounds, (4) gross-alpha and gross–beta radiologic indicators, and (5) bacteriologicals (i.e., total Coliform, heterotrophic plate count, and *E. coli*). Summary reports provided by the laboratory and field data sheets are included in Appendices D and E-2.

Based on field measurements and laboratory analyses, the water quality from SW Well 1A is excellent. Aesthetically, the water was cold, clear, odorless, and has a slight metallic/mineral taste. No volatile organic compounds, synthetic organic compounds, herbicides, or hydrogen sulfide were detected. With the exception of manganese, the analytical results show that concentrations for federal and state

regulated inorganic compounds to be below regulatory standards for drinking water. The following regulated inorganic constituents were detected:

- Barium was detected at 0.004 mg/L, below the MCL of 2 mg/L;
- Chloride was detected at 3.6 mg/L, below the SMCL of 250 mg/L;
- Fluoride was detected at 0.11 mg/L, below the MCL of 4 mg/L;
- Iron (total) was detected at 0.11 mg/L, below the SMCL of 0.3 mg/L;
- Manganese (total) was detected at 0.14 mg/L, above the SMCL of 0.05 mg/L;
- Odor was noted at 1 color unit, below the SMCL of 3 color units;
- Sodium was detected at 5.45 mg/L. There is no MCL for sodium. The recommended action level is 20 mg/L;
- Specific conductance was detected at 176 µS/cm, below the SMCL of 700 µS/cm;
- Sulfate was detected at 3.4 mg/L, below the secondary MCL of 250 mg/L; and
- Total dissolved solids was detected at 117 mg/L, below the SMCL of 500 mg/L.

The only inorganic constituent having a concentration above its regulatory criteria was manganese. Total and dissolved manganese were detected at 0.14 and 0.15 mg/L, respectively, and are approximately three times the recommended limit. The laboratory results show that manganese is mostly in dissolved form. As previously mentioned, meeting the SMCL for manganese is not a mandatory requirement, and is only provided as a recommendation for aesthetic quality.

A bacteriological sample was submitted to the laboratory for analysis of total coliform, heterotrophic plate count (HPC), and *E. Coli*. The results from this analysis showed:

- *E. coli* to be below the detection limit of <2 MPN/100mL. Because *E. coli* is a specific fecal coliform and its presence is used as an indicator of fecal contamination in drinking water tests, the absence of *E. coli* indicate the absence of fecal coliform bacteria in the water sample. The laboratory confirmed the absence of fecal coliform (Edge Analytical, Inc., personal communication, November 11, 2010);
- Coliforms are naturally present in the environment. Although not a health threat itself, total coliforms are used to indicate whether other potentially harmful bacteria may be present. The total coliform result of 2 MPN/100 mL suggests the presence of coliform bacteria other than fecal coliform and *E. coli* because these were not detected; and
- HPC is a test performed to assess the total number of all types of bacteria common in water. HPC was very low detected at 4 CFU/mL. For reference, federal criteria for HPC require disinfection and/or filtration to maintain HPC levels to less than 500 CFU/mL.

Repeat bacteriological samples should be collected as part of the source approval process to validate the coliform presence result. It is possible that the result is due to a circumstance or condition that is not representative of source water quality (e.g., coliform contamination from drilling or pumping equipment temporarily installed for testing the well). It should be noted that the bacteriological testing was conducted

before the well was disinfected and it is possible that the result is due to this circumstance or is a sample collection artifact as coliform is not likely to be present in the system at that depth.

Radiological analysis included testing for gross alpha, gross beta, radium-226 and -228, and radon. Gross alpha and beta, and radium-226 and -228 levels were below detection limits. Radon was detected at 234 pCi/L, below the proposed federal drinking water criteria of 300 pCi/L. It is unclear how radon concentrations will behave during prolonged pumping, and the City should consider monitoring for radon once the well is online for production. The City should consider integrating (or reserving space for) a radon treatment option (e.g., aeration or granular activated carbon systems) as part of any planned treatment facilities to avoid adding infrastructure (or changing existing infrastructure) at a later time.

The chemical signature of groundwater from SW Well 1A is most consistent with groundwater from the deeper, regional TQu flow regime. Groundwater quality from SW Well 1A was compared to water chemistries of the same nearby wells and regional hydrogeologic units as shown in Figure 22. The figure shows SW Well 1A to plot amongst the other wells and units (with the exception of Tb), indicating a similar origin (infiltration of precipitation) and water type (calcium/magnesium-bicarbonate). Although the relative concentrations of calcium, sodium, and potassium are slightly lower in SW Well 1A compared to the other deeper units (Figure 23), bicarbonate/alkalinity, total dissolved solids, silica, pH, and specific conductance values are most consistent with the chemical characteristics of the deep aquifer system (Table 6 in Drost et al., 1998). These findings, coupled with the hydrostratigraphic relationships discussed in Section 3.0, indicate that SW Well 1A is completed in the deeper, regional groundwater flow regime of the TQu.

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

The City of Yelm has constructed and tested a new water supply well and has evaluated potential impacts associated with withdrawing groundwater from the deeper portion of the regional aquifer system. Conclusions from the investigation including recommendations for next steps are summarized in the following subsections.

6.1 Drilling and Well Construction

A new water supply well (SW Well 1A; Ecology Well Tag No. ALM 113) was constructed in the Tahoma Terra area west of Yelm in Thurston County, Washington (SE¼, SE¼, Section 23, T17N, R1E W.M.) to evaluate the area as a potential new source for groundwater development. The 12-inch diameter well was constructed at a ground surface elevation of approximately 381 feet NGVD29 and extends to a depth of 633 feet below ground surface. A surface casing was set to 327.7 feet bgs to limit the withdrawal from the deepest aquifer unit. Samples collected during drilling were examined and compared to the physical characteristics of regional hydrostratigraphic units indicating that the well is completed in the unconsolidated and undifferentiated deposits of the TQu unit, which is considered part of the deeper, regional groundwater flow system. Three 35-slot screen sections were placed in the water-bearing intervals of 369 to 437 ft bgs, 487 to 547 ft bgs, and 611 to 625 ft bgs. The annular space between the screen assembly and production casing and borehole is filled with 10-20 Colorado silica sand filter pack. The filter pack extends from 353 to 633 ft bgs.

6.2 Aquifer Testing

A step-rate test was conducted at pumping rates of 750, 1,300 and 1,800 gpm for a minimum of 90 minutes each as pumping water levels stabilized before increasing the production rate. Total drawdown of approximately 29.1, 49.6, and 68.2 feet were observed in the pumping well for each of the respective pumping rates equating to short-term specific capacity values of 25.8, 26.2, and 26.4 gpm/ft, respectively.

A constant-rate aquifer test, including baseline and recovery monitoring, was conducted over a period of 14 days. The pumping portion of the aquifer test was conducted at a constant rate of 2,100 gallons per minute for a period of 73 hours, which resulted in a maximum drawdown of approximately 82.2 feet. The specific capacity at the end of the test was 25.5 gpm/ft. Based on the ratio of the actual (25.5 gpm/ft) to theoretical (23.9 gpm/ft) specific capacity, the well efficiency is estimated at 93 percent.

The late time recovery response curve trends toward zero residual drawdown at t/t' = 1 indicating the recharge to the system was capable of supporting the withdrawal.

Transmissivity estimates of the TQu in the vicinity of SW Well 1A ranged between 58,900 and 42,400 gpd/ft. The geometric mean transmissivity equated to 47,827 gpd/ft. Storativity was estimated at 2.0×10^{-4}, and is consistent with values for confined aquifers.

A total of 10 wells consisting of piezometers, private domestic wells, and municipal test wells targeting both shallow and deep portions of the aquifer system were included in the observation network and monitored as part of the SW Well 1A testing program. Hydraulic response to pumping SW Well 1A was not apparent in any of the observation wells. Though long term response cannot be precluded, these results indicate that groundwater development from SW Well 1A is not expected to result in significant impact to existing groundwater users or nearby surface water features.

Given the relatively high specific capacity, large available drawdown, and no apparent response in shallower portions of the aquifer system, future groundwater development of the TQu aquifer in the Yelm area appears feasible.

6.3 Water Quality

The water quality from SW Well 1A is excellent. Aesthetically, the water was cold, clear, odorless, and has a slight metallic/mineral taste. No volatile organic compounds, synthetic organic compounds, herbicides, or hydrogen sulfide were detected.

The only inorganic constituent having a concentration above its regulatory criteria was manganese. Total and dissolved manganese were detected at 0.14 and 0.15 mg/L, respectively, and are approximately three times the recommended limit

The total coliform result of 2 MPN/100 mL suggests the presence of coliform bacteria (no fecal coliform or *E. coli* were detected). However, the sample was collected before the well was disinfected and it is possible that the result is due to this circumstance or is a sample collection artifact as coliform is not likely to be present in the system at that depth.

Radon was detected at 234 pCi/L, below the proposed federal drinking water criteria of 300 pCi/L.

The chemical signature of groundwater from SW Well 1A is most consistent with groundwater from the deeper, regional TQu flow regime. These findings, coupled with the hydrostratigraphic units encountered during drilling, indicate that SW Well 1A is completed in the deeper, regional groundwater flow regime of the TQu.

6.4 Recommendations

Based on the results of the drilling and testing program at SW Well 1A, Golder recommends the following:

- As part of the final design, the well should be equipped with the following:
  - Two water level access pipes for long-term water level monitoring. One pipe should have a ¾-inch inner diameter to accommodate a water level probe and the second should have a 1 ½- inch diameter to allow installation of a pressure transducer for continuous water level monitoring; and

  - A filter pack fill tube to allow placement of additional filter pack as it may settle over time and potentially allow finer-grained native formation to pass through the well screen. Filter pack should be 10-20 Colorado silica sand and maintained to a depth of 353 ft bgs.

- Static water levels, pumping rates, and pumping volumes should be monitored on a regular basis to track seasonal water level fluctuations and well performance;
- Based on the aquifer test results and allowances for seasonal groundwater level fluctuations, pump submergence requirements, and uncertainty, the projected pumping water level at 2,100 gpm is estimated at 186 ft bgs and the pump intake should be set to a depth of 266 feet bgs;
- Repeat bacteriological samples should be collected as part of the source approval process to validate the coliform presence result;
- Treatment would likely be required for manganese to maintain the delivered water aesthetic quality and prevent scaling in the City's piping and distribution system;
- Golder recommends the City track radon concentrations over time once the well is online for production to determine if levels increase or decrease after extended pumping. Additionally, the City may consider providing contingency for radon treatment as part of the final treatment facility design;
- According to a well inspection survey completed by Thurston County, the proposed SW Well 1A site meets requirements of WAC 246-290 for new drinking water source approval, provided:
  - A declaration of covenant (public water source) of the 100-ft sanitary control around the well head is recorded with the Thurston County Auditor's office;
  - All surface runoff is conveyed away from the well and out of the 100-ft sanitary control area through standard construction practices such as proper grading and ditching;
  - Any use, handling, or storage of potentially hazardous materials is maintained away from the well and out of the 100-ft sanitary control area;
  - Adequate measures are taken to protect the source from unauthorized access, such as fences and locked gates, as the well site is proposed to be located within a public park;
  - Prior to putting the new source into production for drinking water purposes, the temporary stormwater retention/settling pond adjacent to SW Well 1A must be backfilled with clean soils. Documentation confirming the pond has been properly backfilled must be submitted to Department of Health Office of Drinking Water for their review and approval; and
  - Submit water system plans and specifications to Dan Gariepy at the Washington State Department of Health Office of Drinking Water to obtain approval.
- A wellhead protection plan for SW Well 1A.

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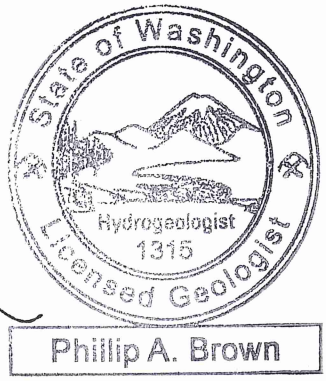

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KJ/AC initials

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TABLES

TABLE 1
LITHOLOGIC AND HYDROLOGIC CHARACTERISTICS OF GEOHYDROLOGIC UNITS (Drost et al., 1999)

System	Series	Geologic unit		Geohydrologic unit, in this report[1]	Typical thickness (feet)	Lithologic characteristics	Hydrologic characteristics
Quaternary	Holocene		Alluvium	Qvr Qvrm	10-40	Alluvial and deltaic sand and gravel along major water courses. Moderately to well-sorted glacial sand and gravel, including kettled end moraine	An aquifer where saturated. Groundwater is mostly unconfined. Perched conditions occur locally.
	Pleistocene	Vashon Drift	Recessional outwash and end moraine				
			Till	Qvt[2]	20-55	Unsorted sand, gravel, and boulders in a matrix of silt and clay.	Confining bed, but can yield usable amounts of water. Some thin lenses of clean sand and gravel.
			Advance outwash	Qva	10-45	Poorly to moderately well-sorted, well-rounded gravel in a matrix of sand with some sand lenses.	Ground water, mostly confined. Used extensively for public supplies near Tumwater.
		Kitsap Formation		Qf[3]	20-70	Predominantly clay and silt, with some layers of sand and gravel. Minor amounts of peat and wood.	Confining bed, but in places yields usable amounts of water.
		Salmon Springs(?) Drift (Noble and Wallace, 1966) / Deposits of "penultimate" glaciation (Lea, 1984)		Qc	15-70	Coarse sand and gravel, deeply stained with red or brown iron oxides.	Water is confined. Used extensively for industrial purposes near Tumwater.
		Unconsolidated and undifferentiated deposits		TQu	Not known	Various layers of clay, silt, sand, and gravel of both glacial and nonglacial origin.	Contains both aquifers and confining beds. Water probably confined.
Tertiary	Miocene and Eocene	Bedrock		Tb	Not known	Sedimentary rocks consisting of claystone, siltstone, sandstone, and minor beds of coal. Igneous bodies of andesite and basalt.	Poorly permeable base of unconsolidated sediments. Locally an aquifer, but generally unreliable. Water contained in fractures and joints. Well yields relatively small. Numerous abandoned wells.

[1]The identification of geohydrologic units in this report is a "best estimate" based on drillers' logs and existing surficial geology maps.
[2]Includes "late Vashon lake deposits" (Washington State Department of Ecology, 1980). May include till of "penultimate" glaciation (Lea, 1984).
[3]Includes alluvium younger than Kitsap Formation in Nisqually River delta. May include some Vashon till (where multiple tills are present). May include till of "penultimate" glaciation (Lea, 1984).

SOURCE: Drost et al., 1999

TABLE 2
NETWORK MONITORING WELLS

Project Well Name	Well Log ID	Well Tag No.	Well Owner	Well Type	Distance From SW Well 1A (ft)	Well Diameter (in)	Well Depth (ft bgs)	(1)Monitoring Method	(2)Estimated Barometric Efficiency, *BE* (dimensionless)	(3)Northing, *y* (ft)	(3)Easting, *x* (ft)	MP (ft ags)	(4)Ground Surface Elevation (ft NGVD29)	MP Elevation (ft NGVD29)	Bottom Elevation of Well (ft NGVD29)	(5)Geohydrologic Unit
SW Well 1A	n/a	ALM113	City of Yelm	Municipal test well	0	12	633	T/M	0.50	593518.16	1106759.98	2.58	381	383.58	-252	Tqu
Thompson Creek MW	n/a	n/a	City of Yelm	Monitoring well	1,855	1	17	T/M	0.75	593280.88	1108599.37	3.8	332.79	336.59	316	Qvr
P18	537234	BAS468	Thurston Highlands LLC	Piezometer	1,978	2	56	T/M	0.78	594477.37	1105030.51	2.4	378.67	381.07	323	Qva
Baker Well	30264	n/a	Virgil and Darlene Baker	Private domestic well	2,174	6	84	T/M	0.70	595210.16	1108125.08	0.65	345	345.65	261	Qva
P2	492212	APC066	Thurston Highlands LLC	Piezometer	2,441	2	59	T/M	0.52	593173.21	1104343.34	1.5	374.35	375.85	315	Qvt
Purvis Well	23405	n/a	David and Rose Purvis	Private domestic well	2,733	6	155	T/M	0.70	596146.14	1107510.74	0.36	382	382.36	227	Qc
P3	492210	APC063	Thurston Highlands LLC	Piezometer	3,887	2	61.2	M	---	592457.39	1103020.35	2.74	402.38	405.12	341	Qvr
North Test Well	120946	ABV265	City of Yelm	Municipal test well	6,309	8	240	T/M	0.53	591606.43	1100747.11	1.92	453.87	455.79	214	Tqu
South Test Well	120948	ABV267	City of Yelm	Municipal test well	8,393	8	260	T/M	0.53	588320.47	1100170.69	3.27	454.48	457.75	194	Tqu
West Test Well	120947	ABV266	City of Yelm	Municipal test well	10,326	8	290	M	---	589658.31	1097182.44	1.38	442.18	443.56	152	Tqu
SW Well 1	n/a	n/a	City of Yelm	Municipal test well	10,394	12	410	T/M	0.62	589385.00	1097223.00	2.46	442.12	444.58	32	Tqu

Notes: (1) T = pressure transducer; M = manual water level probe

(2) Barometric efficiency (*BE*) estimated by evaluating the change in water level in the well compared to the change in barometric pressure over the same period using baseline data collected prior to conducting the aquifer tests. Domestic use inhibited estimation of *BE* in the Purvis and Baker wells and were assigned values of 0.78 (same as P18).

(3) Washington State Plane NAD 83/91 coordinate system

(4) Ground surface elevations were obtained from survey results reported by Pacific Groundwater Group (2008) with the exception of SW Well 1A and the Baker and Purvis Wells, which were obtained from USGS topographic maps and digital elevation models.

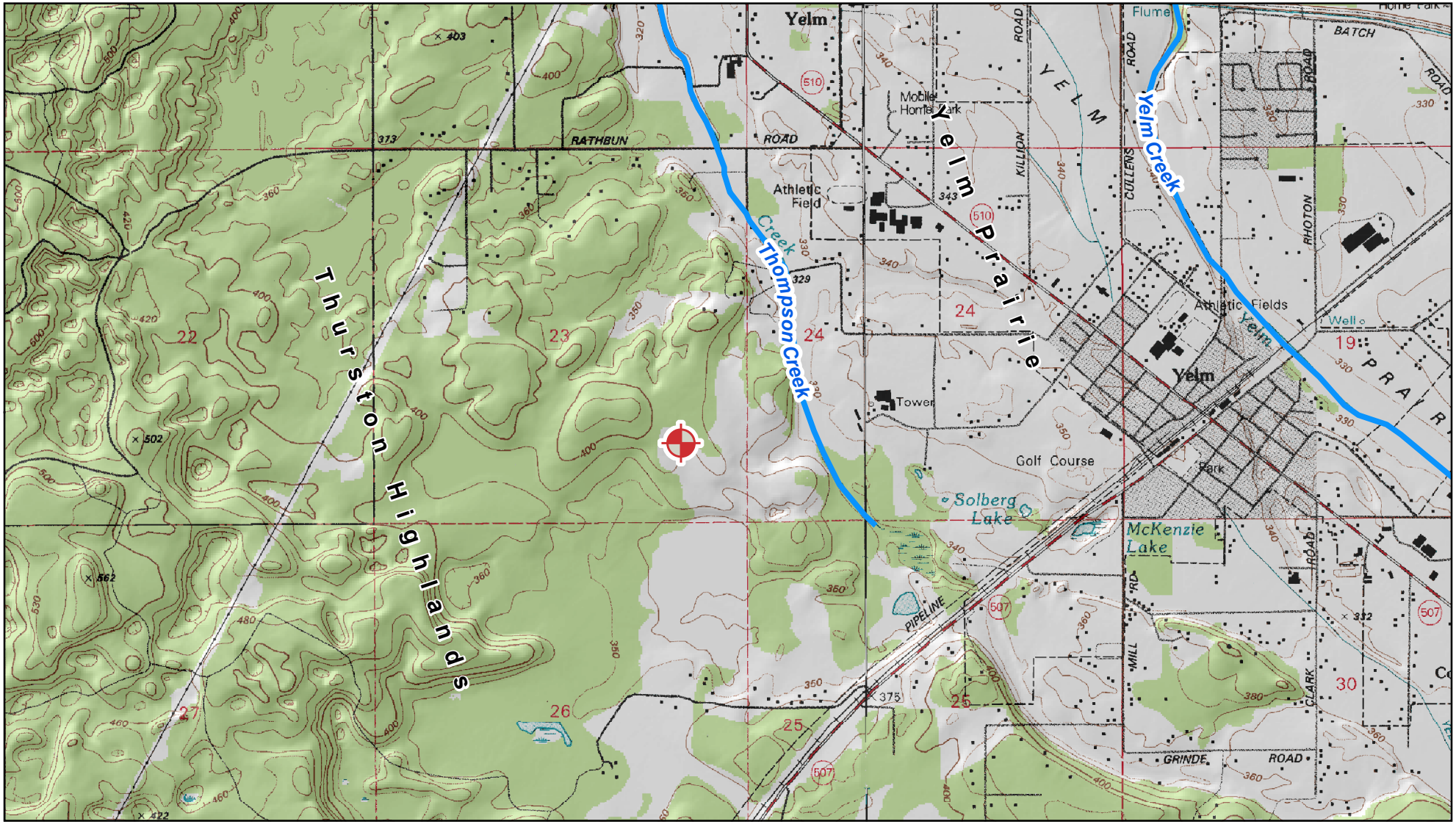
(5) Qvr = recessional outwash; Qvt = glacial till; Qva = advance outwash; Qc = Salmon Springs drift; Tqu = unconsolidated and undifferentiated deposits (nomenclature from Drost et al., 1999)

ft = feet; in = inches; bgs = below ground surface; ags = above ground surface; NGVD29 = National Geodetic Vertical Datum 1929

TABLE 3
TRANSMISSIVITY AND STORATIVITY ESTIMATES

Test Type and Solution	Transmissivity (gpd/ft)	Storativity, *S* (dimensionless)
Step-Rate Testing		
Pumping Data		
Birsoy and Summers (1980)	48,000	2.0E-04
Eden and Hazel (1973)	58,900	---
Constant-Rate Testing		
Pumping Data		
Theis (1935), Confined	42,400	---
Cooper and Jacob (1946), Straight Line Method	43,650	---
Recovery Data		
Theis, 1946 (Recovery)	---	---
Geometric Mean	***47,827***	***2.0E-04***

FIGURES



LEGEND

SW Well 1A

N

0 2000

Scale in Feet

Map Projection:
UTM NAD27, Zone 10 North

Source:
Washington State Geospatial Data Archive;
Washington Department of Ecology

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

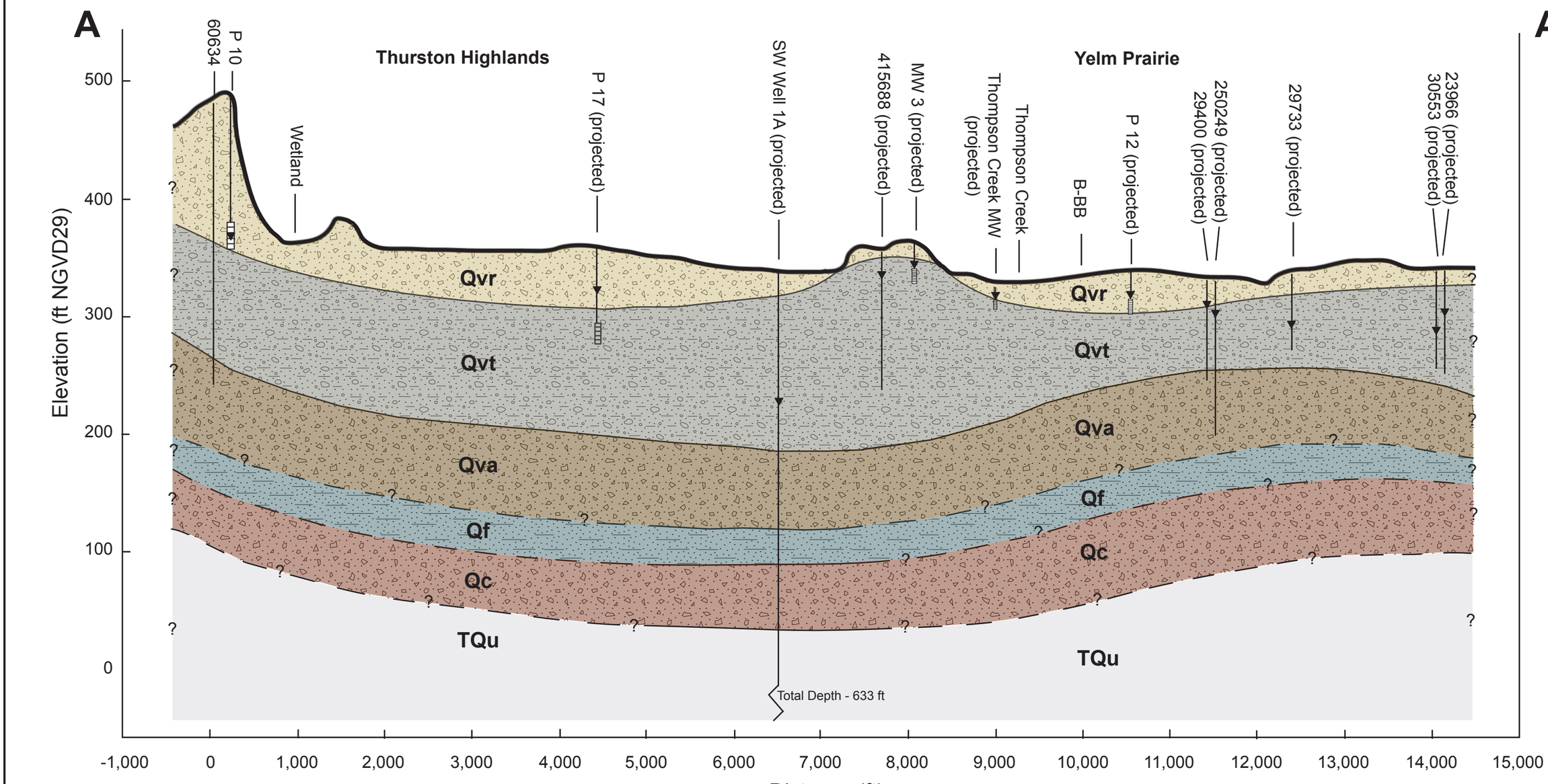
FIGURE 1

SITE LOCATION

CITY OF YELM SOUTHWEST WELL 1A DEVELOPMENT PROJECT

103-99709; SWWell1A_SiteLocation.mxd | 3/14/2011 | KDJ

Golder Associates



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

(TQu) - Layers of clay, silt, sand and gravel of glacial and nonglacial origin.

▼ **Water Level**

Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **2**
GEOLOGIC CROSS-SECTION A-AA
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

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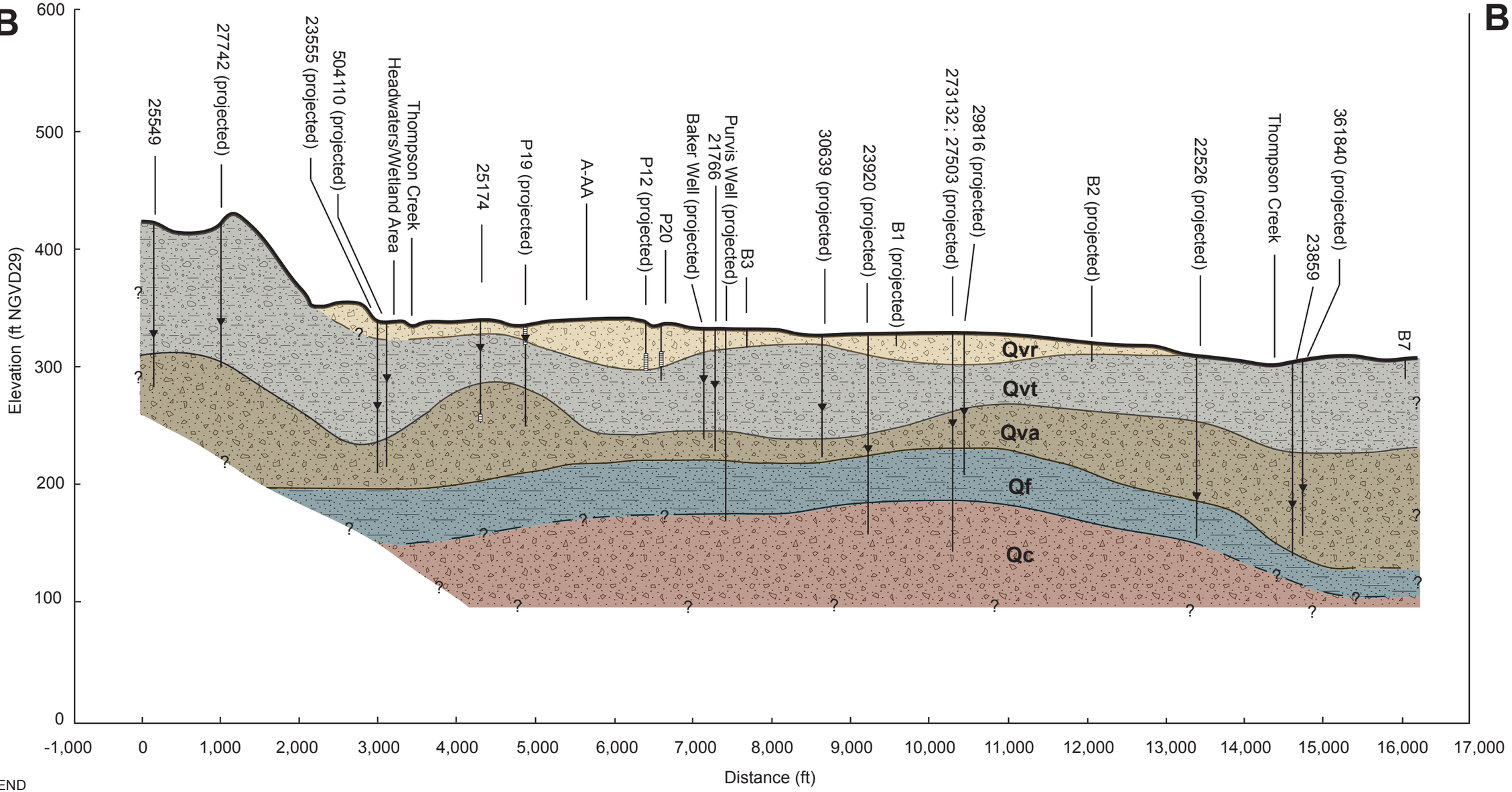
Golder Associates

B

BB



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

▼ **Water Level**

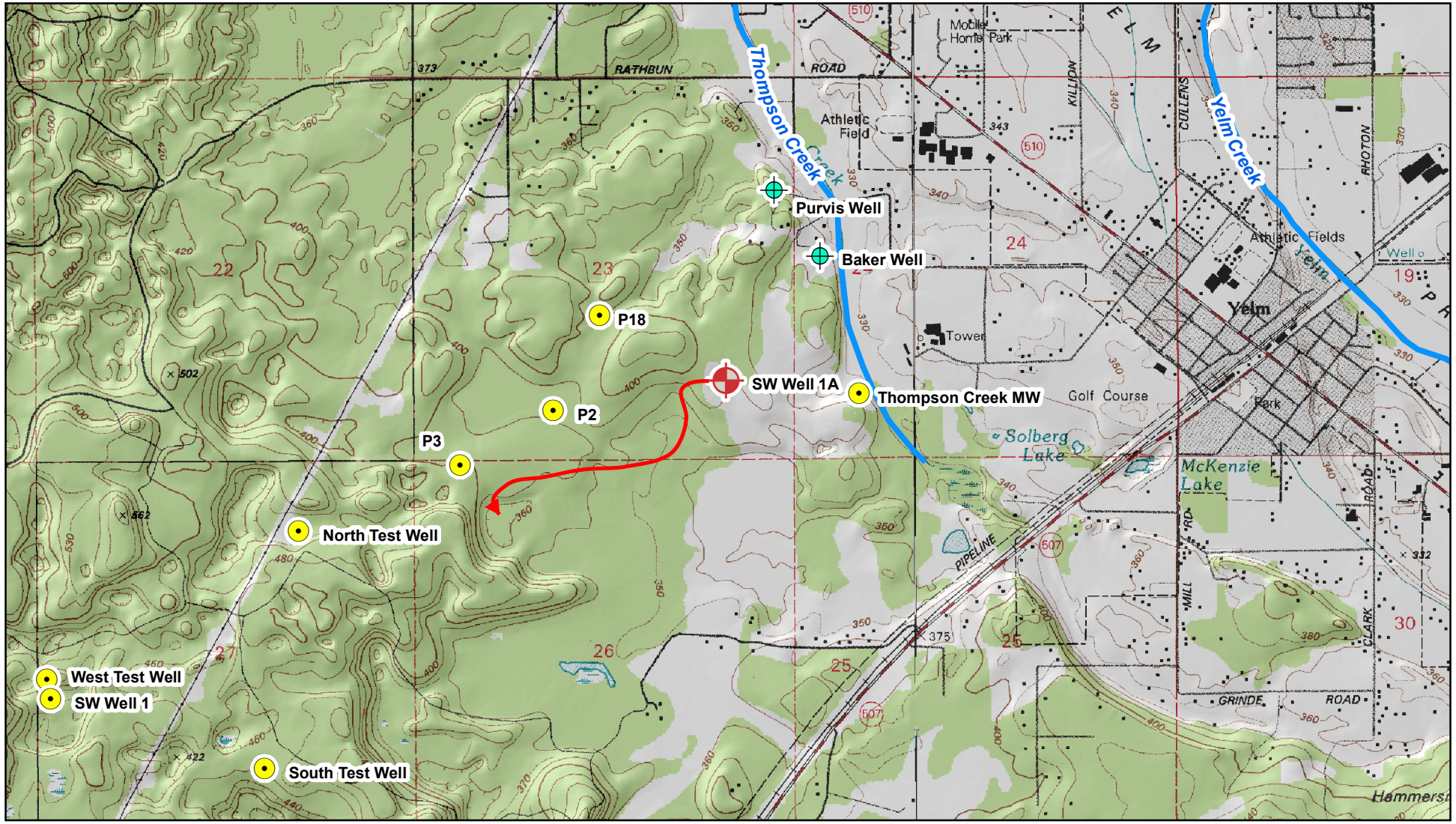
Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **3**
GEOLOGIC CROSS-SECTION B-BB
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

10399709fig03.ai | Mod: 03/14/11 | LMB

Golder Associates



LEGEND

- SW Well No. 1A (pumping well)
- Domestic Well
- Piezometer/Monitoring Well
- Streams
- Aquifer Test Discharge Water

0 2000

Scale in Feet

Map Projection:
UTM NAD27, Zone 10 North

Source:
Washington State Geospatial Data Archive;
Washington Department of Ecology

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

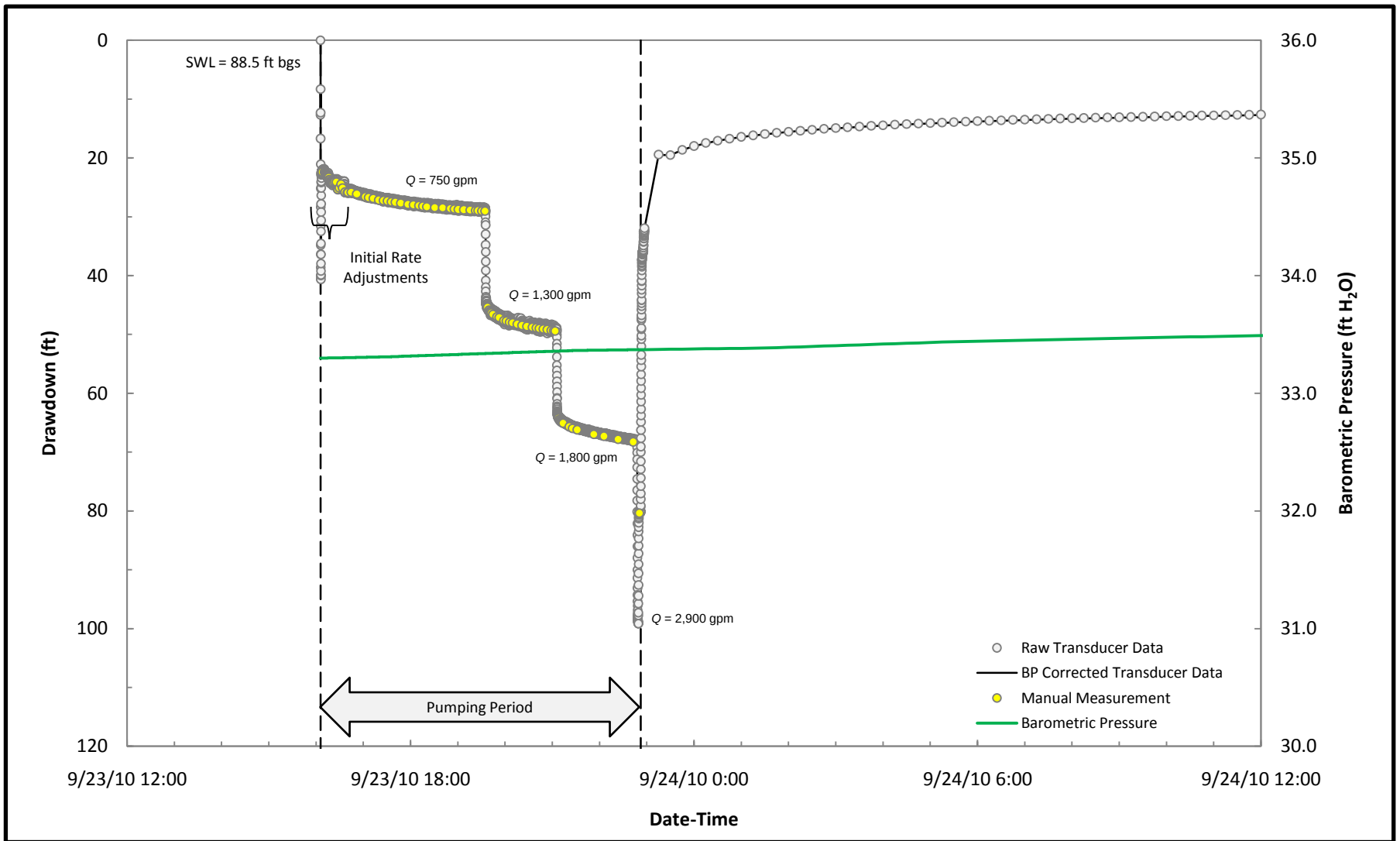
FIGURE **4**

OBSERVATION WELL NETWORK MONITORING LOCATIONS

CITY OF YELM SOUTHWEST WELL 1A DEVELOPMENT PROJECT

103-99709; SWWell1A_ObsWellNetwork.mxd | 3/14/2011 | KDJ

Golder Associates



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			Checked: LMB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
	Client Name: City of Yelm, WA	Date: January 17, 2011	FIGURE 5

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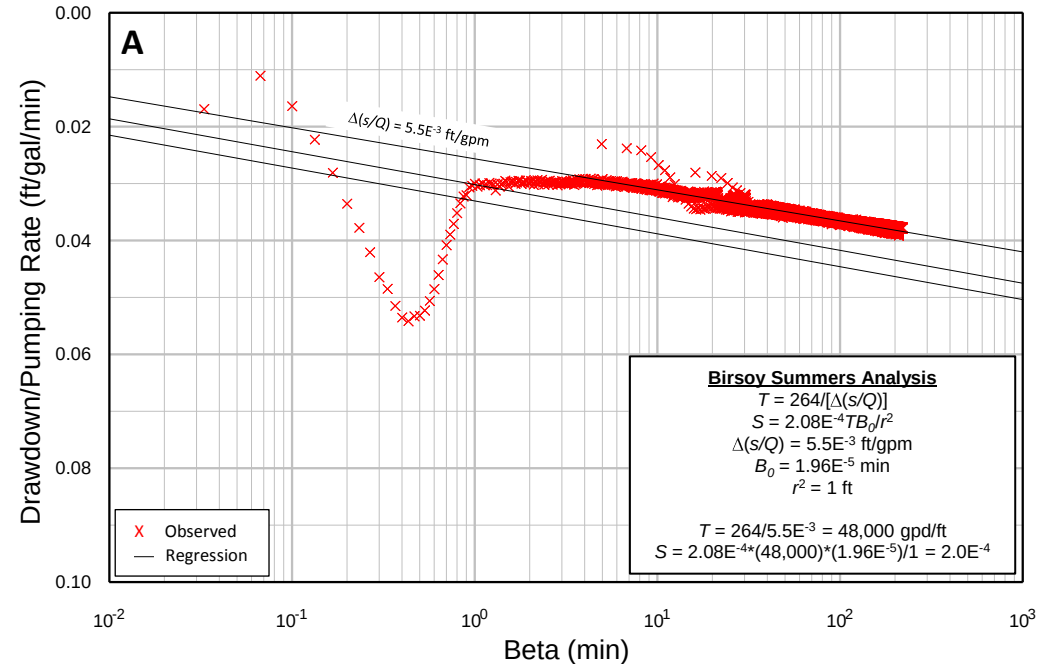
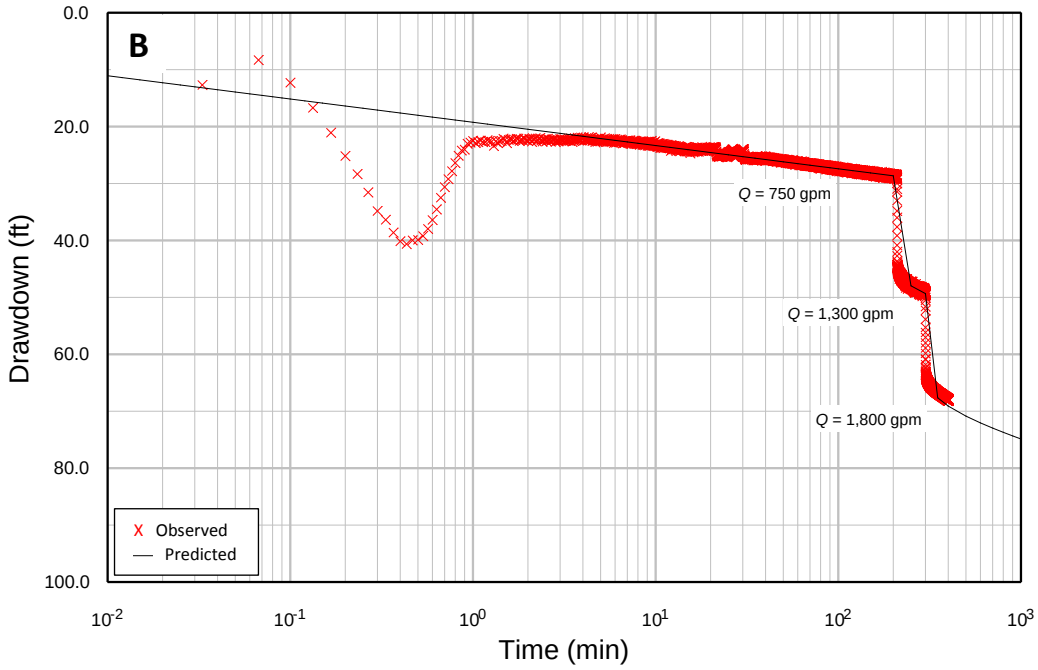
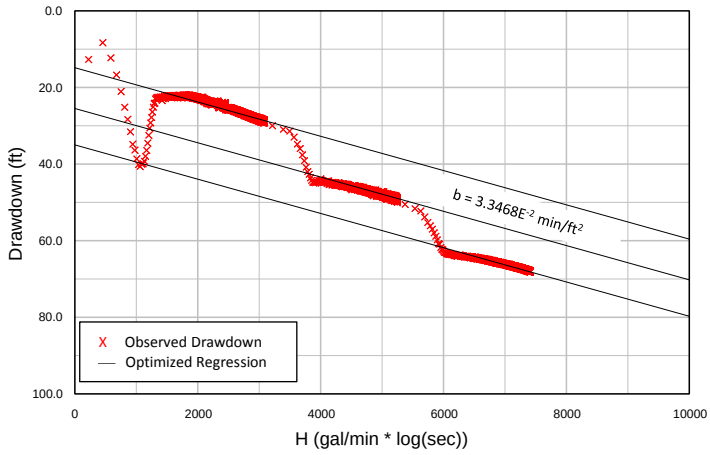




Golder Associates	Title: SW WELL 1A STEP-RATE TEST RESULTS - BIRSOY AND SUMMERS (1980)		Drawn: KDJ
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Checked: LMB
			Reviewed: PAB
	Client Name: City of Yelm, WA	Date: January 17, 2011	FIGURE 6

A



Eden Hazel Analysis

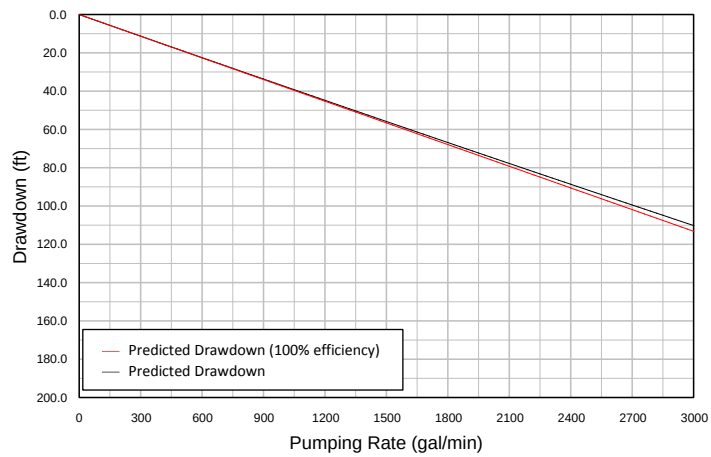
$T = 24{,}774/4\pi b$

b = slope of best fit lines

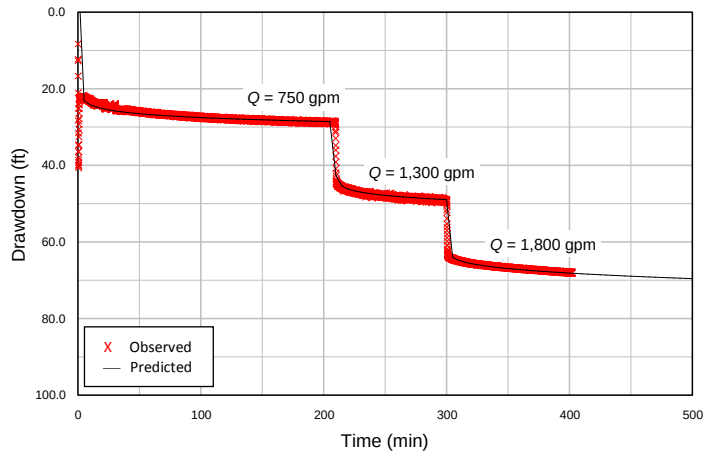
$b = 3.347E^{-2}$ min/ft²

T = 58,900 gpd/ft

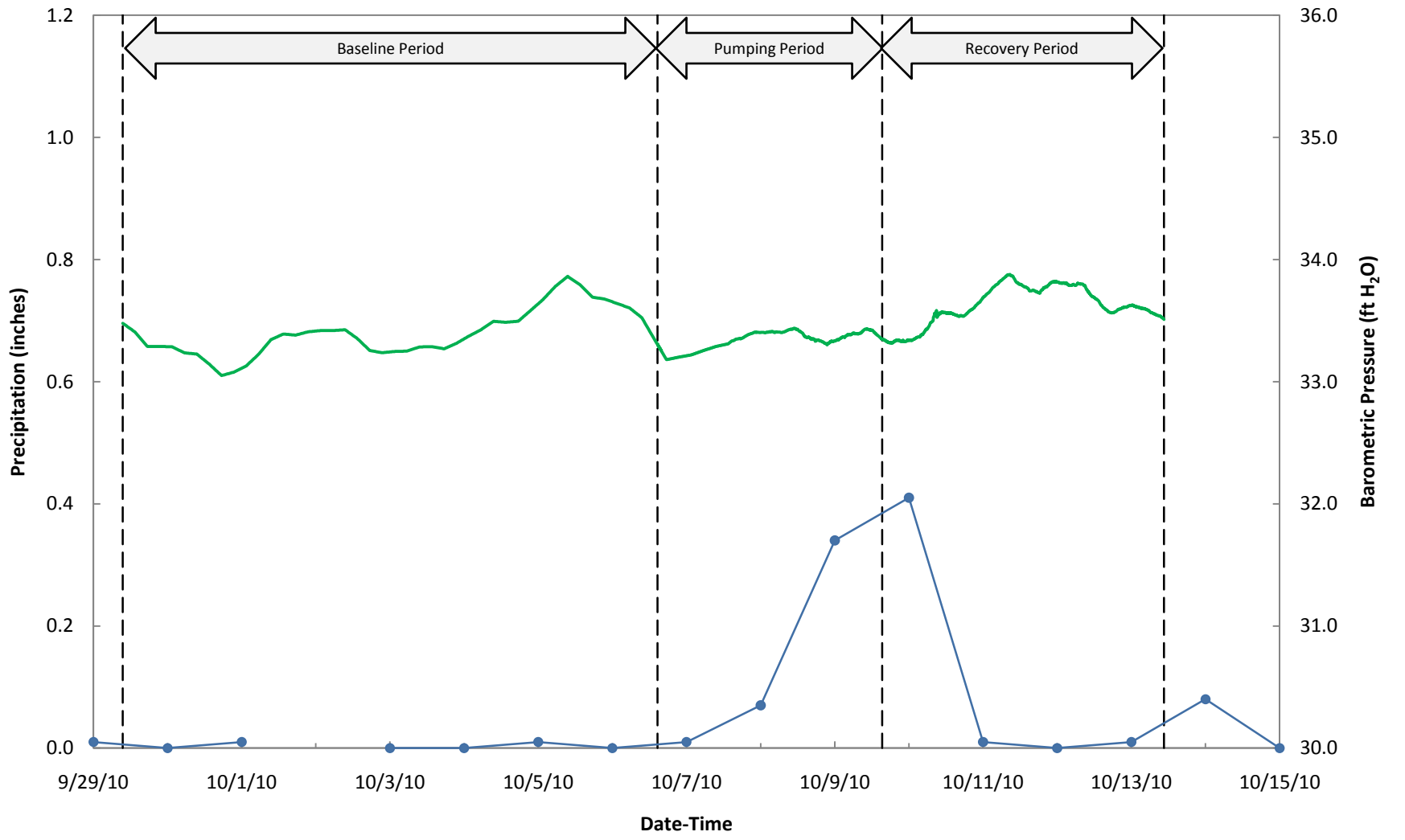
B



C



Golder Associates	Title: SW WELL 1A STEP-RATE TEST RESULTS - EDEN AND HAZEL (1973)	Drawn	KDJ
		Checked	LMB
	Project Name: SW Well 1A Development Project / Project No.: 103-99709	Reviewed	PAB
	Client Name: City of Yelm, WA / Date: January 17, 2011	FIGURE	7

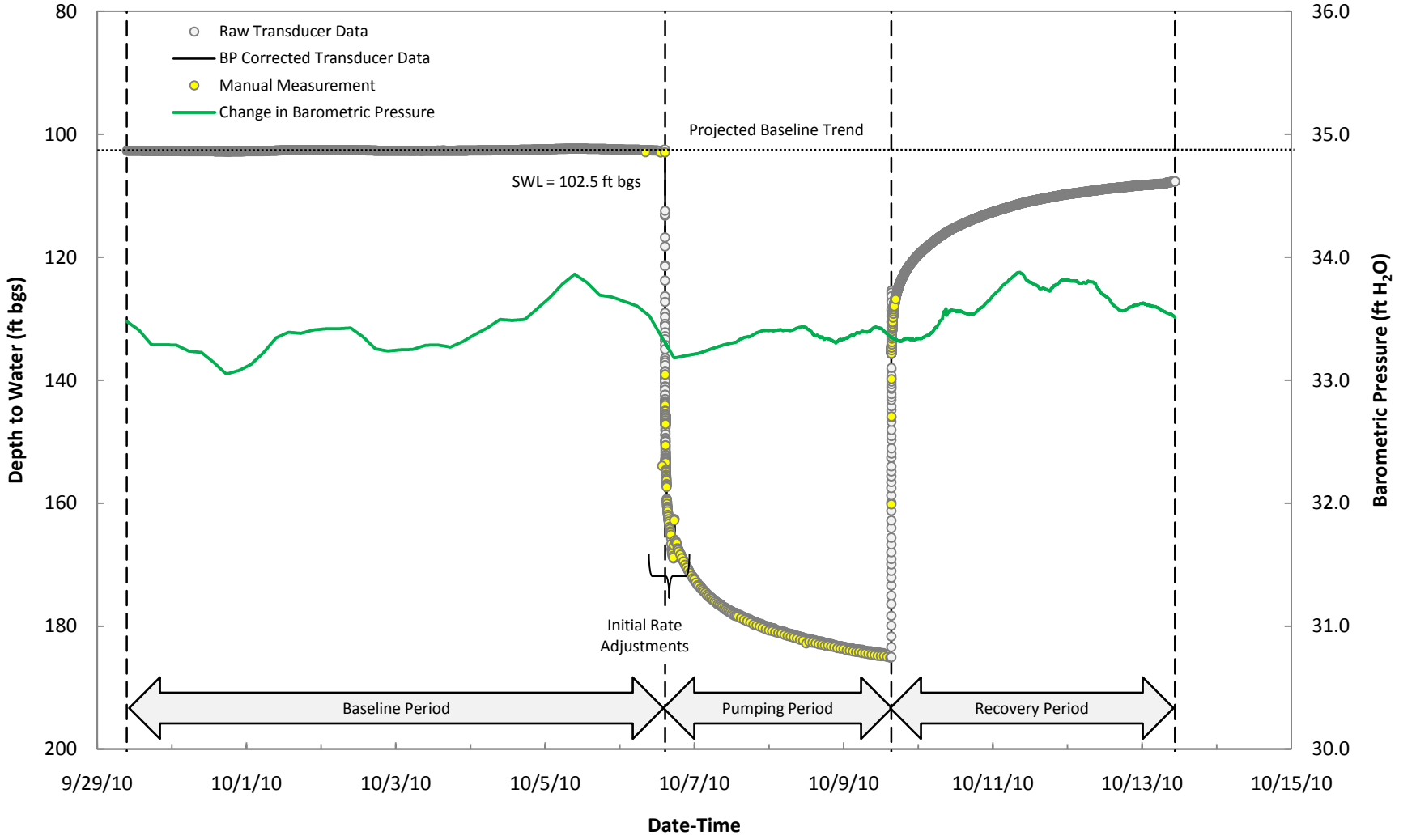


Golder Associates

Precipitation
Barometric Pressure

Title	PRECIPITATION AND BAROMETRIC PRESSURE		
Project Name	SW Well 1A Development Project	Project No.	103-99709
Client Name	City of Yelm, WA	Date	January 17, 2011

Drawn	KDJ
Checked	LMB
Reviewed	PAB
FIGURE	8

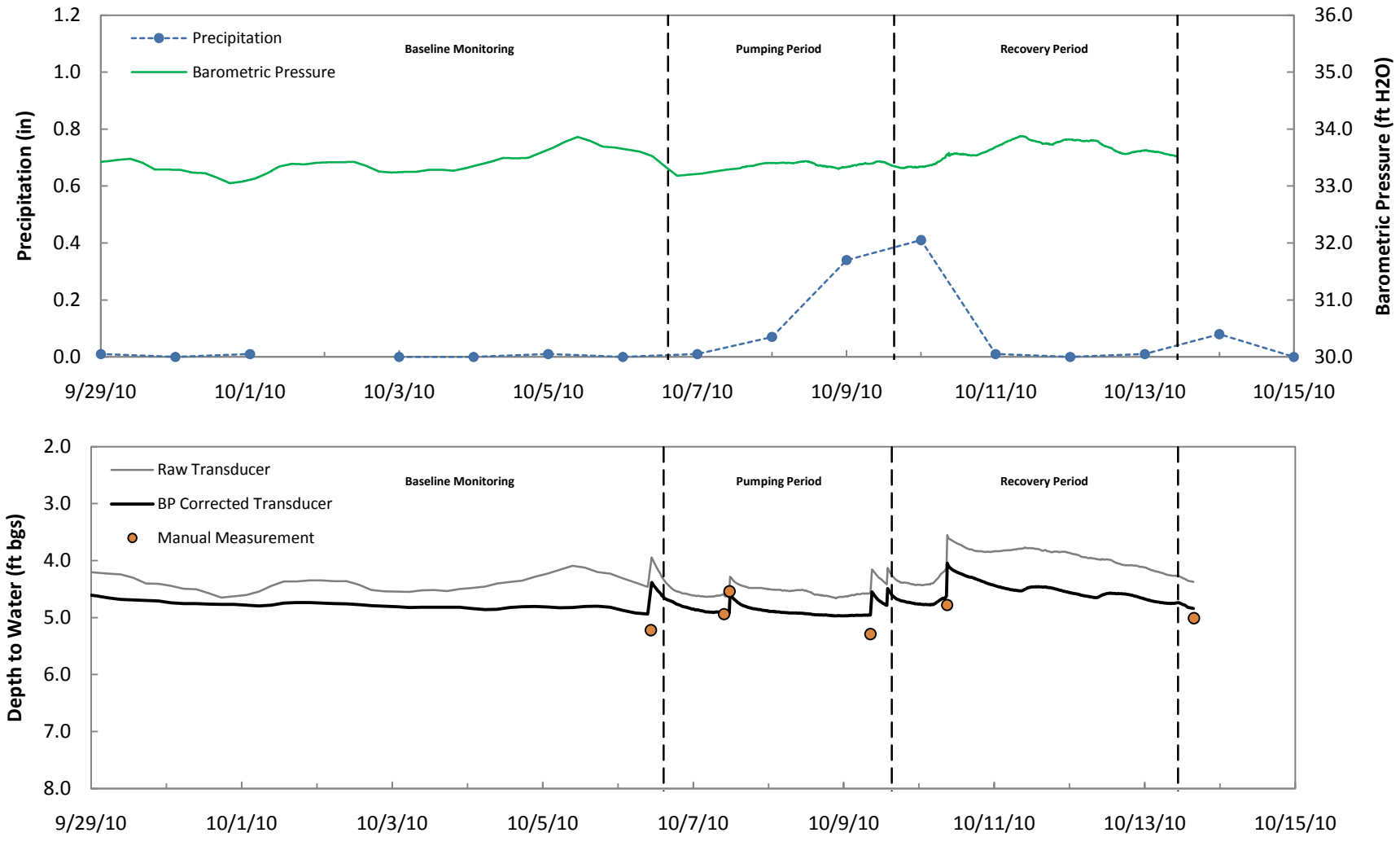


Golder Associates

Title	SW WELL 1A CONSTANT-RATE TEST HYDROGRAPH		
Project Name	SW Well 1A Development Project	Project No.	103-99709
Client Name	City of Yelm, WA	Date	January 17, 2011

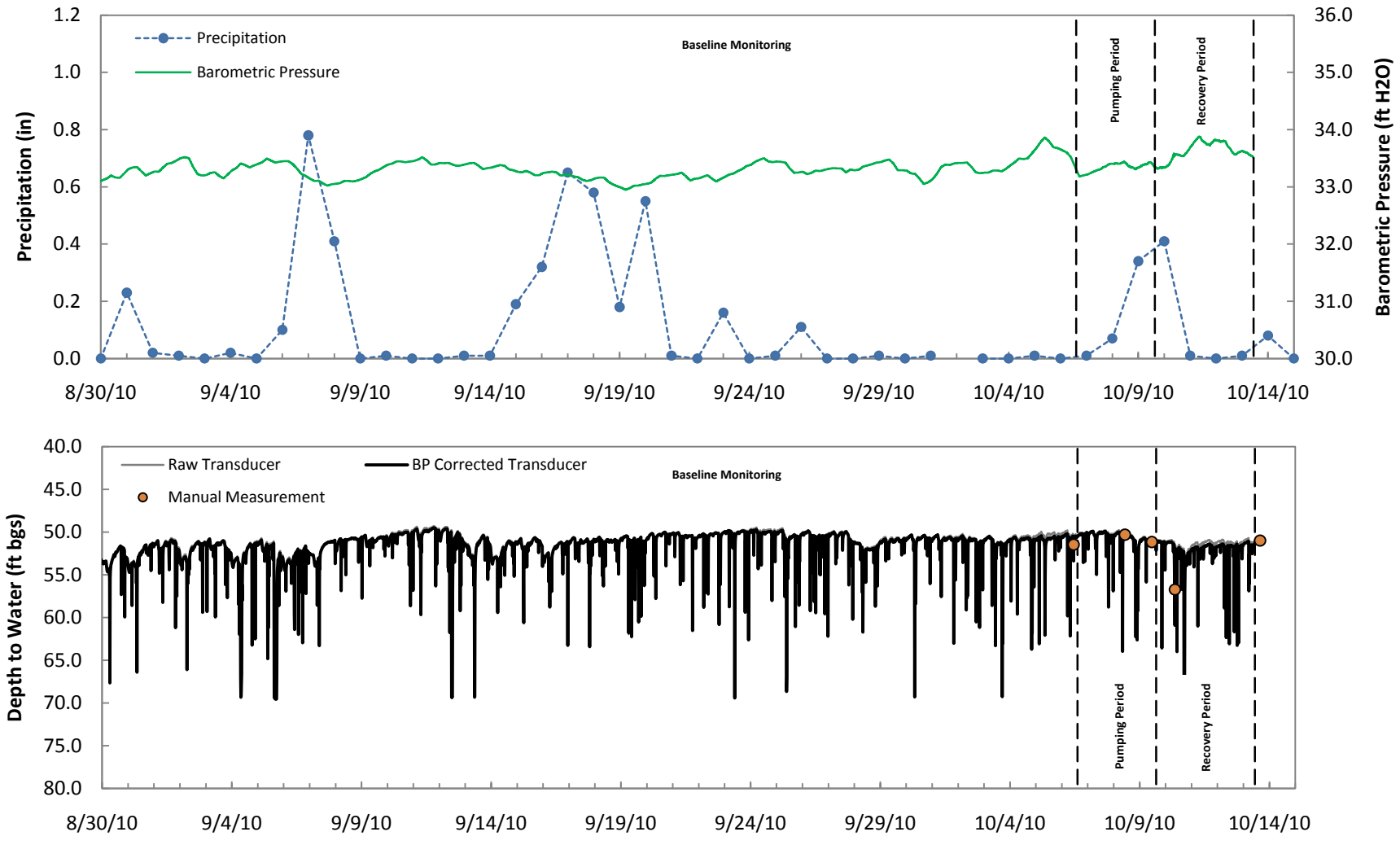
Drawn	KDJ
Checked	LMB
Reviewed	PAB
FIGURE	9

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Step Test\SW Yelm Well No1 StepTest_3.xlsx



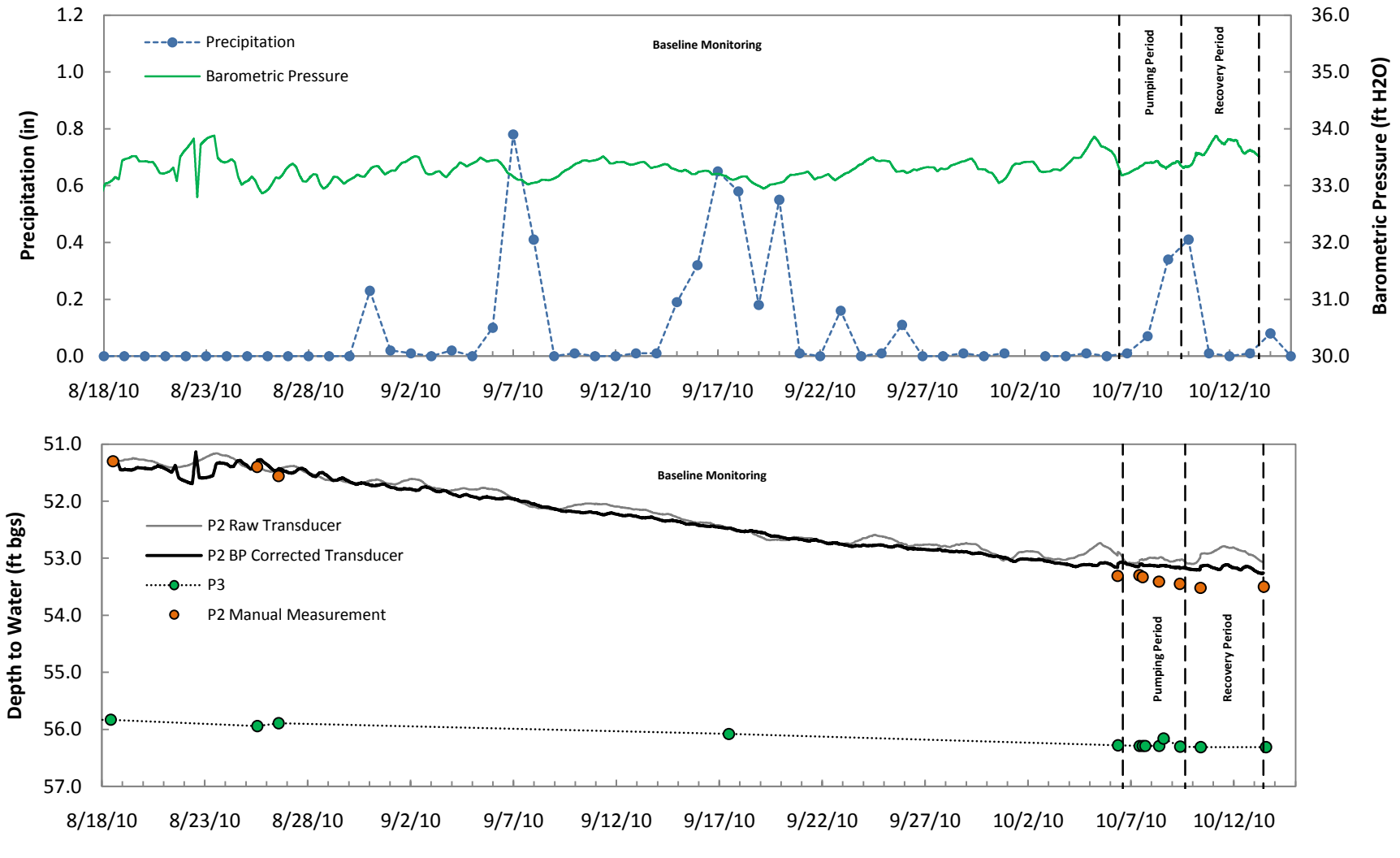
Golder Associates	Title: THOMPSON CREEK MONITORING WELL HYDROGRAPH		Drawn: KDJ
			Checked: LMB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
	Client Name: City of Yelm	Date: January 17, 2011	FIGURE 10

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Constant Rate Test\MW Data\Monitoring Well Data.xlsx



Golder Associates	Title: BAKER WELL HYDROGRAPH		Drawn: KDJ
			Checked: LMB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
	Client Name: City of Yelm	Date: January 17, 2011	FIGURE 11

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Constant Rate Test\MW Data\Monitoring Well Data.xlsx



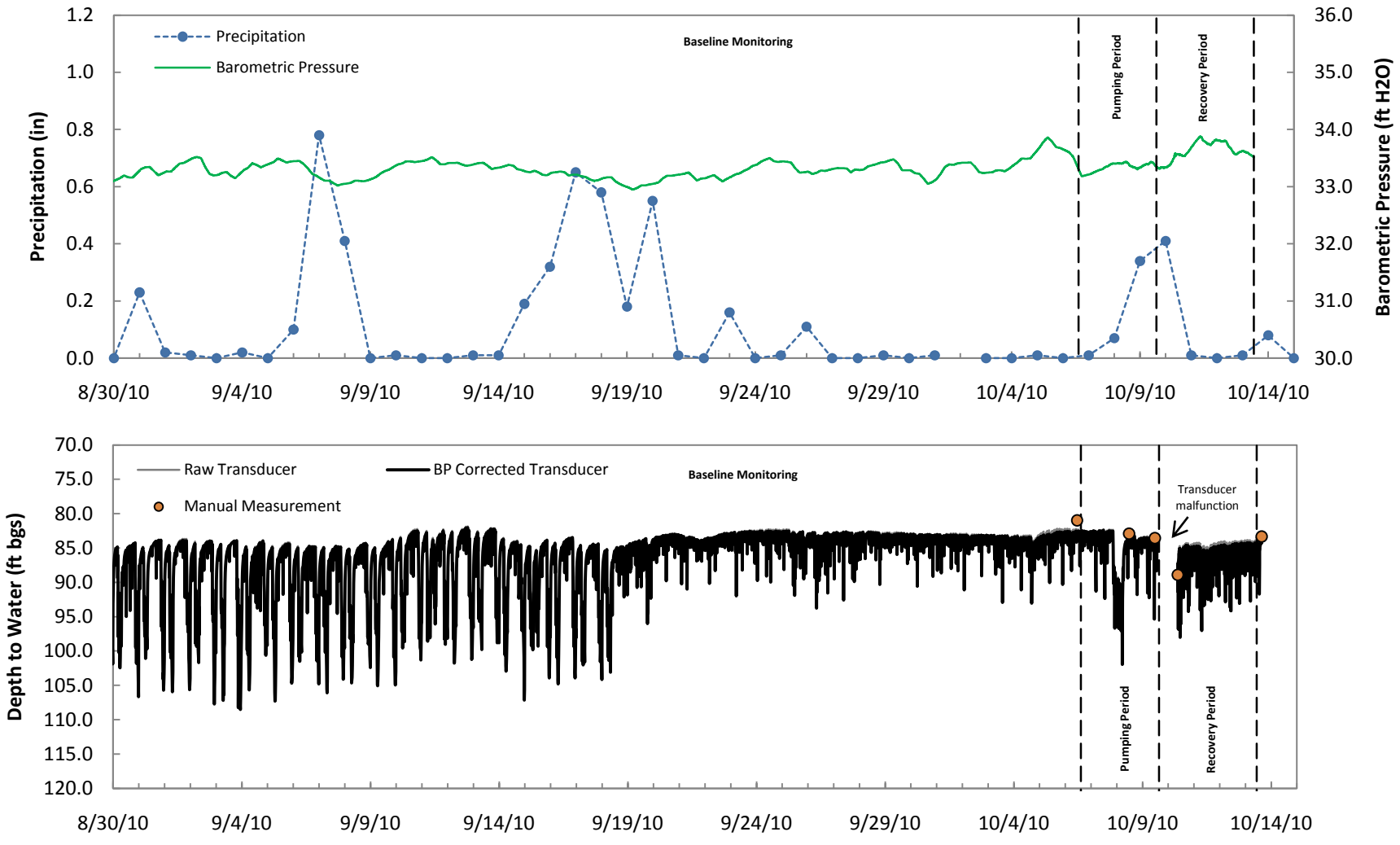
Golder Associates

Title	P2 AND P3 HYDROGRAPHS		
Project Name	SW Well 1A Development Project	Project No.	103-99709
Client Name	City of Yelm	Date	January 17, 2011

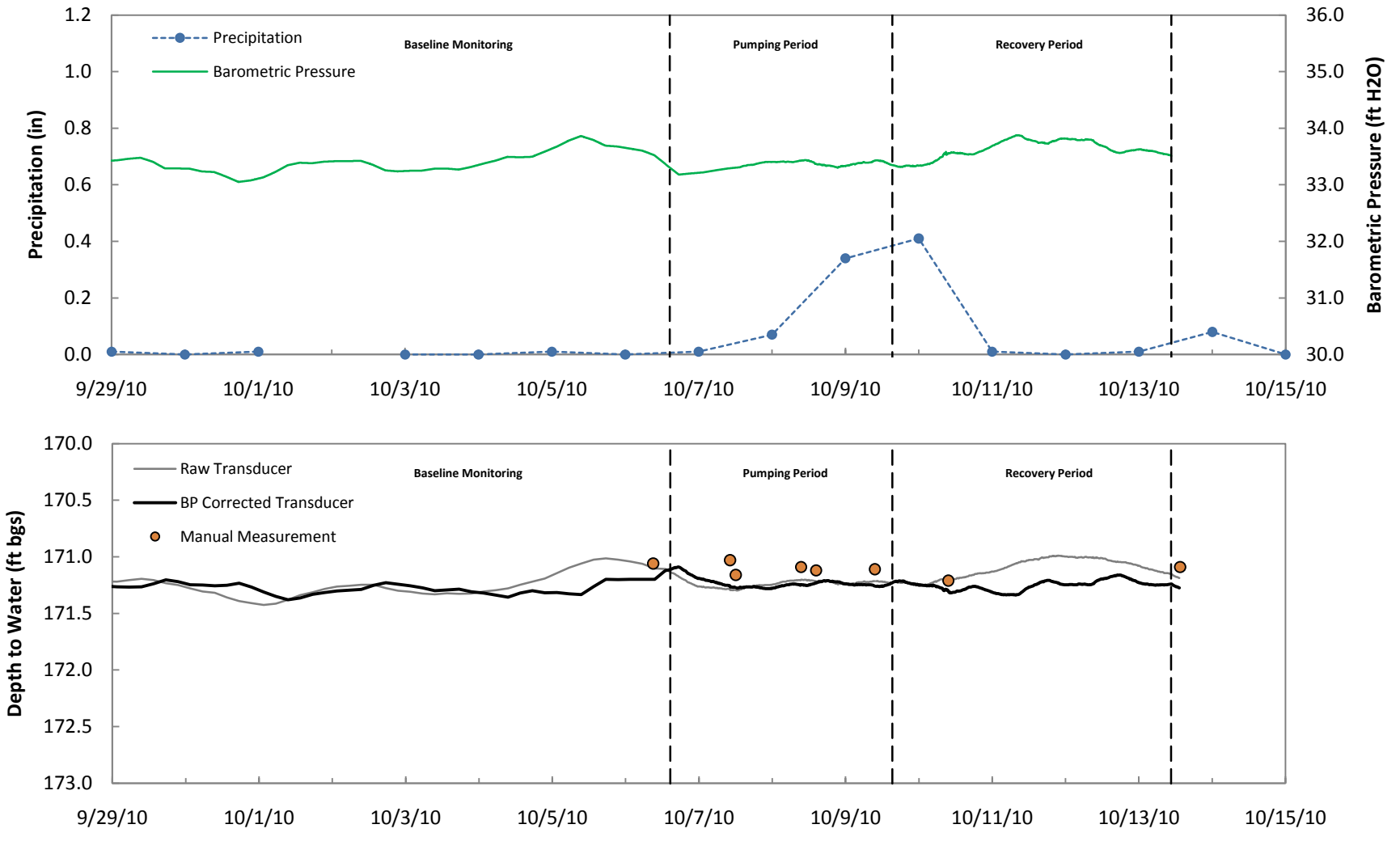
Drawn	KDJ
Checked	LMB
Reviewed	PAB

FIGURE 12

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Constant Rate Test\MW Data\Monitoring Well Data.xlsx

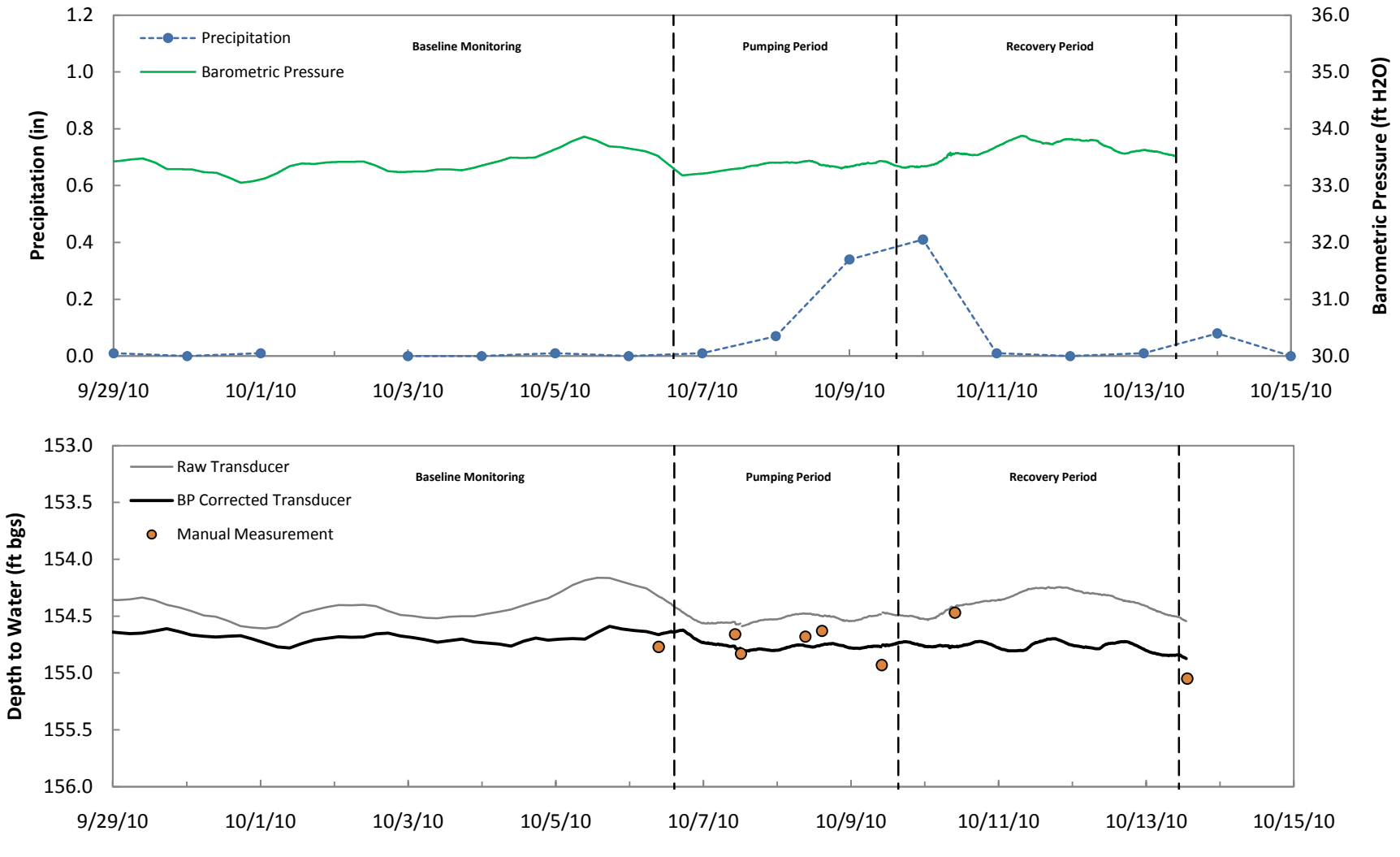


Golder Associates	Title: PURVIS WELL HYDROGRAPH		Drawn: KDJ
			Checked: LMB
			Reviewed: PAB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	FIGURE 13
	Client Name: City of Yelm	Date: January 17, 2011	



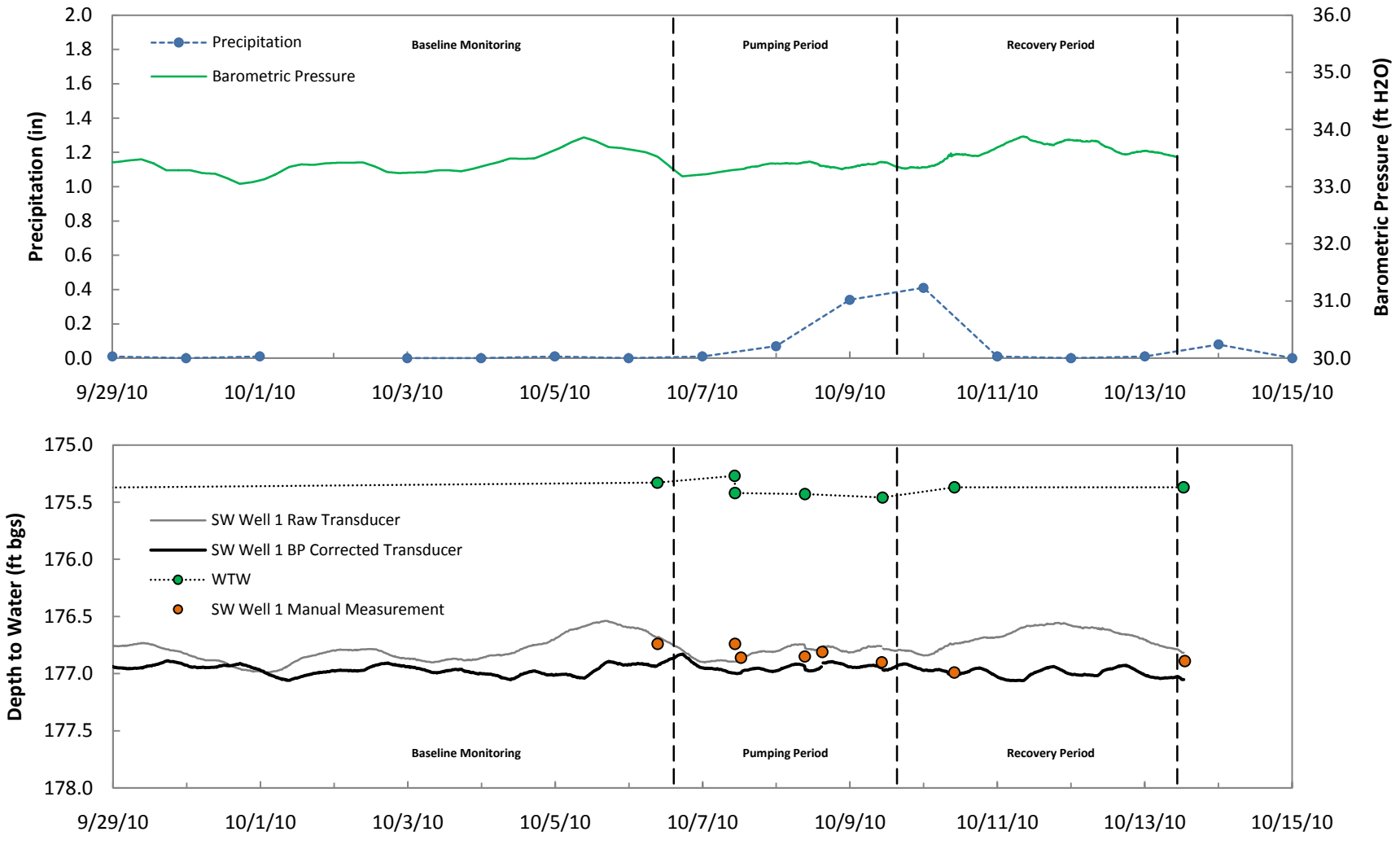
Golder Associates		Title	NORTH TEST WELL HYDROGRAPH	Drawn	KDJ
				Checked	LMB
		Project Name	SW Well 1A Development Project	Project No. 103-99709	Reviewed PAB
		Client Name	City of Yelm	Date January 17, 2011	FIGURE 14

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Constant Rate Test\MW Data\Monitoring Well Data.xlsx

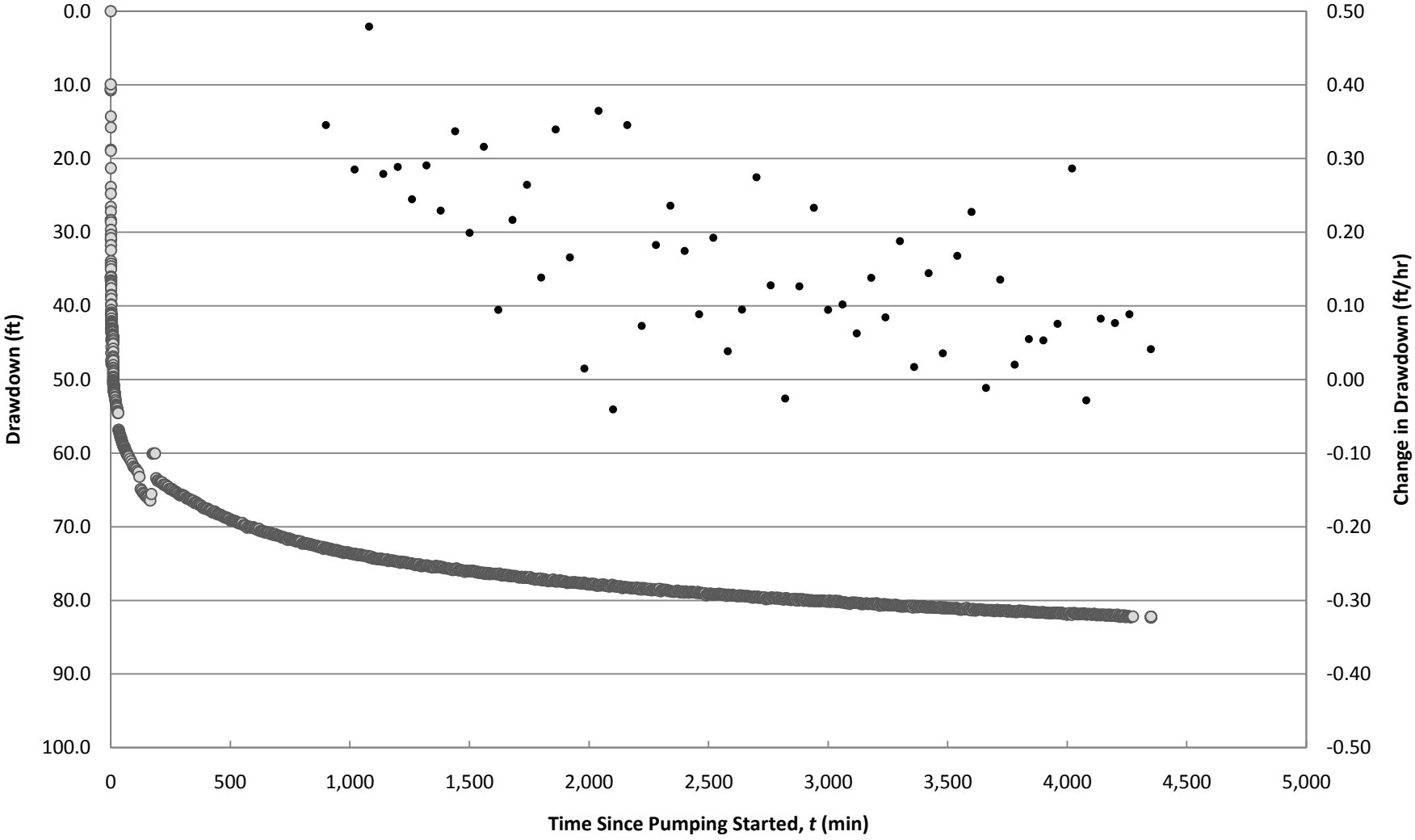


Golder Associates		Title	SOUTH TEST WELL HYDROGRAPH	Drawn	KDJ
				Checked	LMB
		Project Name	SW Well 1A Development Project	Project No. 103-99709	Reviewed PAB
		Client Name	City of Yelm	Date January 17, 2011	FIGURE 15

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Constant Rate Test\MW Data\Monitoring Well Data.xlsx



Golder Associates	Title: SW WELL 1 AND WEST TEST WELL HYDROGRAPHS		Drawn: KDJ
			Checked: LMB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
	Client Name: City of Yelm	Date: January 17, 2011	FIGURE 16



Golder Associates

○ BP Corrected Transducer Data

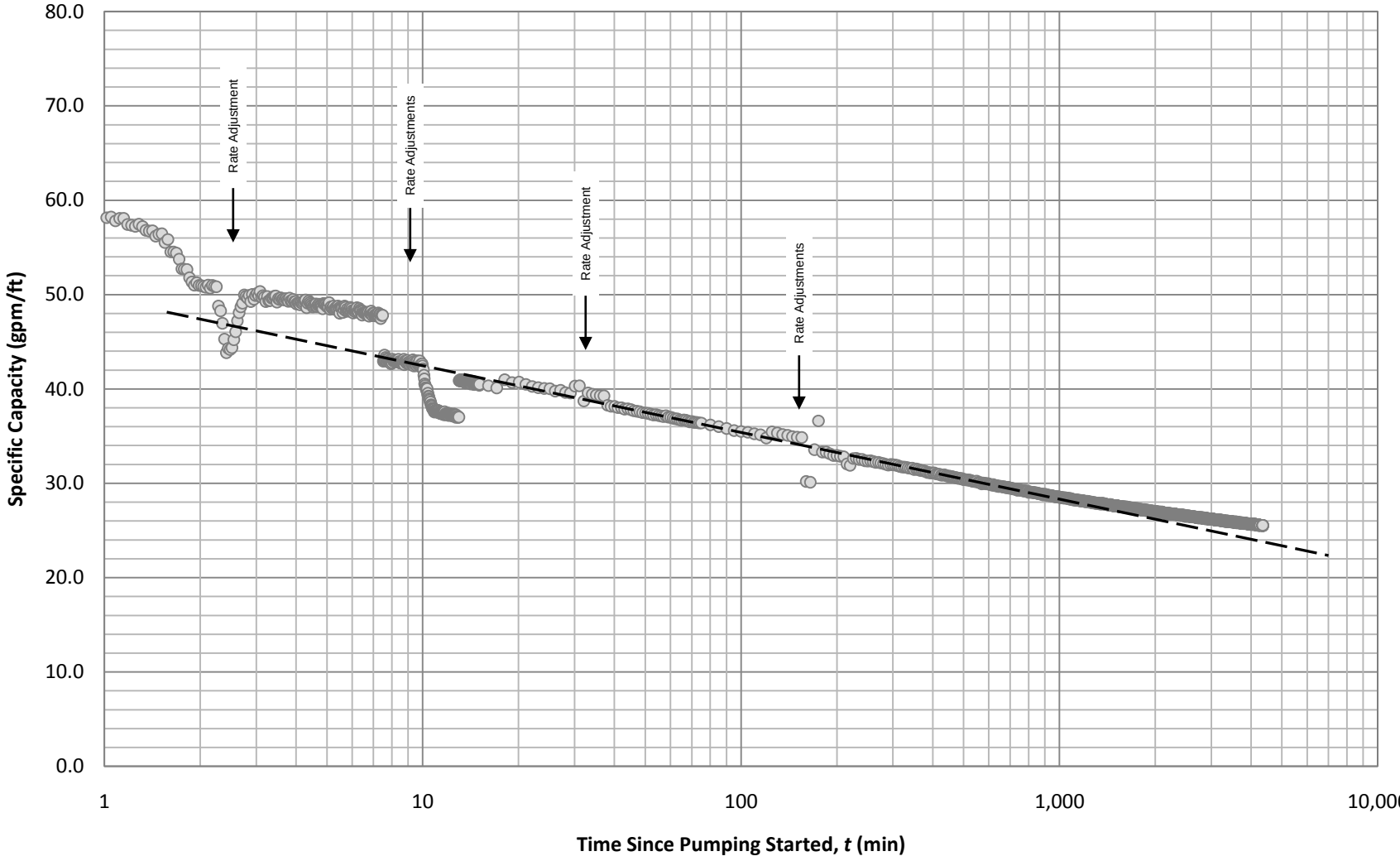
● Change in Drawdown

Title	SW WELL 1A CHANGE IN DRAWDOWN DURING PUMPING		
Project Name	SW Well 1A Development Project	Project No.	103-99709
Client Name	City of Yelm, WA	Date	January 17, 2011

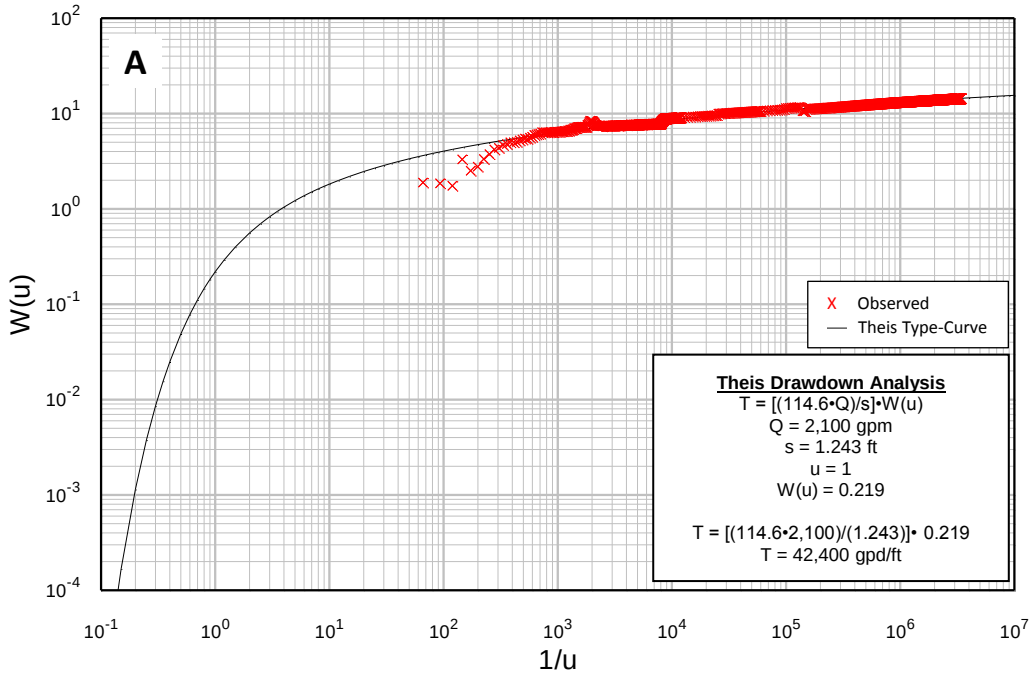
Drawn	KDJ
Checked	LMB
Reviewed	PAB

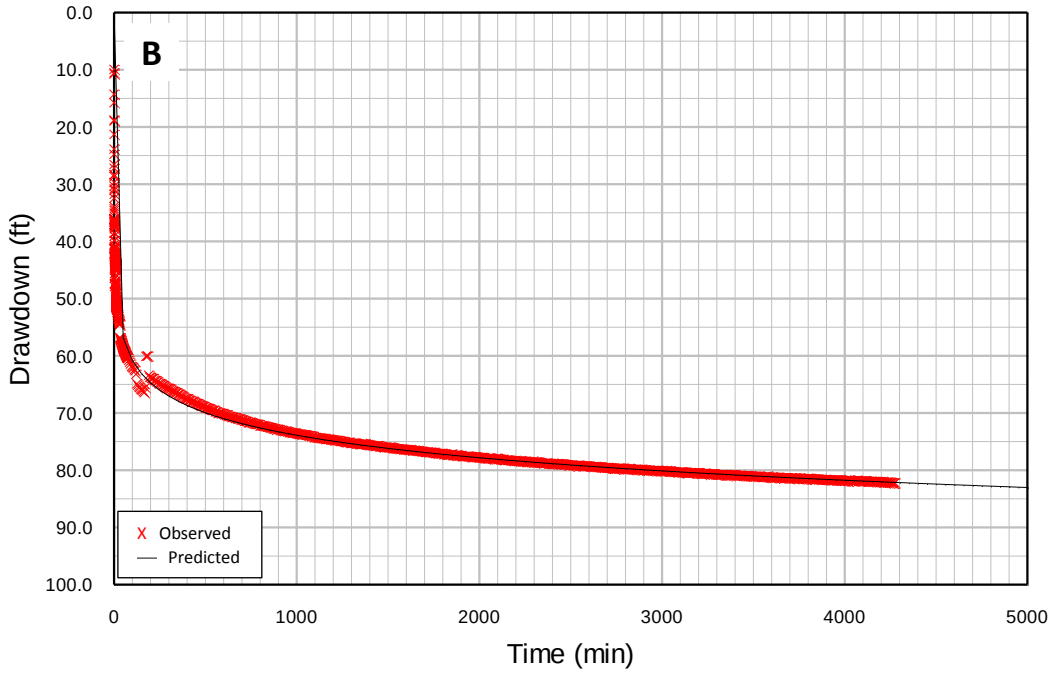
FIGURE 17

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Step Test\SW Yelm Well No1 StepTest_3.xlsx

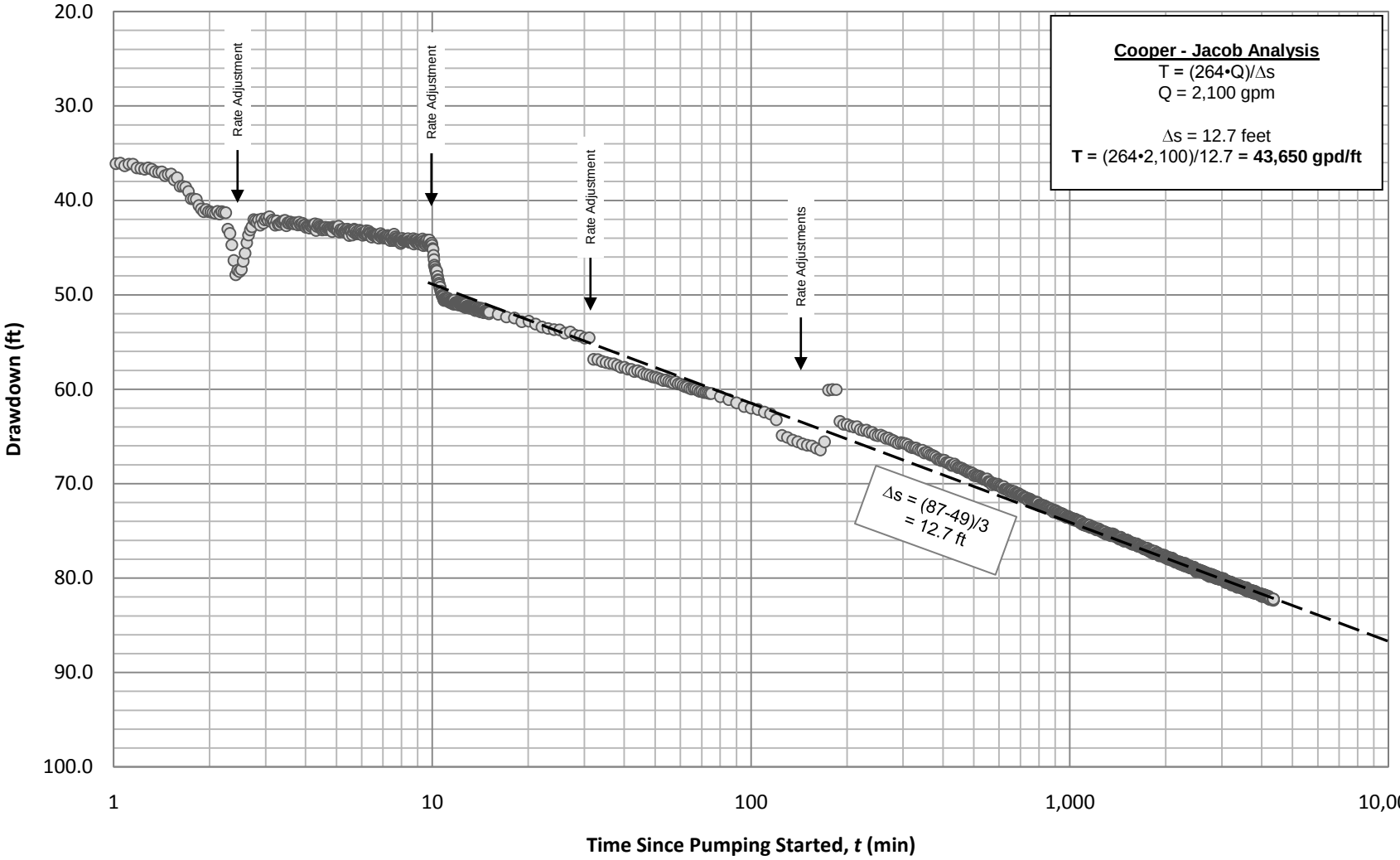


Golder Associates	SC	Title: SW WELL 1A HYDRAULIC RESPONSE – SPECIFIC CAPACITY VS. PUMPING TIME		Drawn	KDJ
				Checked	LMB
		Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed	PAB
		Client Name: City of Yelm, WA	Date: January 18, 2011	FIGURE	18

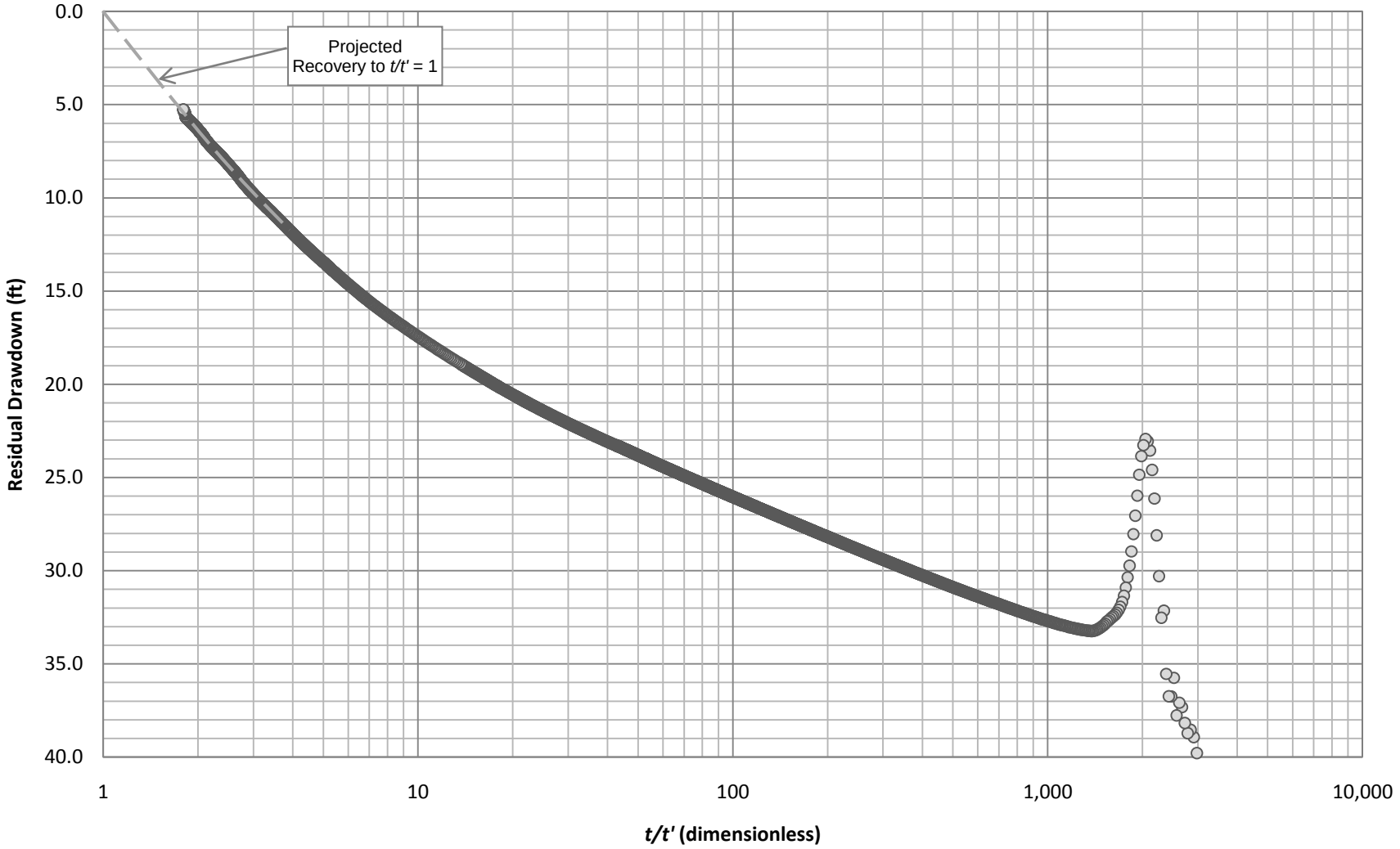




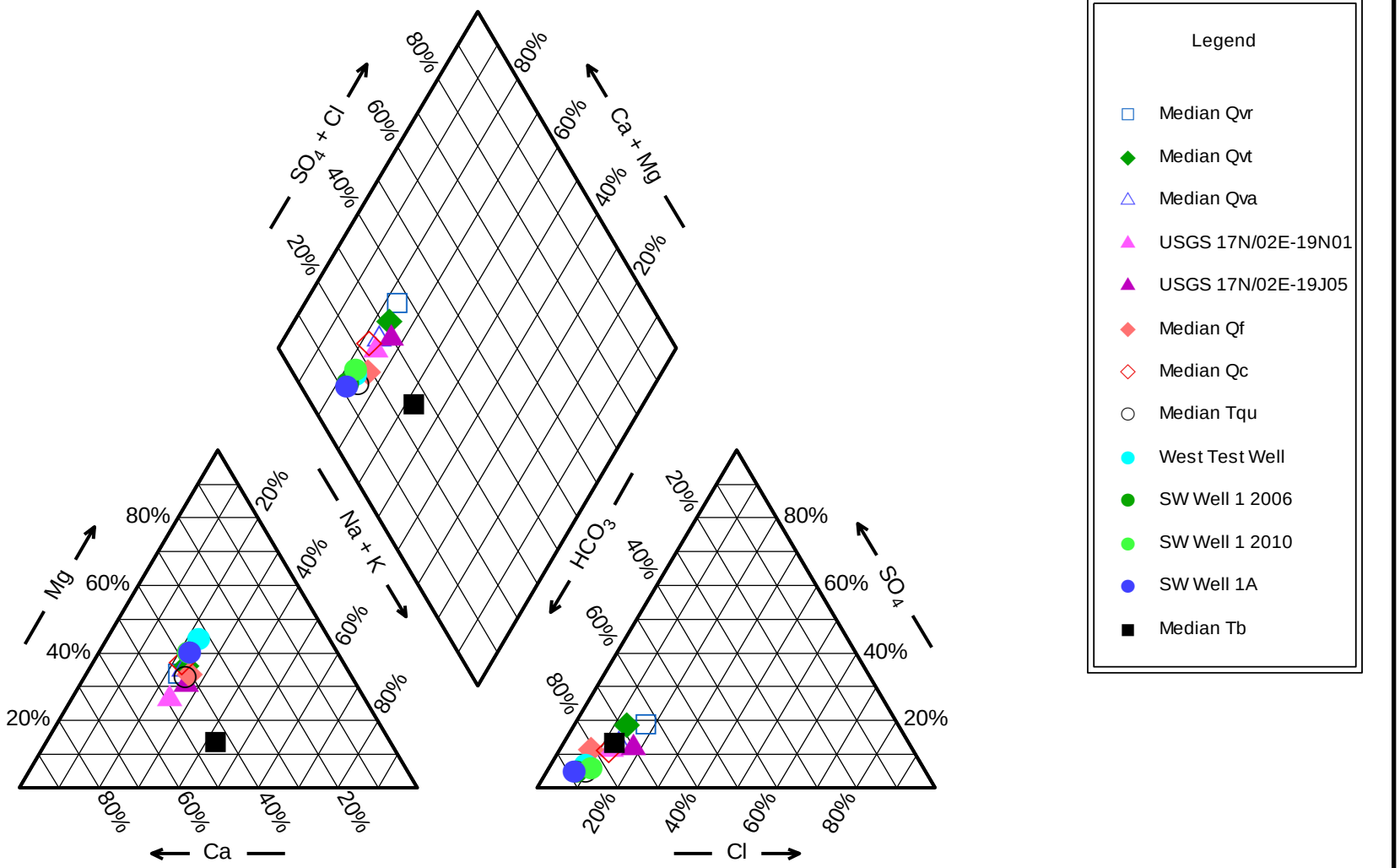
Golder Associates	Title: SW WELL 1A HYDRAULIC RESPONSE – THEIS (CONFINED; 1935)		Drawn: KDJ
			Checked: LMB
	Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
	Client Name: City of Yelm, WA	Date: January 17, 2011	FIGURE 19



Golder Associates	○ BP Corrected Transducer Data	Title: SW WELL 1A SEMILOG DRAWDOWN – COOPER AND JACOB (STRAIGHT LINE METHOD; 1946)		Drawn: KDJ
				Checked: LMB
		Project Name: SW Well 1A Development Project	Project No.: 103-99709	Reviewed: PAB
		Client Name: City of Yelm, WA	Date: January 17, 2011	FIGURE 20



Golder Associates	○ BP Corrected Transducer Data	Title	SW WELL 1A SEMILOG RECOVERY – THEIS (1946)	Drawn	KDJ
				Checked	LMB
		Project Name	SW Well 1A Development Project	Project No. 103-99709	Reviewed PAB
		Client Name	City of Yelm, WA	Date January 17, 2011	FIGURE 21



Golder Associates

Title	PIPER DIAGRAM		
Project Name	SW Well 1A Development Project	Project No.	103-99709
Client Name	City of Yelm, WA	Date	January 17, 2011

Drawn	KDJ
Checked	LMB
Reviewed	PAB

FIGURE 22

S:\Projects\2010\2010 Water Group Projects\10399709 COY SW Well No 2\Phase 3 - Aquifer Testing\Water Quality\FIG22_Piper Plot.xlsx

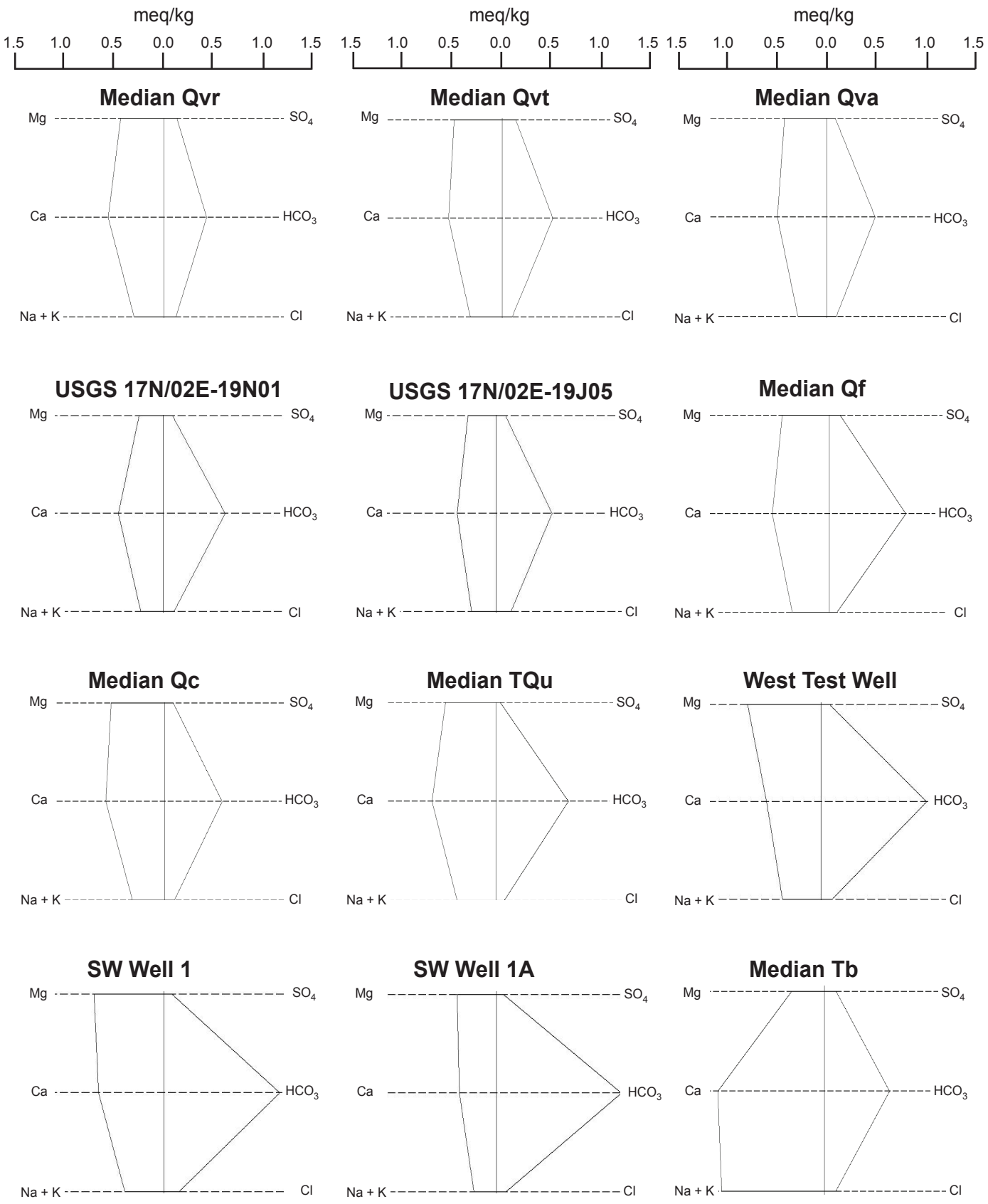
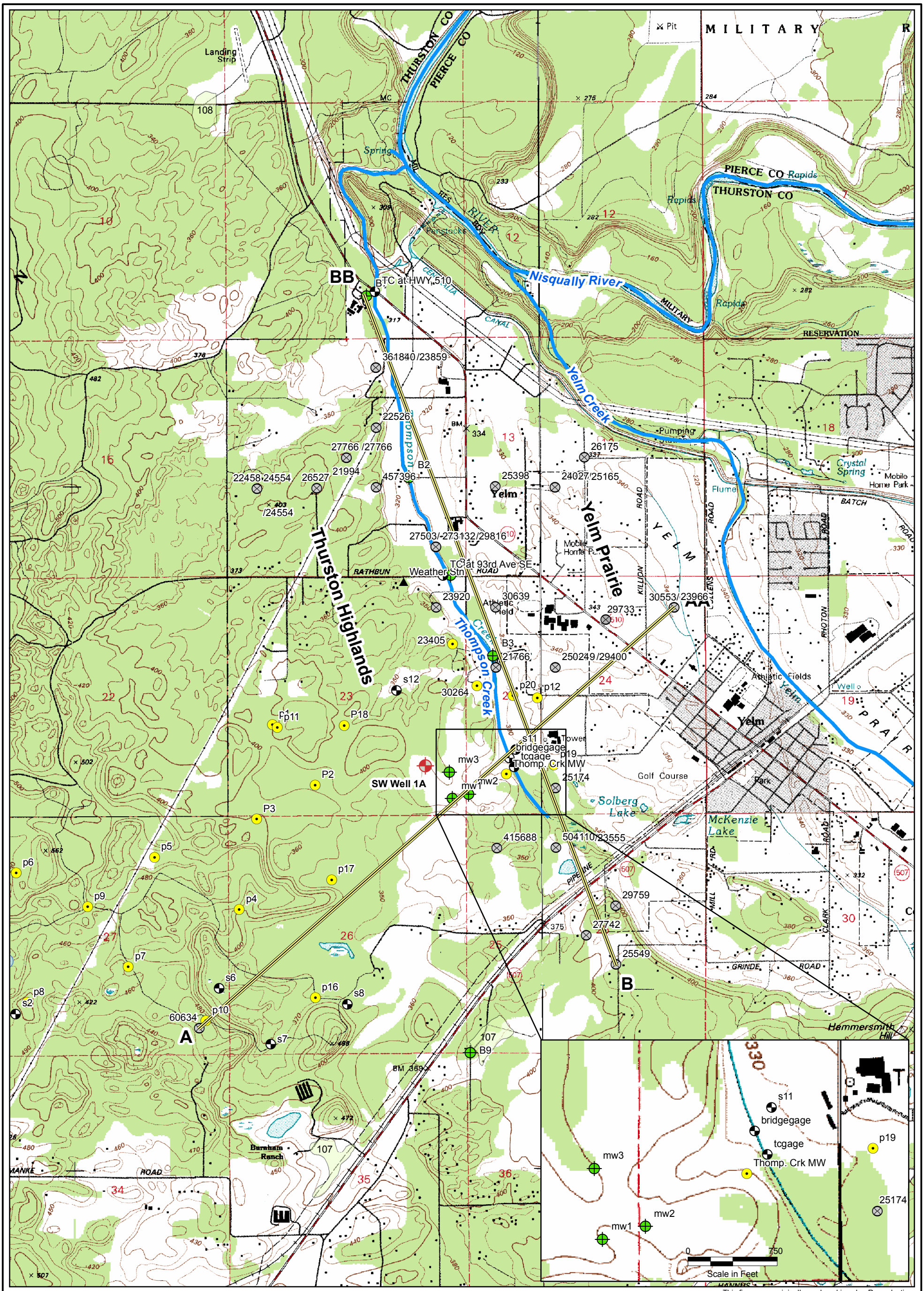


FIGURE **23**
STIFF DIAGRAMS
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

Golder Associates

APPENDIX A

GEOLOGIC CROSS-SECTIONS AND BOREHOLE LOGS



LEGEND

- Ecology Well Logs
- Monitoring Wells
- Piezometers
- SW Well 1A
- Staff Gagues
- Weather Station
- Streams

0 2000
Scale in Feet

Map Projection:
UTM NAD27, Zone 10 North

Source:
Washington State Geospatial Data Archive;
Washington Department of Ecology

N

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

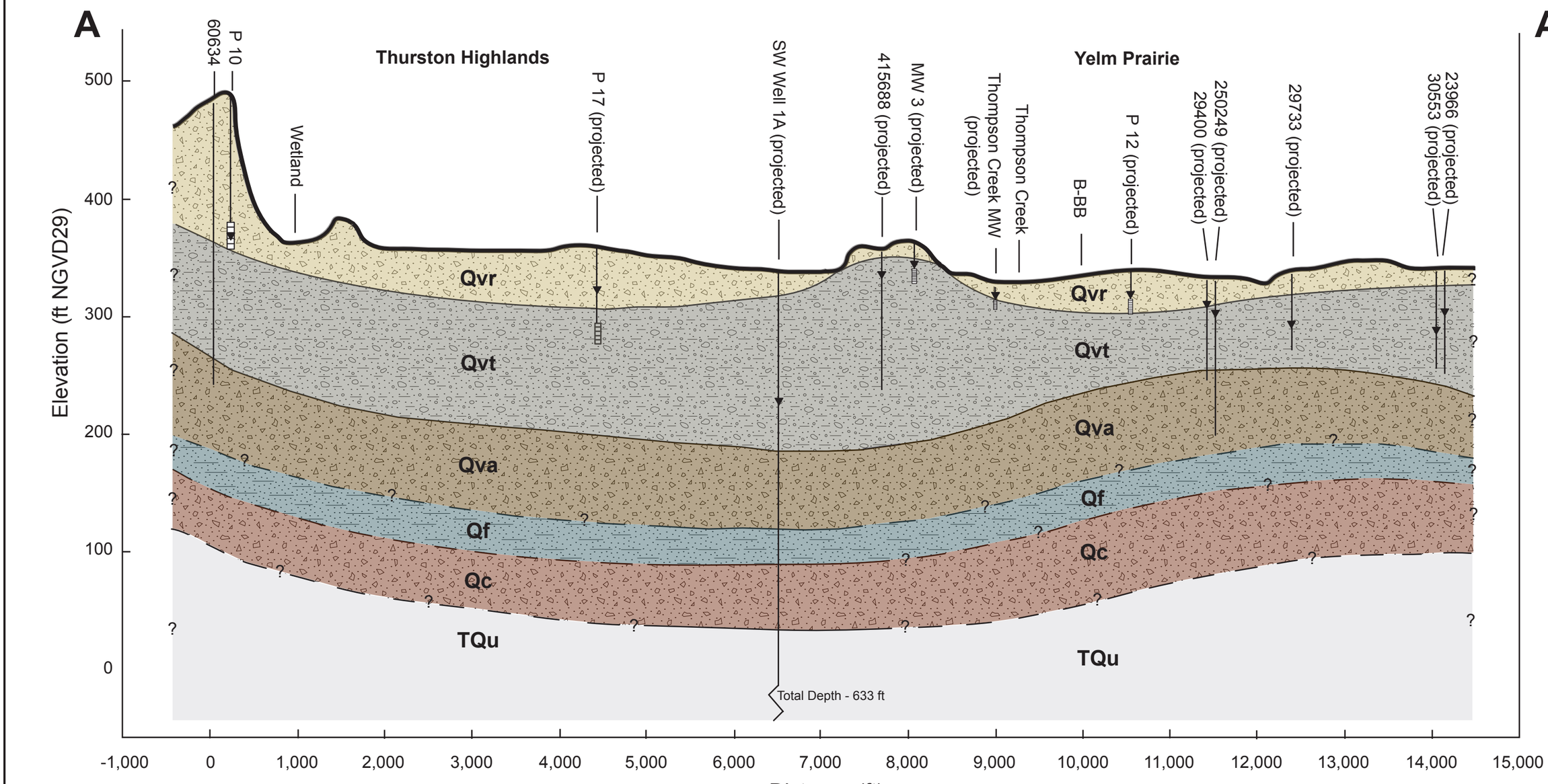
FIGURE **A-1**

GEOLOGIC CROSS-SECTION AND WELL LOCATIONS

CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

10399709 SWWell1ACross-SectionsWellLocations.mxd | 1/17/2011 | KJANSSEN

Golder Associates



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

(TQu) - Layers of clay, silt, sand and gravel of glacial and nonglacial origin.

▼ **Water Level**

Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **2**
GEOLOGIC CROSS-SECTION A-AA
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

10399709fig02.ai | Mod: 01/17/11 | LMB

Golder Associates

GA

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. 098134
UNIQUE WELL I.D. # ~~AEC 583~~
Water Right Permit No. AGV 583

(1) OWNER: Name Robert Lincoln Address 11304 Price LN. SE Rainer WA.

(2) LOCATION OF WELL: County Thurston SE 1/4 SE 1/4 Sec 27 T. 17 N., R. 1E W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) Same As Above & 11338 Price LN SE

(3) PROPOSED USE: [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] Dewater 12 A.D.

(4) TYPE OF WORK: Owner's number of well (if more than one) 2

Abandoned [ ] New well [X] Method: Dug [ ] Bored [ ]
Deepened [ ] Cable [ ] Driven [X]
Reconditioned [ ] Rotary [X] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 236' feet. Depth of completed well 236' ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from +2 ft. to 236' ft.
Welded [X]
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to 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? 20' 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 209 ft. below top of well Date 11/14/98
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?
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

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest ~~180~~ 15 gal./min. with stem set at 230 ft. for 2 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [ ]

(10) WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION

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 information.

MATERIAL	FROM	TO
HARD PAN	0	20
BOULDERS / GRAVEL	20	100
SAND GRAVEL	100	110
GRAVEL / BOULDERS	110	205
GRAVEL WATER	205	236
GRAVEL WATER	236	246

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MAY 14 1999
DEPARTMENT OF ECOLOGY
WELL DRILLING UNIT

Work Started 11/11 19. Completed 11/16 19 98

WELL CONSTRUCTOR CERTIFICATION:

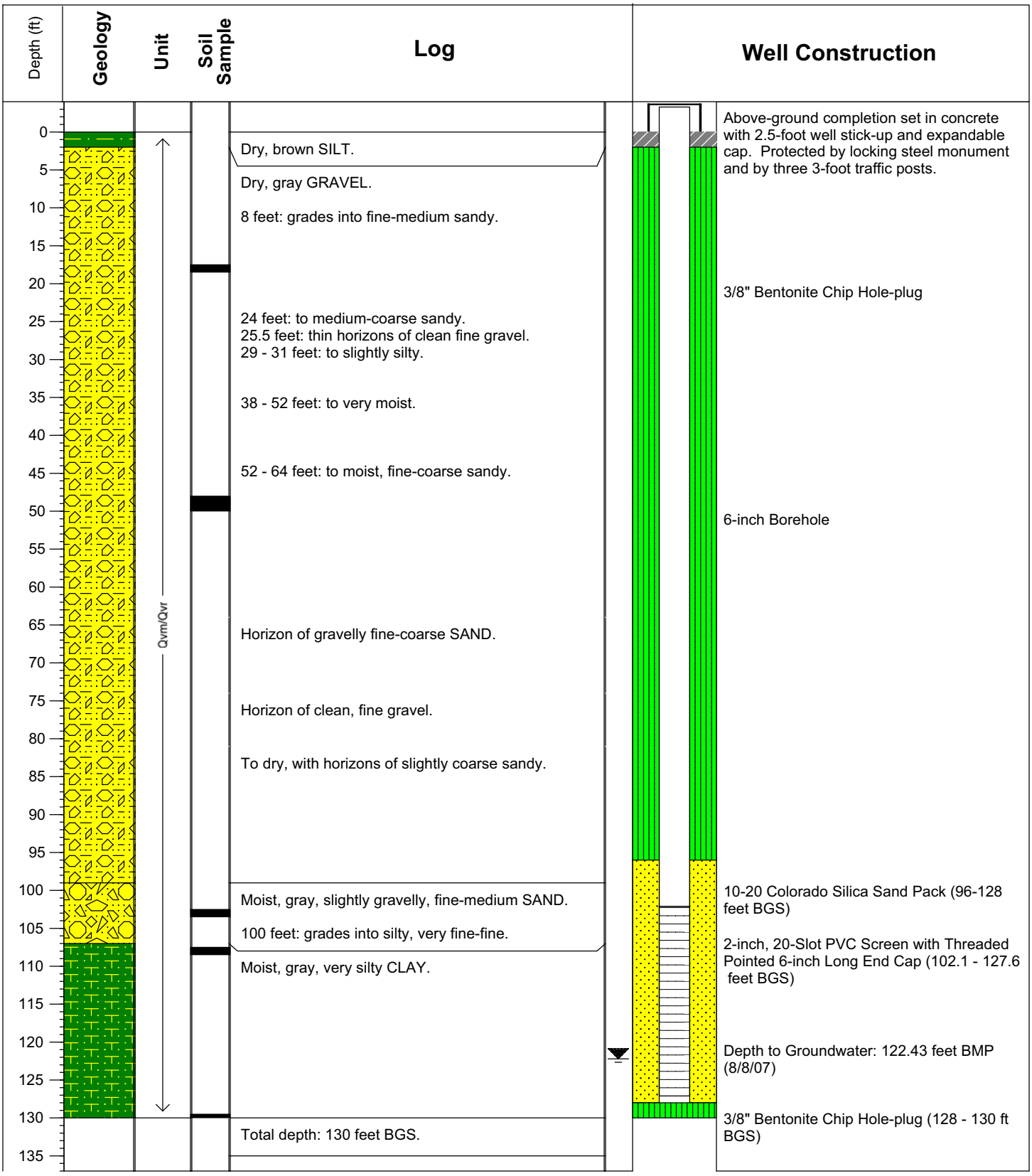
I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

NAME Dean Brothers Drilling Inc. (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 7804 Diagonal Rd SE.
(Signed) David Fraser (WELL DRILLER) License No. 2378
Contractor's Registration No. DEANBDI053LW Date 11/16/98 19 98

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs, contact the Water Resources Program at (206) 407-6600. The TDD number is (206) 407-6006.

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

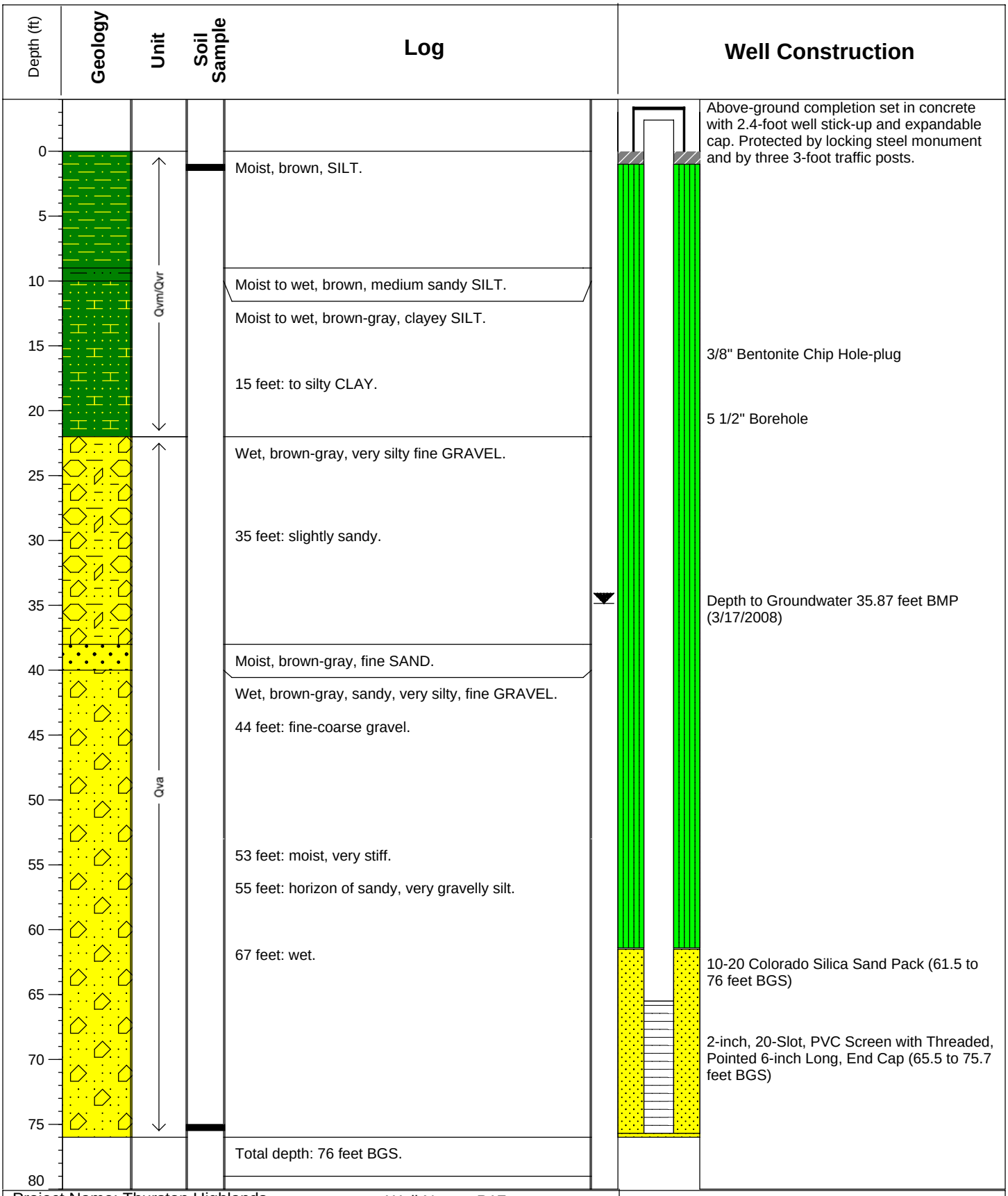


Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Ron
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P10
Ecology ID: APC078
MP Elevation: 483.71
Datum: NGVD 29
Installed: 8/7 - 8/2007
DTW: 122.43 BMP on 8/8/2007

Figure A-10
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P10
Shea, Carr, Jewell
Yelm, Washington
JC0701, 8/2007

PgG



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Tim
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P17
Ecology ID: BAS470
MP Elevation: 349.56
Datum: NGVD 29
Installed: 3/14/2008
DTW: 35.87 BMP on 3/17/2008

Figure A-16
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P17
Thurston Highlands, LLC
Yelm, Washington
JC0701, 9/2008

PgG

RESOURCE PROTECTION WELL REPORT Notice of Intent No. R59967

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)* 303327

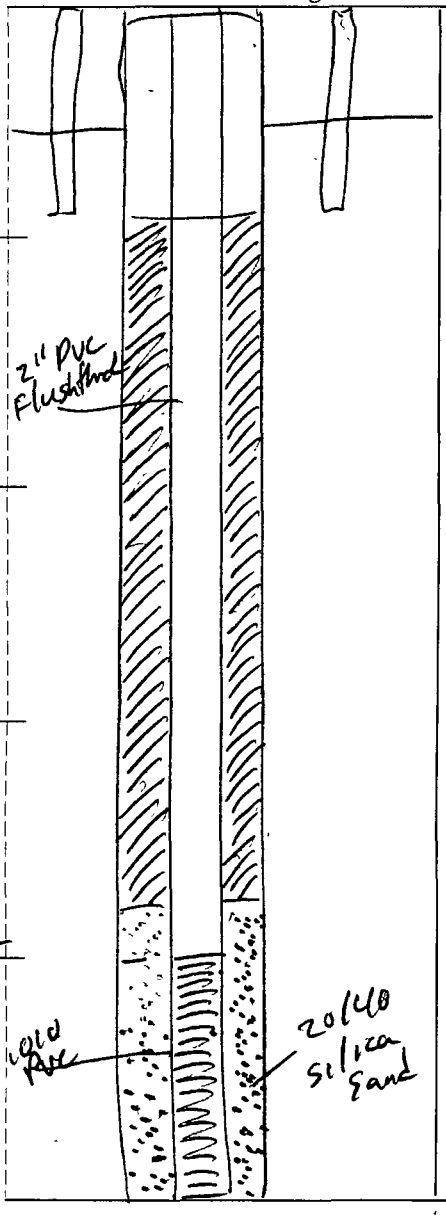
(X) Construction
( ) Decommission *Original Construction Notice of Intent Number* _____

Type of Well *("x" in circle)*
(X) Resource Protection
( ) Geotech Soil Boring

Property Owner Thurston Highlands Assoc. LLC
Unique Ecology Well ID Tag No BAS470
Consulting Firm Pacific Groundwater Group
Driller or Trainee Name Timothy S. Smith
Driller or Trainee Signature [signature]
Driller or Trainee License No 2837

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

Site Address SW Longmire St
City Yelm County Thurston
Location NE 1/4 - 1/4 NW 1/4 Sec 26 Twn 17N R 1 (E)WM *circle one*
Lat/Long (s, t, r still REQUIRED) Lat Deg _____ Lat Min/Sec _____ Long Deg _____ Long Min/Sec _____
Tax Parcel No 21726200000
Cased or Uncased Diameter _____ Static Level 60'
Work/Decommission Start Date 3/14/08
Work/Decommission Completed Date 3/14/08

Construction/Design	Well Data	Formation Description
	Drilled method: 6" tube Air Rotary casing: 2" sch 40 PVC +2.5 - 65' screen 2" sch 40 PVC .010 65 - 75' sand: 20/40 silica sand 62 - 75' seal: Bentonite chips 3 - 62'	0 silt 9 sandy silt 10 clayey silt silty clay 22 silty gravel 38 sand 40 silty gravel 53 very silty tight gravel

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MAY 15 2008
Washington State Department of Ecology

Scale 1"= _____ Page _____ of _____

Please print, sign and return to the Department of Ecology

Water Well Report

Original – Ecology, 1st copy – owner, 2nd copy – driller

Construction/Decommission

☒ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* 178603

Current Notice of Intent No. W189951

Unique Ecology Well ID Tag No. AKM-893

Water Right Permit No. EXEMPT

Property Owner Name Pat THOMAS

Well Street Address 14628 GLORIA RD SE

City YELM County THURSTON

Location NW1/4-1/4 NW1/4 Sec 25 Twn 17N R 1E ☐ E WM ☐ or WWM ☐ circle one

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

Tax Parcel No. 21725220302

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

DIMENSIONS: Diameter of well 6 inches, drilled 117 ft.
Depth of completed well 117 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6 " Diam. from 0 ft. to 117 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 _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____
Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
Material used in seal Bentonite chips
Did any strata contain unusable water? ☐ Yes ☐ No
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

PUMP: Manufacturer's Name _____
Type: _____ H.P. _____

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 22 ft. below top of well Date 7-12-05
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? _____
Yield: _____ gal./min. with _____ ft. drawdown after _____ 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

Date of test _____
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest 13-15 gal./min. with stem set at 100 ft. for 2.5 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 indicate all water encountered. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
brn Sand	0	10
dry brn Sand	10	30
grey Coarse Sand - Gravel - Active	30	62
fine silt + Lg gravel	62	84
grey silt	84	96
dense brn Sand + gravels w/ boulders	96	117

RECEIVED
AUG 25 2005
Washington State Department of Ecology

Start Date 7-11-05 Completed Date 7-12-05

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) John Artman
Driller/Engineer/Trainee Signature _____
Driller or trainee License No. 2673

If TRAINEE,
Driller's Licensed No. _____
Driller's Signature _____

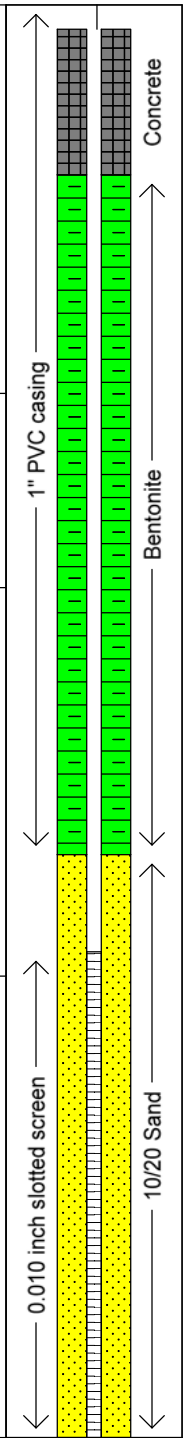
Drilling Company Hart Drilling / Boart Longyear
Address PO Box 1890
City, State, Zip MILTON WA 98354
Contractor's Registration No BOARTLC055PZ Date 7-28-05

Ecology is an Equal Opportunity Employer. ECY 050-1-20 (Rev 2/03)

Project Name: **Tahoma Terra**	Well No. : **MW-3**
Location : Yelm	DOE Well No. : APF 880
Drilling Contractor : ESN NW	**WELL INFORMATION**
Drilling Equipment : Power Probe 9500	Total Depth : 29.5 Feet
Driller : Don Harnden	Casing : 17.5' x 1"
Logged By : Kevin Vandehey	Screen Length :10'x1"
Date : 6/8/07	Filter Pack : 10/20 sand
Depth to water : N/A	Seal : No. 8 Bentonite

INSIGHT GEOLOGIC, INC.

Depth/Feet	Lithology	Inches Driven /Recovery	USCS	SOIL DESCRIPTION	Well Construction
0		48/32	SP	SAND: Light gray fine sand, loose, moist	
5		48/44			
		48/48		Grades to fine to medium sand	
10					
		48/34	GM	GRAVEL WITH SAND: Light gray fine to coarse gravel with fine to coarse sand, dense, moist	
15		48/14			
20				Very dense, no samples taken	
25					



RECORD OF BOREHOLE THOMPSON CREEK MW

SHEET 1 of 1

PROJECT: Yelm Groundwater Study
PROJECT NUMBER: 043-1328
LOCATION: Thompson Creek

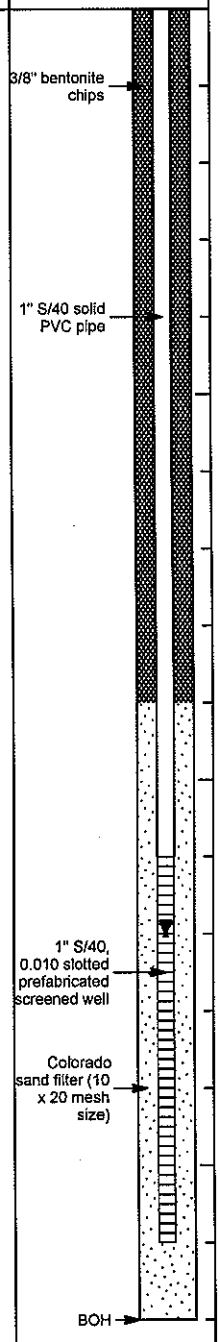
DRILLING DATE: 11-9-05
DRILLING METHOD: Hollow Stem Auger
DRILL RIG: Canterra CT 450 #123

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: Not Surveyed
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	COMMENTS
0	0.0 - 2.0 **SANDY SILT w/ GRAVEL** dark grayish brown (moist 10YR 2/2); poorly graded, subrounded gravels 1-2" dia.; fine sands; very soft	ML				
	2.0 - 6.0 **WELL-GRADED GRAVEL w/ SILT and SAND** dark brown (moist 10YR 3/3); subrounded/subangular gravels 1-2" dia.	GW-GM				
5	6.0 - 7.5 **POORLY GRADED SAND w/ GRAVEL** brown (moist 10YR 4/3); trace gravels subrounded/subangular to 1" dia.; soft; moist	SP				
	7.5 - 10.0 **WELL-GRADED GRAVEL w/ SILT and SAND** brown (moist 10YR 4/3); gravels to 3/4" dia.; moist	GW-GM				
10	10.0 - 15.0 Same as above; dark grayish brown (moist 10YR 4/2); trace gravels to 1" dia.; fine sands	GW-GM				Water encountered at 12' bgs.
15	15.0 - 16.0 **POORLY GRADED SAND** greenish gray (wet 10GY 5/1); trace silt; soft	SP				
	16.0 - 17.0 **SILT** greenish gray (moist 5GY 5/1); soft	ML				
20	Boring completed at 17.0 ft.					

WELL CONSTRUCTION NOTES
WATER LEVELS
WELL GRAPHIC

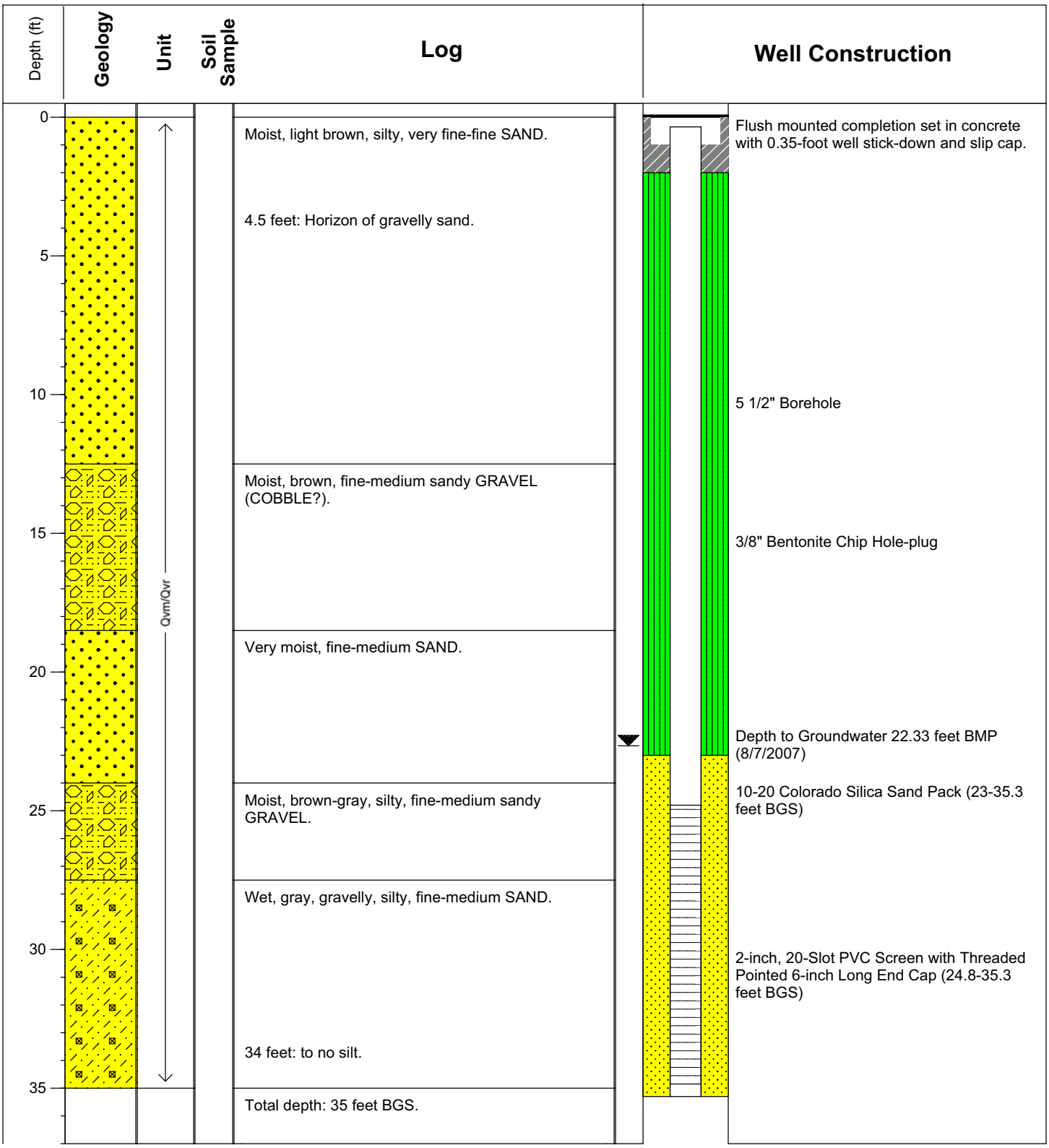


DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: Ken Phillips

LOGGED: Ken Janssen
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG THOMPSON CREEK.GPJ GLDR_WA.GDT 5/9/06



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Ron
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P12
Ecology ID: APC076
MP Elevation: 337.42
Datum: NGVD 29
Installed: 8/6/2007
DTW: 22.33 BMP on 8/7/2007

Figure A-12
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P12
Shea, Carr, Jewell
Yelm, Washington
JC0701, 8/2007

PgG

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. R 71618

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☑ Construction 273203

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm Pacific Groundwater Group

Unique Ecology Well ID Tag No. APC076 P-12

Type of Well *(select one)*

☑ Resource Protection

☐ Geotech Soil Boring

Property Owner Thurston Highlands LLC

Site Address West Yelm undeveloped

City Yelm County Thurston

Location NE 1/4-1/4 SW 1/4 Sec 24 Twn 17 R 1 Select One ☑ EWM ☐ WWM

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

Tax Parcel No. 78640000010

Cased or Uncased Diameter 6" Static Level 24'

Work/Decommission Start Date 8/6/07

Work/Decommission Completed Date 8/6/07

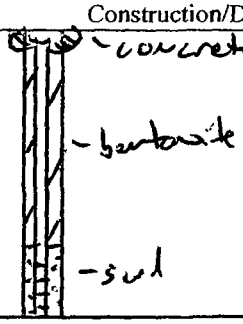
WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Ronald Sunk

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 2661

If trainee, licensed driller's Signature and License No. _____

Construction/Design	Well Data	Formation Description
	Drill Method: Air Rotary Casing: 2" sch 40 PVC +5 to 25 Screen: 2" sch 40 PVC .020 25' to 35' Sand: 10/20 22 to 35 Seal: Bentonite chips 2 to 22'	silty sands w/gravels
35		35'

SCALE: 1"= 35'

PAGE 1 OF 1

ECY 050-12 (Rev. 2/03)

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. 012495
Water Right Permit No.

(1) OWNER: Name WILLUWEIT SIDNEY & KATHY Address 14812 BERRY VALLEY RD YELM, WA 98597-

(2) LOCATION OF WELL: County THURSTON - SE 1/4 NW 1/4 Sec 24 T 17 N., R 1E WM
(2a) STREET ADDRESS OF WELL (or nearest address) SAME

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one)
NEW WELL Method: AIR ROTARY

(5) DIMENSIONS: Diameter of well 06 inches
Drilled 90 ft. Depth of completed well 90 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 06 * Dia. from 0 ft. to 90 ft.
WELDED * Dia. from ft. to ft.
* Dia. from ft. to ft.

Perforations: NO
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE CLAY
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 22 ft. below top of well Date 04/17/89
Artesian Pressure lbs. per square inch Date / /
Artesian water controlled by

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

Recovery data

Time	Water Level	Time	Water Level	Time	Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 20 gal/min. w/ stem set at 85 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? 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 in formation.

MATERIAL	FROM	TO
TOPSOIL	0	2
TOPSOIL GRAVEL COBBLES	2	5
GRAVEL COBBLES SEEPAGE	5	19
CLAY GRAVEL COBBLES	19	77
LOOSE GRAVEL CLAY AND WATER	77	82
SAND GRAVEL WATER	82	90

Work started 04/17/89 Completed 04/17/89

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

NAME RICHARDSON WELL DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS PO BOX 94427 TACOMA WA 98

[SIGNED] [signature] License No. 1424

Contractor's Registration No. RICHAW#3210B Date 05/11/89

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W123417
UNIQUE WELL I.D. # ACY777
Water Right Permit No.

(1) **OWNER:** Name HOFFMAN, JESSE Address 9910 DURANT ST. S.E. YELM, WA 98597

(2) **LOCATION OF WELL:** County THRUSTON SE 1/4 NW 1/4 Sec 24 T. 17 N., R 1E W.M.

(2a) **STREET ADDRESS OF WELL** (or nearest address) 9910 DURANT ST.SE YELM, WA 98597

(3) **PROPOSED USE:** [X] Domestic [ ] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ] DeWater

(4) **TYPE OF WORK:** Owner's number of well (If more than one)
Abandoned [ ] New well [X] Method: Dug [ ] Bored [ ] Deepened [ ] Cable [ ] Driven [ ] Reconditioned [ ] Rotary [X] Jetted [ ]

(5) **DIMENSIONS:** Diameter of well 6 inches. Drilled 137 feet. Depth of completed well 137 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6" Diam. from +1.5 ft. to 137 ft.
Welded [X]
Liner installed [ ] " Diam. from ft. to ft.
Threaded [ ] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to 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? 18 ft.
Material used in seal BENTONITE CHIPS
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
Type: H.P.

(8) **WATER LEVELS:** Land-surface elevation above mean sea level ft.
Static level 31 ft. below top of well Date 12/30/99
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 [X] If yes, by whom?
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

Date of test
Bailer test gal./min. with ft. drawdown after hrs.
Airtest 15 gal./min. with stem set at 135 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(10) **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

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 information.

MATERIAL	FROM	TO
BROWN BOULDERS COBBLES GRAVEL SAND SILT	0	30
DARK BROWN COBBLES LOOSE GRAVEL SAND SILT WET	30	33
BROWN BOULDERS COBBLES GRAVEL SAND SILT SOME WATER	33	40
GRAY SILTY SAND WET	40	50
GRAY CLAY	50	65
GRAY COBBLES GRAVEL SAND CLAY	65	70
BROWN COBBLES GRAVEL SAND SILT WET SOME WATER	70	74
BROWN COBBLES GRAVEL SAND SILT WET	74	90
BROWN COBBLES GRAVEL SAND SILT SOME WATER 3-5 GPM	90	103
REDDISH BROWN COBBLES GRAVEL SAND SILT SOME WATER 3-5 GPM	103	112
BROWN COBBLES GRAVEL SAND SILT SOME WATER 5-7 GPM	112	120
BROWN COARSE GRAVEL SAND SILT WATER	120	137

Work Started 12/29/99 Completed 12/30/99

WELL CONSTRUCTOR CERTIFICATION:

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

NAME TACOMA PUMP & DRILLING (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address 30316 MTN. HWY. GRAHAM, WA 98338
(Signed) (WELL DRILLER) License No. 2432
Contractor's Registration No. TACOMPD203PF Date 1/24/00

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. ....
Permit No. ....

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

(1) OWNER: Name T ed Foreid Address Rt. 3 Box 3861 Yelm, Wa. 98597

(2) LOCATION OF WELL: County Thurston — SW ¼ NE ¼ Sec 24 T 17 N., R. 1E 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) 1

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 64 ft. Depth of completed well 61 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6" Diam. from 0 ft. to 61 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 .... Model No. ......
Diam. ...... Slot size ...... from ...... ft. to ...... ft.
Diam. ...... Slot size ...... from ...... ft. to ...... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: ......
Gravel placed from ...... ft. to ...... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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 None
Type: ...... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level ...... ft.
Static level 48 ft. below top of well Date 11-28-73
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? ......
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

Date of test ......
Bailer test 15 gal./min. with 5 ft. drawdown after 1 hrs.
Artesian flow ...... g.p.m. Date 11-28-73
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
Top soil & sand	0	2
Gravel & boulders	2	20
Seapage	20	21
Clay gravel & boulders	21	45
Yellow clay	45	51
Gray clay	51	53
Clay gravel & sand	53	59
Water & gravel	59	64

RECEIVED
OCT 1 ... 1974
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 11-28, 19 73 Completed 11-28, 19 73

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 Richardson Well Drilling Co. (Person, firm, or corporation) (Type or print)

Address 219 So. 115th Tacoma, Wa. 98444

[Signed] [signature] (Well Driller)

License No. 223-02-6500 Date 12-13, 19 73

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) **OWNER:** Name William C. Gibby Address Rt. # 1 Box 1940-9, Yelm, Wa. 98597

(2) **LOCATION OF WELL:** County Thurston — NE ¼ NE ¼ Sec 24 T. 17 N., R. 1E 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) ....
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 83 ft. Depth of completed well 83 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from 0 ft. to 83 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 Model No
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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 42 ft. below top of well Date 1/13/76
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?
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

Date of test
Bailer test 15 gal./min. with 25 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date 1/13/76
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
Top soil & gravel	0	1
Gravel, boulders & clay	1	12
Hardpan & boulders	12	40
Gravel, little water	40	43
Clay, gravel & Boulders	43	79
Clay & gravel, water	79	83

RECEIVED
(illegible) 3 1976
DEPARTMENT OF ECOLOGY

Work started 1/12/ 19 76 Completed 1/13/76 19

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 Richardson Well Drilling Company
(Person, firm, or corporation) (Type or print)
Address P.O. Box 44408, Tacoma, Wa. 98444

[Signed] (Well Driller)

License No. 223-02-6500 Date February 25, 1976

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name Douglas L. Cameron Address Rt. # 3 Box 3249, Yelm, Wa. 98597

(2) LOCATION OF WELL: County Thurston — NE ¼ NE ¼ Sec. 24 T. 17 N., R. 1E W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 84 ft. Depth of completed well 80 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 80 ft.
Threaded [ ] ..... " Diam. from ..... ft. to ..... ft.
Welded [X] ..... " Diam. from ..... ft. to ..... ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name .....
Type ..... Model No. .....
Diam. ..... Slot size ..... from ..... ft. to ..... 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? 20 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 Jacuzzi Bros., Inc.
Type: Submersible, 5S4B H.P. 1/2

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 35 ft. below top of well Date 7/8/74
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 [X] If yes, by whom? .....
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

Date of test 7/8/74
Bailer test 15 gal./min. with 20 ft. drawdown after 1 hrs.
Artesian flow ..... g.p.m. Date .....
Temperature of water ..... Was a chemical analysis made? Yes [ ] No [X]

(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
Top soil	0	5
Sand & gravel	5	20
Hardpan	20	40
Gray clay, gravel & some water	40	60
[illegible]	[illegible]	[illegible]
Gray clay & gravel	60	78
Gravel, water	78	80
Boulder	80	84

RECEIVED
AUG 21 1974
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 7/8/ 19 74 Completed 7/8/ 19 74

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 Richardson Well Drilling Company
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44408, Tacoma, Wa. 98444

[Signed] .....
(Well Driller)

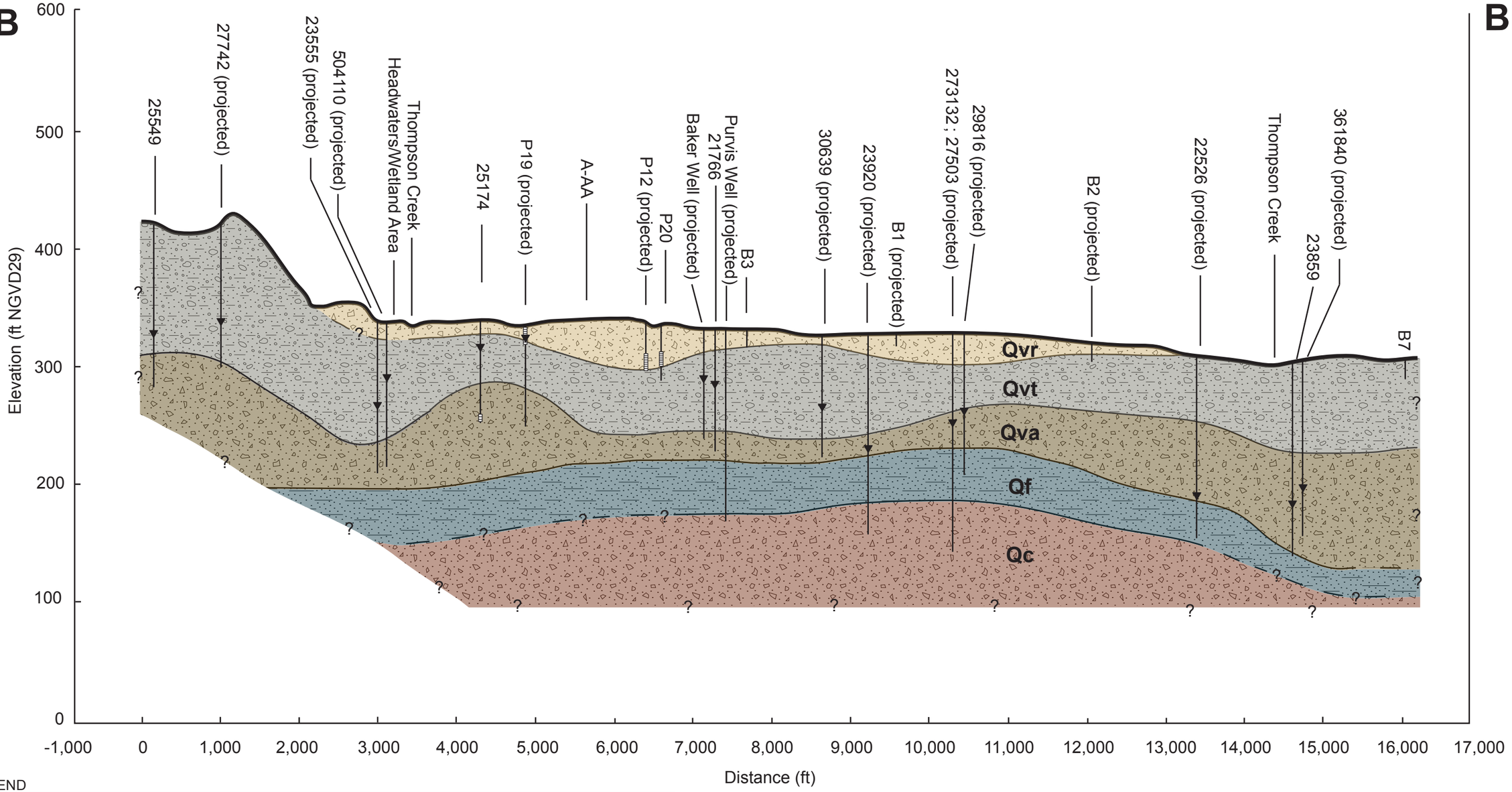
License No. 223-02-6500 Date August 20, 19 74

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

B

BB



LEGEND

Recessional Outwash (Qvr) - Sand and gravel, locally including low-permeability moraine deposits (Qvrm) of unsorted and unlayered rock debris known as till; groundwater is mostly unconfined, but perched water conditions occur in areas of Qvrm deposits.

Till (Qvt) - Unsorted and unlayered deposits of sand, gravel, cobbles, and boulders in a compacted and indurated matrix of silt and clay with some lenses of clean sand and gravel; confining unit.

Advanced Outwash (Qva) - Gravel in a matrix of sand with some sand lenses; groundwater is confined.

Kitsap Formation (Qf) - Predominately clay and silt, with some layers of sand and gravel, and may include some till or till-like deposits; confining unit.

Salmon Springs (?) Drift (Qc) - Pre-Vashon glacial deposits of sand and gravel typically stained red or brown; groundwater is confined.

▼ **Water Level**

Screened Interval

Note: See Figure A-1 in Appendix A for cross section location.

FIGURE **3**
GEOLOGIC CROSS-SECTION B-BB
CITY OF YELM SW WELL 1A DEVELOPMENT PROJECT

10399709fig03.ai | Mod: 03/14/11 | LMB

Golder Associates

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. 012479
Water Right Permit No.

(1) OWNER: Name FORRESTER, JAMES Address PO BOX 524 YELM, WA 98597-

(2) LOCATION OF WELL: County THURSTON - NW 1/4 SE 1/4 Sec 25 T 17 N., R 1E WM
(2a) STREET ADDRESS OF WELL (or nearest address) 15140 FOX HILL RD

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one)
NEW WELL Method: AIR ROTARY

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 136.7 ft. Depth of completed well 136.7 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from 0 ft. to 136.7 ft.
WELDED " Dia. from ft. to ft.
" Dia. from ft. to ft.

Perforations: NO
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE CLAY
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 92 ft. below top of well Date 11/08/88
Artesian Pressure lbs. per square inch Date / /
Artesian water controlled by

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

Recovery data
Time Water Level Time Water Level Time Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 20 gal/min. w/ stem set at 132 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? 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 in formation.

MATERIAL	FROM	TO
TOPSOIL COBBLES	0	04
HARDPAN COBBLES BOULDERS	04	16
CLAY GRAVEL COBBLES	16	32
GRAVEL SILTY	32	40
CLAY GRAVEL	40	44
GRAVEL CLAY BAND	44	60
GRAVEL CLAY SEEPAGE	60	98
HARDPAN GRAVEL	98	101
LOOSE GRAVEL CLAY	101	111
LOOSE SAND GRAVEL	111	128
LOOSE SAND GRAVEL	128	136.7

Work started 11/04/88 Completed 11/08/88

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

NAME RICHARDSON WELL DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS P O BOX 44427

[SIGNED] Boyd Richardson License No. 1424

Contractor's Registration No. RICHAW*32109 Date 12/01/88

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) **OWNER:** Name Mr Bud Barton P.O. Box Address 1091 Yelm Wash 98580

(2) **LOCATION OF WELL:** County Thurston Div I Track 23 — ¼ ¼ Sec 25 T. 17 N., R. 1E W.M.

Bearing and distance from section or subdivision corner Site 8249. Hobby Acres

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

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

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 114 ft. Depth of completed well 114 ft.

(6) **CONSTRUCTION DETAILS:** Plus 1 Ft Above Grade
Casing installed: 6 " Diam. from 0 ft. to 114 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☐ No ☒
Type of perforator used open bottom
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 Model No
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 18 ft.
Material used in seal Bentonite Puddle Clay
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 1120 ft.
Static level 80 ft. below top of well Date 3-24-82
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?
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

Date of test 3-24-82
Bailer test 14 gal./min. with 25 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water 49 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
Brown Sand + Gravel	0	41
Gray Till + Large Rocks	41	56
Brown Clay + Damp Gravel	56	83
Gray Clay Binder Gravel w/ B-	83	114

RECEIVED
JUN 10 1982
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 3-23, 19 82 Completed 3-24, 19 82

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 Stoican Drilling Co Inc (Person, firm, or corporation) (Type or print)
Address P.O. Box 161 Sequim Wash 98382
[Signed] Valeri Stoican (President) 0473 (Well Driller)
Tom Ahlemang
License No. 0246 Date 4-29, 19 82
RT I Box 175 Eatonville Wn 98328
Ph - 847-6994

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Delia M. Chambers Address 1612 Sonata Lane, Lake San Marcos, Cal.

(2) LOCATION OF WELL: County Thurston N2NE ¼ NW ¼ Sec. 25 T. 17 N., R. 1E. W.M.

Bearing and distance from section or subdivision corner

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) 1
New well [X] Method: Dug [ ] Bored [ ]
Deepened [ ] Cable [ ] Driven [ ]
Reconditioned [ ] Rotary [X] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 123 ft. Depth of completed well 120 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 120 ft.
Threaded [ ] " Diam. from ft. to ft.
Welded [X] " Diam. from ft. to ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to 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? 20 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 Jacuzzi
Type 1S4C H.P. 1

(8) WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 68 ft. below top of well Date 9-15-77
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 [X] If yes, by whom?
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

Date of test 9-15-77
Bailer test 20 gal./min. with 44 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? Yes [ ] No [X]

(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
Top Soil	0	2
Gravel & Bolders	2	5
Hardpan	5	36
Seapage & Sandy Clay	36	52
Clay	52	61
A little Water	61	63
Hardpan & Bolders	63	102
Yellow Clay & Gravel	102	112
Clay, Gravel & Bolders	112	118
Water & Gravel	118	123

RECEIVED
OCT 21 1977
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 9-15- 19 77 Completed 0-15 19 77

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44408 Tacoma, Wa. 98444

[Signed] (Well Driller)

License No. 223-02-6500 Date 9-29 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

WATER WELL REPORT

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

Construction/Decommission *("x" in circle)* 278623

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION*

Notice of Intent Number _____

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 120 ft. Depth of completed well 115 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 6 " Diam. from +1 ft. to 115 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 _____

Type _____ Model No. _____

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Materials placed from _____ ft. to _____ ft.

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.

Material used in seal BENTONITE CHIPS

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP: Manufacturer's Name _____

Type: _____ H.P _____

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

Static level 45 ft. below top of well Date 10/25/07

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? _____

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

Date of test _____

Bailer Test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 20 gal./min. with stem set at 110 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

Temperature of water 51 Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. WE07313

Unique Ecology Well ID Tag No. BAC354

Water Right Permit No. EXEMPT WELL

Property Owner Name JENISE MUGLER

Well Street Address 15009 STATE ROUTE 507 SE

City YELM County THURSTON

Location NE 1/4-1/4 NW 1/4 Sec 25 Twn 17N R 1E EWM ☒ Check Or WWM ☐ One

(s, t, r Still REQUIRED)

Lat/Long Lat Deg _____ Lat Min/Sec _____

Long Deg _____ Long Min/Sec _____

Tax Parcel No. (Required) 21725240100

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 SANDY LOAM	0	3
BROWN SILT BOUND SANDY GRAVEL,	3	
LOOSE		15
BROWN SILTY SANDY CLAY WITH GRAVEL	15	28
GRAY SILT BOUND SANDY GRAVEL, TIGHT,	28	
DRY		38
GRAY SILT BOUND SANDY GRAVEL, LOOSE	38	
MOIST		70
BROWN SILTY SANDY GRAVEL WITH CLAY	70	
MOIST, TIGHT		81
GRAY SILT BOUND SANDY GRAVEL, WET	81	95
BROWN SILT BOUND MEDIUM TO COARSE	95	
SANDY GRAVEL, LOOSE, WATER		120

RECEIVED

NOV 30 2007

Washington State Department of Ecology

Start Date 10/24/07 Completed Date 10/25/07

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) BRANDON HICKS

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2785

IF TRAINEE Driller's License No: _____

Driller's Signature _____

Drilling Company ARCADIA DRILLING INC.

Address PO BOX 1790

City, State, Zip SHELTON , WA , 98584

Contractor's Registration No. ARCADDI098K1 Date 11/1/07

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. _____
Permit No. _____

(1) **OWNER:** Name Henry Dragt Address Rt. 3 Box 3880 Yelm, Wa. 98597

(2) **LOCATION OF WELL:** County Thurston SE ¼ SW ¼ Sec 24 T. 17 N., R. 1E 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) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 80 ft. Depth of completed well 80 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 8 " Diam. from 0 ft. to 80 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 Johnson Well Screen
Type Stainless Steel Model No.
Diam. 8 Slot size 60 from 75 ft. to 80 ft.
Diam. ____ Slot size ____ from ____ ft. to ____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ____ ft. to ____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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: HP

(8) **WATER LEVELS:** Land-surface elevation above mean sea level .... ft.
Static level 20 ft. below top of well Date 2-3-78
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?
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

Date of test
Bailer test 100 gal./min. with 10 ft. drawdown after 1 hrs.
Airlift test ____ g.p.m. Date 2-3-78
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
Surface seal	0	20
Black soil	0	2
Brown sand	2	11
Hardpan	11	18
Sand & gravel (rust colored clay)	18	37
Sand & gravel, little gray clay 95-100GPM	37	47
Gray clay some gravels lot of iron	47	50
Sand & gravel	50	80

Work started 2-3 , 19 78 Completed 2-3 , 19 78

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44408 Tacoma, Wa. 98444

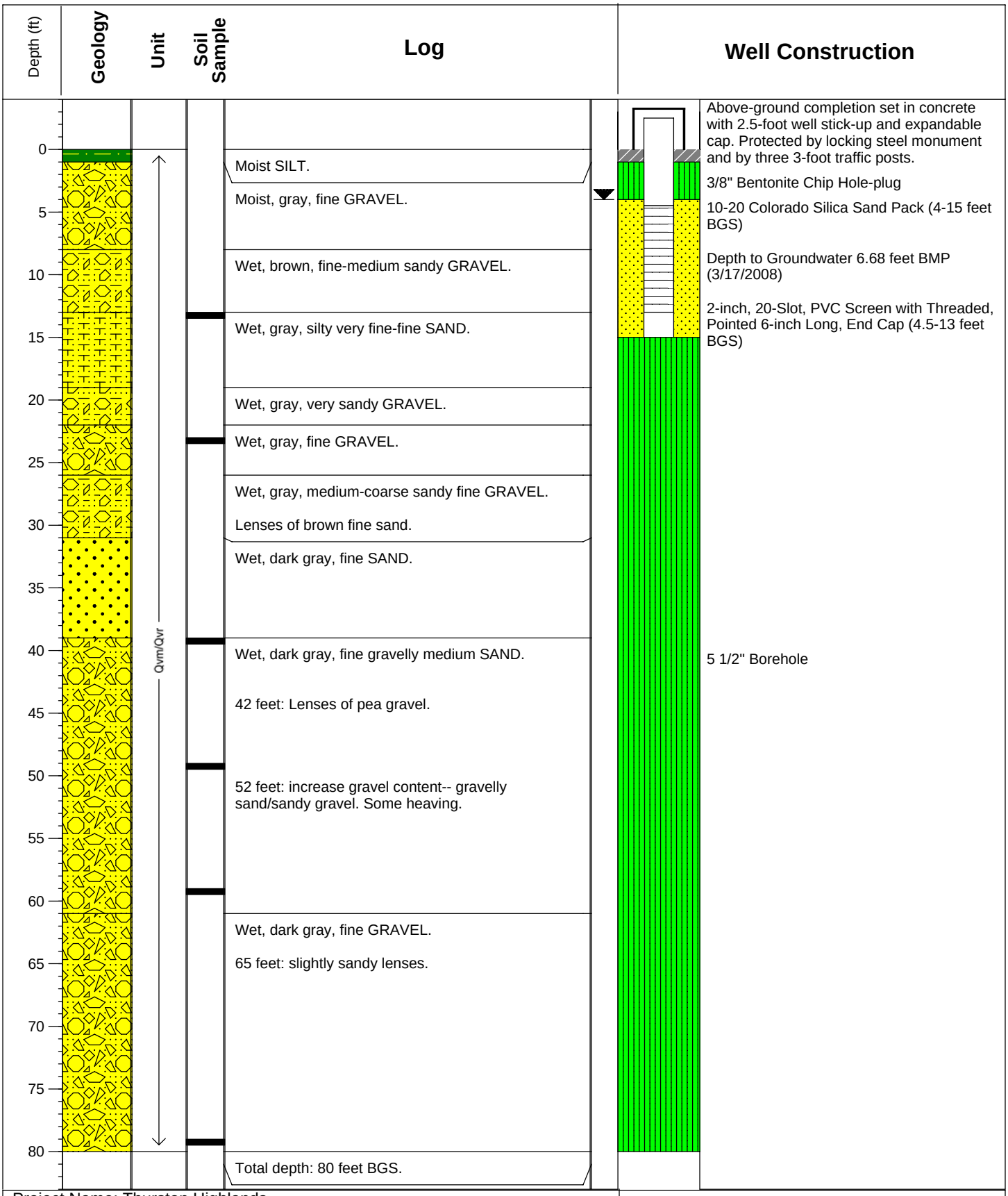
[Signed] _____ (Well Driller)

License No. 223-02-6500 Date 5-31 , 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

3/11/78



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Tim
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P19
Ecology ID: BAS466
MP Elevation: 334.52
Datum: NGVD 29
Installed: 3/12/2008
DTW: 6.68 BMP on 3/17/2008

Figure A-18
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P19
Thurston Highlands, LLC
Yelm, Washington
JC0701, 9/2008

PgG

RESOURCE PROTECTION WELL REPORT Notice of Intent No. R59969

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)* 303324

- ⊗ Construction
- ○ Decommission *Original Construction Notice of Intent Number* _____

Type of Well *("x" in circle)*

- ⊗ Resource Protection
- ○ Geotech Soil Boring

Property Owner Thurston Highlands Assoc. LLC.

Unique Ecology Well ID Tag No BAS 467

Consulting Firm Pacific Groundwater Group

Driller or Trainee Name Timothy S. Smith

Driller or Trainee Signature [signature]

Driller or Trainee License No 2837

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

Site Address SW longmire st.

City Yelm County. Thurston

Location ~~SW~~ NE 1/4- 1/4 ~~NW~~ SW 1/4 Sec 24 Twn 17N R 1 (E)WM or WWM *circle one*

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

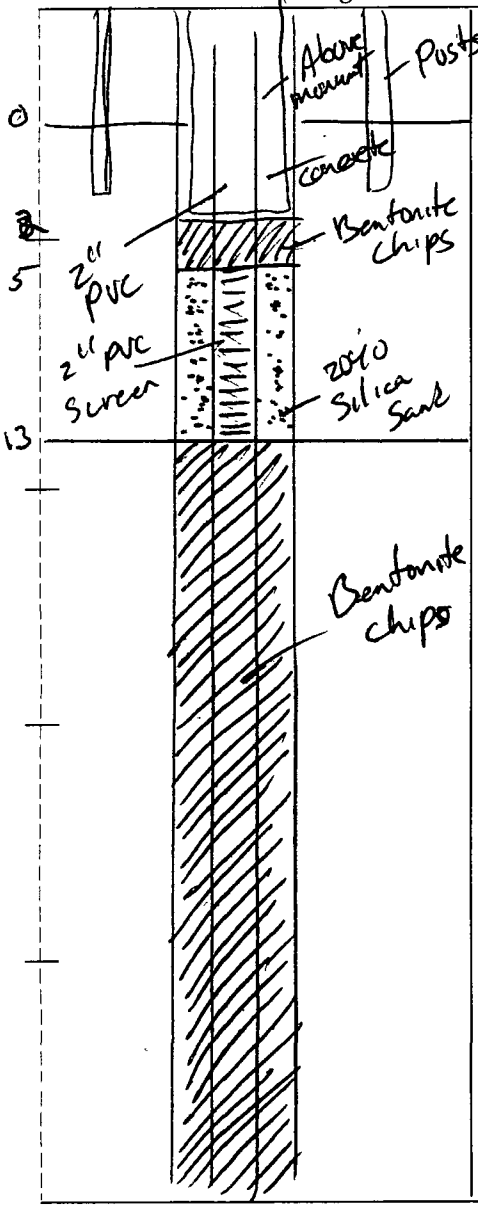
Tax Parcel No. 78640000014

Cased or Uncased Diameter 2" Static Level 8'

Work/Decommission Start Date 3/12/08

Work/Decommission Completed Date 3/12/08

Construction/Design



Well Data

Drilled method - 6" tube air. Rotary

casing; 2" sch 40 PVC +2.5 - 5'

screen; 2" sch 40 PVC .010 5 - 13'

Sand; 20/40 silica Sand 5 - 13'

Seal; Bentonite chips 2 - 5' 13' - 80'

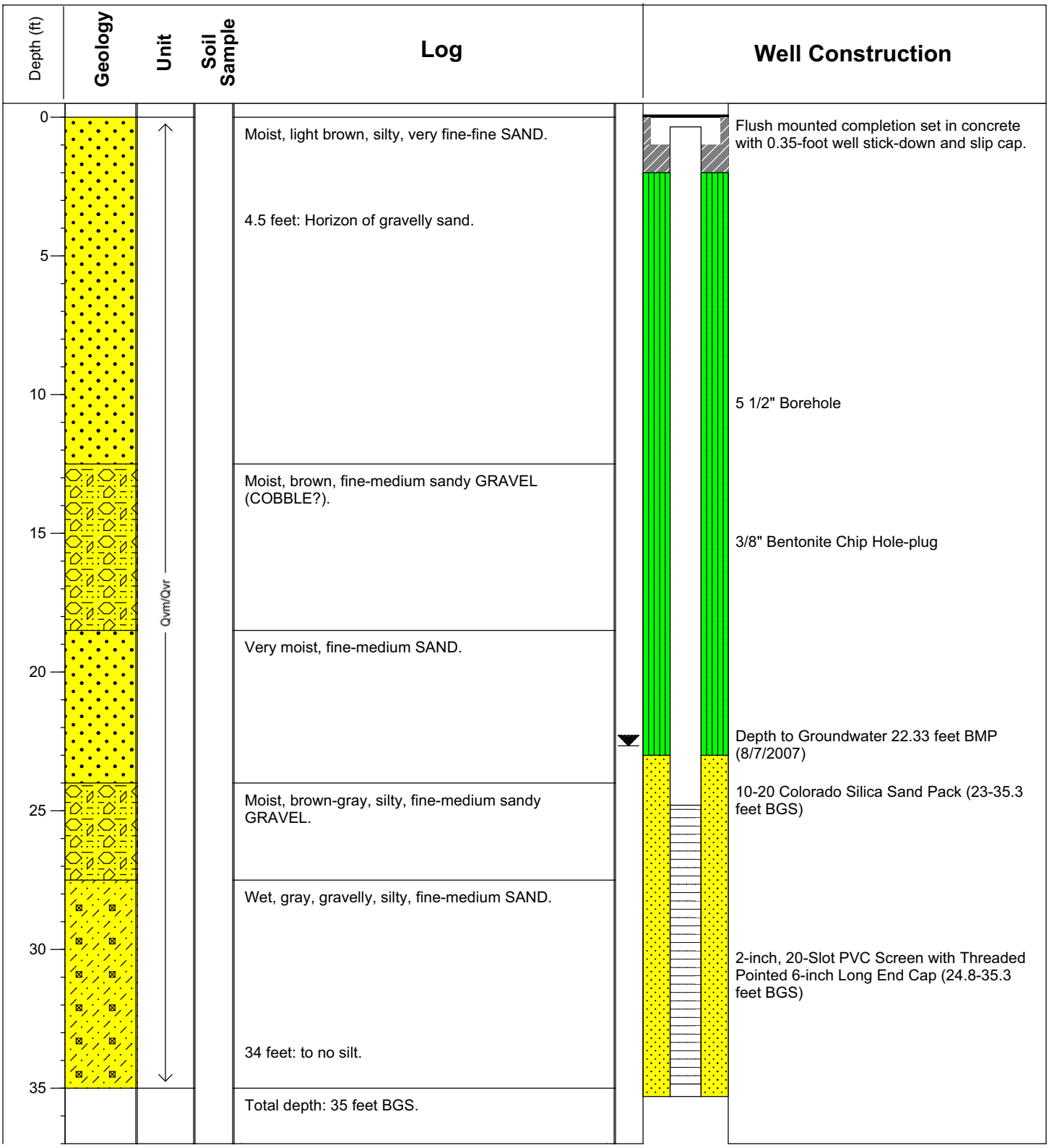
Formation Description

0	
silt	1
gravel, wet	8
sandy gravel, wet	13
silty sand wet	19
sandy gravel wet	31
sand wet	39
gravelly sand wet	61
Gravel wet	80

RECEIVED
MAY 15 2008
Washington State Department of Ecology

Scale 1"= _____ Page _____ of _____

ECY 050-12 (Rev 2/01)



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Ron
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P12
Ecology ID: APC076
MP Elevation: 337.42
Datum: NGVD 29
Installed: 8/6/2007
DTW: 22.33 BMP on 8/7/2007

Figure A-12
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P12
Shea, Carr, Jewell
Yelm, Washington
JC0701, 8/2007

PgG

Please print, sign and return by mail to Department of Ecology

RESOURCE PROTECTION WELL REPORT

CURRENT Notice of Intent No. R 71618

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *(select one)*

☑ Construction 273203

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Consulting Firm Pacific Groundwater Group

Unique Ecology Well ID Tag No. APC076 P-12

Type of Well *(select one)*

☑ Resource Protection

☐ Geotech Soil Boring

Property Owner Thurston Highlands LLC

Site Address West Yelm undeveloped

City Yelm County Thurston

Location NE 1/4-1/4 SW 1/4 Sec 24 Twn 17 R 1 Select One ☑ EWM ☐ WWM

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

Tax Parcel No. 78640000010

Cased or Uncased Diameter 6" Static Level 24'

Work/Decommission Start Date 8/6/07

Work/Decommission Completed Date 8/6/07

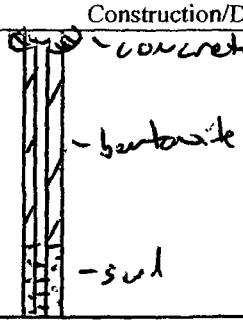
WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

☑ Driller ☐ Engineer ☐ Trainee Name (Print) Ronald Sunk

Driller/Engineer /Trainee Signature _____

Driller or Trainee License No. 2661

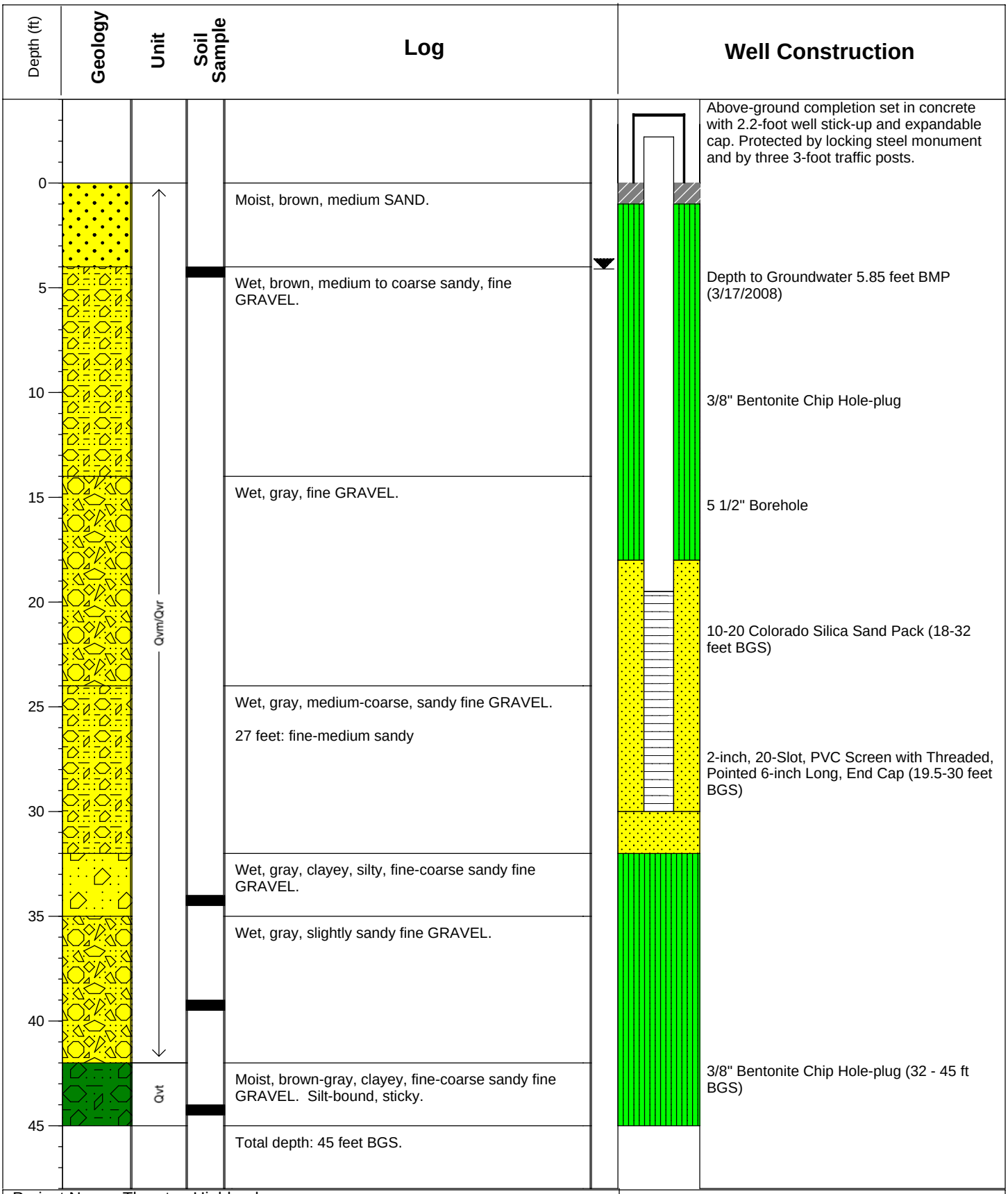
If trainee, licensed driller's Signature and License No. _____

Construction/Design	Well Data	Formation Description
	Drill Method: Air Rotary Casing: 2" sch 40 PVC +5 to 25 Screen: 2" sch 40 PVC .020 25' to 35' Sand: 10/20 22 to 35 Seal: Bentonite chips 2 to 22'	silty sands w/gravels
35		35'

SCALE: 1"= 35'

PAGE 1 OF 1

ECY 050-12 (Rev. 2/03)



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Tim
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P20
Ecology ID: BAS467
MP Elevation: 332.52
Datum: NGVD 29
Installed: 3/12/2008
DTW: 5.85 BMP on 3/17/2008

Figure A-19
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P20
Thurston Highlands, LLC
Yelm, Washington
JC0701, 9/2008

PgG

RESOURCE PROTECTION WELL REPORT Notice of Intent No. R59920

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

Construction/Decommission *("x" in circle)* 303323
- ⊗ Construction
- ○ Decommission *Original Construction Notice of Intent Number* _____

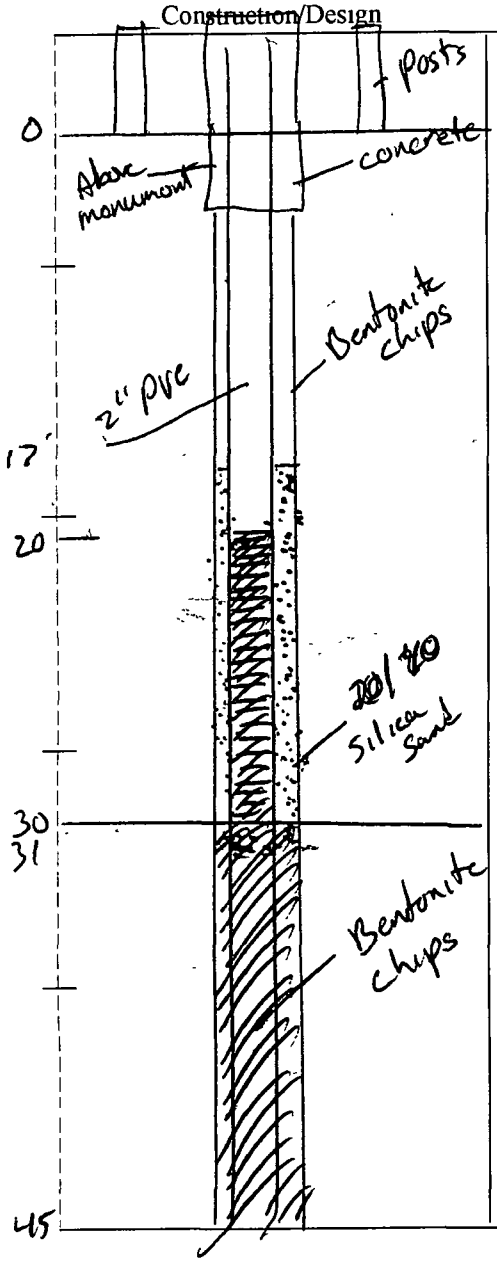
Type of Well *("x" in circle)*
- ⊗ Resource Protection
- ○ Geotech Soil Boring

Property Owner Thurston Highlands Assoc. LLC
Unique Ecology Well ID Tag No BAS466
Consulting Firm Pacific Groundwater Group
Driller or Trainee Name Timothy S. Smith
Driller or Trainee Signature [signature]
Driller or Trainee License No 2837

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

Site Address SW Longmire St.
City Yelm County: Thurston
Location SW 1/4- 1/4 NW 1/4 Sec 24 Twn 17N R 1 (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 21724230400
Cased or Uncased Diameter 2" Static Level 24'
Work/Decommission Start Date 3-12-08
Work/Decommission Completed Date 3-12-08

Construction/Design



Scale 1"= _____

Well Data

Drilled method - 6" rubex Air Rotary
casing: 2" sch. 40 PVC +2.5 - 20'
Screen: 2" sch 40 PVC .010
Sand: 20/40 silica Sand 17'-38'
seal: Bentonite chips 2'-17' 31'-45'

RECEIVED
MAY 15 2008
Washington State Department of Ecology

Formation Description

sand	4
sandy gravel wet	14'
gravel wet	24
sandy gravel wet	32
clayey, silty, sandy gravel, wet	35
gravel wet	42
clayey, sandy gravel	45

ECY 050-12 (Rev 2/01)

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. [illegible]
Water Right Permit No.

(1) OWNER: Name AM. SAVINGS BK. C/O MOORE Address PO BOX 2027 TACOMA, WA 98401-2027

(2) LOCATION OF WELL: County THURSTON - SW 1/4 NW 1/4 Sec 24 T 17 N., R 1E WM
(2a) STREET ADDRESS OF WELL (or nearest address) 15050 LONGMIRE ST

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one)
NEW WELL Method: AIR ROTARY

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 96.7 ft. Depth of completed well 96.7 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from 0 ft. to 96.7 ft.
WELDED " Dia. from ft. to ft.
" Dia. from ft. to ft.

Perforations: NO
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

Surface seal: YES To what depth? 18 ft.
Material used in seal BENTONITE CLAY
Did any strata contain unusable water? NO
Type of water? Depth of strata ft.
Method of sealing strata off

(7) PUMP: Manufacturer's Name [illegible]
Type [illegible] H.P. 1\2

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 46 ft. below top of well Date 09/08/98
Artesian Pressure lbs. per square inch Date / /
Artesian water controlled by

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

Recovery data

Time	Water Level	Time	Water Level	Time	Water Level

Date of test / /
Bailer test gal/min. ft. drawdown after hrs.
Air test 10 gal/min. w/ stem set at 91 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? 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 in formation.

MATERIAL	FROM	TO
TOPSOIL COBBLES	0	4
COBBLES BOULDERS AND GRAVEL	4	12
CLAY BOULDERS AND GRAVEL	12	20
CLAY GRAVEL COBBLES	20	23
BOULDERS	23	30
SAND SILTY GRAVEL	30	32
CLAY AND GRAVEL	32	38
CLAY	38	45
CLAY GRAVEL SEEPAGE	45	60
CLAY AND GRAVEL	60	72
HARDPAN AND GRAVEL	72	78
CLAY AND GRAVEL	78	89
SAND GRAVEL WATER	89	96.7

RECEIVED
OCT
Department of Ecology
Southwest Regional Office

Work started 09/07/98 Completed 09/08/98

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

NAME RICHARDSON WELL DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS P O BOX 44427

[SIGNED] [signature] License No. 1424

Contractor's Registration No. RICHAW*32108 Date 10/07/98

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name DAVID PURVIS Address 14504 BERRY VALLEY RD. S.E.

(2) LOCATION OF WELL: County PIERCE — SW ¼ NW ¼ Sec 24 T. 17 N., R. 1 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) ....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

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

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from ..... ft. to ..... 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 ..... Model No .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☐ Size of gravel: .....
Gravel placed from ..... ft. to ..... 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 ..... ft. below top of well Date .....
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? .....
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

Date of test .....
Bailer test 15 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
TOPSOIL	0	3
HARDPAN	3	48
GRAVEL - WATER 7-8	48	52
HARDPAN	52	60
GRAVEL - WATER 1-2	60	62
HARDPAN	62	78
GRAVEL - WATER 1	78	108
HARDPAN	108	137
ROCK	137	139
CEMENTED SAND-GRAVEL - ROCKS	139	155
SAND GRAVEL - WATER	155	

RECEIVED
DEC 15 1980
DEPARTMENT OF ECOLOGY NORTHWEST REGION

RECEIVED
DEC 1 0 1980

Work started 9-10- 19 80 Completed 9-11- 19 80

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 TACOMA PUMP & DRILLING CO. INC.
(Person, firm, or corporation) (Type or print)

Address 30316 MT. HWY. GRAHAM

[Signed] .....
(Well Driller)

License No. ..... Date ..... 19 .....

(USE ADDITIONAL SHEETS IF NECESSARY)

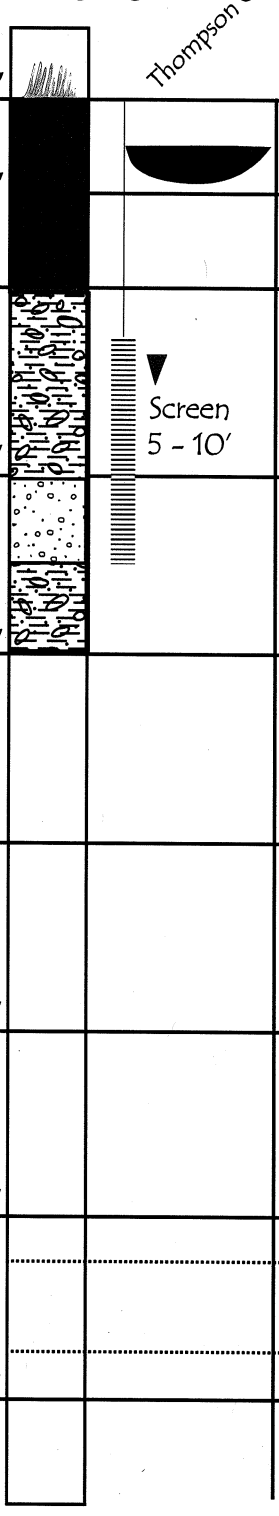
ECY 050-1-20

PROJECT: **Yelm GW Study** Date: April 1, 2008 Boring ID: B-3

Location: Berry Valley Rd & Thompson Creek Time: 12:01 p.m.

Drillers: Don & Chris Ross of ESN Northwest Weather Conditions: Cold, Sunny

Hydrogeologist: N. Romero Dept: Water & Waste Mgmt, TC Page: 1/1



Lithologic Description	% Recovery	Details
Land Surface Elev. 326 ft above msl		
Black, Organic, Clayey Silt, w/ some gravel	80%	Moist
Black, Organic, Clayey Silt, w/ wood debris		Dry
Red Clayey Gravel and Sand (old till?) Weathering Rinds on Cobbles, Friable Lavendar Andesites	100%	Wet 6 - 8'
Gravel, small and angular, wet, clayey Clayey Gravel, compact, hard	80%	Wet

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name WILSON HOMES INC. Address 14127-93 AVE. S.E.

(2) LOCATION OF WELL: County YELM Thurston — NW¼ NW¼ Sec 24 T. 17 N., R. 1E 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) .....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 100 ft. Depth of completed well 100 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 100 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 ..... Model No. .....
Diam ..... Slot size ..... from ..... ft. to ..... ft.
Diam ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☑ Size of gravel: .....
Gravel placed from ..... ft. to ..... 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 BERKELEY
Type: SUB H.P. 3/4

(8) WATER LEVELS: Land-surface elevation above mean sea level ..... ft.
Static level 60 ft. below top of well Date 11-15-79
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? .....
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

Date of test .....
Bailer test 10 gal./min. with 35 ft. drawdown after 1 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
TOPSOIL	0	3
HARDPAN - ROCKS	3	90
SAND - GRAVEL - WATER	90	100

RECEIVED
MAR 27 1980
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 11-15, 19 79 Completed 11-15-, 19 79

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 TACOMA PUMP & DRILLING INC.
(Person, firm, or corporation) (Type or print)

Address 30316 MT. HWY GRAHAM

[Signed] Eric Hansen by
(Well Driller)

License No. 0710 Date 1/4, 1980

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Dorothy I. Myers Address 1122 So. 124th Tacoma, Wa. 98444

(2) LOCATION OF WELL: County Thurston NE ¼ NE ¼ Sec 23 T 17 N., R 1E 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) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 180 ft. Depth of completed well 180 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 180 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 Model No
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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 Jacuzzi Bros.
Type: 7s4b H.P. 3/4

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 130 ft. below top of well Date 7-29-82
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?
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

Date of test
Bailer test 15 gal./min. with 25 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date 7-29-82
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
Gravel & boulders	0	10
Grey clay	10	12
~~Gx~~ Hardpan	12	40
Gravel & clay	40	48
Sand, gravel & boulders	48	60
Gravel & clay	60	83
Hardpan	83	100
Gravel-clay~~xxxxxxxx~~ (seapage)	100	153
Sand & gravel	153	180

RECEIVED
AUG 27 1982
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 7-29 19 82 Completed 7-29 19 82

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44427 Tacoma, Wa. 98444

[Signed] (Well Driller)

License No. 223-02-6500 Date 8-17 19 82

(USE ADDITIONAL SHEETS IF NECESSARY)

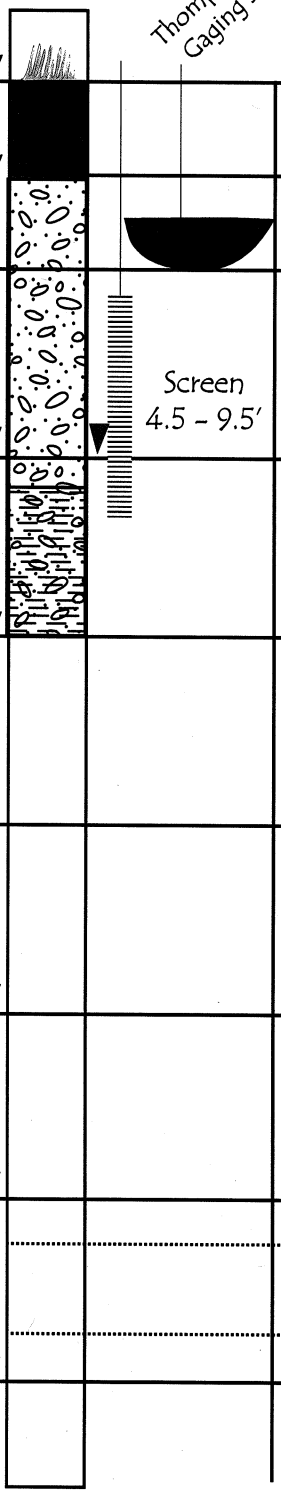
ECY 050-1-20

PROJECT: **Yelm GW Study** Date: April 1, 2008 Boring ID: B-1

Location: 93rd & Thompson Creek (Next to Stream Gage) Time: 8:35 a.m.

Drillers: Don & Chris Ross of ESN Northwest Weather Conditions: Cold, Sunny

Hydrogeologist: N. Romero Dept: Water & Waste Mgmt, TC Page: 1/1



Lithologic Description	% Recovery	Details
Land Surface Elev. 324 ft above msl		
Black, Organic, Clayey Silt, w/ some gravel	30%	Moist
Brown, Sandy Gravel, Dry w/ FeO Clay binder		Dry
Brown, Sandy Gravel, Dry w/ FeO Clay binder Weathering Rinds on Cobbles, Friable	80%	Dry
Wet, Clayey Gravel and Sand, Compact, w/ FeO clay (old till?)	80%	Wet @ 8 - 9'

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. ....

Permit No. ....

Const.

(1) OWNER: Name Jeff Knight c/o E.A. Wickland Address 10914 SE 293rd Auburn, Wa. 98002

(2) LOCATION OF WELL: County Thurston — SE ¼ SE ¼ Sec 14 T 17 N., R 1E W.M.

Bearing and distance from section or subdivision corner None

(3) PROPOSED USE: Domestic [X] Industrial [ ] Municipal [ ] Irrigation [ ] Test Well [ ] Other [ ]

(4) TYPE OF WORK: Owner's number of well (if more than one) 2

New well [X] Method: Dug [ ] Bored [ ]
Deepened [ ] Cable [ ] Driven [ ]
Reconditioned [ ] Rotary [X] Jetted [ ]

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 100 ft. Depth of completed well 100 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 100 ft.
Threaded [ ] ...... " Diam. from ...... ft. to ...... ft.
Welded [X] ...... " Diam. from ...... ft. to ...... ft.

Perforations: Yes [ ] No [X]
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 [X]
Manufacturer's Name ....
Type .... Model No. ....
Diam. ...... Slot size ...... from ...... ft. to ...... 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? 18 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 ....
Type: .... H.P. ......

(8) WATER LEVELS: Land-surface elevation above mean sea level ...... ft.
Static level 65 ft. below top of well Date 8-22-86
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 [X] If yes, by whom? ....
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

Date of test ....
Bailer test 25 gal./min. with 15 ft. drawdown after 1 hrs.
Artesian flow ...... g.p.m. Date 8-22-86
Temperature of water ...... Was a chemical analysis made? Yes [ ] No [X]

(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
Topsoil and gravel	0	12
Gravel and boulders	12	24
Compact sand and gravel	24	69
Loose sand and gravel	69	100

RECEIVED '87 FEB 13 AM 9:50 SW REGIONAL OFFICE

Work started 8-21, 19 86 Completed 8-22, 19 86

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44427 Tacoma, Wa. 98444

[Signed] [signature] (Well Driller)

License No. 0419 Date 12-11, 19 86

Smith

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Well Tagging Form

Well 3

Unique Well Tag No: AGP 177

RECORD VERIFICATION (check ✓one)

☒ Well Report available (please attach this form to the well report and submit it to the Ecology Regional Office near you).
If a well report is not available, please complete a "Water Well Report for an Existing Well" form. This form is available at Ecology's headquarters office. **Do not use this form for wells that do not have a Water Well Report.**

WELL OWNERSHIP, IF DIFFERENT FROM WELL REPORT

First Name: Messiah Ranch Last Name: _____

Street Address: _____

City: _____ State: _____

LOCATION OF WELL, IF DIFFERENT FROM WELL REPORT

Well Address: _____

City: Yelm County: Thurston

T. 17 N. R. 1 E W.M. Sec. 13 SW ¼ of the SW

FOR AGENCY USE ONLY

Latitude _____ _____ ' _____ _____ "

Longitude _____ _____ ' _____ _____ "

☐ GPS
☐ Topographic Map
☐ Survey
☐ Computer generated

Elevation at land surface _____ feet/meters *(circle one)*

☐ Digital Altimeter
☐ Topographic Map
☐ Other _____

Additional information, if available:

☐ Location marked on topographic map *(please attach)*
☐ Location marked on air photo *(please attach)*

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WELL CHARACTERISTICS

Physical description of well (size of casing, type of well, housing, etc.)

Location of Well identification Tag:

Was supplemental tag need for ease of identifying well: ☐ Yes ☐ No

If yes, where was tag placed? _____

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Scale 1:24,000 (1" = 2,000')

Indicate the location of the well within the Section by drawing a dot at that point

SECTION _____

COMMENTS:

FOR ECOLOGY WATER RESOURCES PROGRAM ONLY

Water Right # 58406 Date Issued _____

Circle One: Application Permit Certification Claim Exempt

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. 28341
Water Right Permit No.

(1) OWNER: Name MESSIAH ARABIAN STUD FARM Address 14507 YELM HWY YELM, WA 98597-

(2) LOCATION OF WELL: County THURSTON - SE 1/4 SE 1/4 Sec 14 T 17 N., R 1E WM.
(2a) STREET ADDRESS OF WELL (or nearest address) 14507 YELM HWY

(3) PROPOSED USE: DOMESTIC

(4) TYPE OF WORK: Owner's Number of well (If more than one)
DEEPENED Method: AIR ROTARY

(5) DIMENSIONS: Diameter of well 6 inches
Drilled 80 ft. Depth of completed well 180 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 " Dia. from 100 ft. to 180 ft.
WELDED " Dia. from ft. to ft.
" Dia. from ft. to ft.

Perforations: NO
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

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

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

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

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

(8) WATER LEVELS: Land-surface elevation above mean sea level ... ft.
Static level 71.5 ft. below top of well Date 09/14/89
Artesian Pressure lbs. per square inch Date / /
Artesian water controlled by

(9) WELL TESTS: Drawdown is amount water level is lowered below static level.
Was a pump test made? YES If yes, by whom? PUMPMAN
Yield: 30 gal./min with 11 ft. drawdown after 4 hrs.

Recovery data

Time	Water Level	Time	Water Level	Time	Water Level

Date of test 09/21/89
Bailer test gal/min. ft. drawdown after hrs.
Air test 35 gal/min. w/ stem set at 175 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? 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 in formation.

MATERIAL	FROM	TO
CEMENTED SAND AND GRAVEL	100	130
SAND AND GRAVEL CLAY	130	140
SAND AND GRAVEL AND SEEPAGE	140	170
SAND GRAVEL AND WATER	170	177
COMPACTED SAND GRAVEL SEEPAGE	177	180

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NOV - 1 '89
AM 8:30

Work started 09/14/89 Completed 09/14/89

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

NAME RICHARDSON WELL DRILLING
(Person, firm, or corporation) (Type or print)

ADDRESS P O BOX 44427

[SIGNED] Boyd Bart License No. 1424

Contractor's Registration No. RICHAW*3210B Date 09/28/89

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name The Messiah Arabian Stud Farm Address 14507 Yelm Hwy. SE Yelm, Wa. 98597

(2) LOCATION OF WELL: County Thurston — SE ¼ SE ¼ Sec. 14 T17 N., R. 1E 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) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 115 ft. Depth of completed well 115 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 115 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 Model No
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to 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 Jacuzzi Bros.
Type: [redacted] 5s4xp11HP 5

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 65 ft. below top of well Date 10-18-83
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?
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

Date of test
Bailer test 40 gal./min. with 14 ft. drawdown after 1 hrs.
Artesian flow g.p.m. Date 10-18-83
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
Surface seal	0	18
Coarse hardpan & boulders-layers of grey sand & gravel	18	74
Brown coarse sand & gravel-boulders	74	115

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NOV 17 1983
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 10-18 19 83 Completed 10-18 19 83

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

Address P.O. Box 44427 Tacoma, Wa. 98444

[Signed] (Well Driller)

License No. 0419 Date 10-26 19 83

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Well Tagging Form Well 4

Unique Well Tag No: AGP 182

RECORD VERIFICATION (check ✓one)

☒ Well Report available (please attach this form to the well report and submit it to the Ecology Regional Office near you).

If a well report is not available, please complete a "Water Well Report for an Existing Well" form. This form is available at Ecology's headquarters office. **Do not use this form for wells that do not have a Water Well Report.**

WELL OWNERSHIP, IF DIFFERENT FROM WELL REPORT

First Name: Messiah Ranch Last Name: _____

Street Address: _____

City: _____ State: _____

LOCATION OF WELL, IF DIFFERENT FROM WELL REPORT

Well Address: _____

City: Yelm County: Thurston

T. 17 N. R. 1 E W.M. Sec. 14 SE ¼ of the SE

FOR AGENCY USE ONLY

Latitude _____ _____ ' _____ _____ "

Longitude _____ _____ ' _____ _____ "

☐ GPS
☐ Topographic Map
☐ Survey
☐ Computer generated

Elevation at land surface _____ feet/meters *(circle one)*

☐ Digital Altimeter
☐ Topographic Map
☐ Other _____

Additional information, if available:

☐ Location marked on topographic map *(please attach)*
☐ Location marked on air photo *(please attach)*

RECEIVED
NOV 06 2006
DEPARTMENT OF ECOLOGY

FOR AGENCY USE ONLY

WELL CHARACTERISTICS

Physical description of well (size of casing, type of well, housing, etc.)

_____

_____

_____

Location of Well identification Tag:

_____

_____

Was supplemental tag need for ease of identifying well? ☐ Yes ☐ No

If yes, where was tag placed? _____

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

Scale 1:24,000 (1" = 2,000')

Indicate the location of the well within the Section by drawing a dot at that point

SECTION _____

COMMENTS:

_____

_____

_____

FOR ECOLOGY WATER RESOURCES PROGRAM ONLY

Water Right # 58106 Date Issued _____

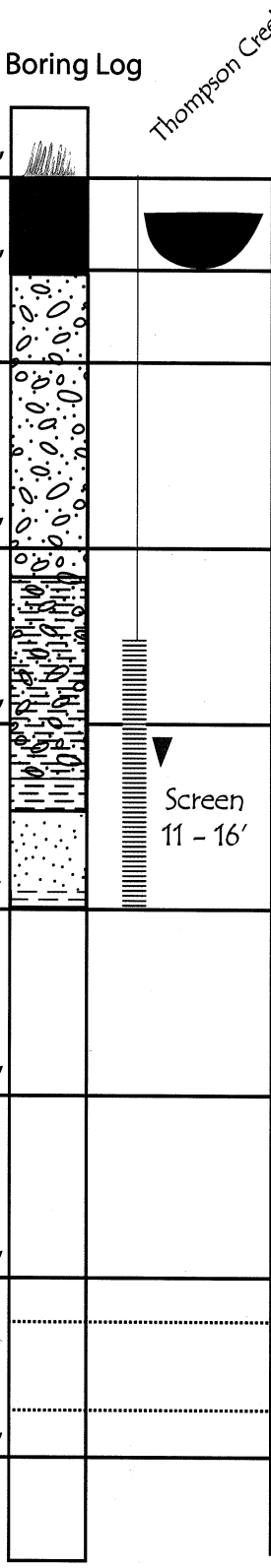
Circle One: Application Permit Certification Claim Exempt

PROJECT: **Yelm GW Study** Date: April 1, 2008 Boring ID: B-2

Location: 89th & Thompson Creek Time: 10:14 a.m.

Drillers: Don & Chris Ross of ESN Northwest Weather Conditions: Cold, Sunny

Hydrogeologist: N. Romero Dept: Water & Waste Mgmt, TC Page: 1/1



Lithologic Description	% Recovery	Details
Land Surface Elev. 322 ft above msl		
Black, Organic, Clayey Gravel	30%	Moist
Brown, Sandy Cobbles, Gravel, Dry		Dry
Dry, Brown, Clayey Gravel & Sand Weathering Rinds on Cobbles, Friable	90%	Dry
Dry, Brown, Clayey Gravel and Sand Compact	90%	Dry
Dry, Brown, Clayey Gravel and Sand Compact - 2" wet gravel seam @ 13' Wet, Brown, Coarse Sand 14 - 16'	90%	Dry Wet

File: Orig. & First Copy - Dept of Ecology
Second Copy - Owner; Third Copy - Driller

WATER WELL REPORT
State of Washington

Start Card No. W097953
Unique Well ID 1
Water Right Permit No.

(1) OWNER: Name CAPP Address 34222-102ND AVE. S ROY WA 98580 Page 1 of
(2) LOCATION OF WELL: County THURSTON SW 1/4 NE 1/4 Sec 14 T 17 N R 1 E
(2a) STREET ADDRESS OF WELL (or nearest address) 14035 SE 86TH LANE YELM WA

(3) PROPOSED USE: DOMESTIC
(4) Type of work: NEW WELL
Method: ROTARY

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 150 feet. Depth of completed well 150 ft.

(6) CONSTRUCTION DETAILS:
Casing instld: 6 " Diam. from 0 ft. to 144.6 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 _ No X
Manufacturer's Name
Type Model No
Diam Slot size from ft. to 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? 20 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 JACUZZ
Type SUBMERSIBLE H.P. 0.75

(8) WATER LEVELS: Surface elev above mean sea level ft.
Static level 115 ft. below top of well Date 02/26/97
Artesian pressure lbs. per sq. in. Date
Artesian pressure is controlled by

(9) WELL TESTS: Pump test made? ___ By whom?
Yield 0 gal./min. with ft. drawdown after 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.

Date of test
Bailer test 0 gal/min with ft. drawdown after hr
Airtest 15 gal/min with stem set at 139 ft. for 2 hrs
Artesian flow 0 gal/min Date
Temperature of water Was chemical analysis made? NO

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION

Material	From	To
BROWN CLAY COBBLES	0	6
GRAVEL BROWN CLAY	6	20
SAND GRAVEL SILT	20	35
LARGER GRAVEL SAND SILT	35	60
LARGE GRAVEL SOME COBBLES	60	80
GRAVEL SAND COBBLES	80	117
GRAVEL, RUST COLORED CLAY	117	135
GRAVEL, BOULDERS, CLAY WATER	135	140
GRAAVEL, SAND, COBBLES WATER	140	146
TIGHTER GRAAVEL, SAND, SILT	146	150

Work Started 12/24/97 Completed 12/26/97

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 RICHARDSON WELL DRILLING
Address P.O. Box 44427 Tacoma WA 98444

(Signed) _____ Lic. No 1547
(Well Driller)
Contractor's Registration No. RICHAW*3210B Date 01/07/
Based on form ECL 050-1-20 (2/93)**f-1329- by Speed Systems Co

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT
STATE OF WASHINGTON

Application No. .....
Permit No. .....

(1) OWNER: Name Donald C. Anderson Address Rt.3 Box 3540 Yelm, Wa. 98597

(2) LOCATION OF WELL: County Thurston — NW ¼ NE ¼ Sec. 14 T. 17 N., R. 1E 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) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

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

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 160 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 Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel packed: Yes ☐ No ☒ Size of gravel:
Gravel placed from ft. to ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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 Jacuzzi
Type: 15S40 H.P 1½

(8) WATER LEVELS: Land-surface elevation above mean sea level .... ft.
Static level 118 ft. below top of well Date 1-17-77
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?
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

Date of test
Bailer test 30 gal./min. with 31 ft. drawdown after 1 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
Surface Seal	0	20
Silty Brown Clay	0	7
Hard Pan	7	60
Sand & Gravel compacted	60	80
Gravel Silty some Clay	80	102
Sand Stone	102	105
Compacted Silty Gravel	105	140
Gravel, & Clay Water (30gpm)	140	160

RECEIVED
JUL 14 1977
DEPARTMENT OF ECOLOGY
SOUTHWEST REGIONAL OFFICE

Work started 1-17 19 77 Completed 1-17 19 77

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 Richardson's Well Drilling
(Person, firm, or corporation) (Type or print)

Address P.C. Box 44408 Tacoma, Wa. 98444

[Signed] (Well Driller)

License No. 223-02-6500 Date 5-18 19 77

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

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

WATER WELL REPORT
State of Washington

Start Card No. W172614
Unique Well ID AHL631
Water Right Permit No.

132184

(1) OWNER: Name DONALD ANDERSON JR Address P/O BOX 1712 YELM WA 98597

(2) LOCATION OF WELL· County THURSTON NW 1/4 NE 1/4 Sec 14 T 17 N R 1 EW

(2a) STREET ADDRESS OF WELL (or nearest address) 14229 YELM HWY YELM WA 98597

(3) PROPOSED USE: DOMESTIC

(4) Type of work: NEW WELL
Method: ROTARY

(5) DIMENSIONS· Diameter of well 6 inches.
Drilled 144 feet. Depth of completed well 141 ft.

(6) CONSTRUCTION DETAILS·
Casing instld: 6 " Diam. from 0 ft. to 141 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 _ No X
Manufacturer's Name
Type Model No
Diam Slot size from ft. to 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? 18 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
Type H.P. 0

(8) WATER LEVELS. Surface elev above mean sea level ft.
Static level 104.7 ft. below top of well Date 03/16/03
Artesian pressure lbs. per sq. in. Date
Artesian pressure is controlled by

(9) WELL TESTS: Pump test made? ___ By whom?
Yield 0 gal./min. with ft. drawdown after 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.

Date of test
Bailer test 0 gal/min with ft. drawdown after hr
Airtest 15 gal/min with stem set at 135 ft. for 1 hrs
Artesian flow 0 gal/min Date
Temperature of water Was chemical analysis made? NO

(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION

Material	From	To
BROWN CLAY	0	12
SILTY BROWN SAND, GRAVEL, COBBLES	12	45
BOULDER	45	47
SILTY BROWN SAND, GRAVEL, COBBLES	47	84
BOULDER	84	86
BROWN SAND, GRAVEL	86	87
BOULDER	87	90
BROWN SAND, GRAVEL	90	91
BOULDER	91	93
BROWN SAND, GRAVEL	93	95
BOULDER	95	98
BROWN SAND, GRAVEL, COBBLES, BOULDERS	98	120
BROWN SAND, GRAVEL, WATER	120	144

Work Started 03/13/03 Completed 03/16/03

WELL CONSTRUCTOR CERTIFICATION:
I constructed and/or accept responsibility for construction o this well, and its compliance with all Washington well construction standards. Materials used and the information reporte above are true to my best knowledge and belief.
Name RICHARDSON WELL DRILLING
Address P.O. Box 44427 Tacoma WA 98444

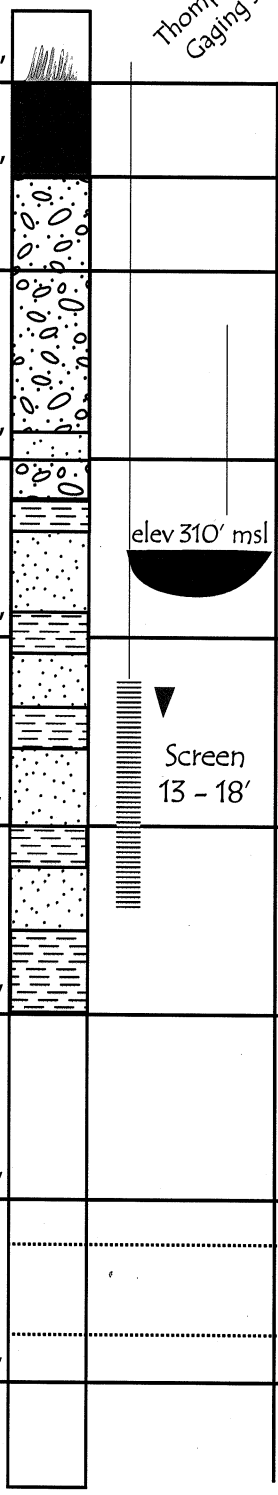
(Signed) _____ Lic. No 2246
(Well Driller)
Contractor's Registration No. RICHAW*3210B Date 03/18/0
Based on form ECL 050-1-20 (2/93)**f-1329- by Speed Systems Cor

PROJECT: **Yelm GW Study** Date: April 4, 2008 Boring ID: B-7

Location: State Route 510 & Thompson Creek (At School; Close to Stream Gage) Time: 8:35 a.m.

Drillers: Don & Chris Ross of ESN Northwest Weather Conditions: Cold, Rainy

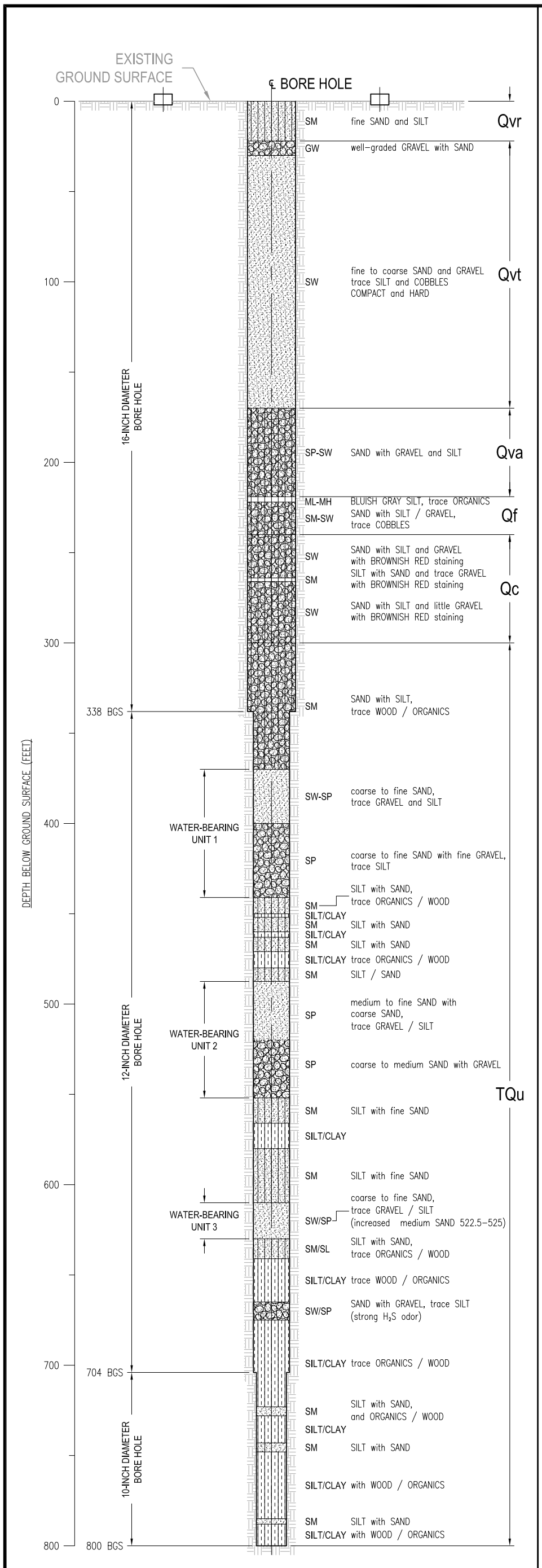
Hydrogeologist: N. Romero Dept: Water & Waste Mgmt, TC Page: 1/1



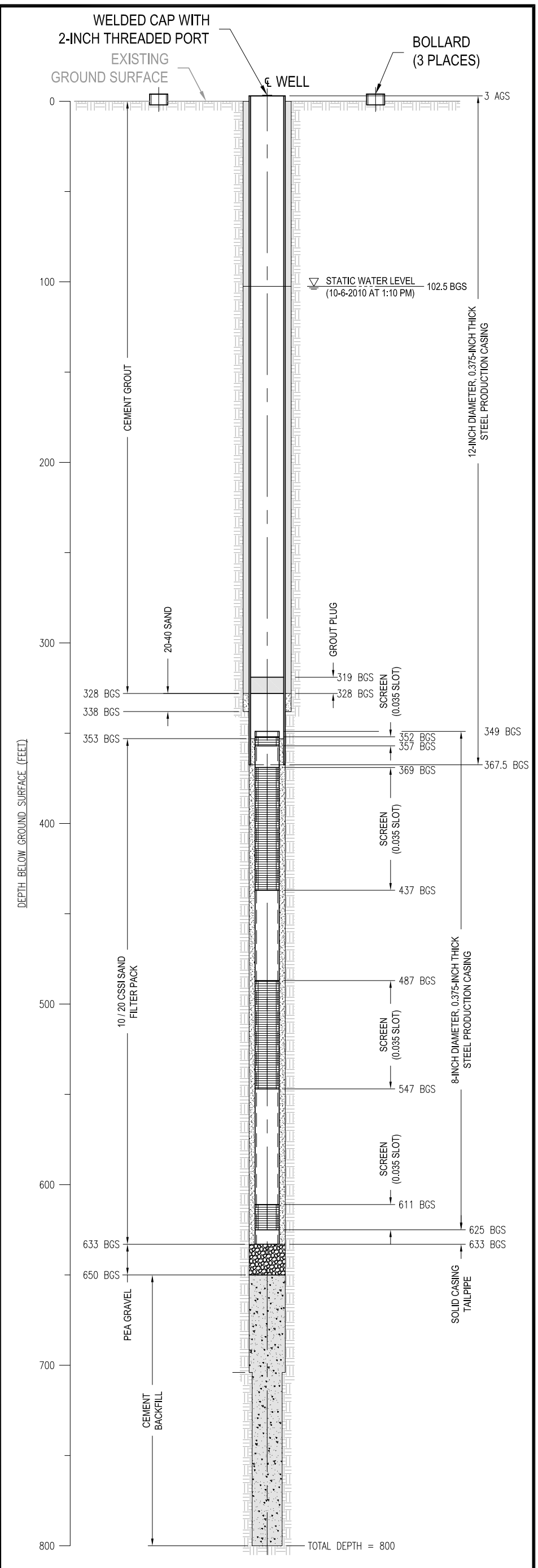
Lithologic Description	% Recovery	Details
Land Surface Elev. 320 ft above msl		
Black, Organic, Clayey Silt, w/ some gravel	60%	Moist
Brown, Sandy Gravel, Dry w/ some clay		Dry
Brown, Sandy Gravel, Dry 6" Dry, Loose Coarse Sand @ 7'	80%	Dry
Clayey Gravel and Sand, compact @10' Clayey Silt Layers, Brown, Laminated 3' of Dry, Loose Medium Sand Clayey Plug @ bottom of core rod	100%	Dry
Clayey Silt, "Fat", Saturated, Brown (Glacio-lucustrine) Wet Medium Sand, Brown	60%	Wet
Wet Medium Sand, Brown Clayey Silt, "Fat", Saturated, Brown Glacio-lucustrine	100%	Wet

APPENDIX B

SW WELL 1A BOREHOLE AND CONSTRUCTION DIAGRAMS AND WATER WELL REPORT



GEOLOGICAL LOG
(HORIZONTAL EXAGGERATION = 20:1)



WELL ASSEMBLY
(HORIZONTAL EXAGGERATION = 20:1)

NOTES:
1. ALL DIMENSIONS ARE IN FEET, EXCEPT AS NOTED.

AS-BUILT SCHEMATIC OF SW WELL 1A

COY/SW Well No. 1A/WA

Golder Associates

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 WE11324

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 12" inches, drilled 800 ft. Depth of completed well 633 ft.

CONSTRUCTION DETAILS

Casing Installed: ☒ Welded 12" Diam. from +2 ft. to 367.5 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 Johnson Screen

Type Wire-wrapped Model No.

Diam. 8" Slot size 0.035 from 352 ft. to 357 ft.

Diam. 8" Slot size 0.035 from 369 ft. to 437 ft.

Gravel/Filter packed: ☒ Yes ☐ No Size of gravel/sand 10x20

Materials placed from 353 ft. to 633 ft.

Surface Seal: ☒ Yes ☐ No To what depth? 327.7 ft.

Material used in seal Neat cement

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? Depth of strata

Method of sealing strata off

PUMP: Manufacturer's Name Goulds

Type: Lineshaft turbine H.P.

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

Static level 102.5 ft. below top of well Date 10/6/10

Artesian pressure N/A 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? Boart Longyear

Yield: 2100 gal./min. with 82.2 ft. drawdown after 73 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

Date of test

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

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

Artesian flow ____ g.p.m. Date

Temperature of water 54 Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. WE11324

Unique Ecology Well ID Tag No. ALM113

Water Right Permit No. Application G2-29804, G2-29805 and G2-29806

Property Owner Name City of Yelm

Well Street Address Tahoma Blvd SE & Dotson St. SE

City Yelm County Thurston

Location SE 1/4-1/4 SE 1/4 Sec 23 Twn 17 R 1E **(s, t, r Still REQUIRED)** EWM ☒ Or WWM ☐

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

Tax Parcel No. (Required) 78640000024

CONSTRUCTION OR DECOMMISSION PROCEDURE

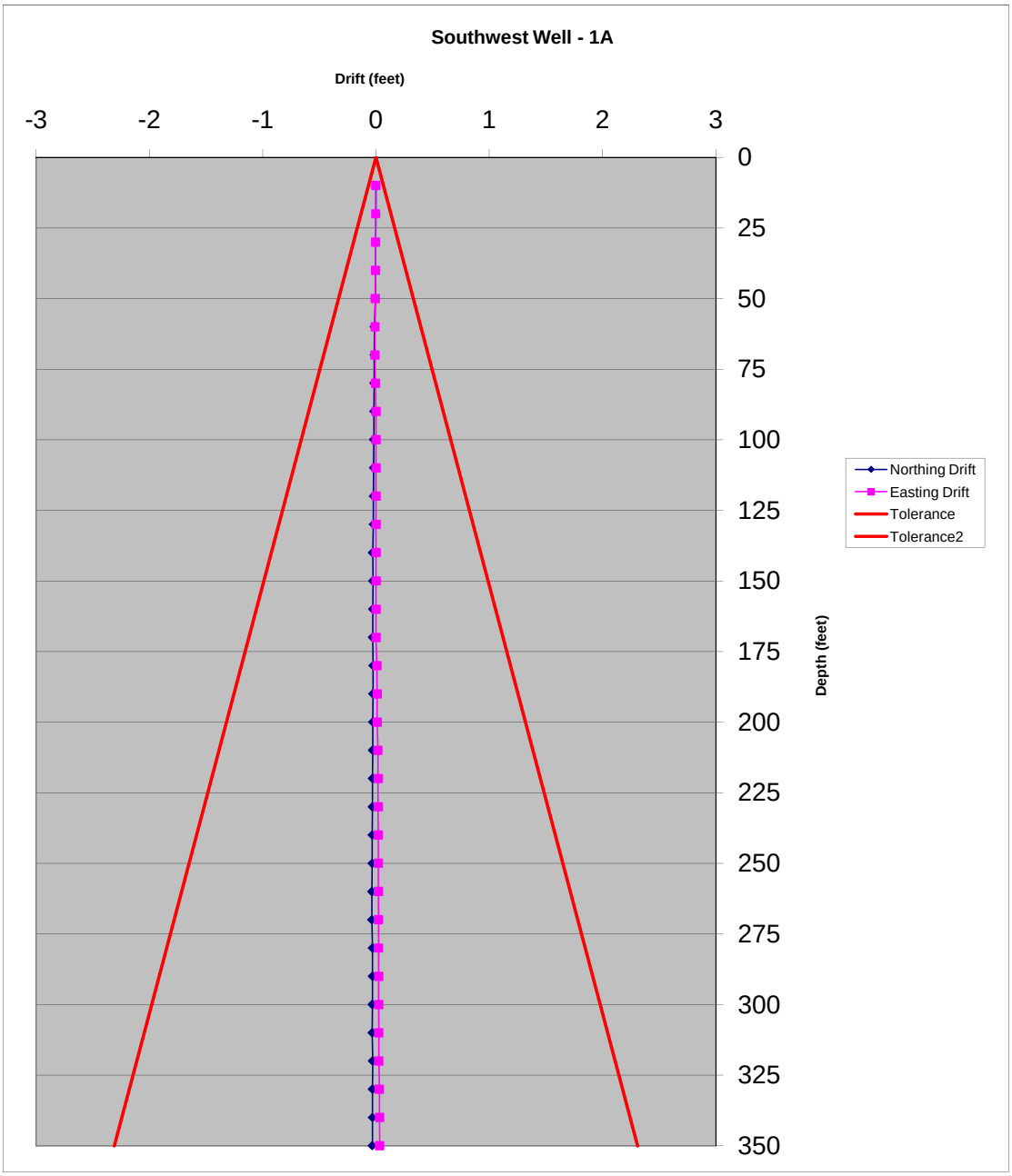
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)

MATERIAL	FROM	TO
Fine sand w/ some silt	0	25
Med/fine sand, gravel, cobble	25	170
Med/fine sand with grave/silt	170	219
Silty with fine sand and wood	219	240
Silty sand/iron oxide stainin	240	300
Silty sand with wood	300	370
Silty sand	370	400
Silt and clay	400	453
Fine sand and silt	453	470
Silt and clay, some wood	470	485
Silty fine sand	485	525
Med to coarse sand	525	552
Silt with fine sand	552	610
Fine to med sand/gravel	610	630
Silt/clay with wood	630	665
Fine to coarse sand/gravel	665	675
Silt/clay	675	800

Start Date 4/27/10 Completed Date 10/8/10

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) Duane Stevenson	Drilling Company Boart Longyear
Driller/Engineer/Trainee Signature	Address 11277 SW Clay St, Suite A
Driller or trainee License No. 2795	City, State, Zip Sherwood, OR 97140 , ,
IF TRAINEE: Driller's License No:	Contractor's
Driller's Signature:	Registration No. Date



Notes:

Positive deflection indicates drift away listed compass direction

Negative deflection indicates drift towards from listed compass direction

Size of Casing = 12.75 in., OD, 12 in. ID. Size of Plummet = 11.75 in., OD

Height of Apex Above top of Well = 35 ft.

Plumbness and Alignment - Southwest Well 1A

Size of Casing = 12.00 in., ID; Size of Plummet = 11.75 in. OD

Height of Apex Above Top of Well = 35.00 ft

Depth of Plummet Below Top of Well	Horizontal Deflection of Plumb Line (Inches)				Calculated Drift of Well (Inches)			
ft	North (in)	South (in)	East (in)	West (in)	North	South	East	West
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	-0.005	0.005	-0.010	0.010	-0.006	0.006	-0.013	0.013
20	-0.010	0.010	-0.020	0.020	-0.016	0.016	-0.031	0.031
30	-0.015	0.015	-0.020	0.020	-0.028	0.028	-0.037	0.037
40	-0.015	0.015	-0.020	0.020	-0.032	0.032	-0.043	0.043
50	-0.025	0.025	-0.030	0.030	-0.061	0.061	-0.073	0.073
60	-0.060	0.060	-0.035	0.035	-0.163	0.163	-0.095	0.095
70	-0.060	0.060	-0.035	0.035	-0.180	0.180	-0.105	0.105
80	-0.060	0.060	-0.015	0.015	-0.197	0.197	-0.049	0.049
90	-0.060	0.060	0.000	0.000	-0.214	0.214	0.000	0.000
100	-0.060	0.060	0.000	0.000	-0.231	0.231	0.000	0.000
110	-0.060	0.060	0.000	0.000	-0.249	0.249	0.000	0.000
120	-0.060	0.060	0.000	0.000	-0.266	0.266	0.000	0.000
130	-0.060	0.060	0.000	0.000	-0.283	0.283	0.000	0.000
140	-0.070	0.070	0.000	0.000	-0.350	0.350	0.000	0.000
150	-0.060	0.060	0.000	0.000	-0.317	0.317	0.000	0.000
160	-0.060	0.060	0.000	0.000	-0.334	0.334	0.000	0.000
170	-0.060	0.060	0.000	0.000	-0.351	0.351	0.000	0.000
180	-0.050	0.050	0.015	-0.015	-0.307	0.307	0.092	-0.092
190	-0.050	0.050	0.020	-0.020	-0.321	0.321	0.129	-0.129
200	-0.050	0.050	0.020	-0.020	-0.336	0.336	0.134	-0.134
210	-0.050	0.050	0.030	-0.030	-0.350	0.350	0.210	-0.210
220	-0.050	0.050	0.030	-0.030	-0.364	0.364	0.219	-0.219
230	-0.050	0.050	0.030	-0.030	-0.379	0.379	0.227	-0.227
240	-0.050	0.050	0.030	-0.030	-0.393	0.393	0.236	-0.236
250	-0.050	0.050	0.030	-0.030	-0.407	0.407	0.244	-0.244
260	-0.050	0.050	0.030	-0.030	-0.421	0.421	0.253	-0.253
270	-0.050	0.050	0.030	-0.030	-0.436	0.436	0.261	-0.261
280	-0.040	0.040	0.030	-0.030	-0.360	0.360	0.270	-0.270
290	-0.040	0.040	0.030	-0.030	-0.371	0.371	0.279	-0.279
300	-0.040	0.040	0.030	-0.030	-0.383	0.383	0.287	-0.287
310	-0.040	0.040	0.030	-0.030	-0.394	0.394	0.296	-0.296
320	-0.035	0.035	0.030	-0.030	-0.355	0.355	0.304	-0.304
330	-0.035	0.035	0.035	-0.035	-0.365	0.365	0.365	-0.365
340	-0.035	0.035	0.035	-0.035	-0.375	0.375	0.375	-0.375
350	-0.035	0.035	0.035	-0.035	-0.385	0.385	0.385	-0.385

APPENDIX C

AVAILABLE WELL LOGS AND CONSTRUCTION DIAGRAMS OF NETWORK OBSERVATION WELLS

RECORD OF BOREHOLE THOMPSON CREEK MW

SHEET 1 of 1

PROJECT: Yelm Groundwater Study
PROJECT NUMBER: 043-1328
LOCATION: Thompson Creek

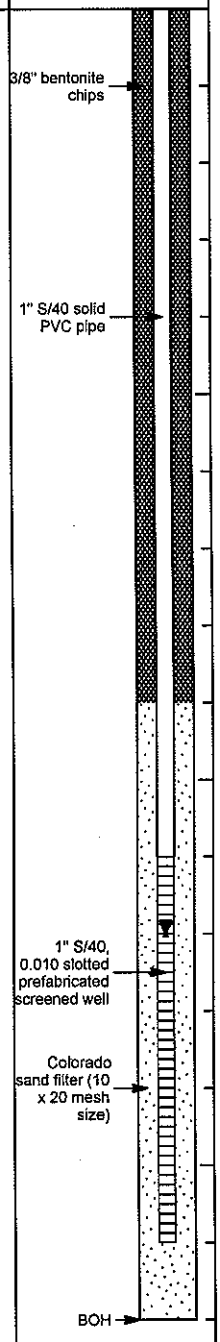
DRILLING DATE: 11-9-05
DRILLING METHOD: Hollow Stem Auger
DRILL RIG: Canterra CT 450 #123

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: Not Surveyed
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	COMMENTS
0	0.0 - 2.0 **SANDY SILT w/ GRAVEL** dark grayish brown (moist 10YR 2/2); poorly graded, subrounded gravels 1-2" dia.; fine sands; very soft	ML				
	2.0 - 6.0 **WELL-GRADED GRAVEL w/ SILT and SAND** dark brown (moist 10YR 3/3); subrounded/subangular gravels 1-2" dia.	GW-GM				
5	6.0 - 7.5 **POORLY GRADED SAND w/ GRAVEL** brown (moist 10YR 4/3); trace gravels subrounded/subangular to 1" dia.; soft; moist	SP				
	7.5 - 10.0 **WELL-GRADED GRAVEL w/ SILT and SAND** brown (moist 10YR 4/3); gravels to 3/4" dia.; moist	GW-GM				
10	10.0 - 15.0 Same as above; dark grayish brown (moist 10YR 4/2); trace gravels to 1" dia.; fine sands	GW-GM				Water encountered at 12' bgs.
15	15.0 - 16.0 **POORLY GRADED SAND** greenish gray (wet 10GY 5/1); trace silt; soft	SP				
	16.0 - 17.0 **SILT** greenish gray (moist 5GY 5/1); soft	ML				
20	Boring completed at 17.0 ft.					

WELL CONSTRUCTION NOTES
WATER LEVELS
WELL GRAPHIC

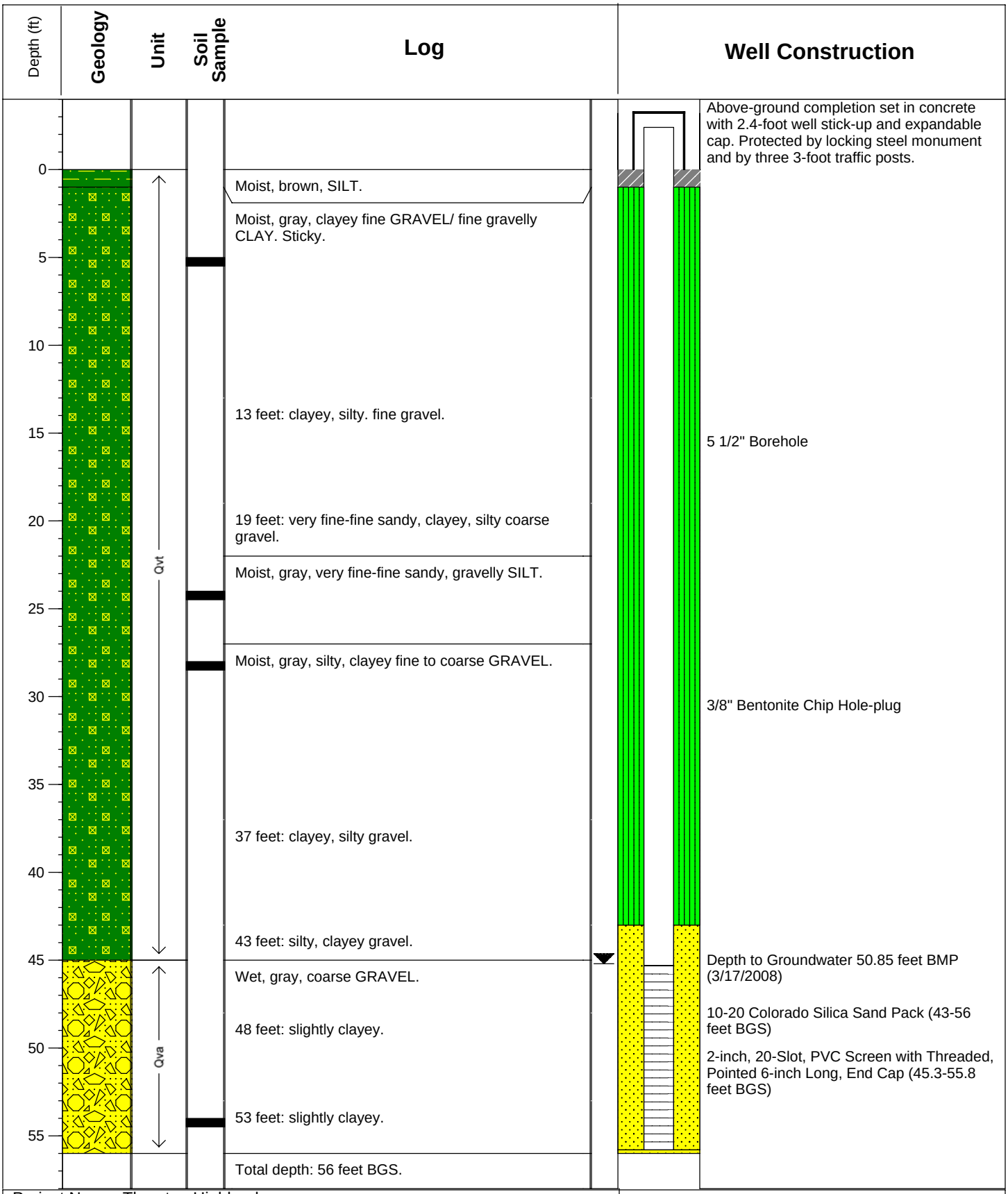


DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: Ken Phillips

LOGGED: Ken Janssen
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG THOMPSON CREEK.GPJ GLDR_WA.GDT 5/9/06



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Tim
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P18
Ecology ID: BAS468
MP Elevation: 381.07
Datum: NGVD 29
Installed: 3/13/2008
DTW: 50.85 BMP on 3/17/2008

Figure A-17
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P18
Thurston Highlands, LLC
Yelm, Washington
JC0701, 9/2008

PgG

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name Virgil Baker-Sunrise Homes Address 5622 Pacific Ave, SE Lacey, Wa. 98503

(2) LOCATION OF WELL: County Thurston — SW ¼ NW ¼ Sec 24 T. 17 N., R 1E 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) 1
New well ☒ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☒ Jetted ☐

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 85 ft. Depth of completed well 84 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from 0 ft. to 84 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 ..... Model No .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☒ Size of gravel: .....
Gravel placed from ..... ft. to ..... ft.

Surface seal: Yes ☒ No ☐ To what depth? 20 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 Jacuzzi Bros.
Type: 1S4C H.P. 1

(8) WATER LEVELS: Land-surface elevation above mean sea level ..... ft.
Static level 55 ft. below top of well Date 3-21-78
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? .....
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

Date of test .....
Bailer test 15 gal./min. with 10 ft. drawdown after 1 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
Surface seal	0	20
Brown silty clay	0	10
Sand & gravel	10	15
Hardpan	15	18
Sand & gravel, with clay (7Gpm)	18	70
Brown clay	70	78
Sand & gravel with little clay	78	85

Work started 3-21 19 78 Completed 3-21 19 78

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 Richardson Well Drilling Co.
(Person, firm, or corporation) (Type or print)

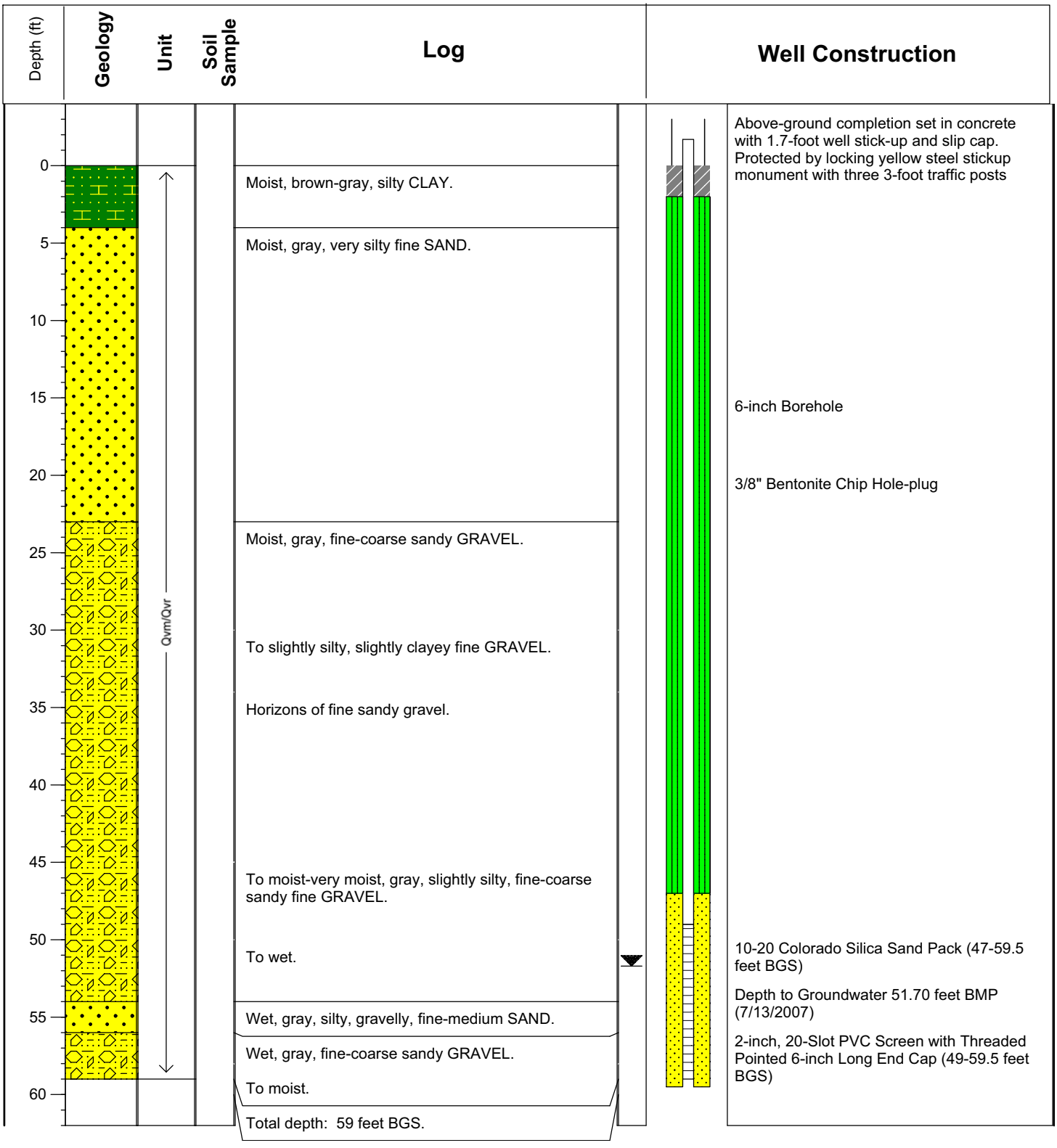
Address P.O. Box 44408 Tacoma, Wa. 98444

[Signed] .....
(Well Driller)

License No. 223-02-6500 Date 6-21 19 78

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

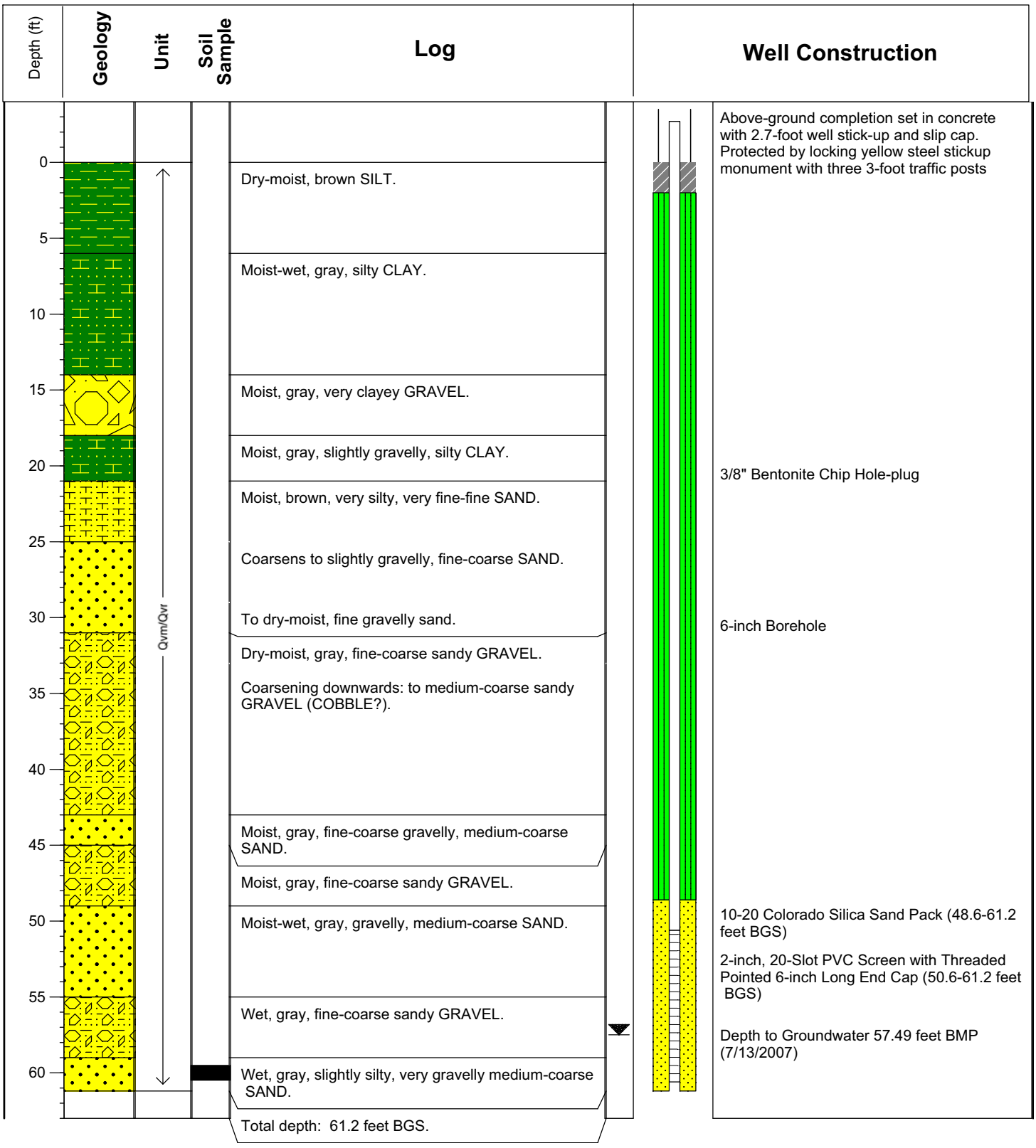


Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Ron
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P2
Ecology ID: apc066
MP Elevation: 375.85
Datum: NGVD 29
Installed: 6/26/2007
DTW: 51.70 BMP on 7/13/2007

Figure A-2
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P2
Shea, Carr, Jewell
Yelm, Washington
JC0701, 7/2007

PgG



Project Name: Thurston Highlands
Drilling Method: 5 1/2" Air Rotary
Driller: Ron
Firm: Environmental West Exploration
Consulting Firm: Pacific Groundwater Group
Logged by: Tad Cline
Location: Thurston Highlands

Well Name: P3
Ecology ID: APC063
MP Elevation: 405.12
Datum: NGVD 29
Installed: 6/26/2007
DTW: 57.49 BMP on 7/13/2007

Figure A-3
GEOLOGIC LOG AND AS-BUILT FOR PIEZOMETER P3
Shea, Carr, Jewell
Yelm, Washington
JC0701, 7/2007

PgG

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Application No. .....

Permit No. .....

(1) OWNER: Name DAVID PURVIS Address 14504 BERRY VALLEY RD. S.E.

(2) LOCATION OF WELL: County PIERCE — SW ¼ NW ¼ Sec 24 T. 17 N., R. 1 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) ....
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☐ Driven ☐
Reconditioned ☐ Rotary ☑ Jetted ☐

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

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from ..... ft. to ..... 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 ..... Model No .....
Diam. ..... Slot size ..... from ..... ft. to ..... ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☐ No ☐ Size of gravel: .....
Gravel placed from ..... ft. to ..... 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 ..... ft. below top of well Date .....
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? .....
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

Date of test .....
Bailer test 15 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
TOPSOIL	0	3
HARDPAN	3	48
GRAVEL - WATER 7-8	48	52
HARDPAN	52	60
GRAVEL - WATER 1-2	60	62
HARDPAN	62	78
GRAVEL - WATER 1	78	108
HARDPAN	108	137
ROCK	137	139
CEMENTED SAND-GRAVEL - ROCKS	139	155
SAND GRAVEL - WATER	155	

RECEIVED
DEC 15 1980
DEPARTMENT OF ECOLOGY NORTHWEST REGION

RECEIVED
DEC 1 0 1980

Work started 9-10- 19 80 Completed 9-11- 19 80

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 TACOMA PUMP & DRILLING CO. INC.
(Person, firm, or corporation) (Type or print)

Address 30316 MT. HWY. GRAHAM

[Signed] .....
(Well Driller)

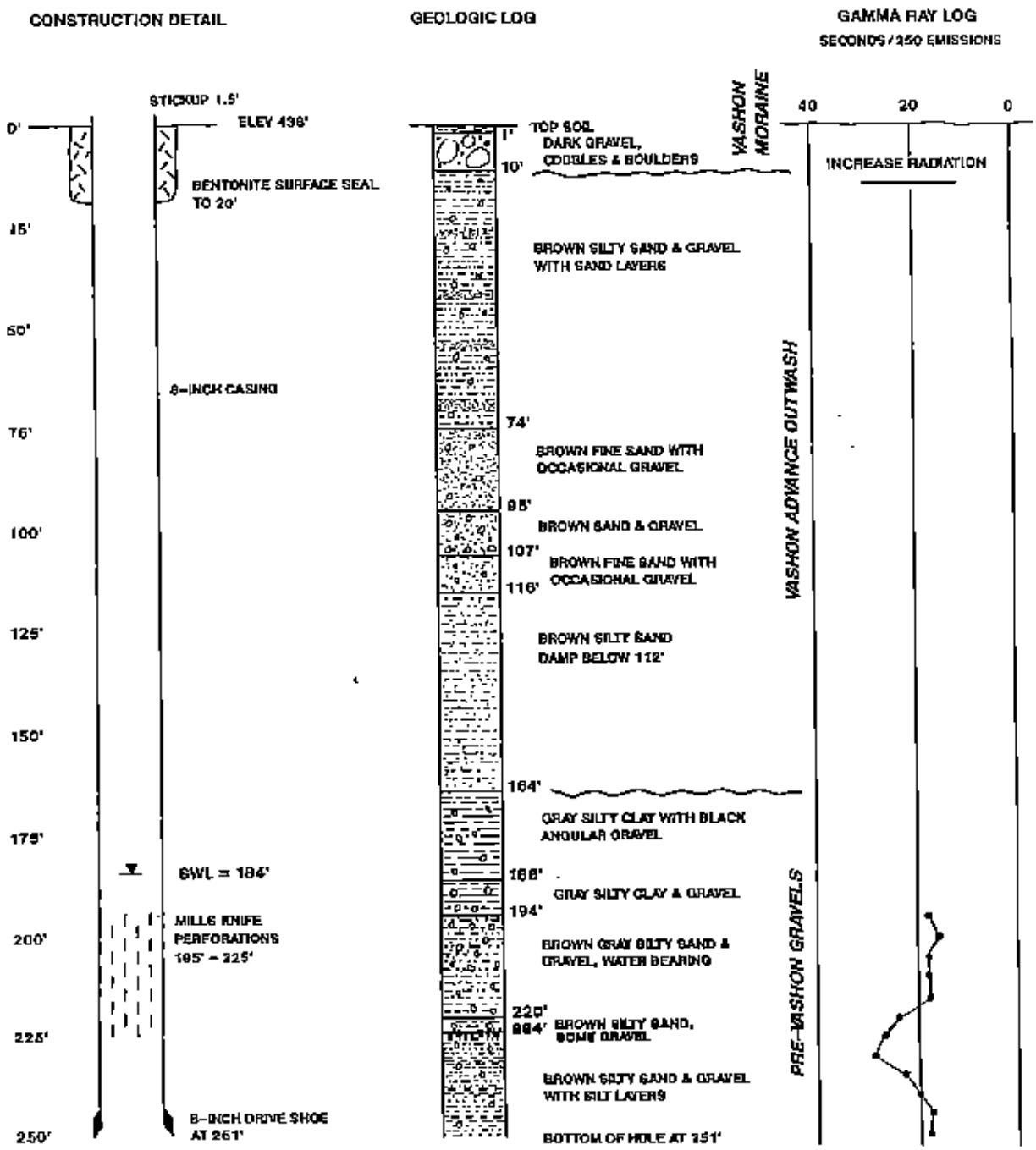
License No. ..... Date ..... 19 .....

(USE ADDITIONAL SHEETS IF NECESSARY)

ECY 050-1-20

FIGURE 2A

THURSTON HIGHLANDS
NORTH TEST WELL



PUMP TEST:

Q = 40, s = 10.3

Q/s = 4.2

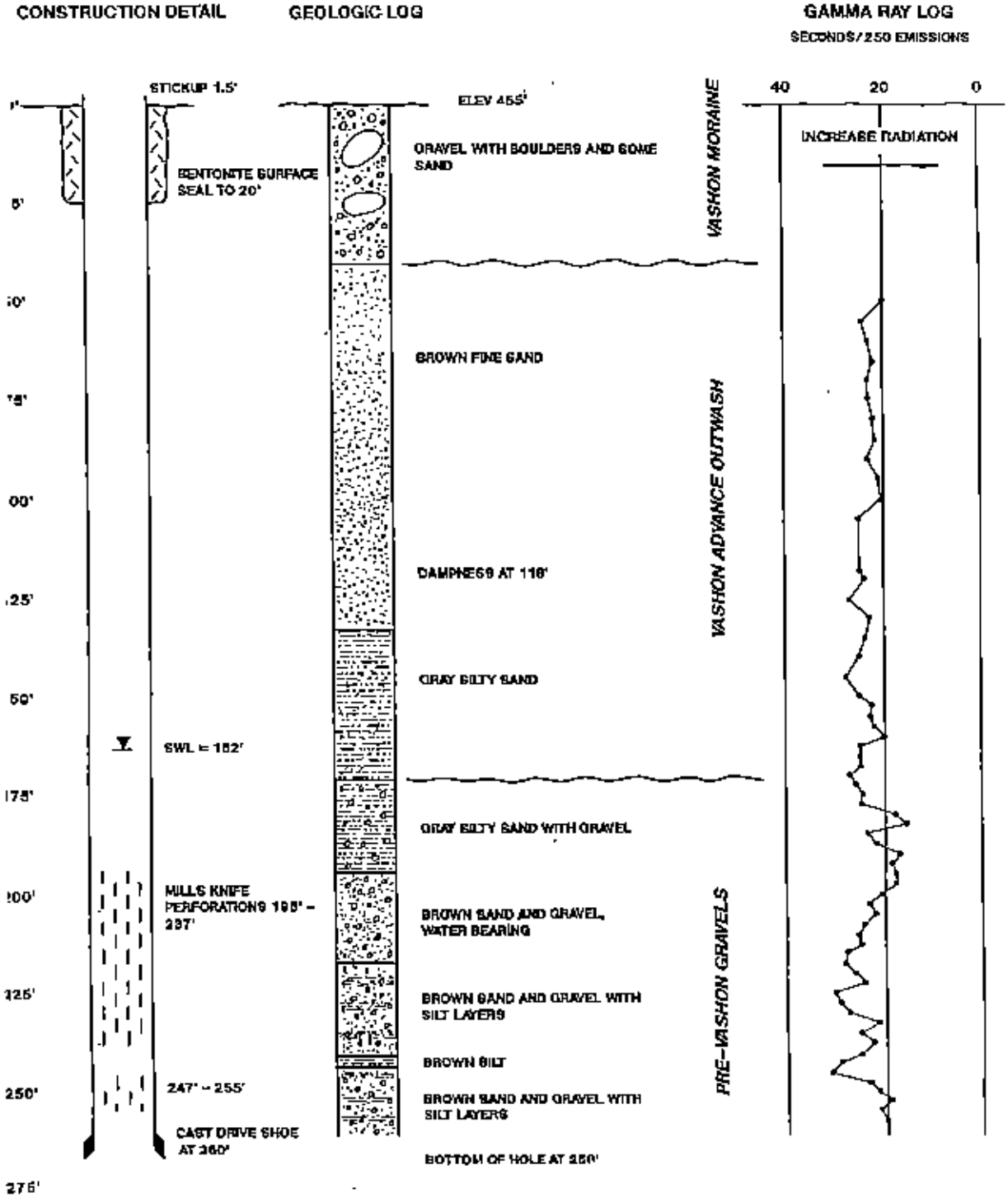
T = 4200

JOB #8116

ROBINSON & NOBLE, INC

THURSTON HIGHLANDS
SOUTH TEST WELL

FIGURE 2C



PUMP TEST:

Q = 71, s = 27.5

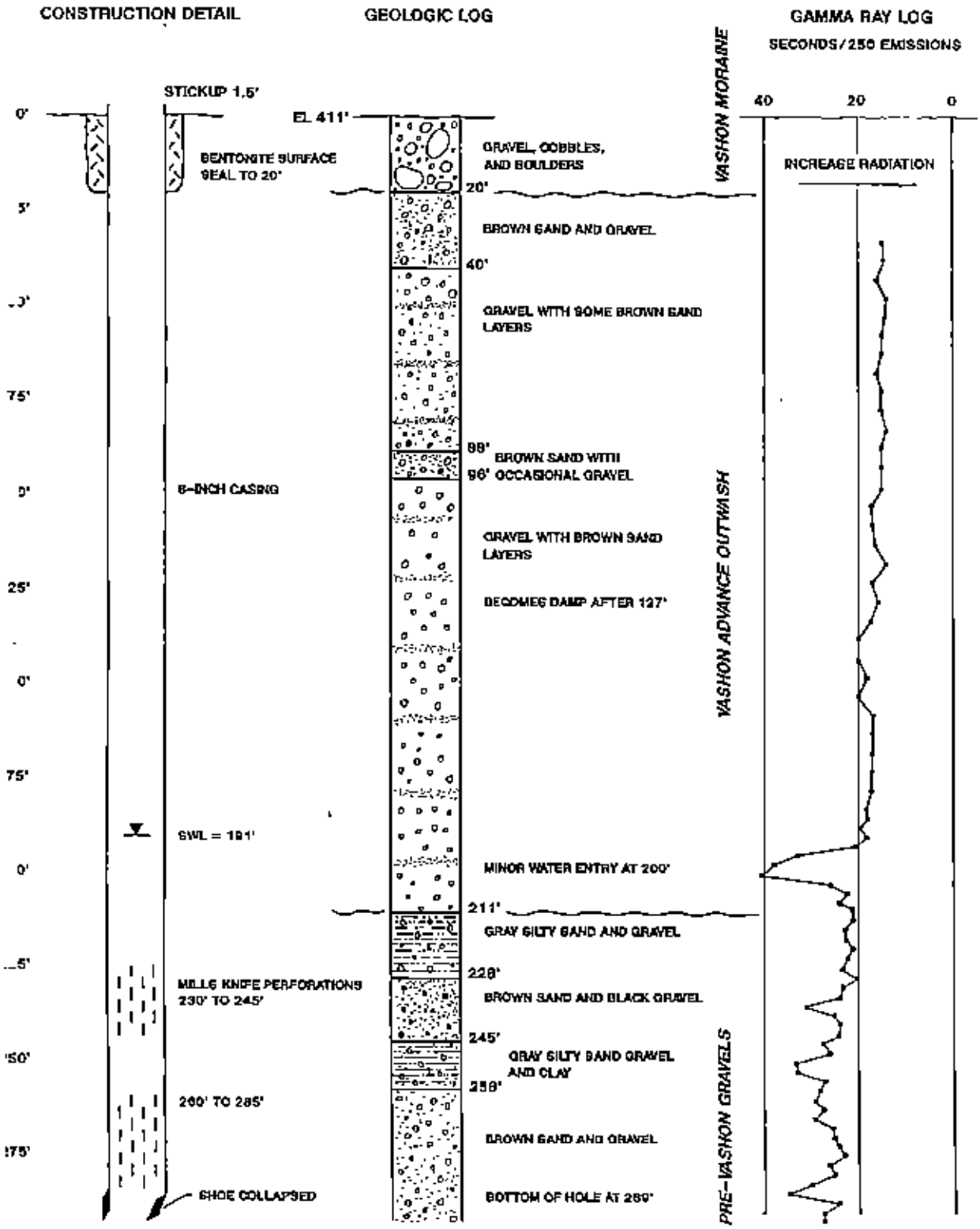
Q/s = 2.6

T = 2700

JOB #6119

ROBINSON & NOBLE, INC.

WEST TEST WELL



PUMP TEST:

Q = 159, s = 15

Q/s = 10.6

T = 36,000 (dd)

T = 105,000 (rea)

JOB #6116

ROBINSON & NOBLE, INC

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 1 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES, WATER LEVELS, WELL GRAPHIC
0	0.0 - 20.0 Mixture of silt, sand, gravel and cobbles	FILL				0-8' Drillers report mixture of silt, sand, gravel, and cobbles	Carbon steel casing 12-inch Nom. Dia.
10						Drillers report silt, sand, gravel and cobbles	Carbon steel casing 16-inch Nom. Dia. Neat cement surface seal
15						Drillers report silty sand and gravels with large cobbles from 17-30'	
20	20.0 - 30.0 **SANDY SILT with GRAVEL** dark grayish brown (moist 2.5Y 4/2); well graded, subangular gravels up to 2" dia.; well graded sands; some woody debris	ML		GRAB			Native formation
25							
30	30.0 - 40.0 **SANDY SILT with GRAVEL** same as above except gravels up to 1" dia.			GRAB		Drillers report silty sand, gravels and cobbles from 30-36'	
35		ML				Drillers report silty sand, gravels and cobbles from 36-47'	
40	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 2 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES, WATER LEVELS, WELL GRAPHIC
40	40.0 - 50.0 **SANDY SILT with GRAVEL** same as above			GRAB			
45		ML				Drillers report silt, sand, gravel and cobbles from 47-49' Drillers report brown silt with few gravels from 49-53'	
50	50.0 - 60.0 **SANDY SILT with GRAVEL** same as above			GRAB			
55		ML				Drillers report brown silt, sand, gravel, and cobbles from 53-61'	
60	60.0 - 70.0 **SANDY SILT with GRAVEL** same as above			GRAB		Drillers report brown silty sand and gravels with cobbles from 61-80'	Native formation
65		ML					
70	70.0 - 80.0 **Well-graded SAND with SILT and GRAVEL** dark grayish brown (moist 2.5Y 4/2); well graded sands; well graded, subrounded gravels up to 1" dia.			GRAB			
75		SW-SM					
80	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 3 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES WATER LEVELS WELL GRAPHIC
80	80.0 - 90.0 **Well-graded SAND with SILT and GRAVEL** same as above	SW-SM		GRAB		Drillers report brown silty sand and gravels from 80-98'	
90	90.0 - 100.0 **Well-graded SAND with SILT and GRAVEL** same as above except well graded, subrounded/subangular gravels up to 2" dia.	SM		GRAB			
100	100.0 - 110.0 **SANDY SILT with GRAVEL** dark greenish gray (moist 10Y 4/1); well graded sands; well graded, subrounded/subangular gravels up to 1" dia.	ML		GRAB		Drillers report brown silty sand and gravels from 103-112'	Native formation
110	110.0 - 120.0 **SANDY SILT - SILTY SAND, with GRAVEL** dark greenish gray (moist 10Y 4/1); well graded sands; well graded, subrounded/subangular gravels up to 1" dia.	ML-SM		GRAB		Drillers report brown/gray silt and gravels from 112-126'	
120	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 4 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES WATER LEVELS WELL GRAPHIC
120	120.0 - 130.0 **SANDY SILT - SILTY SAND, with GRAVEL** same as above	ML-SM		GRAB			
125						Drillers report brown silt, sand, gravels, and cobbles from 126-138'	
130	130.0 - 140.0 **SANDY SILT - SILTY SAND, with GRAVEL** same as above except gravels rounded to subrounded			GRAB			
135		ML-SM				Drillers report brown silty sand and gravel with cobbles from 138-155'	
140	140.0 - 150.0 **SANDY SILT - SILTY SAND, with GRAVEL** same as above except poorly graded gravels 1-2" dia.; basalt cobble 3+" dia.			GRAB			Native formation →
145		ML-SM					
150	150.0 - 160.0 **SANDY SILT - SILTY SAND, with GRAVEL** same as above except poorly graded, subrounded/subangular gravels up to 3/4" dia.			GRAB			
155		ML-SM				Drillers report brown silty sand and gravel with cobbles from 155-170'	
160	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
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LOGGED: K. Janssen and A. Clark
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DATE: 5/8/2006

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PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 5 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES WATER LEVELS WELL GRAPHIC
160	160.0 - 170.0 **SANDY SILT - SILTY SAND, with GRAVEL** same as above except poorly-graded gravels up to 1" dia.	ML-SM		GRAB			
170	170.0 - 180.0 Same as above	ML-SM		GRAB		Drillers report brown silty sand, gravels and cobbles from 170-185'	Carbon steel casing 12-inch Nom. Dia.
180	180.0 - 190.0 **GRAVELLY SILT** brown (5Y 5/2); well graded sands; well graded gravels; subrounded to subangular gravels; largest observed gravel 1" to 2" diameter	ML		GRAB		Drillers report brown silty sand, gravels and large cobbles and occasional silt-bound layers from 185-196'	Native formation
190	190.0 - 200.0 **SANDY SILT - SILTY SAND, with GRAVEL** olive gray (moist: 5Y 5/2); stiff, blocky silt (10GY 6/1) with mottles (5YR 5/6); well-graded sands; well-graded, subrounded gravels up to 2" dia.; some cobbles up to 5"+ dia.; some fine rootlets	ML-SM		GRAB			
195							
200	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
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DATE: 5/8/2006

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PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 6 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES, WATER LEVELS, WELL GRAPHIC
200	200.0 - 210.0 **SILTY SAND with GRAVEL** dark gray (moist: 5Y 4/1); well-graded sands; well-graded gravels, subrounded/subangular gravels up to 2" in dia.; some cobbles up to 3" in dia.	SM		GRAB			
205						Drillers note minor water entry at 205'	Minor water entry noted at 205' bgs
210	210.0 - 220.0 **Well-graded SAND with SILT and GRAVEL** dark gray (moist: 5Y 4/1); subrounded/subangular gravels up to 1" dia.; some cobbles up to 3"+ dia.	SW-SM		GRAB			
215							
220	220.0 - 226.0 Same as above; % gravels declining; gravels up to 1" dia.	SW-SM					Native formation
225							
230	226.0 - 230.0 Same as above; finer sands; % gravels declining; gravels up to 1-2" dia.	SW-SM		GRAB			
	230.0 - 234.0 Same as above; gravels up to 2" dia.	SW-SM		GRAB			
235	234.0 - 236.0 **SILTY SAND - SILTY GRAVEL** olive (moist: 5Y 4/3) well-graded sands and gravels; gravels up to 2" dia.; cobbles up to 3"+ dia.; some oxidation on cobbles	SM-GM		GRAB		Drillers note silt layer	
	236.0 - 240.0 Same as above; well graded gravels; gravels up to 2" dia.; some cobbles from 3"-4" dia.; trace amounts of oxidation on gravels; silt with small amounts of clay as binder; silts are soft and blocky (gray 5Y 5/1 with orange 5YR 4/6 mottles)	SM-GM		GRAB		Silt bound layers at 236' bgs.	
240	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

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Golder Associates

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 7 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES WATER LEVELS WELL GRAPHIC
240	240.0 - 244.0 **SILTY SAND** olive (moist: 5Y 3/3) well graded gravels; subrounded to subangular gravels; gravels to 1"+ dia.; some cobbles to 3"+ dia.	SM		GRAB			
245	244.0 - 250.0 **SILT** light yellowish brown (moist: 2.5Y 6/4); some oxidation; trace poorly graded sands; some poorly graded gravels	ML		GRAB			
250	250.0 - 260.0 **SILTY GRAVEL - GRAVELLY SILT** olive gray (5Y 5/2); trace clay; well graded sands; subrounded gravels to 2"+ dia.; silt/clay as matrix (greenish gray)	GW-GM		GRAB			
255							
260	260.0 - 270.0 **SILTY GRAVEL** olive gray (5Y 5/2); well graded sands; well graded gravels; subrounded gravels to 2"+ dia.	GM		GRAB			Native formation →
265							
270	270.0 - 280.0 **SILTY GRAVEL-GRAVELLY SILT** well graded sands; well graded gravels; subrounded gravels to 2"+ dia.	GW-GM		GRAB			
275							
280	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 8 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	COMMENTS	WELL CONSTRUCTION NOTES WATER LEVELS WELL GRAPHIC
280	280.0 - 290.0 Same as above; dark gray (5Y 4/1); cobbles to 6"+ dia.	GW-GM		GRAB		Drillers report gray silt bound gravels and sand from 280-293'; water going down (283'-9"+10'-1" = 293'-10" +13'-11" = 307'-9")	
290	290.0 - 293.0 **SILTY GRAVEL** dark greenish gray (10Y 4/1); grayish/blue; well graded sand; coarse gravels to 2.5" dia.; rounded to subrounded gravels; gravels in fine sand to clay matrix; clay form ribbons (soft)	GM		GRAB		Drillers report large cobbles and gravels with sand from 293-304'; gray silt binder; water up and down	
295	293.0 - 296.0 **SILTY SAND** bluish black (10G 2.5/1); fines are pale olive (5Y 6/3); gravels subrounded to 2" dia.	SM		GRAB		Note recovery around 296' to 298' appeared to have less clay than 301' sample; cleaner returns	
	296.0 - 298.0 Same as above; coarse sands	SM		GRAB			
	298.0 - 301.0 Same as above; fine sands	SM		GRAB			
300	301.0 - 304.0 Same as above; increasing gravels and cobbles; most sand is broken from larger materials (fresh); gravels subangular to rounded	SM		GRAB			Native formation →
305	304.0 - 307.0 **SILTY SAND - SANDY SILT** very dark gray (5Y 3/1); well graded gravel	SM-ML		GRAB		Drillers report large cobbles and gravels with sand and gray silt binder from 304-317'; making water; 307'-9" + 9'-10" = 3177" +10'-1" = 327'-8"	
	307.0 - 310.0 **SILTY SAND w/ GRAVEL** very dark gray (5Y 3/1);	SM		GRAB			
310	310.0 - 313.0 **SILTY GRAVEL w/ SAND** very dark gray (5Y 3/1); cobbles with clay; clay is bluish-gray (not as abundant as 307'); cobbles are up to 6" x 3" in size; gravels and cobbles are subrounded to rounded	GM		GRAB			
315	313.0 - 316.0 Same as above; greenish black (5GY 2.5/1); fines are olive (5Y 5/3)	GM		GRAB		Sample at 316' - Silty/sandy gravels with cobbles and clay; some cobbles 4-5" in dia.; large gravels and cobbles mostly subrounded, clay is greenish blue-gray with slightly mottled appearance and is sticky; forms slight ribbons; increasing fines in matrix than in sample from 313'	
	316.0 - 319.0 **SILTY-CLAYEY GRAVEL w/SAND** greenish gray (10Y 5/1)	GC-GM		GRAB			
320	Log continued on next page	GW-GM					

DRILLING CONTRACTOR: Holt Drilling, Inc.
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LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 9 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES, WATER LEVELS, WELL GRAPHIC
320	319.0 - 322.0 **SITLY SAND w/GRAVEL** dark gray (5Y 4/1); trace cobbles; sand and clay; most coarse sand is ground material; gravels are broken to 2" dia.; less fines than 316' sample; fines are olive (5Y 5/3)*(Continued)* 322.0 - 325.0 **SANDY GRAVEL w/ SILT** dark gray (5Y 4/1); cobbles to 6" x 4" in size; brown medium to coarse sand; fewer fines (silts and clays) than in 319' sample; noted pumice; noted pink sand 325.0 - 328.0 **SANDY GRAVEL w/SILT** dark gray (5Y 4/1); mottles (7.5YR 4/6); silts (5Y 7/3); with cobbles and clay; brown fine to medium sand; clay is greenish brown and soft; forms slight ribbons; much sand sizes appear to be broken larger material; gravel is subrounded; oxidation in matrix 328.0 - 331.0 Same as above; olive (5Y 5/3); some gravels 3" x 1" in size 331.0 - 334.0 Same as above	GW-GM		GRAB		Driller reports large cobbles; gravels with sand and gray silt from 317-324'; making some water; 327'-8" Drillers report large cobbles and gravels with sand and gray silt from 324-334'; 327'-8" + 10'-0" = 337'-8"	
325		GW-GM		GRAB			
330		GW-GM		GRAB			
335		GW-GM		GRAB			
	334.0 - 337.0 **WELL GRADED GRAVELLY SAND** very dark gray (5Y 3/1); fines pale olive (5Y 6/4); fine to coarse sands ground cuttings from gravels and cobbles; fewer fines; gravels green and brown; gravels subrounded; gravels 2" x 1.5" in size 337.0 - 340.0 same as above; some cobbles/clay; unbroken gravels are subrounded to rounded to 2" dia.; increasing fines	SWG		GRAB		Drillers report large cobbles and gravels with sand and gray silt binder from 334-344'; 337'-8" + 9'-10" = 347'-6"	Riser pipe with rubber packer 5'-1" above top of screen
340		SWG		GRAB		Driller reports formation of water still looks brown at 340-343'	
	340.0 - 343.0 same as above; fewer fines than in 337' sample; clay noted attatched to gravels; most medium to coarse sand is broken material	SWG		GRAB			Naturally developed (no filter pack)
345	343.0 - 346.0 Same as above; less silt/clay	SWG		GRAB		Driller reports large cobbles and gravel with sand and gray silt binder from 344-354'; static level at 218' bgs. in AM.; 347'-6" + 10'-0" = 357'-6"	70-slot stainless steel wire wrap screen
	346.0 - 349.0 Same as above; increased silt/clay content; silt/clay noted as matrix support for gravel and sand	SWG					
350	349.0 - 352.0 same as above; fewer fines; increased amounts of undisturbed coarse sands and gravel; appears cleaner; trace cementation; clay/silt grayish brown in color, soft and forms ribons; clay/silts do not support larger grains	SWG		GRAB		Note - not in sample, but discarded along sample area are cobbles, some are 4-7" in dia.; uncertain about depth interval; between 334' and 354'	
	352.0 - 354.0 **POORLY-GRADED GRAVEL** very dark gray (5Y 3/1); some fines; well graded sands and gravels; silt pale olive(5Y 6/4); gravels subrounded to rounded; gravel 2" x 1" in size	GP		GRAB		Interval for bail-down test; note - returns were from 4th bail and are mostly medium to course sand size broken from larger grains; gravels to 1" dia.; gravels subrounded; fines present but minor silt/clay; not complete sample but closest material to test zone Note - after collecting 357' sample, drilling gets hung up on cobbles as noted by the driller	
355	354.0 - 357.0 **POORLY-GRADED SAND** medium to coarse sands; trace fines; little coarse to fine gravels; gravels subrounded to 1" dia.	SP					Low carbon steel casing
	357.0 - 360.0 **POORLY-GRADED SAND** very dark gray (5Y 3/1); medium to coarse sands; trace fines; little coarse to fine gravels; gravels subangular-subrounded to 1" dia.; trace cobbles to 4" dia.	SP		GRAB			
360	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 10 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	COMMENTS	WELL CONSTRUCTION NOTES WATER LEVELS WELL GRAPHIC
360	360.0 - 363.0 **WELL-GRADED SAND** very dark gray (5Y 3/1); trace fines; little coarse gravels; gravels subrounded to 2" dia.	SW		GRAB		Bail down test performed	
	363.0 - 366.0 **POORLY-GRADED SAND** very dark gray (5Y 3/1); fines olive (5Y 5/3); medium sands; little fines; some coarse to fine gravels; gravels subangular to subrounded	SP		GRAB			
365	366.0 - 369.0 **WELL-GRADED SAND** dark greenish gray (10GY 3/1); trace fines; some coarse to fine gravels	SW		GRAB		Coarse graines and large cobbles not included in samples but observed in sampling area (cobbles up to 9" x 5"; noted), unknown depths ; subrounded cobbles	70-slot stainless steel wire wrap screen
	369.0 - 372.0 same as above; increased coarse sands and gravels; gravels to 1.5" dia.	SW		GRAB			
370	372.0 - 375.0 same as above; trace cobbles; little fines	SW		GRAB			
375	375.0 - 378.0 same as above	SW		GRAB			
	378.0 - 381.0 **POORLY-GRADED SAND** black (N 2.5/); trace fines; some coarse to fine gravels; gravels rounded-subrounded to 2.5" dia.	SP		GRAB			
380	381.0 - 384.0 same as above	SP		GRAB			Low carbon steel casing
	384.0 - 387.0 **SILTY GRAVEL w/ SAND** dark greenish gray (5G 3/1); trace silts olive (5Y 5/4); some clay mottled dark greenish gray to black (5G 3/1 - N 2.5/); trace cobbles to 4" dia.	GM		GRAB			
385	387.0 - 390.0 **POORLY-GRADED GRAVELLY SAND** very dark gray (N 3/); trace fines; gravels rounded-subrounded to 2.5" dia.	SPG		GRAB			
390	390.0 - 393.0 same as above; gravels to 3.5" dia.	SPG		GRAB		Driller notes large cobbles	50-slot stainless steel wire wrap screen
	393.0 - 396.0 same as above; gravels subrounded to angular; gravels to 2" dia.;	SPG		GRAB			
395	396.0 - 399.0 same as above; gravels subrounded	SPG		GRAB			100-slot stainless steel wire wrap screen
400	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

RECORD OF BOREHOLE SW YELM NO. 1

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA
DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:
DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed
ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES TYPE	SAMPLES NUMBER	COMMENTS	WELL CONSTRUCTION NOTES WATER LEVELS WELL GRAPHIC
400	399.0 - 402.0 same as above *(Continued)*	SPG					
	402.0 - 405.0 **POORLY-GRADED SAND** very dark gray (N 3/); trace fines; little coarse to fine gravels; gravels rounded-subrounded to 1" dia.	SP		GRAB		Driller notes change to sand at 401' bgs and reddish color	
405	405.0 - 408.0 same as above; some coarse to fine gravels	SP		GRAB			Low carbon steel casing
	408.0 - 411.0 **POORLY-GRADED GRAVELLY SAND** very dark gray (N 3/); trace fines; gravels subrounded to 4" dia.	SPG		GRAB			
410	411.0 - 414.0 **POORLY-GRADED SAND** very dark gray (N 3/); trace fines; some coarse to fine gravels; gravels rounded-subrounded to 1" dia.	SP		GRAB		Large cobble encountered at 413.5' bgs. required drilling here with hammer; hammer not used from at least 390' to 413.5' bgs. Driller believes this is a silty zone instead. Color change in water is now now greyish/brown instead of greenish/black at casing depth 415.5' bgs.	
415	414.0 - 417.0 same as above; little coarse to fine gravels; little fines; gravels subrounded to 2" dia.	SP		GRAB			
	417.0 - 420.0 same as above; some coarse to fine gravels	SP		GRAB			
420	420.0 - 423.0 **POORLY-GRADED GRAVELLY SAND** very dark gray (N 3/); trace fines; fine sands; gravels subrounded to rounded; gravels to 1/2" dia.	SPG		GRAB			
	423.0 - 426.0 **POORLY-GRADED GRAVELLY SAND** very dark gray (N 3/); trace fines; fine sands; gravels subangular-rounded to 2" dia.	SPG		GRAB		Note driller collects sample of wood at approximately 425' bgs.	
425	426.0 - 429.0 **POORLY-GRADED SAND** very dark gray (N 3/); trace fines; some coarse to fine gravels; gravels rounded-subrounded to 2.5" dia.	SP		GRAB			
	429.0 - 432.0 same as above; gravels to 1/2" dia.; increased fine gravels	SP		GRAB			Gravel backfill, in accordance with WAC 173-160
430	432.0 - 435.0 same as abve; little coarse to fine gravels; gravels subangular to rounded	SP		GRAB			
	435.0 - 438.0 **SILTY GRAVEL w/ SAND** greenish gray (10Y 5/1); well graded gravels; gravels subrounded-rounded to 2" dia.;	GM		GRAB			
435		SP		GRAB			
440	Log continued on next page						

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

RECORD OF BOREHOLE SW YELM NO. 1

SHEET 12 of 12

PROJECT: Anderson Property
PROJECT NUMBER: 043-1328
LOCATION: Thurston County, Yelm, WA

DRILLING DATE: 8/17/05
DRILLING METHOD: Cable tool
DRILL RIG:

DATUM:
AZIMUTH: N/A
COORDINATES: not surveyed

ELEVATION: 450
INCLINATION: -90

DEPTH (ft)	SOIL PROFILE: DESCRIPTION	Geological Unit	GRAPHIC LOG	SAMPLES: TYPE	SAMPLES: NUMBER	FIELD OBSERVATIONS: COMMENTS	WELL CONSTRUCTION: NOTES WATER LEVELS WELL GRAPHIC
440	438.0 - 441.0 **POORLY-GRADED SAND** very dark gray (N 3/); trace fines light olive gray (5Y 6/2); some coarse to fine gravels; gravels subangular-subrounded to 3" dia. *(Continued)* 441.0 - 444.0 same as above; increased coarse sands; gravels rounded-subrounded to 2" dia.	SP SP		GRAB			
445	444.0 - 446.0 **POORLY to WELL-GRADED SAND** very dark gray (N 3/); trace fines light olive gray (5Y 6/2); some coarse to fine gravels; gravels subangular-subrounded to 3" dia.	SP-SW		GRAB		Small sample from 445' bgs taken; gravels (small to course) in matrix of silty clay with fine to medium sands; silt/clay is gray w/greenish zones; clay forms ribbons; is soft and forms film; one course gravel to 3.5" dia.	Gravel backfill, in accordance with WAC 173-160
450	Boring completed at 450.0 ft.						
455							
460							
465							
470							
475							
480							

DRILLING CONTRACTOR: Holt Drilling, Inc.
DRILLER: T. Farenbach and R. Miller

LOGGED: K. Janssen and A. Clark
CHECKED: Mark Wirganowicz
DATE: 5/8/2006

Golder Associates

PORTLAND GEOLOGICAL LOG YELM LOGS.GPJ GLDR_WA.GDT 5/9/06

APPENDIX D

AQUIFER TEST WATER LEVEL AND WATER QUALITY FIELD DATA SHEETS

Golder Associates

PROJECT NUMBER	WELL NUMBER	SHEET / OF
10399709	SW Well 1A	1 / 4

Aquifer Test Data Sheet

WELL #: SW Well 1A — (PUMPING) / RECOVERY
TYPE OF DATA: Manual Water levels Step-Test — RECOVERY / DRAWDOWN
WELL DIAMETER: 12"
PUMPING WELL:
CHECK VALVE INSTALLED ON PUMP? Yes
DISTANCE FROM PUMPING WELL: NA
M.P.: 2.58 ft ags
HOW Q MEASURED: Totalizing Flow Meter
HOW WL'S MEASURED Manual Sounding Probe
INITIAL DEPTH TO WATER: 91.04
COMMENTS: STEP-RATE TEST

DEPTH: 633'
DIAMETER: 12"
ELEVATION:

DATE: 7/23/10
DATA COLLECTED BY: L. Bartosik, K. Janssen
DATA LOGGER: Yes
PUMP ELEVATION:
OTHER:

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet) BMP	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (gal)	Pump on, off, rate change; pump type; water quality; etc.
Start 16:06		90.04	Feet BMP			START 6 GAL on totalizer
16:06		110.6 BMP				
	2min 20s	113.44				
16 2:20		113.44	160 gpm			585 gpm
	3min 30sec					600 gpm
	5min	113.44				600 gpm
16:12	6min 10s	113.55				
16:12	6min 40s	113.65				
16:13		113.81				575 gpm
16:14		113.94				
16:14:45		114.00				
	9min 16s	114.04				575 gpm
16:15:30		114.24				
16:16	10 min 30	14.34				
16:17		114.72				
16:18		114.78				
16:19		114.99				
16:20		115.06				
16:21		115.14				
16:22		115.23				
16:24		115.12				
16:26		115.15				550/575 gpm
~~16:28~~						
16:27						rate increase
16:28		116.41				
16:30		116.13				
16:32		115.50				
16:33						rate increase to 575
16:34		116.16				
16:36		~~116.85~~				rate increase back to 575 - trying to get H2O overall
16:37		116.85				
16:40		116.94				575 gpm
16:41		116.90				
16:44	38					24,000 gal
16:45		116.88				550-575 gpm
16:51						575 GPM
16:52		117.17				575 GPM 26.13 total ft K: 22.0
17:03		117.65				550 GPM 35K Gallons
17:07		117.77				
17:13	67	117.91				550 GPM - Totalizer 41.5K gal.

my time (min) ahead of KJ

STEP 1

Golder Associates

PROJECT NUMBER	WELL NUMBER	SHEET 2 OF 4
10399709	SW 4A	

Aquifer Test Data Sheet

WELL #: SW Well 7A
TYPE OF DATA: Manual WL
WELL DIAMETER: 12"
PUMPING WELL: Yes
CHECK VALVE INSTALLED ON PUMP? Yes
DISTANCE FROM PUMPING WELL: NA
M.P.:
HOW Q MEASURED: Totalizing Flow Meter
HOW WL'S MEASURED: Sounding Probe
INITIAL DEPTH TO WATER: 91.64
COMMENTS: STEP RATE TEST

PUMPING / RECOVERY
RECOVERY / DRAWDOWN
DEPTH: 633
DIAMETER: 12"
ELEVATION:

DATE: 7/23/10
DATA COLLECTED BY: L. Bortolik, K. Janssen
DATA LOGGER:
PUMP ELEVATION:
OTHER:

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet)	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (x 1000) (gal)	Pump on, off, rate change; pump type; water quality; etc.
STEP 1						
17:20	74	118.20	27.16	550	45K	
17:26	80	118.28	27.24	550	48	
17:31	85	118.37	27.33	550	51.5	
17:36	90	118.~~45~~	27.~~41~~	550	53.5	
17:41	95	118.58	27.54	550/525	57.5	550/525
17:48	102	118.73	27.69	550/525	61.5	
17:57	111	118.94	27.9	550	67	
18:08	118	119.02	27.98	550	71	
18:~~01~~	125	119.15	28.11	550	~~75~~ 75	
18:16	130	119.25	28.21			
18:21	135	119.35	28.31	550	80.5	
18:31	145	119.47	28.43	~~550~~	~~91~~	
18:41	155	119.53	28.49	550	91	
18:51	165	119.65	28.61	550	96.5	
18:56	~~170~~	119.72	28.68	550		
19:01	175	119.79	28.75	550	102	
19:08	182	119.84	28.8	550	106	
STEP 1						
19:16	190	119.90	28.86	550		
19:23	197	119.98	28.94	550	113	
19:26	200	120.01	28.97	550	116	
19:31	205	120.06	29.02	550		
19:35	209	120.08	29.04	550	122	
1935						Bump up step Set at 1100
1936	210					
~~1938~~		~~136.30~~				
		+3.0				
1938	212	136.43	45.39			1100
~~1939~~						+100
1940	214	136.93	45.~~89~~			1100
1941	215	137.13	46.09			1100
1942	216	137.23	46.19			1100
1943	217	137.38	~~43~~ 46.34			1100
1945	219	137.62	46.58			1100
1950	224	138.06	47.02			1100
1953	228	138.19	47.15			1100
~~1956~~	~~232~~	~~138.61~~				
1959	234	138.70	47.66		151	1100
2002 ~~1927~~	237	138.78	47.74		155	1100
2006	241	138.98	47.94			

PROJECT NUMBER	WELL NUMBER	
SW 7A	10399709	SHEET 3 OF 4

Golder Associates

Aquifer Test Data Sheet

WELL #: SW Well 7A
TYPE OF DATA: Manual
WELL DIAMETER: 12"
PUMPING WELL: yes
CHECK VALVE INSTALLED ON PUMP? yes
DISTANCE FROM PUMPING WELL: NA
M.P.:
HOW Q MEASURED: Sounder, totalizer
HOW WL'S MEASURED
INITIAL DEPTH TO WATER: 91.04
COMMENTS: STEP RATE TEST

~~PUMPING~~ / RECOVERY
RECOVERY / DRAWDOWN
DEPTH: 633
DIAMETER: 12"
ELEVATION:

DATE: 9/23/10
DATA COLLECTED BY: L Bartosik, K Janssen
DATA LOGGER: yes
PUMP ELEVATION:
OTHER:

	TIME DATA		WATER LEVEL DATA		Pump Rate (gal / min)	Totalizer Reading (gal)	REMARKS
	Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet)	Drawdown (feet)			Pump on, off, rate change; pump type; water quality; etc.
	2010	245	139.08	48.04	1100	165	
	2016	251	139.30	48.26	1100	173	
	2022	257	139.51	48.47			
	2028	263	139.67	48.63	1100	187	
	2035	270	139.83	48.79	1100	195.5	
	2040	275	139.93	48.89	1100	202	
Step 2	2044	280	140.04	49.0	1100	207.5	
	2049	285	140.13	49.09	1100	212.5	
	2054	~~300~~ 290	140.22	49.18	1100	218	
	2059	295	140.38	49.34	1100	225	
	2102	298	140.41	49.37	1100		
	2104	300	140.45	49.41	1100		
						302 min	in 2106 Bumped flow up to ~~1600~~ 1600
	2108	304	155.30	64.26			
	2109	305	155.56	64.52			1600
	2110	306	155.69	64.65			
	2111	307	155.85	64.81			
Step 3	2112	308	155.93	64.89	1600	244	140
	2113	309	156.06	65.02			
	2114	310	156.13	65.09	1600	248	
	2122	318	156.73	65.69	1600	264	
	2126	322	157.01	~~65.89~~ 65.97	1600		
	~~2132~~						
	2132	328	157.24	66.20			
	2153	349	158.03	66.99			
	2158	354				325.5	
	2206	362	158.34	67.3	1600	345	48 psi ~ 4' downstream of well
	2224	380	158.85	67.81	1600	375	
	2237	→ 1415 RPM / 47 PSI / 1600 GPM.					
		13' 2" from well head to flow meter					
		2' 8" from flow meter to valve					
		14 OD pipe					
	2243		159.30	68.26			

SD35728~~181~~ 42

1771 46MIN 81.5K gal

Golder Associates

PROJECT NUMBER: 1D399709

WELL NUMBER: SW WELL A

SHEET 4 OF 4

Aquifer Test Data Sheet

WELL #: SW1A

TYPE OF DATA: Manual

WELL DIAMETER: 12"

PUMPING WELL: Yes

CHECK VALVE INSTALLED ON PUMP? Yes

DISTANCE FROM PUMPING WELL: NA

M.P.:

HOW Q MEASURED: totalizer

HOW WL'S MEASURED Manual sounder

INITIAL DEPTH TO WATER: 91.04

COMMENTS: STEP RATE TEST

(PUMPING) / RECOVERY

RECOVERY / DRAWDOWN

DEPTH:

DIAMETER:

ELEVATION:

DATE: 9/28/10

DATA COLLECTED BY: L. Bertosik K. Jaeger

DATA LOGGER:

PUMP ELEVATION:

OTHER:

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet)	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (gal)	Pump on, off, rate change; pump type; water quality; etc.
2248				2700 GPM		Bumped ↑ to 1900 RPM
2250						Down to 2050 GPM - 60 PSI - 1620 RPM
2251		171.4		1~~7~~.2100 GPM		-Shut pump down

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PROJECT NUMBER 10399709 | WELL NUMBER SW Well 1A | SHEET 1 OF 8

Aquifer Test Data Sheet

WELL #: SW Well 1A
TYPE OF DATA: Manual
WELL DIAMETER: 12"
PUMPING WELL: Yes
CHECK VALVE INSTALLED ON PUMP? @ well head
DISTANCE FROM PUMPING WELL: 0
M.P.: 2.58' AGS
HOW Q MEASURED: Totalizing flow Meter
HOW WL'S MEASURED Manual Probe
INITIAL DEPTH TO WATER: 105.52 bmp
COMMENTS: Constant Rate Test

(PUMPING) / RECOVERY
RECOVERY / DRAWDOWN
DEPTH: 633
DIAMETER: 12"
ELEVATION:

DATE: 10/6/10
DATA COLLECTED BY: L. Bartosik
DATA LOGGER:
PUMP ELEVATION:
OTHER:

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet) BMP	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (gal)	Pump on, off, rate change; pump type; water quality; etc.
9/6/10 0820	—	105.50	/	/	/	
1310	—	105.52	/	/	/	
1437:00						START
: 59		141.67	133759			
00: 1:56		146.65	135256			
2:42		147.54	135942	2100		
3:15		147.61	140315	1900	600	
4:00		148.03	140800			
4:28		148.17	140928			
5:06		148.38	141206			
5:37		148.64	141537			
6:13		148.82	141913			
00: 6:48		149.10	142348	2100		
7:30		149.40	143030	1900	607	increased Rate ~1750
8:34		149.55	144034			
9:17		149.74	144717			
10:11		153.17	145311			
11:23		155.98	150023			increase! rate ~1800
1300		156.53	150000	2100		
1459		157.17	151559			
1549		157.42	152449			
1642		157.58	153342			
17:40		157.93	154040			
18:00			154500	2150	629	
19:00		158.08	155600			
20:00		158.20	160500			
21:00		158.53	161500			
22:00		158.65	162500			
23:50		158.89	164250			
27:20		159.45	171820			
28:30		159.66	172930			
1507	30:00	159.96		2200		Bumped up rate
15:09:27				2250	659	
15:10:30		162.26				
15:13		162.71				
15:18		163.19				
15:20		163.40		2200	684	

Golder Associates

PROJECT NUMBER: 10399709

WELL NUMBER: SW Well 7A

SHEET 2 OF 8

Aquifer Test Data Sheet

WELL #: SW Well 7A
TYPE OF DATA: Manual
WELL DIAMETER: 12"
PUMPING WELL: Yes
CHECK VALVE INSTALLED ON PUMP?
DISTANCE FROM PUMPING WELL:
M.P.: 2.58 Ags
HOW Q MEASURED: Totalizer / flow meter
HOW WL'S MEASURED: Manual - sounding probe
INITIAL DEPTH TO WATER: 105.52'
COMMENTS: Constant Rate Test

PUMPING / RECOVERY
RECOVERY / DRAWDOWN
DEPTH: 233
DIAMETER: 12"
ELEVATION:

DATE: 10/6/10
DATA COLLECTED BY: L. Bartosik
DATA LOGGER:
PUMP ELEVATION:
OTHER:

2 min ahead of clock time

Start 14:37

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet)	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (gal)	Pump on, off, rate change; pump type; water quality; etc.
15:22:00		163.57				
15:25:00		163.87				
15:32		164.46		2200	703	
15:36		164.75		2200	717.5	
15:41		165.18		2200		
15:47	70	165.58		2200	741.5	
15:53	76	165.91		2200	752	
15:59	82					
16:02	85	166.44		2200	773	
16:09	92	166.80		2200	789	- closing valves and discharge line (not over hill yet due to open valves)
16:16	99	167.17		2200	802	
16:22	105	167.40	61.88	2200	814	
16:28	111	167.72	62.2	2200	827.5	SC = 35.4 GPM/ft
16:39	122	169.21		2250	851.5	
16:41	124			2500		- flow meter very erratic (2200 - 2700)
16:50	133					- flow meter still erratic (2100 - 2600)
16:53	136	170.76	8	2300 (Range	2900 - 2600)	
17:04	147	171.17	65.65	2300	908	886 on totalizer
17:14	157	171.44		2200	930	- still erratic (2100 GPM - 2600 GPM)
17:27		169.48		2200	958.5	- Needle stable
17:31				2000		→ Needle going down
17:33		165.37		2000	971	
1748						Bumped up to 2100 (opened valve)
1745		168.61	63.09	2100	994	
1757		168.97		2100	1021	- Needle Steady
18:10		168.80	63.28	2050	1052	Adjust
18:20		169.08		2100		
1838		169.93		2100	1109	
18:48		170.15		2100	1127	

Pumping Test Form

Project Number: 103-99709
Project Name: COY/SW Well No2/1A
Start Time: 14:37:00
Initial Flowmeter Reading:
Initial Water Level: 185.52' BMP
Datum Description:

Well Name: SW Well No 1A
Date of Test: 10/6/10
Type of Test: Constant Rate
Contractor: Boart Longyear
Observer: L. Bartosik

Date & Time	Instantaneous Reading (gpm)	Totalizer reading (gallons)	Depth to Water (feet)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Electrical Conductivity (µS/cm)	Temperature °C (°F) / ORP mV
10/6/10 15:15	2200	674	163.19'	7.48	1.25	0.81	177	11.39 / -7.7
10/6/10 ~~15:25~~	crystal	clear; no odor; slight metallic after taste;						cold
15:25	2200	695	163.87	7.70	1.23	0.66	178	11.67 / -13.5
15:41	2200	729	165.18	7.67	1.30	0.62	178	11.27 / -14.6
15:53	2200	752	165.91	7.69	0.74	0.55	178	11.50 / -14.0
16:02	2200	773	166.44	7.61	1.01	0.56	177	11.52 / -13.5
16:09	2200	789	166.80	7.40	0.82	0.56	177	11.09 / -6.9
16:22	2200	814	167.40	7.36	0.77	0.52	177	11.36 / -13.2
16:39	2250	851.5	169.21	7.38	0.65	0.49	177	11.17 / -7.8
16:53	2300	886	170.76	7.39	0.67	0.46	177	11.31 / -5.7
17:04	2300	908	171.17	7.36	0.74	0.45	178	11.25 / -13.0
17:14	2300	930	171.44	7.37	0.86	0.51	178	11.08 / -9.6
17:45	2100	994	168.61	7.44	0.49	0.44	177	10.82 / -14.6
18:48	2100	1127	170.15	7.87	X	0.40	177	11.12 / 19.6
19:00	2100	1148	170.45	7.79		0.41	177	11-14 / 14.1
19:30	2100	1216	170.95	7.63		0.37	176	11.00 / 25.4
20:00	2100	1278	171.5	7.58		0.37	180	11.00 / 14.6
20:30	2100	1342	172.05	7.48		0.36	180	10.92 / 15.8
21:00	2100	1403	172.6	7.49		0.35	180	10.85 / -37.5

Pumping Test Form

Project Number: 103-99709
Project Name: COY/SW WELL H02/WA
Start Time: 14:37:00
Initial Flowmeter Reading:
Initial Water Level: 105.52' bmp
Datum Description:

Well Name: SW WELL No 1A
Date of Test: 10/6 PM - 10/7 AM
Type of Test: CONSTANT RATE
Contractor: BOART LONGYEAR
Observer: L Bartosik

Date & Time	Instantaneous Reading (gpm)	Totalizer reading (gallons) X1000	Depth to Water (feet)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Electrical Conductivity (mS/cm)	Temperature (°F)	
10-6-10 21:30	2100	1466	173.05	7.45		0.38	180	10.85	-28.4
22:00	2100	1527	173.5	7.45		0.43	179	10:74	-32.3
22:30	2100	1590	173.9	7.44		0.42	180	10.58	-36.9
23:00	2100	1652	174.4	7.43		0.43	186	10:78	-39.6
23:30	2100	1714	174.8	7.45		0.42	180	10:65	-41.
24:00	2100	1776	175.10	7.44		.45	186	10.76	38.7
10-7-10 00:30	2100	1838	175.51	7.45		.43	180	10.80	-40.7
1:00	2100	1899	175.92	7.48		.42	180	10.74	-40.3
1:30	2100	1961	176.04	7.54		.40	179	10.76	-42.3
2:00	2100	2023	176.47	7.50		.47	180	10.86	-36.3
2:30	2100	2084	176.68	7.51		.47	180	10.60	-34.9
3:00	2100	2146	176.96	7.51		.45	180	10.74	-36.5
3:30	2100	2208	177.2	7.51		.41	180	10.60	-45.4
4:00	2100	2269	177.51	7.51		.46	179	10.59	-41.9
4:30	2100	2331	177.76	7.55		.44	180	10.60	-45.4
5:00	2100	2393	178	7.55		.35	179	10.53	-42.6
5:30	2100	2454	178.12	7.57		.37	179	10.55	-50.1
6:00	2100	2515	178.39	7.57		.38	179	10.54	-47.2
6:30	2100	2576	178.59	7.57		.40	179	10.64	-46.3

Pumping Test Form

Project Number: 103-99709
Project Name: COY / SW WELL WO2/WA
Start Time: 14:37:00 10/6/10
Initial Flowmeter Reading:
Initial Water Level: 105.52' BMP
Datum Description:

Well Name: SW WELL NO. 1A
Date of Test: Start 10/6/10
Type of Test: CONSTANT RATE
Contractor: BOART LONGYEAR
Observer: L. BARTOSIK

Date & Time	Instantaneous Reading (gpm)	Totalizer reading (gallons) x1000	Depth to Water (feet)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Electrical Conductivity (mS/cm)	Temperature (°F)	
10/7/10 7:00	2100	2638	178.79	7.5		.40	178	10.43	-42.9
7:30	2100	2700	179.04	7.51		.39	179	10.76	-46.8
8:00	2100	2760	179.16	7.47		.38	180	10.90	-49.8
8:30	2100	2822	179.35	7.44		.32	180	10.89	-41.7
9:00	2100	2883	179.46	7.52		.35	180	10.95	-46.6
9:30	2100	2944	179.73	7.49		.37	180	11.05	-49.7
10:00	2100	3006	179.90	7.5		.37	180	11.06	-50.1
10:30	2100	3067	180.07	7.46		.39	180	11.18	-51.5
11:00	2100	3128	180.24	7.44		.35	180	11.29	-56.5
11:30	2100	3189	180.38	7.37		.37	179	11.47	-58.7
12:00	2100	3251	180.55	7.33		.38	179	11.51	-60.2
12:30	2100	3313	180.75	7.18		.38	180	11.63	-63.2
13:00	2100	3376	180.9	7.17		.37	180	11.63	-61.7
13:30	2100	3439	120.91	7.32		.38	180	11.47	-59.6
14:00	2100	3499	181.00	7.37		.37	179	11.49	-61.3
~~14:30~~ 15	2100	3617	181.3	7.49		.37	179	11.58	-65.1
~~15:00~~ 16	2100	3739	181.55	7.48		.37	179	11.50	-64.1
~~15:30~~ 17	2100	3861	181.8	7.48		.38	179	11.50	-64.1
~~16:00~~ 18	2100	3983	182.0	7.53		.37	178	11.52	-65.4

10/7/10 am/pm Time K	Depth to Water (ft. BRP)	Drawdown (ft) 10/7	Specific Capacity	Sand Reading	Water Quality pH	Dissolved Oxygen	Elect. Cond.	Temp.	Discharge Rates Time	Flow Hand Reading gpm	Totalizer Reading	Calculated Rate gpm
5:30am	178.12			NONE	~~7.5~~					2100	2454	2033
6:00	178.39			"						2100	2515	2033
6:30	178.59			"						2100	2576	2033
7:00	178.79			"						2100	2638	2066
7:30	179.04			"						2100	2700	2066
8:00	179.16			"						2100	2760	2000
8:30	179.35			"						2100	2822	2066
9:00	179.46			"						2100	2883	2033
9:30	179.73			"						2100	2944	2033
10:00	179.90			"						2100	3006	2066
10:30	180.07			"						2100	3067	2033
11:00	180.24			"						2100	3128	2033
11:30	180.38			"						2100	3189	2033
12:00	180.55			"						2100	3251	2066
12:30	180.75			"						2100	3313	2066
1:00	180.9			"						2100	3376	2100
1:30	180.91			"						2100	3439	2100
2:00	181.00			"						2100	3497	1933
~~2:30~~ 3	181.3			"						2100	3617	2000
3:00 4	181.55			"						2100	3739	2033
~~3:30~~ 5	181.80	10/7		"						2100	3861	2033
~~4:00~~ 6	182.00	1800		"						2100	3983	2033
~~4:30~~ 7	182.3	1900		"	7.52	.37	179	11.50 -68.1		2100	4105	2033
~~5:00~~ 8	182.45	2000		"	7.41	.38	179	11.31 -63.2		2100	4227	2033
~~5:30~~ 9	182.65	2100			7.52	.37	178	11.39 -62.4		2100	4349	2033
~~6:00~~ 10	182.85	2200			7.54	.36	178	11.29 -63.8		2100	4470	2016
~~6:30~~ 11	183.1	10/7			7.53	.36	178	11.46 62.8		2100	4595	2083
~~7:00~~ 12	183.3	pm DD 10/15			7.55	.33	178	11.30 -71.5		2100	4713	1966

starting over hours

Job Number / Location: 0069 YELM, WA

Page: ~~2~~ 6 of 8

7/8/10 am/pm

Time	Depth to Water (ft. BRP)	Drawdown (ft)	Specific Capacity	Sand Reading	Water Quality				Discharge Rates			
					PH	DO	EC	Temp.	Time	Flow Hand Reading gpm	Totalizer Reading	Calculated Rate gpm
1100	183.37	0100 hr	10/8		7.57	.34	177	1121/-72.7		2100	4835	2033
1:00	183.55	0200			7.57	.34	177	11.27/-72.8		2100	4957	2033
1:00	183.72	0300			7.57	.34	177	11.30/-73.6		2100	5078	2016
:00	183.81	0400			7.60	.34	177	11.33/-75		2100	5200	2033
:00	184.01	0500			7.59	.33	177	11.36/-73.9		2100	5322	2033
:00	184.18	0600			7.62	.33	176	11.45/-77.1		2100	5442	2000
:00	184.31	0700			7.60	.35	176	11.08/-75		2100	5563	2016
:00	184.45	0800			7.59	.33	175	11.11/-76.6		2100	5685	2033
:00	184.60	0900			7.58	.30	176	11.10/-77		2100	5806	2016
:00	184.8	1000			7.58	.33	176	11.44/-77.5		2100	5929	2050
:00	184.95	1100			7.58	.35	176	11.38/-80.2		2100	6048	1983
:00	185.14	1200			7.56	.33	175	11.94/-81.6		2100	6169	2016
:00	185.15	1300			7.54	.35	174	11.87/-84.1		2100	6290	2016
:00	185.25	1400			7.54	.33	175	11.84/-82.7		2100	6411	2016
:00	185.35	1500			7.53	.35	174	11.93/-82.7		2100	6532	2016
4:00	185.520	1600			7.61	30	175	1193/-87.6		2100	6653	2016
5:00	185.6	1700			7.59	.26	174	1196/-87.0		2100	6774	2016
6:00	185.75	1800			7.59	.24	173	1158/-79.9		2100	6895	2016
7:00	185.75	1900			7.63	.29	173	1172/-83.6		2100	7017	2033
8:00	185.9	2000			7.64	.27	172	1175/-84.6		2100	7137	2000
9:00	186.0	2100			7.66	.29	172	1166/-85.1		2100	7258	2016
10:00	186.15	2200			7.66	.26	172	1178/-83.5		2100	7380	2033
11:00	186.25	2300			7.64	.30	171	1159/-82.0		2100	7499	1983
1200	186.3	0000	10/9		7.66	.27	171	1164/-82.0		2100	7620	2016
1:00	186.54				7.67	.28	170	11.59/-84.4		2100	7740	2000
2:00	186.57				7.69	.28	170	11.82/-85.5		2100	7860	2000
3:00	186.70				7.65	.27	171	11.62/-83.4		2100	7981	2016
4:00	186.79				7.65	.30	170	11.74/-83.8		2100	8102	2016

7/8

10/9/10 am/pm Time	Depth to Water (ft. BRP)	Drawdown (ft)	Specific Capacity	Sand Reading	Water Quality P.H.	D.O.	E.C.	Temp	Discharge Rates Time	Flow Hand Reading gpm	Totalizer Reading	Calculated Rate gpm
5:00	186.81				7.66	.31	170	11.35/-82.8		2100	8203	2016
6:00	186.95				7.69	.31	169	11.63/-84.6		2100	8343	2000
7:00	187.02				7.66	.29	169	11.67/-84.4		2100	8463	2000
8:00	187.11				7.68	.30	168	11.71/-84.8		2100	8584	2016
9:00	187.23				7.68	.27	168	11.79/-86.9		2100	8704	2000
10:00	187.30				7.67	.29	168	11.99/-88		2100	8825	2016
11:00	187.40				7.69	.29	168	12.20 -88.1		2100	8946	2016
12:00	187.45				7.67	.26	168	12.27/-90.8		2100	9067	2016
1:00	187.45				7.66	.29	168	11.96/-88.7		2100	9187	2000
2:00	187.6				7.66	.30	167	11.59/89.5		2100	9307	2000
3:00	187.7				167	.28	167	11.70/-89.5		2100	9426	1983

Job Number / Location: 0069 Yelm, WA.

Page: 8 of 8

Golder Associates

PROJECT NUMBER: 10399709

WELL NUMBER: SW 7A

SHEET 1 OF 1

Aquifer Test Data Sheet

WELL #: SW7A
TYPE OF DATA: Manual
WELL DIAMETER: 12"
PUMPING WELL: Yes
CHECK VALVE INSTALLED ON PUMP? Yes (Crate @ top)
DISTANCE FROM PUMPING WELL: NA
M.P.: 2.58
HOW Q MEASURED: Totalizing flow meter
HOW WL'S MEASURED: sounder
INITIAL DEPTH TO WATER: 105.52
COMMENTS: RECOVERY - CR-TEST

~~PUMPING~~ / RECOVERY
RECOVERY / ~~DRAWDOWN~~
DEPTH: 633
DIAMETER: 12"
ELEVATION:

DATE: 10/9/10
DATA COLLECTED BY:
DATA LOGGER:
PUMP ELEVATION:
OTHER:

TIME DATA		WATER LEVEL DATA				REMARKS
Clock Time HR:MM:SS	Elapsed Time (min)	Depth to Water (feet)	Drawdown (feet)	Pump Rate (gal / min)	Totalizer Reading (gal)	Pump on, off, rate change; pump type; water quality; etc.
STOP AT 1529						
	:43	162.77				
	1:15	148.48				
	1:32	142.41				
	2:40	138.26				pump fully off
	4:00	138.26				
	5:00	137.72				
	5:50	137.29				
	7:00	136.78				
15:29	8:15	136.43				
	10:00					
15:32		135.49				
15:33		135.13				
15:36		134.60				
15:37		134.28				
15:38		134.10				
15:40		133.90				
15:43		133.43				
15:46		133.12				
15:52		132.43				
16:00		131.78				
16:05		131.40				
16:10		131.06				
16:15		130.77				
16:19		130.54				
16:42		129.43				
10/10/10	10:40	118.60' BMP				

TCMW

Water Level Monitoring Data Sheet

Location: Thompson Creek
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 1" / 17' BGS
Pump Installed? NO Pump Type: NO
Is the Well Used? NO
Any known trouble spots in the well? NO
Weather _____

Contact Person/Info:
Measuring Point (MP): ~~1~~ 2' AGS
MP Height Above Ground: ~~2~~ 3.8'
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	1030	9.02' BMP		LB	
10/7/10	0951	8.74' BMP		LB	
10/7/10	1134	8.34' BMP		LB	Downloaded Data
10/9/10	0830	9.09 BMP		LB	downloaded data
10/10/10	0859	8.68 BMP		LB	*Rain
10/13/10	@1540	8.81' BMP		LB	

NTW

Water Level Monitoring Data Sheet

Location: Thurston Highlands
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 8" / 250' BGS
Pump Installed? NO Pump Type: NA
Is the Well Used? NO
Any known trouble spots in the well? NO
Weather _____

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 1.92' AGS
Survey Mark Elevation:
Correction to Survey Mark: (Labeled STW on well)

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	0900	172.98'		LB	PIC start
10/7/10	1011	172.95'		LB	
10/7/10	1202	173.08'		LB	downloaded data
10/8/10	0927	173.01'		LB	
10/8/10	1422	173.04'		LB	downloaded data
10/9/10	0935	173.03'		LB	
10/10/10	0939	173.13'		LB	
10/11/10	1332	173.01		KF	

STW

Water Level Monitoring Data Sheet

Golder Associates

Location: Thurston Highlands
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 8"/260' bgs
Pump Installed? ND Pump Type:
Is the Well Used? ND
Any known trouble spots in the well? ND

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 3.27' AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date	Time	Depth to Water (feet)	Water Level Elevation (feet)	By	Comments
10/6/10	0930	158.04'		LB	pre start
10/7/10	1019	156.93'		LB	
10/7/10	1213	1588.10'		LB	Down loaded data
10/8/10	0910	157.95		LB	
10/8/10	1435	157.90		LB	
10/9/10	1001	158.20		LB	
10/10/10	0948	157.74		LB	
10.13.10	1320	158.32		KY	

P2

Water Level Monitoring Data Sheet

Golder Associates

Location: Thurston Highlands
Type of data: Manual Only / (Electronic + Manual)
Well Diameter/Depth: 2"/59'
Pump Installed? NO Pump Type: NA
Is the Well Used? NO
Any known trouble spots in the well? NO
Weather ____________________

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 1.5' AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	~~083~~ 0835	54.81'		LB	Pre-test start
10/7/10	1002	54.80'		LB	
10/7/10	1344	54.83'		LB	
10/8/10	0847	54.91		LB	
10/9/10	0906	54.95		LB	
10/10/10	0916	55.02		LB	
10/13/10	1059	55.00		[illegible]	Removed transducer S/N 2526018

P18

Water Level Monitoring Data Sheet

Location: Thurston Highlands
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 2"/56' bgs
Pump Installed? NO Pump Type: NA
Is the Well Used? NO
Any known trouble spots in the well? NO
Weather _____

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 2.41' AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	0845	57.42'		LB	probe hit bottom of well
10/8/10	0853	57.41'		LB	Probe hit bottom
10/9/10	0923	57.41'		LB	" "
10/10/10	0925	57.41'		LB	" "
10/12/10	10:52	57.43'		KJ	removed Transducer S/N = 1526014

P3

Water Level Monitoring Data Sheet

Location: Thurston Highlands
Type of data: Manual Only / ~~Electronic + Manual~~
Well Diameter/Depth: 2"/61.2bgs
Pump Installed? ND Pump Type:
Is the Well Used? ND
Any known trouble spots in the well? ND
Weather _____

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 2.74'AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10.6.10	0855	59.02		LB	
10/7/10	1006	59.03		LB	
10/7/10	1353	59.03		LB	
10/7/10	1647	59.03		LB	
10/8/10	0903	59.03		LB	
10/8/10	1414	58.90		LB	
10/9/10	0928	59.04		LB	
10/10/10	0931	59.05		LB	
10.13.10	1327	59.05		KJ	

WTW

Water Level Monitoring Data Sheet

Location: Highlands
Type of data: ~~Manual Only~~ / Electronic + Manual
Well Diameter/Depth: 8"/290' bgs
Pump Installed? ND Pump Type:
Is the Well Used? No
Any known trouble spots in the well? No
Manual only

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 1.38'
Survey Mark Elevation:
Correction to Survey Mark:

Date	Time	Depth to Water (feet)	Water Level Elevation (feet)	By	Comments
10/6/10	0915	←	176.71'	LB	
10/7/10	1026	176.65		LB	
		~~176.80~~			
10/7/10	1033	176.80		LB	
10/8/10	0920	176.81		LB	
10/9/10	1037	176.84		LB	
10/10/10	1002	176.75		LB	
10/12/10	1240	176.75		KJ	

Baker Well

Water Level Monitoring Data Sheet

Golder Associates

Location: Berry Valley Rd, Yelm WA
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 6"/84' bgs
Pump Installed? Yes Pump Type: Unknown
Is the Well Used? Yes, Domestic
Any known trouble spots in the well? None
Weather _____

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 0.65'AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	1050	52.12		LB	After pump shut off
10/8/10	1025	50.97		LB	Not pumping
10/9/10	1116	51.82		LB	Pumped & shut down during visit
10/10/10	0834	57.38		LB	
10.13.10	1530	51.65		KJ	Pump off
11.15.10	1510	48.80		LB	Pump off

Purvis Well

Water Level Monitoring Data Sheet

Golder Associates

Location: 14504 Berry Valley RD SE, Yelm, WA
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 6"/155' bgs
Pump Installed? Yes Pump Type: Unknown
Is the Well Used? Yes
Any known trouble spots in the well? No
Weather _____

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 0.36'AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date (mm/dd/yy)	Time (hrmm)	Depth to Water (ft bmp)	Water Level Elev. (ft amsl)	By	Comments
10/6/10	1100	81.35		LB	
10/8/10	1125	83.27'		LB	Not pumping
10/9/10	1130	83.93		LB	
10/10/10	852	89.27		LB	Not pumping
10.13.10	1510	83.69		KJ.	Pump off
11.18.10	1521	79.01'		LB	Pump off

SW Well No 1

Water Level Monitoring Data Sheet

Golder Associates

Location: Thurston Highlands
Type of data: Manual Only / Electronic + Manual
Well Diameter/Depth: 12"/410'bgs
Pump Installed? No Pump Type:
Is the Well Used? No
Any known trouble spots in the well? NA

Contact Person/Info:
Measuring Point (MP):
MP Height Above Ground: 2.46' AGS
Survey Mark Elevation:
Correction to Survey Mark:

Date	Time	Depth to Water (feet)	Water Level Elevation (feet)	By	Comments
10/6/10	0920	179.20		LB	Pre-start
10/7/10	1034	179.20		LB	
10/7/10	1230	179.32		LB	Downloaded Data
10/8/10	0917	179.31		LB	Top not all the way on
10/8/10	1458	179.27		LB	downloaded data
10/9/10	1022	179.36		LB	
10/10/10	0959	179.45		LB	
10.13.10	1303	179.35		KF	

PROJECT NUMBER	WELL NUMBER	
103.99709	SW Yelm Well #1	SHEET 1 OF 1

Golder Associates

Water Quality Field Parameters

PROJECT: SW Yelm Well #2 LOCATION: Thurston Highlands, Yelm, WA
DEVELOPMENT CONTRACTOR: Robert Longyear LOGGER: K Jones
DEVELOPMENT METHOD AND EQUIPMENT USED: Purging well, 150 HP Pump
START WATER LEVELS: DATE: 5.19.10 START TIME: 1639 END TIME: 1720

MAXIMUM DRAWDOWN DURING PUMPING: —
RANGE AND AVERAGE DISCHARGE RATE: ~ 200 gpm
TOTAL QUANTITY OF WATER DISCHARGED: 7800 gallons
DISPOSITION OF DISCHARGE WATER: to ground surface
NOTES / COMMENTS:

Time	Volume Discharged (gallons)	DO (mg/L)	RedOx Potential (mv)	Turbidity (NTU)	Temperature (°C)	pH (-)	Specific Conductivity (µS/cm)	Remarks (color, odor, sheen, sediment, etc.)
1531	—	—	—	—	—	—	—	SWL = 180.9 ft btoc
1531	—	—	—	—	—	—	—	totalizer reading before test = 4863700 gal.
1639	—	—	—	—	—	—	—	start purge
1645	1600	1.85	400	—	9.84	6.56	104	
1648	2100	1.74	393	—	9.84	6.44	105	
1654	3100	2.30	379	—	9.84	6.34	107	
1659	4100	2.63	357	—	9.85	6.29	108	
1707	5500	2.82	324	—	9.84	6.40	109	
1715	7000	2.99	217	—	9.84	6.25	109	
1716	7200	2.99	209	—	9.84	6.24	109	bubbles collecting on outer surface of DO probe
1718	7400	2.92	196	—	9.83	6.24	110	
1720	7800	3.03	183	—	9.84	6.23	110	collected sample

total depth of well = 450 ft
450 − 180.9 = 269.1 ft
well volume = $\pi r^2 * 269.1 = (3.14)(0.5)^2(269.1) = 211.2\ ft^3$
= 1580 gallons
3 well volumes = 1580 * 3 = 4740 gallons

Golder Associates
Record of Calibration

Date	Time	Meter Type	Meter Brand	Meter Model	Golder Equip #	Standard Value (give units)	Standard Temp (C or F)	Meter Reading (give units)	Other
5.19.10	1430	multimeter	YSI	556	—	1000 µS/cm	20	1000 µS/cm	specific conductance
					—	4.00		4.00	pH
					—	7.02		7.02	
					—	10.06		10.07	
					—	199 mV		199.0 mV	ORP
					—	100%		98%	DO

Project Name: SW Yelm #2

Site Name: SW Yelm Well #1

Project Number: 103-99709

Operator: K Lange

Investigation Description: Collect WP sample from SW Yelm Well #1

Page 1 of 1

Golder Associates

Record_of_Calibration_Form.xls
5/03

APPENDIX E-1

WATER QUALITY LABORATORY RESULTS
SW WELL 1

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

ANALYTICAL REPORT

Job Number: 680-57854-1

Job Description: City of Yelm

For:
Golder Associates Inc.
9 Monroe Parkway
Lake Oswego, OR 97035

Attention: Kenny Janssen

Approved for release.
Bernard Kirkland
Project Manager I
6/8/2010 12:30 PM

Bernard Kirkland
Project Manager I
bernard.kirkland@testamericainc.com
06/08/2010

Savannah Certifications and ID #s: A2LA: 0399.01; AL: 41450; ARDEQ: 88-0692; ARDOH; AZ: AZ0741; CA: 03217CA; CO; CT: PH0161; DE; FL: E87052; GA: 803; Guam; HI; IL: 200022; IN; IA: 353; KS: E-10322; KY EPPC: 90084; KY UST; LA DEQ: 30690; LA DHH: LA080008; ME: 2008022; MD: 250; MA: M-GA006; MI: 9925; MS; NFESC: 249; NV: GA00006; NJ: GA769; NM; NY: 10842; NC DWQ: 269; NC DHHS: 13701; PA: 68-00474; PR: GA00006; RI: LAO00244; SC: 98001001; TN: TN0296; TX: T104704185; USEPA: GA00006; VT: VT-87052; VA: 00302; WA; WV DEP: 094; WV DHHR: 9950 C; WI DNR: 999819810; WY/EPAR8: 8TMS-Q

TestAmerica Laboratories, Inc.
TestAmerica Savannah 5102 LaRoche Avenue, Savannah, GA 31404
Tel (912) 354-7858 Fax (912) 352-0165 www.testamericainc.com

ACCREDITED IN ACCORDANCE WITH nelac

Job Narrative
680-57854-1

Receipt
All samples were received in good condition within temperature requirements.

Metals
No analytical or quality issues were noted.

General Chemistry
Method(s) 300.0: Due to the high concentration of nitrate, the matrix spike (MS) for batch 169566 could not be evaluated for accuracy . The associated laboratory control sample (LCS) met acceptance criteria.

Method(s) 4500 P F: The following sample was received with little holding time remaining and was analyzed outside of analytical holding time : SW Well No 1 (680-57854-1). Data has been flagged.

No other analytical or quality issues were noted.

METHOD SUMMARY

Client: Golder Associates Inc.

Job Number: 680-57854-1

Description	Lab Location	Method	Preparation Method
Matrix Water			
Metals (ICP)	TAL SAV	40CFR136A 200.7 Rev 4.4	
Metals (ICP)	TAL SAV	EPA 200.7 Rev 4.4	
Sample Filtration	TAL SAV		FILTRATION
Preparation, Metals	TAL SAV		EPA 200
Sample Filtration	TAL SAV		FILTRATION
Metals (ICP/MS)	TAL SAV	EPA 200.8	
Preparation, Metals	TAL SAV		EPA 200
Anions, Ion Chromatography	TAL SAV	MCAWW 300.0	
Anions, Ion Chromatography	TAL SAV	MCAWW 300.0	
Orthophosphate	TAL SAV	SM 4500 P F	
Alkalinity	TAL SAV	SM SM 2320B	
Solids, Total Dissolved (TDS)	TAL SAV	SM SM 2540C	

Lab References:

TAL SAV = TestAmerica Savannah

Method References:

40CFR136A = "Methods for Organic Chemical Analysis of Municipal Industrial Wastewater", 40CFR, Part 136, Appendix A, October 26, 1984 and subsequent revisions.

EPA = US Environmental Protection Agency

MCAWW = "Methods For Chemical Analysis Of Water And Wastes", EPA-600/4-79-020, March 1983 And Subsequent Revisions.

SM = "Standard Methods For The Examination Of Water And Wastewater",

SAMPLE SUMMARY

Client: Golder Associates Inc.

Job Number: 680-57854-1

Lab Sample ID	Client Sample ID	Client Matrix	Date/Time Sampled	Date/Time Received
680-57854-1	SW Well No 1	Water	05/19/2010 1720	05/21/2010 0845

Client: Golder Associates Inc.

Job Number: 680-57854-1

Client Sample ID: **SW Well No 1**

Lab Sample ID: 680-57854-1
Client Matrix: Water

Date Sampled: 05/19/2010 1720
Date Received: 05/21/2010 0845

200.7 Rev 4.4 Metals (ICP)

Method:	200.7 Rev 4.4	Analysis Batch: 680-170366		Instrument ID:	ICPD
Preparation:	200	Prep Batch: 680-169672		Lab File ID:	169672.chr
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	06/01/2010 2223			Final Weight/Volume:	50 mL
Date Prepared:	05/25/2010 1340				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Aluminum	200	U	100	200
Calcium	13000		97	500
Copper	20	U	5.0	20
Iron	1200		24	50
Magnesium	8400		20	500
Manganese	140		3.0	10
Potassium	2000		40	1000
Silver	10	U	0.97	10
Sodium	7800		280	1000
Zinc	6.8	J	6.3	20

200.7 Rev 4.4 Metals (ICP)-Dissolved

Method:	200.7 Rev 4.4	Analysis Batch: 680-170764		Instrument ID:	Varian ICP
Preparation:	N/A			Lab File ID:	E006072010A.csv
Dilution:	1.0			Initial Weight/Volume:	
Date Analyzed:	06/07/2010 1503			Final Weight/Volume:	1.0 mL
Date Prepared:					

Analyte	Result (ug/L)	Qualifier	MDL	RL
Dissolved SiO2, Silica	41000		50	500

Method:	200.7 Rev 4.4	Analysis Batch: 680-170811		Instrument ID:	ICPD
Preparation:	200	Prep Batch: 680-170376		Lab File ID:	170376.chr
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	06/07/2010 2028			Final Weight/Volume:	50 mL
Date Prepared:	06/02/2010 1529				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Dissolved Iron	50	U	24	50
Dissolved Manganese	20		3.0	10

200.8 Metals (ICP/MS)

Method:	200.8	Analysis Batch: 680-170612		Instrument ID:	ICPMSB
Preparation:	200	Prep Batch: 680-169606		Lab File ID:	169606.chr
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	05/28/2010 0713			Final Weight/Volume:	50 mL
Date Prepared:	05/25/2010 0936				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Antimony	1.0	U	0.40	1.0
Arsenic	5.1		0.37	1.0

Client: Golder Associates Inc.

Job Number: 680-57854-1

Client Sample ID: **SW Well No 1**

Lab Sample ID: 680-57854-1
Client Matrix: Water

Date Sampled: 05/19/2010 1720
Date Received: 05/21/2010 0845

200.8 Metals (ICP/MS)

Analyte	Result (ug/L)	Qualifier	MDL	RL
Barium	6.6		0.14	2.0
Cadmium	0.10	U	0.043	0.10
Chromium	2.0	U	1.0	2.0
Copper	1.9		0.50	1.0
Lead	0.29	J	0.060	0.30
Mercury	0.20	U	0.058	0.20
Selenium	2.0	U	0.58	2.0
Thallium	0.20	U	0.10	0.20

Method:	200.8	Analysis Batch: 680-170609		Instrument ID:	ICPMSB
Preparation:	200	Prep Batch: 680-169606		Lab File ID:	169606606.chr
Dilution:	1.0			Initial Weight/Volume:	50 mL
Date Analyzed:	06/04/2010 0531			Final Weight/Volume:	50 mL
Date Prepared:	05/25/2010 0936				

Analyte	Result (ug/L)	Qualifier	MDL	RL
Beryllium	0.40	U	0.15	0.40

General Chemistry

Client Sample ID: **SW Well No 1**

Lab Sample ID: 680-57854-1
Client Matrix: Water

Date Sampled: 05/19/2010 1720
Date Received: 05/21/2010 0845

Analyte	Result	Qual	Units	MDL	RL	Dil	Method
Chloride	5.2		mg/L	0.20	1.0	1.0	300.0
Analysis Batch: 680-170177	Date Analyzed: 05/30/2010 1223						
Nitrate as N	1.9		mg/L	0.015	0.050	1.0	300.0
Analysis Batch: 680-169566	Date Analyzed: 05/21/2010 1151						
Fluoride	0.079	J	mg/L	0.020	0.20	1.0	300.0
Analysis Batch: 680-170177	Date Analyzed: 05/30/2010 1223						
Nitrite as N	0.050	U	mg/L	0.015	0.050	1.0	300.0
Analysis Batch: 680-169566	Date Analyzed: 05/21/2010 1151						
Sulfate	3.7		mg/L	0.50	1.0	1.0	300.0
Analysis Batch: 680-170177	Date Analyzed: 05/30/2010 1223						
ortho-Phosphate	0.040	J H	mg/L	0.016	0.050	1.0	4500 P F
Analysis Batch: 680-170192	Date Analyzed: 05/24/2010 0916						

Analyte	Result	Qual	Units	RL	RL	Dil	Method
Alkalinity	70		mg/L	5.0	5.0	1.0	SM 2320B
Analysis Batch: 680-169554	Date Analyzed: 05/24/2010 1359						
Bicarbonate Alkalinity as CaCO3	70		mg/L	5.0	5.0	1.0	SM 2320B
Analysis Batch: 680-169554	Date Analyzed: 05/24/2010 1359						
Carbon Dioxide, Free	5.0	U	mg/L	5.0	5.0	1.0	SM 2320B
Analysis Batch: 680-169554	Date Analyzed: 05/24/2010 1359						
Total Dissolved Solids	130		mg/L	5.0	5.0	1.0	SM 2540C
Analysis Batch: 680-169640	Date Analyzed: 05/25/2010 1209						

DATA REPORTING QUALIFIERS

Client: Golder Associates Inc. Job Number: 680-57854-1

Lab Section	Qualifier	Description
Metals		
	U	Indicates the analyte was analyzed for but not detected.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
General Chemistry		
	U	Indicates the analyte was analyzed for but not detected.
	J	Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
	H	Sample was prepped or analyzed beyond the specified holding time

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-169672

Method: 200.7 Rev 4.4
Preparation: 200

Lab Sample ID: MB 680-169672/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/01/2010 2006
Date Prepared: 05/25/2010 1340

Analysis Batch: 680-170366
Prep Batch: 680-169672
Units: ug/L

Instrument ID: ICPD
Lab File ID: 169672.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Aluminum	200	U	100	200
Calcium	500	U	97	500
Copper	20	U	5.0	20
Iron	50	U	24	50
Magnesium	500	U	20	500
Manganese	10	U	3.0	10
Potassium	1000	U	40	1000
Silver	10	U	0.97	10
Sodium	1000	U	280	1000
Zinc	20	U	6.3	20

Lab Control Sample - Batch: 680-169672

Method: 200.7 Rev 4.4
Preparation: 200

Lab Sample ID: LCS 680-169672/20-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/01/2010 2011
Date Prepared: 05/25/2010 1340

Analysis Batch: 680-170366
Prep Batch: 680-169672
Units: ug/L

Instrument ID: ICPD
Lab File ID: 169672.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Aluminum	2000	2020	101	85 - 115	
Calcium	5000	5060	101	85 - 115	
Copper	250	250	100	85 - 115	
Iron	1000	1000	100	85 - 115	
Magnesium	5000	5030	101	85 - 115	
Manganese	500	513	103	85 - 115	
Potassium	5000	5380	108	85 - 115	
Silver	50.0	50.1	100	85 - 115	
Sodium	5000	5050	101	85 - 115	
Zinc	500	521	104	85 - 115	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-170376

Method: 200.7 Rev 4.4
Preparation: 200
Dissolved

Lab Sample ID: MB 680-170372/19-B
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/07/2010 1753
Date Prepared: 06/02/2010 1516

Analysis Batch: 680-170811
Prep Batch: 680-170376
Units: ug/L

Instrument ID: ICPD
Lab File ID: 170376.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Dissolved Iron	50	U	24	50
Dissolved Manganese	10	U	3.0	10

Lab Control Sample - Batch: 680-170376

Method: 200.7 Rev 4.4
Preparation: 200

Lab Sample ID: LCS 680-170376/26-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/07/2010 1758
Date Prepared: 06/02/2010 1516

Analysis Batch: 680-170811
Prep Batch: 680-170376
Units: ug/L

Instrument ID: ICPD
Lab File ID: 170376.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Dissolved Iron	1000	1050	105	85 - 115	
Dissolved Manganese	500	529	106	85 - 115	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-170764

Method: 200.7 Rev 4.4
Preparation: N/A

Lab Sample ID: MB 680-170706/1-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/07/2010 1351
Date Prepared: N/A

Analysis Batch: 680-170764
Prep Batch: N/A
Units: ug/L

Instrument ID: Varian ICP
Lab File ID: E006072010A.csv
Initial Weight/Volume:
Final Weight/Volume: 1.0 mL

Analyte	Result	Qual	MDL	RL
Dissolved SiO2, Silica	500	U	50	500

Lab Control Sample - Batch: 680-170764

Method: 200.7 Rev 4.4
Preparation: N/A

Lab Sample ID: LCS 680-170706/2-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/07/2010 1354
Date Prepared: N/A

Analysis Batch: 680-170764
Prep Batch: N/A
Units: ug/L

Instrument ID: Varian ICP
Lab File ID: E006072010A.csv
Initial Weight/Volume:
Final Weight/Volume: 1.0 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Dissolved SiO2, Silica	10000	10100	101	85 - 115	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-169606

Method: 200.8
Preparation: 200

Lab Sample ID: MB 680-169606/18-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/28/2010 0421
Date Prepared: 05/25/2010 0936

Analysis Batch: 680-170612
Prep Batch: 680-169606
Units: ug/L

Instrument ID: ICPMSB
Lab File ID: 169606.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Antimony	1.0	U	0.40	1.0
Arsenic	1.0	U	0.37	1.0
Barium	2.0	U	0.14	2.0
Cadmium	0.10	U	0.043	0.10
Chromium	2.0	U	1.0	2.0
Copper	1.0	U	0.50	1.0
Lead	0.30	U	0.060	0.30
Mercury	0.20	U	0.058	0.20
Selenium	2.0	U	0.58	2.0
Thallium	0.20	U	0.10	0.20

Method Blank - Batch: 680-169606

Method: 200.8
Preparation: 200

Lab Sample ID: MB 680-169606/18-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/04/2010 1051
Date Prepared: 05/25/2010 0936

Analysis Batch: 680-170609
Prep Batch: 680-169606
Units: ug/L

Instrument ID: ICPMSB
Lab File ID: 169606606.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Result	Qual	MDL	RL
Antimony	1.0	U	0.40	1.0
Arsenic	1.0	U	0.37	1.0
Barium	2.0	U	0.14	2.0
Beryllium	0.40	U	0.15	0.40
Cadmium	0.10	U	0.043	0.10
Chromium	2.0	U	1.0	2.0
Copper	1.0	U	0.50	1.0
Lead	0.30	U	0.060	0.30
Mercury	0.20	U	0.058	0.20
Selenium	2.0	U	0.58	2.0
Thallium	0.20	U	0.10	0.20

Client: Golder Associates Inc.

Job Number: 680-57854-1

Lab Control Sample - Batch: 680-169606

Method: 200.8
Preparation: 200

Lab Sample ID: LCS 680-169606/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/28/2010 0433
Date Prepared: 05/25/2010 0936

Analysis Batch: 680-170612
Prep Batch: 680-169606
Units: ug/L

Instrument ID: ICPMSB
Lab File ID: 169606.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	10.0	10.8	108	85 - 115	
Arsenic	20.0	20.5	102	85 - 115	
Barium	20.0	19.5	97	85 - 115	
Cadmium	10.0	9.98	100	85 - 115	
Chromium	20.0	19.7	98	85 - 115	
Copper	20.0	20.9	104	85 - 115	
Lead	10.0	9.82	98	85 - 115	
Mercury	1.00	0.982	98	85 - 115	
Selenium	20.0	20.6	103	85 - 115	
Thallium	8.00	7.60	95	85 - 115	

Lab Control Sample - Batch: 680-169606

Method: 200.8
Preparation: 200

Lab Sample ID: LCS 680-169606/19-A
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 06/04/2010 1057
Date Prepared: 05/25/2010 0936

Analysis Batch: 680-170609
Prep Batch: 680-169606
Units: ug/L

Instrument ID: ICPMSB
Lab File ID: 169606606.chr
Initial Weight/Volume: 50 mL
Final Weight/Volume: 50 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Antimony	10.0	10.9	109	85 - 115	
Arsenic	20.0	20.2	101	85 - 115	
Barium	20.0	19.5	97	85 - 115	
Beryllium	10.0	10.0	100	85 - 115	
Cadmium	10.0	10.2	102	85 - 115	
Chromium	20.0	20.3	102	85 - 115	
Copper	20.0	20.6	103	85 - 115	
Lead	10.0	10.1	101	85 - 115	
Mercury	1.00	1.05	105	85 - 115	
Selenium	20.0	21.0	105	85 - 115	
Thallium	8.00	7.74	97	85 - 115	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-169566

Method: 300.0
Preparation: N/A

Lab Sample ID: MB 680-169566/7
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/21/2010 1114
Date Prepared: N/A

Analysis Batch: 680-169566
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0005.d
Initial Weight/Volume:
Final Weight/Volume: 5 mL

Analyte	Result	Qual	MDL	RL
Nitrate as N	0.050	U	0.015	0.050
Nitrate Nitrite as N	0.050	U	0.015	0.050
Nitrite as N	0.050	U	0.015	0.050

Lab Control Sample - Batch: 680-169566

Method: 300.0
Preparation: N/A

Lab Sample ID: LCS 680-169566/8
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/21/2010 1126
Date Prepared: N/A

Analysis Batch: 680-169566
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0006.d
Initial Weight/Volume:
Final Weight/Volume: 5 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Nitrate as N	0.499	0.490	98	90 - 110	
Nitrite as N	0.502	0.498	99	90 - 110	

Matrix Spike - Batch: 680-169566

Method: 300.0
Preparation: N/A

Lab Sample ID: 680-57854-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/21/2010 1204
Date Prepared: N/A

Analysis Batch: 680-169566
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0009.d
Initial Weight/Volume:
Final Weight/Volume: 5 mL
1 uL

Analyte	Sample Result/Qual		Spike Amount	Result	% Rec.	Limit	Qual
Nitrite as N	0.050	U	0.997	1.03	104	90 - 110	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-170177

Method: 300.0
Preparation: N/A

Lab Sample ID: MB 680-170177/2
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/30/2010 1133
Date Prepared: N/A

Analysis Batch: 680-170177
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0005.d
Initial Weight/Volume: 1.0 mL
Final Weight/Volume: 5 mL

Analyte	Result	Qual	MDL	RL
Chloride	1.0	U	0.20	1.0
Fluoride	0.20	U	0.020	0.20
Sulfate	1.0	U	0.50	1.0

Lab Control Sample - Batch: 680-170177

Method: 300.0
Preparation: N/A

Lab Sample ID: LCS 680-170177/3
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/30/2010 1146
Date Prepared: N/A

Analysis Batch: 680-170177
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0006.d
Initial Weight/Volume: 1.0 mL
Final Weight/Volume: 5 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Chloride	10.0	10.3	103	90 - 110	
Fluoride	2.00	2.15	107	90 - 110	
Sulfate	10.0	10.6	106	90 - 110	

Matrix Spike - Batch: 680-170177

Method: 300.0
Preparation: N/A

Lab Sample ID: 680-57854-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/30/2010 1235
Date Prepared: N/A

Analysis Batch: 680-170177
Prep Batch: N/A
Units: mg/L

Instrument ID: ICG
Lab File ID: 0010.d
Initial Weight/Volume: 1.0 mL
Final Weight/Volume: 5 mL
1 uL

Analyte	Sample Result/Qual		Spike Amount	Result	% Rec.	Limit	Qual
Chloride	5.2		10.0	16.0	108	90 - 110	
Fluoride	0.079	J	2.00	2.22	107	90 - 110	
Sulfate	3.7		10.0	13.9	102	90 - 110	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-170192

Method: 4500 P F
Preparation: N/A

Lab Sample ID: MB 680-170192/1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/24/2010 0916
Date Prepared: N/A

Analysis Batch: 680-170192
Prep Batch: N/A
Units: mg/L

Instrument ID: KONELAB2
Lab File ID: N/A
Initial Weight/Volume: 2 mL
Final Weight/Volume: 2 mL

Analyte	Result	Qual	MDL	RL
ortho-Phosphate	0.050	U	0.016	0.050

Lab Control Sample - Batch: 680-170192

Method: 4500 P F
Preparation: N/A

Lab Sample ID: LCS 680-170192/2
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/24/2010 0916
Date Prepared: N/A

Analysis Batch: 680-170192
Prep Batch: N/A
Units: mg/L

Instrument ID: KONELAB2
Lab File ID: N/A
Initial Weight/Volume: 2 mL
Final Weight/Volume: 2 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
ortho-Phosphate	1.20	1.23	103	90 - 110	

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-169554

Method: SM 2320B
Preparation: N/A

Lab Sample ID: MB 680-169554/5
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/24/2010 1254
Date Prepared: N/A

Analysis Batch: 680-169554
Prep Batch: N/A
Units: mg/L

Instrument ID: MANTECH
Lab File ID: alk052410a.TXT
Initial Weight/Volume: 25 mL
Final Weight/Volume: 25 mL

Analyte	Result	Qual	RL	RL
Alkalinity	5.0	U	5.0	5.0
Bicarbonate Alkalinity as CaCO3	5.0	U	5.0	5.0
Carbon Dioxide, Free	5.0	U	5.0	5.0

Lab Control Sample - Batch: 680-169554

Method: SM 2320B
Preparation: N/A

Lab Sample ID: LCS 680-169554/6
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/24/2010 1304
Date Prepared: N/A

Analysis Batch: 680-169554
Prep Batch: N/A
Units: mg/L

Instrument ID: MANTECH
Lab File ID: alk052410a.TXT
Initial Weight/Volume: 25 mL
Final Weight/Volume: 25 mL

Analyte	Spike Amount	Result	% Rec.	Limit	Qual
Alkalinity	576	563	98	80 - 120	

Duplicate - Batch: 680-169554

Method: SM 2320B
Preparation: N/A

Lab Sample ID: 680-57854-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/24/2010 1406
Date Prepared: N/A

Analysis Batch: 680-169554
Prep Batch: N/A
Units: mg/L

Instrument ID: MANTECH
Lab File ID: alk052410a.TXT
Initial Weight/Volume: 25 mL
Final Weight/Volume: 25 mL

Analyte	Sample Result/Qual		Result	RPD	Limit	Qual
Alkalinity	70		70.4	0	30	
Bicarbonate Alkalinity as CaCO3	70		70.1	0	30	
Carbon Dioxide, Free	5.0	U	5.0	NC	30	U

Client: Golder Associates Inc.

Job Number: 680-57854-1

Method Blank - Batch: 680-169640

Method: SM 2540C
Preparation: N/A

Lab Sample ID: MB 680-169640/1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/25/2010 1209
Date Prepared: N/A

Analysis Batch: 680-169640
Prep Batch: N/A
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 100 mL
Final Weight/Volume: 100 mL

Analyte	Result	Qual	RL	RL
Total Dissolved Solids	5.0	U	5.0	5.0

Lab Control Sample/
Lab Control Sample Duplicate Recovery Report - Batch: 680-169640

Method: SM 2540C
Preparation: N/A

LCS Lab Sample ID: LCS 680-169640/2
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/25/2010 1209
Date Prepared: N/A

Analysis Batch: 680-169640
Prep Batch: N/A
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 100 mL
Final Weight/Volume: 100 mL

LCSD Lab Sample ID: LCSD 680-169640/3
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/25/2010 1209
Date Prepared: N/A

Analysis Batch: 680-169640
Prep Batch: N/A
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 100 mL
Final Weight/Volume: 100 mL

Analyte	% Rec. LCS	% Rec. LCSD	Limit	RPD	RPD Limit	LCS Qual	LCSD Qual
Total Dissolved Solids	104	108	80 - 120	4	25		

Duplicate - Batch: 680-169640

Method: SM 2540C
Preparation: N/A

Lab Sample ID: 680-57854-1
Client Matrix: Water
Dilution: 1.0
Date Analyzed: 05/25/2010 1209
Date Prepared: N/A

Analysis Batch: 680-169640
Prep Batch: N/A
Units: mg/L

Instrument ID: No Equipment Assigned
Lab File ID: N/A
Initial Weight/Volume: 100 mL
Final Weight/Volume: 100 mL

Analyte	Sample Result/Qual	Result	RPD	Limit	Qual
Total Dissolved Solids	130	134	2	25	

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Seattle
5755 8th Street E.
Tacoma, WA 98424
Tel. 253-922-2310
Fax 253-922-5047
www.testamericainc.com

☐ Rush
☐ Short Hold

Chain of Custody Record

Client	Client Contact	Date	Chain of Custody Number
Golder Associates Inc	Kenny Janssen	5.20.10	7367
Address	**Telephone Number (Area Code)/Fax Number**	**Lab Number**	**Page** 1 **of** 1
9 Monroe Parkway Ste 270	503-607-1820		
City Lake Oswego ~~Portland~~ **State** OR **Zip Code** 97035	**Sampler** K. Janssen **Lab Contact**		
Project Name and Location (State) City of Yelm/SW Well No 2/WA	**Billing Contact** Andrea Cornette		
Contract/Purchase Order/Quote No. Lab project# 68007670			

Sample I.D. and Location/Description (Containers for each sample may be combined on one line)	Date	Time	Matrix: Air	Matrix: Aqueous	Matrix: Sed.	Matrix: Soil	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/NaOH	Alkalinity/CO3/HCO3	200.7 diss metals, diss SiO2/silica	200.7/200.8 Metals	2540C TDS	4500 PE orthophosphate	300.0 28D Bws chloride fluoride sulfate	300.0 48Hr Bw Nitrate Nitrite	Special Instructions/ Conditions of Receipt
SW Well NO1-1	5.19.10	1720		X									X							
SW Well NO1-2	5.19.10	1720		X										X						
SW Well No1-3	5.19.10	1720		X					X						X					
SW Well No1-4	5.19.10	1720		X												X				
SW Well No1-5	5.19.10	1720		X													X			~~[illegible]~~
SW Well No1-6	5.19.10	1720		X														X		Time Sensitive

2.8°c
680-57854

Cooler ☒ Yes ☐ No Cooler Temp: ______

Possible Hazard Identification ☒ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal ☐ Return To Client ☐ Disposal By Lab ☒ Archive For 1 Months (A fee may be assessed if samples are retained longer than 1 month)

Turn Around Time Required (business days) ☐ 24 Hours ☐ 48 Hours ☐ 5 Days ☒ 10 Days ☐ 15 Days ☐ Other ______

QC Requirements (Specify)

Relinquished By Sign/Print	Date	Time	Received By Sign/Print	Date	Time
1. Elizabeth Bartosik [signature]	5.20.10	800	1. George K Conner [signature]	5/21/10	0845
2.			2.		
3.			3.		

Comments

DISTRIBUTION: WHITE - Stays with the Samples; CANARY - Returned to Client with Report; PINK - Field Copy

APPENDIX E-2

WATER QUALITY LABORATORY RESULTS
SW WELL 1A

EDGE ANALYTICAL LABORATORIES

Burlington WA
Corporate Office
1620 S Walnut St - 98233
800.755.9295 S 360.757.1400

Bellingham WA
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805 Orchard Dr Ste 4 - 98225
360.671.0688

Portland OR
Microbiology/Chemistry
9150 SW Pioneer Ct Ste W- 97070
503.682.7802

November 11, 2010

Mr. Kenny Jannsen
Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

RE: 10-15791 - Drinking Water Yelm WA Thurston Co

Dear Mr. Kenny Jannsen,

Your project: Drinking Water Yelm WA Thurston Co, was received on Thursday October 14, 2010.
The following comments are reported for your project:

Spoke with Kenny Janssen 10/26/10, he said the temperature of the minicipal source was read at 11.5 C. This value is used to calculate corrosivity.

If you have questions phone us at 800 755-9295.

Respectfully Submitted,

Lawrence J Henderson, PhD
Director of Laboratories

Enclosures Data Report
QC Reports
Chain of Custody

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Microbiology/Chemistry
9150 SW Pioneer Ct Ste W- 97070
503.682.7802

INORGANIC COMPOUNDS (IOC) REPORT

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursto

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:

Sample Number: SW1A101310
Lab Number: 156-35398
Collect Date: 10/13/10 11:38
Date Received: 10/14/10
Report Date: 11/11/10
Sampled By: Lizzi B.
Sampler Phone:
Released by:

DOH#	ANALYTES	RESULTS	UNITS	SRL	Trigger	MCL	Analyst	METHOD	Analyzed	COMMENT
	GROSS BETA	ND	pCi/L	4		50	ic	900.0	11/01/10	Analyzed by Pace
	GROSS ALPHA	ND	pCi/L	3		15	ic	900.0	11/01/10	Analyzed by Pace
	RADIUM 226	ND	pCi/L	1			ic	903.1	11/03/10	Analyzed by Pace
	RADIUM 228	ND	pCi/L	1		5	ic	904.0	11/05/10	Analyzed by Pace
	RADON	234	pCi/L	100			sw	913	10/15/10	Analyzed by Energy

NOTES:

SRL (State Reporting Level): indicates the minimum reporting level required by the Washington Department of Health (DOH).
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.
Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the Specified Reporting Limit (SRL).

If you have any questions concerning this report contact us at the above phone number.

FORM: IOC_ST

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Bellingham WA — Microbiology — 805 Orchard Dr Ste 4 - 98225 — 360.671.0688
Portland OR — Microbiology/Chemistry — 9150 SW Pioneer Ct Ste W- 97070 — 503.682.7602

Washington State Department of Health
WATER BACTERIOLOGICAL ANALYSIS

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID
DOH Source Number:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursl

Repeat Sample Number:
Lab Number: 164-35398
Field ID: SW1A101310
Date Collected: 10/13/10 11:38
Date Received: 10/14/10
Date Analyzed: 10/20/10 18:55
Report Date: 11/9/10
Comment:
Peer Review:

DOH#	PARAMETER	RESULT	UNITS	Analyst	METHOD	COMMENT
1	TOTAL COLIFORM	2	MPN/100mL	ab	SM9221 B	
101	Heterotrophic Plate Count	4	CFU/mL	dl	SM9215 B	
3	E. Coli	<2	MPN/100mL	ab	SM9221 F	

If the sample is unsatisfactory you can get information at the following health department websites or phone numbers:

Island Co: http://www.islandcounty.net/health/Envh/DrinkingWater/index.htm
San Juan Co: http://www.sanjuanco.com/health/ehswater.aspx
Skagit Co: http://www.skagitcounty.net/drinkingwater or 360-336-9380
Snohomish Co: 425-339-5250
Whatcom Co: http://www.co.whatcom.wa.us/health/environmental/drinking_water/index.jsp
WSDOH: http://www.doh.wa.gov/ehp/dw/Programs/coliform.htm

NOTES:

If the result is Unsatisfactory a repeat sample is required for Public Water Systems. Private individuals should investigate the cause of the unsatisfactory result and resample.
If E. Coli or Fecal Coliform are present in sample do not drink the water until it is properly treated.

FAX: 607-1825

email: kenny_janssen@golder.com

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INORGANIC COMPOUNDS (IOC) REPORT

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

Reference Number: **10-15791**

Project: Drinking Water Yelm WA Thurston Co
Field ID: SW1A101310
Sample Description: Yelm, WA
Sampled By: Lizzi B.
Sample Date: 10/13/10 11:38

Lab Number: 046-35398
Report Date: 11/9/10
Date Received: 10/14/10
Sampler Phone:

Released By: JM

CAS	Compound	RESULT	UNITS	PQL	MDL	MCL	Analyst	METHOD	Analyze	COMMENT
EPA Regulated										
7440-38-2	ARSENIC	**ND**	mg/L	0.001	0.00022	**0.010**	mvp	200.8	10/28/10	
7440-39-3	BARIUM	**0.004**	mg/L	0.001	2.58E-05	**2**	mvp	200.8	10/28/10	
7440-41-7	BERYLLIUM	**ND**	mg/L	0.001	1.17E-05	**0.004**	mvp	200.8	10/28/10	
7440-43-9	CADMIUM	**ND**	mg/L	0.001	1.89E-05	**0.005**	mvp	200.8	10/28/10	
7440-47-3	CHROMIUM	**ND**	mg/L	0.010	0.00012	**0.1**	mvp	200.8	10/28/10	
7440-36-0	ANTIMONY	**ND**	mg/L	0.001	3.19E-05	**0.006**	mvp	200.8	10/28/10	
7440-28-0	THALLIUM	**ND**	mg/L	0.001	2.04E-05	**0.002**	mvp	200.8	10/28/10	
7440-02-0	NICKEL	**ND**	mg/L	0.005	3.77E-05	**0.1**	mvp	200.8	10/28/10	
7782-49-2	SELENIUM	**ND**	mg/L	0.005	9.70E-05	**0.05**	mvp	200.8	10/28/10	
7439-97-6	MERCURY	**ND**	mg/L	0.0002	0.00004	**0.002**	ccn	245.1	10/22/10	
14797-65-0	NITRITE-N	**ND**	mg/L	0.10	0.0111	**1**	bj	300.0	10/15/10 05:18	
E-10128	TOTAL NITRATE/NITRITE	**ND**	mg/L	0.10	0.0058	**10**	bj	300.0	10/15/10 05:18	
14797-55-8	NITRATE-N	**ND**	mg/L	0.10	0.0076	**10**	bj	300.0	10/15/10 05:18	
16984-48-8	FLUORIDE	**0.11**	mg/L	0.10	0.0037	**4**	bj	300.0	10/15/10	
57-12-5	CYANIDE, FREE	**ND**	mg/L	0.040	0.004	**0.2**	kdw	SM4500-CN F	10/22/10	
EPA Regulated (Secondary)										
7439-89-6	IRON	**0.11**	mg/L	0.050	0.004	**0.3**	bj	200.7	10/21/10	
7440-22-4	SILVER	**ND**	mg/L	0.010	1.78E-05	**0.05**	mvp	200.8	10/28/10	
7439-96-5	MANGANESE	**0.141**	mg/L	0.001	2.22E-05	**0.05**	mvp	200.8	10/28/10	
7440-66-6	ZINC	**ND**	mg/L	0.005	0.00014	**5**	mvp	200.8	10/28/10	
14808-79-8	SULFATE	**3.4**	mg/L	0.2	0.028	**250**	bj	300.0	10/15/10	
16887-00-6	CHLORIDE	**3.6**	mg/L	0.1	0.008	**250**	bj	300.0	10/15/10	
State Regulated										
E-10617	TURBIDITY	**0.51**	NTU	0.10		**1.0**	kdw	180.1	10/14/10 16:51	
E-11778	HARDNESS as Calcium Carbonate	**40.2**	mg/L	3.30	0.055		bj	200.7	10/21/10	
7440-23-5	SODIUM	**5.45**	mg/L	1.0	0.03		bj	200.7	10/21/10	
E-11712	COLOR	**ND**	Color Units	5		**15**	kdw	SM2120 B	10/14/10 16:41	
E-10184	ELECTRICAL CONDUCTIVITY	**169**	uS/cm	10		**700**	ccn	SM2510 B	10/18/10	
E-10173	TOTAL DISSOLVED SOLIDS	**117**	mg/L	20		**500**	ccn	SM2540 C	10/20/10	
State Unregulated										
7440-50-8	COPPER	**ND**	mg/L	0.005	5.44E-05	**1.3**	mvp	200.8	10/28/10	
7439-92-1	LEAD	**ND**	mg/L	0.001	4.19E-05	**0.015**	mvp	200.8	10/28/10	

NOTES:

PQL Practical Quantitation Limit indicates the lower level of quantitation at which an analyte can be determined with a confidence of plus or minus 20%.

MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.

MDL Method Detection Limit is a theoretical detection limit at which there is a 99% certainty that the analyte concentration is greater than zero.

ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.

If you have any questions concerning this report contact us at the above phone number.

FORM: cloc_gen.rpt

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1620 S Walnut St - 98233
800.755.9295 • 360.757.1400

Bellingham WA
Microbiology
805 Orchard Dr Ste 4 - 98225
360.671.0688

Portland OR
Microbiology/Chemistry
9150 SW Pioneer Ct Ste W- 97070
503.682.7802

Data Report

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

Reference Number: **10-15791**
Project: Drinking Water Yelm WA
Thurston Co
Report Date: 11/11/10
Date Received: 10/14/10
Reviewed by:

Sample Description: SW1A101310 - Yelm, WA
Lab Number: 35398
Sample Date: 10/13/10 11:38 am
Collected By: Lizzi B.

CAS ID#	Parameter	Result	PQL	MDL	Units	DF	Method	Analyzed	Analyst	Batch	Comment
7440-61-1	URANIUM	ND	0.001	3.91E-06	mg/L	1.0	200.8	10/28/10	MVP	200.8_101026	
7440-70-2	CALCIUM	7.77	0.500	0.017	mg/L	1.0	200.7	10/21/10	BJ	200.7-101021B	
7439-95-4	MAGNESIUM	5.03	0.500	0.003	mg/L	1.0	200.7	10/21/10	BJ	200.7-101021B	
7440-09-7	POTASSIUM	ND	0.500	0.072	mg/L	1.0	200.7	10/21/10	BJ	200.7-101021B	
E-10139	HYDROGEN ION (pH)	7.07			pH Units	1.0	SM4500-H+ B	10/14/10	KDW	PH_101014	
E-14540	Temperature, Celsius	11.5			C	1.0	SM2550 B	10/26/10	CCN	TEMP_101026	
E-14506	ALKALINITY	80	5.0	1.4	mg CaCO3/L	1.0	SM2320 B	10/15/10	CCN	ALK_101015	
NA	CORROSIVITY	-1.83			SI	1.0	SM203	10/26/10	CCN	COR_101026	
E-11734	ODOR	1	1		TON	1.0	SM2150	10/15/10	KDW	ODOR_101015	
7631-86-9	SILICA	43.8	0.05	0.007	mg/L	1.0	200.7	10/21/10	BJ	200.7-101021B	
124-38-9	CARBON DIOXIDE	ND	0.5		mg/L	1.0	SM4500-CO2 D	10/15/10	CCN	CO2_101015	
NA	SURFACTANTS	ND		0.025	mg/L	1.0	SM5540 C	10/15/10	KF	AMTEST_101015	Analyzed by AmTest
7439-89-6	IRON	0.14	0.050	0.004	mg/L	1.0	200.7/FILTER	10/21/10	BJ	200.7-101021B	
7439-96-5	MANGANESE	0.15	0.001	0.0012	mg/L	1.0	200.7/FILTER	10/21/10	BJ	200.7-101021B	
18496-25-8	HYDROGEN SULFIDE	ND	0.100		mg/L	1.0	SM4500-S2 F	10/19/10	CCN	h2s_101019	
14265-44-2	ORTHO-PHOSPHATE	0.04	0.01	0.0005	mg/L	1.0	SM4500-P F	10/14/10	SPL	OPHOS-101014	
E-10162	TOTAL SUSPENDED SOLIDS	ND	4		mg/L	1.0	SM2540 D	10/20/10	KDW	TSS_101020	
E-10195	TOTAL ORGANIC CARBON	0.14 IJ	0.50	0.085	mg/L	1.0	SM5310 B	10/21/10	BJ	TOC_101021	
E-14506	ALKALINITY	80	5.0	1.4	mgCaCO3/L	1.0	SM2320 B	10/15/10	CCN	ALK_101015	
NA	BICARBONATE	80	5.0	1.4	mg CaCO3/L	1.0	SM2320 B	10/15/10	CCN	ALK_101015	
7429-90-5	ALUMINUM	ND	0.010	0.007	mg/L	1.0	200.7	10/21/10	BJ	200.7-101021B	
7664-41-7	AMMONIA	0.10	0.05	0.0072	mg/L	1.0	SM4500-NH3 G	10/21/10	SPL	NH3-101021	

Notes:
ND = Not detected above the listed practical quantitation limit (PQL) or not above the Method Detection Limit (MDL), if requested.
PQL = Practical Quantitation Limit is the lowest level that can be achieved within specified limits of precision and accuracy during routine laboratory operating conditions.
D.F. - Dilution Factor

If you have any questions concerning this report contact us at the above phone number.

Form: cResult.rpt

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Portland OR — Microbiology/Chemistry — 9150 SW Pioneer Ct Ste W- 97070 — 503.682.7602

VOLATILE ORGANIC COMPOUNDS (VOC) REPORT

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursl

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 524_101019
Date Analyzed: 10/19/10
Report Date: 10/25/10
Analyst: HY
Peer Review:

EPA Method 524.2 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	EPA/State Regulated						
102	ETHYLENE DIBROMIDE (EDB)	ND	ug/L	0.5	0.02	0.05	Screening Only / PQL 0.5 ug/L
103	1,2-DIBROMO-3-CHLOROPROPANE	ND	ug/L	0.5	0.04	0.2	Screening Only / PQL 0.5 ug/L
160	TOTAL XYLENES	ND	ug/L	0.5	0.5	10000	
57	T - 1,2 - DICHLOROETHYLENE	ND	ug/L	0.5	0.5	100	
60	CIS - 1,2 - DICHLOROETHYLENE	ND	ug/L	0.5	0.5	70	
47	1,1,1 - TRICHLOROETHANE	ND	ug/L	0.5	0.5	200	
48	CARBON TETRACHLORIDE	ND	ug/L	0.5	0.5	5	
49	BENZENE	ND	ug/L	0.5	0.5	5	
50	1,2 - DICHLOROETHANE	ND	ug/L	0.5	0.5	5	
51	TRICHLOROETHYLENE	ND	ug/L	0.5	0.5	5	
63	1,2 - DICHLOROPROPANE	ND	ug/L	0.5	0.5	5	
66	TOLUENE	ND	ug/L	0.5	0.5	1000	
67	1,1,2 - TRICHLOROETHANE	ND	ug/L	0.5	0.5	5	
68	TETRACHLOROETHYLENE	ND	ug/L	0.5	0.5	5	
71	CHLOROBENZENE	ND	ug/L	0.5	0.5	100	
73	ETHYLBENZENE	ND	ug/L	0.5	0.5	700	
74	M/P - XYLENE	ND	ug/L	0.5	0.5		
45	VINYL CHLORIDE	ND	ug/L	0.5	0.5	2	
75	O - XYLENE	ND	ug/L	0.5	0.5		
76	STYRENE	ND	ug/L	0.5	0.5	100	
52	P - DICHLOROBENZENE	ND	ug/L	0.5	0.5	75	
84	O - DICHLOROBENZENE	ND	ug/L	0.5	0.5	600	
95	1,2,4, - TRICHLOROBENZENE	ND	ug/L	0.5	0.5	70	
46	1,1 - DICHLOROETHYLENE	ND	ug/L	0.5	0.5	7	
56	METHYLENE CHLORIDE	ND	ug/L	0.5	0.5	5	
	EPA/State Unregulated						

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.
Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: VOC

VOLATILE ORGANIC COMPOUNDS (VOC) REPORT

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
58	1,1 - DICHLOROETHANE	ND	ug/L	0.5	0.5		
59	2,2 - DICHLOROPROPANE	ND	ug/L	0.5	0.5		
86	BROMOCHLOROMETHANE	ND	ug/L	0.5	0.5		
62	1,1 - DICHLOROPROPENE	ND	ug/L	0.5	0.5		
104	DICHLORODIFLUOROMETHANE	ND	ug/L	0.5	0.5		
64	DIBROMOMETHANE	ND	ug/L	0.5	0.5		
65	CIS - 1,3 - DICHLOROPROPENE	ND	ug/L	0.5	0.5		
69	TRANS- 1,3 - DICHLOROPROPENE	ND	ug/L	0.5	0.5		
53	CHLOROMETHANE	ND	ug/L	0.5	0.5		
70	1,3 - DICHLOROPROPANE	ND	ug/L	0.5	0.5		
72	1,1,1,2 - TETRACHLOROETHANE	ND	ug/L	0.5	0.5		
87	ISOPROPYLBENZENE	ND	ug/L	0.5	0.5		
79	1,2,3 - TRICHLOROPROPANE	ND	ug/L	0.5	0.5		
78	BROMOBENZENE	ND	ug/L	0.5	0.5		
80	1,1,2,2 - TETRACHLOROETHANE	ND	ug/L	0.5	0.5		
81	O - CHLOROTOLUENE	ND	ug/L	0.5	0.5		
88	N - PROPYLBENZENE	ND	ug/L	0.5	0.5		
89	1,3,5 - TRIMETHYLBENZENE	ND	ug/L	0.5	0.5		
54	BROMOMETHANE	ND	ug/L	0.5	0.5		
82	P - CHLOROTOLUENE	ND	ug/L	0.5	0.5		
90	TERT - BUTYLBENZENE	ND	ug/L	0.5	0.5		
91	1,2,4 - TRIMETHYLBENZENE	ND	ug/L	0.5	0.5		
92	SEC - BUTYLBENZENE	ND	ug/L	0.5	0.5		
83	M - DICHLOROBENZENE	ND	ug/L	0.5	0.5		
93	P - ISOPROPYLTOLUENE	ND	ug/L	0.5	0.5		
94	N - BUTYLBENZENE	ND	ug/L	0.5	0.5		
55	CHLOROETHANE	ND	ug/L	0.5	0.5		
97	HEXACHLOROBUTADIENE	ND	ug/L	0.5	0.5		
96	NAPHTHALENE	ND	ug/L	0.5	0.5		
98	1,2,3 - TRICHLOROBENZENE	ND	ug/L	0.5	0.5		
85	TRICHLOROFLUOROMETHANE	ND	ug/L	0.5	0.5		
	EPA Regulated - Under Trihalomethanes Program						
31	TOTAL TRIHALOMETHANE	ND	ug/L	0.5	60	80	
27	CHLOROFORM	ND	ug/L	0.5			
28	BROMODICHLOROMETHANE	ND	ug/L	0.5			
29	CHLORODIBROMOMETHANE	ND	ug/L	0.5			
30	BROMOFORM	ND	ug/L	0.5			
	State Unregulated - Other						
0	METHYL TERT-BUTYL ETHER	ND	ug/L	1.0			

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; Federal Action Levels are 0.015 mg/L for Lead and 1.3 mg/L for Copper. Sodium has a recommended limit of 20 mg/L. A blank MCL value indicates a level is not currently established.
Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): Indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: VOC

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ORELAP WA200008

HERBICIDES IN DRINKING WATER

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA thurst

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 515.4_101019
Date Analyzed: 10/20/10
Report Date: 10/22/10
Analyst: CO
Peer Review: PM

EPA Method 515.4 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	EPA Regulated						
37	2,4 - D	ND	ug/L	0.5	0.2	70	
38	2,4,5 - TP (SILVEX)	ND	ug/L	1.0	0.4	50	
134	PENTACHLOROPHENOL	ND	ug/L	0.2	0.08	1	
137	DALAPON	ND	ug/L	5	2	200	
139	DINOSEB	ND	ug/L	1.0	0.4	7	
140	PICLORAM	ND	ug/L	0.5	0.2	500	
	Other						
138	DICAMBA	ND	ug/L	0.2	0.2		
225	DCPA (ACID METABOLITES)	ND	ug/L	0.1	0.1		
135	2,4 DB	ND	ug/L	1.0	1.0		
136	2,4,5 T	ND	ug/L	0.4	0.4		
220	BENTAZON	ND	ug/L	0.5	0.5		
221	DICHLORPROP	ND	ug/L	0.5	0.5		
223	ACIFLUORFEN	ND	ug/L	2.0	2.0		
226	3,5 - DICHLOROBENZOIC ACID	ND	ug/L	0.5	0.5		

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

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ORELAP WA200008

SYNTHETIC ORGANIC COMPOUNDS (SOC) REPORT

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thurst

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 525_101025
Date Analyzed: 10/26/10
Report Date: 11/1/10
Analyst: CO
Peer Review:

EPA Method 525.2 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	EPA Regulated						
33	ENDRIN	ND	ug/L	0.02	0.05	2	
34	LINDANE (BHC - GAMMA)	ND	ug/L	0.04	0.04	0.2	
35	METHOXYCHLOR	ND	ug/L	0.2	10	40	
117	ALACHLOR	ND	ug/L	0.4	0.4	2	
119	ATRAZINE	ND	ug/L	0.2	0.5	3	
120	BENZO(A)PYRENE	ND	ug/L	0.04	0.04	0.2	
122	CHLORDANE, TECHNICAL	ND	ug/L	0.4	0.4	2	
124	DI(ETHYLHEXYL)-ADIPATE	ND	ug/L	1.3	1.3	400	
125	DI(ETHYLHEXYL)-PHTHALATE	ND	ug/L	1.3	1.3	6	
126	HEPTACHLOR	ND	ug/L	0.08	0.09	0.4	
127	HEPTACHLOR EPOXIDE	ND	ug/L	0.04	0.1	0.2	
128	HEXACHLOROBENZENE	ND	ug/L	0.2	0.5	1	
129	HEXACHLOROCYCLO-PENTADIENE	ND	ug/L	0.2	0.5	50	
133	SIMAZINE	ND	ug/L	0.15	0.15	4	
134	PENTACHLOROPHENOL	ND	ug/L	0.4	0.2	1	screening only / compliance by 515.4
	EPA Unregulated						
118	ALDRIN	ND	ug/L	0.2			
121	BUTACHLOR	ND	ug/L	0.4			
123	DIELDRIN	ND	ug/L	0.2			
130	METOLACHLOR	ND	ug/L	1.0			
131	METRIBUZIN	ND	ug/L	0.2			
132	PROPACHLOR	ND	ug/L	0.2			
233	4,4-DDE	ND	ug/L	0.2			
	ACETOCHLOR	ND	ug/L	0.1			
208	EPTC	ND	ug/L	0.3			
218	MOLINATE	ND	ug/L	0.1			
190	TERBACIL	ND	ug/L	0.2			

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

SYNTHETIC ORGANIC COMPOUNDS (SOC) REPORT

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	State Unregulated - Other						
179	BROMACIL	ND	ug/L	0.2			
254	FLUORENE	ND	ug/L	0.2			

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

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ORELAP WA200008

SYNTHETIC ORGANIC COMPOUNDS (SOC) REPORT

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursl

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 508_101025
Date Analyzed: 10/28/10
Report Date: 11/9/10
Analyst: BCV
Peer Review:

EPA Method 508.1 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	PCBs/Toxaphene						
153	PCBS (Total Aroclors)	ND	ug/L	0.2		0.5	
173	AROCLOR 1221	ND	ug/L	100			
174	AROCLOR 1232	ND	ug/L	2.5			
175	AROCLOR 1242	ND	ug/L	1.5			
176	AROCLOR 1248	ND	ug/L	0.5			
177	AROCLOR 1254	ND	ug/L	0.5			
178	AROCLOR 1260	ND	ug/L	1			
180	AROCLOR 1016	ND	ug/L	0.4			
36	TOXAPHENE	ND	ug/L	1	1	3	

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

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ORELAP WA200008

CARBAMATES IN DRINKING WATER

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA thurst

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 531_101020
Date Analyzed: 10/21/10
Report Date: 10/22/10
Analyst: CO
Peer Review: PVT

EPA Method 531.2 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	EPA Regulated						
148	OXYMAL	ND	ug/L	4.0	4.0	200	
146	CARBOFURAN	ND	ug/L	1.8	1.8	40	
	EPA Unregulated						
144	ALDICARB SULFOXIDE	ND	ug/L	1.0	1.0		
143	ALDICARB SULFONE	ND	ug/L	1.6	1.6		
147	METHOMYL	ND	ug/L	1.0	1.0		
141	3-HYDROXYCARBOFURAN	ND	ug/L	2.0	2.0		
142	ALDICARB	ND	ug/L	1.0	1.0		
145	CARBARYL	ND	ug/L	2.0	2.0		
	State Unregulated - Other						
326	PROPOXUR (BAYGON)	ND	ug/L	1.0			
327	METHIOCARB	ND	ug/L	4.0			

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

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ORELAP WA200008

ORGANICS IN DRINKING WATER

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursl

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 547_101109
Date Analyzed: 11/09/10
Report Date: 11/10/10
Analyst: CO
Peer Review:

EPA Method 547 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
	Synthetic Organic Chemicals						
152	GLYPHOSATE	ND	ug/L	13	13	700	

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

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ORELAP WA200008

ENDOTHALL IN DRINKING WATER

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursi

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 548_101018
Date Analyzed: 10/22/10
Report Date: 11/1/10
Analyst: BCV
Peer Review:

EPA Method 548.1 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
151	ENDOTHALL	ND	ug/L	20	20	100	

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

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ORELAP WA200008

ORGANICS IN DRINKING WATER

Client Name: Golder Associates, Inc/Lake Oswego
9 Monroe Parkway Suite 270
Lake Oswego, OR 97035

System Name:
System ID Number:
DOH Source Number:
Multiple Sources:
Sample Type:
Sample Purpose: Investigative or Other
Sample Location: Yelm, WA
County:
Sampled By: Lizzi B.
Sampler Phone:

Reference Number: 10-15791
Project: Drinking Water Yelm WA Thursl

Field ID: SW1A101310
Lab Number: 046-35398
Date Collected: 10/13/10 11:38
Date Extracted: 549_101018
Date Analyzed: 10/18/10
Report Date: 10/21/10
Analyst: EM
Peer Review:

EPA Method 549.2 For State Drinking Water Compliance

DOH#	COMPOUNDS	RESULTS	UNITS	SRL	Trigger	MCL	COMMENT
150	DIQUAT	ND	ug/L	2	2	20	

NOTES:
If a compound is detected > or = to the State Reporting Level, SRL, specified increased monitoring frequencies may occur per DOH.
MCL (Maximum Contaminant Level) maximum permissible level of a contaminant in water established by EPA; a blank MCL value indicates a level is not currently established.

Trigger Level: DOH Drinking Water Response level. Systems with compounds detected in excess of this level are required to take additional samples. Contact your regional DOH office.
ND (Not Detected): indicates that the parameter was not detected above the State Reporting Limit (SRL).

If you have any questions concerning this report contact Lawrence Henderson at the above phone number.

FORM: SOC

QUALITY CONTROL REPORT
SURROGATE REPORT

Reference Number: 10-15791
Report Date: 11/11/10

Lab No	Analyte	Result	Qualifier	Units	Method	Limit
508_101025						
35398	TETRACHLORO-M-XYLENE (SURR)	85		%	508.1	Acceptance Limits 70%-130%
515.4_101019						
35398	2,4 - DCAA (SURR)	111		%	515.4	Acceptance Range is 70 - 130%
525_101025						
35398	1,3-DIMETHYL-2-NITROBENZENE (Surr)	97		%	525.2	Acceptance Range is 70% to 130%
	PYRENE-D10 (Surr)	88		%		Acceptance Range is 70% to 130%
	PERYLENE-D12 (Surr)	74		%		Acceptance Range is 70% to 130%
	TRIPHENYLPHOSPHATE (Surr)	98		%		Acceptance Range is 70% to 130%
531_101020						
35398	BDMC (SURR)	94		%	531.2	Acceptance Range is 70%-130%

*Notation:

A surrogate is a pure compound added to a sample in the laboratory just before processing so that the overall efficiency of a method can be determined.

The Acceptance Limits (or Control Limits) approximate a 99% confidence interval around the mean recovery.

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Laboratory Fortified Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
200.7-101021B	ALUMINUM	0.49	0.5	mg/L	200.7	98	85-115		LFB	
	CALCIUM	10.9	10.5	mg/L	200.7	104	85-115			
	HARDNESS as Calcium Carbonate	70.5	69.5	mg/L	200.7	101	85-115			
	IRON	0.47	0.5	mg/L	200.7	94	85-115			
	IRON	0.47	0.5	mg/L	200.7	94	85-115			
	MAGNESIUM	10.5	10.5	mg/L	200.7	100	85-115			
	MANGANESE	0.47	0.5	mg/L	200.7	94	85-115			
	POTASSIUM	15.3	15	mg/L	200.7	102	85-115			
	SILICA	4.93	5.35	mg/L	200.7	92	85-115			
	SODIUM	10.6	10.5	mg/L	200.7	101	85-115			
245.1_101022	MERCURY	0.00169	0.00167	mg/L	245.1	101	85-115		LFB	
508_101025	AROCLOR 1260	1.6	2	ug/L	508.1	80	60-140		LFB	
	PCBS (Total Aroclors)	1.6	2	ug/L	508.1	80	70-130			
	TETRACHLORO-M-XYLENE (SURR)	84		%	508.1		70-130			
515.4_101019	2,4 - D	2.48	2.5	ug/L	515.4	99	70-130		LFB	
	2,4 - DCAA (SURR)	104		%	515.4		70-130			
	2,4 DB	2.14	2.5	ug/L	515.4	86	70-130			
	2,4,5 - TP (SILVEX)	2.63	2.5	ug/L	515.4	105	70-130			
	2,4,5 T	2.56	2.5	ug/L	515.4	102	70-130			
	ACIFLUORFEN	2.82	2.5	ug/L	515.4	113	70-130			
	BENTAZON	2.05	2.5	ug/L	515.4	82	70-130			
	DALAPON	5	5	ug/L	515.4	100	70-130			
	DCPA (ACID METABOLITES)	2.47	2.5	ug/L	515.4	99	70-130			
	DICAMBA	2.36	2.5	ug/L	515.4	94	70-130			
	DICHLORPROP	2.36	2.5	ug/L	515.4	94	70-130			
	DINOSEB	2.35	2.5	ug/L	515.4	94	70-130			
	PENTACHLOROPHENOL	2.75	2.5	ug/L	515.4	110	70-130			
	PICLORAM	2.71	2.5	ug/L	515.4	108	70-130			

*Notation:

% Recovery = (Result of Analysis)/(True Value) * 100

NA = Indicates % Recovery could not be calculated.

QCS: Quality Control Sample, a solution containing known concentrations of method analytes which is used to fortify an aliquot of reagent matrix. The QCS is obtained from an external source and is used to check lab performance.

LFB: Laboratory Fortified Blank, an aliquot of reagent matrix to which known quantities of method analytes are added in the lab. The LFB is analyzed exactly like a sample, and its purpose is to determine whether method performance is within accepted control limits.

MB or LRB: Method Blank or Laboratory Reagent Blank, an aliquot of reagent matrix is analyzed exactly like a sample, and its purpose is to determine if there is background contamination.

EDGE ANALYTICAL LABORATORIES

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Laboratory Fortified Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
524_101019	1,1 - DICHLOROETHANE	4.2	4	ug/L	524.2	105	70-130		LFB	
	1,1 - DICHLOROETHYLENE	4.5	4	ug/L	524.2	113	70-130			
	1,1 - DICHLOROPROPENE	4.2	4	ug/L	524.2	105	70-130			
	1,1,1 - TRICHLOROETHANE	4.1	4	ug/L	524.2	103	70-130			
	1,1,1,2 - TETRACHLOROETHANE	4.2	4	ug/L	524.2	105	70-130			
	1,1,2 - TRICHLOROETHANE	3.9	4	ug/L	524.2	98	70-130			
	1,1,2,2 - TETRACHLOROETHANE	4.1	4	ug/L	524.2	103	70-130			
	1,2 - DICHLOROETHANE	3.9	4	ug/L	524.2	98	70-130			
	1,2 - DICHLOROPROPANE	4.5	4	ug/L	524.2	113	70-130			
	1,2,3 - TRICHLOROBENZENE	3.8	4	ug/L	524.2	95	70-130			
	1,2,3 - TRICHLOROPROPANE	3.6	4	ug/L	524.2	90	70-130			
	1,2,4 - TRIMETHYLBENZENE	4.0	4	ug/L	524.2	100	70-130			
	1,2,4, - TRICHLOROBENZENE	4.0	4	ug/L	524.2	100	70-130			
	1,2-DIBROMO-3-CHLOROPROPANE	4.0	4	ug/L	524.2	100	70-130			
	1,3 - DICHLOROPROPANE	3.7	4	ug/L	524.2	93	70-130			
	1,3,5 - TRIMETHYLBENZENE	4.0	4	ug/L	524.2	100	70-130			
	2,2 - DICHLOROPROPANE	4.6	4	ug/L	524.2	115	70-130			
	BENZENE	3.9	4	ug/L	524.2	98	70-130			
	BROMOBENZENE	4.0	4	ug/L	524.2	100	70-130			
	BROMOCHLOROMETHANE	4.1	4	ug/L	524.2	103	70-130			
	BROMODICHLOROMETHANE	4.1	4	ug/L	524.2	103	70-130			
	BROMOFORM	3.7	4	ug/L	524.2	93	70-130			
	BROMOMETHANE	4.5	4	ug/L	524.2	113	70-130			
	CARBON TETRACHLORIDE	4.0	4	ug/L	524.2	100	70-130			
	CHLOROBENZENE	4.2	4	ug/L	524.2	105	70-130			
	CHLORODIBROMOMETHANE	3.7	4	ug/L	524.2	93	70-130			
	CHLOROETHANE	4.5	4	ug/L	524.2	113	70-130			
	CHLOROFORM	4.0	4	ug/L	524.2	100	70-130			
	CHLOROMETHANE	3.9	4	ug/L	524.2	98	70-130			
	CIS - 1,2 - DICHLOROETHYLENE	3.9	4	ug/L	524.2	98	70-130			
	CIS - 1,3 - DICHLOROPROPENE	4.0	4	ug/L	524.2	100	70-130			
	DIBROMOMETHANE	4.3	4	ug/L	524.2	108	70-130			
	DICHLORODIFLUOROMETHANE	3.9	4	ug/L	524.2	98	70-130			
	ETHYLBENZENE	3.9	4	ug/L	524.2	98	70-130			
	ETHYLENE DIBROMIDE (EDB)	3.7	4	ug/L	524.2	93	70-130			
	HEXACHLOROBUTADIENE	4.6	4	ug/L	524.2	115	70-130			

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Laboratory Fortified Blank

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524_101019	ISOPROPYLBENZENE	3.9	4	ug/L	524.2	98	70-130		LFB	
	M - DICHLOROBENZENE	4.0	4	ug/L	524.2	100	70-130			
	M/P - XYLENE	7.7	8	ug/L	524.2	96	70-130			
	METHYL TERT-BUTYL ETHER	3.6	4	ug/L	524.2	90	70-130			
	METHYLENE CHLORIDE	3.9	4	ug/L	524.2	98	70-130			
	N - BUTYLBENZENE	4.2	4	ug/L	524.2	105	70-130			
	N - PROPYLBENZENE	3.9	4	ug/L	524.2	98	70-130			
	NAPHTHALENE	3.7	4	ug/L	524.2	93	70-130			
	O - CHLOROTOLUENE	4.0	4	ug/L	524.2	100	70-130			
	O - DICHLOROBENZENE	3.8	4	ug/L	524.2	95	70-130			
	O - XYLENE	3.9	4	ug/L	524.2	98	70-130			
	P - CHLOROTOLUENE	4.0	4	ug/L	524.2	100	70-130			
	P - DICHLOROBENZENE	3.9	4	ug/L	524.2	98	70-130			
	P - ISOPROPYLTOLUENE	4.1	4	ug/L	524.2	103	70-130			
	SEC - BUTYLBENZENE	4.1	4	ug/L	524.2	103	70-130			
	STYRENE	3.8	4	ug/L	524.2	95	70-130			
	T - 1,2 - DICHLOROETHYLENE	3.9	4	ug/L	524.2	98	70-130			
	TERT - BUTYLBENZENE	3.9	4	ug/L	524.2	98	70-130			
	TETRACHLOROETHYLENE	4.5	4	ug/L	524.2	113	70-130			
	TOLUENE	3.9	4	ug/L	524.2	98	70-130			
	TRANS- 1,3 - DICHLOROPROPENE	3.7	4	ug/L	524.2	93	70-130			
	TRICHLOROETHYLENE	4.0	4	ug/L	524.2	100	70-130			
	TRICHLOROFLUOROMETHANE	4.1	4	ug/L	524.2	103	70-130			
	VINYL CHLORIDE	3.9	4	ug/L	524.2	98	70-130			
525_101025	1,3-DIMETHYL-2-NITROBENZENE (Surr)	98		%	525.2		70-130		LFB	
	4,4-DDE	9.6	10	ug/L	525.2	96	70-130			
	ACETOCHLOR	0.97	1	ug/L	525.2	97	70-130			
	ALACHLOR	0.91	1	ug/L	525.2	91	70-130			
	ALDRIN	7.9	10	ug/L	525.2	79	70-130			
	ATRAZINE	0.7	1	ug/L	525.2	70	70-130			
	BENZO(A)PYRENE	0.85	1	ug/L	525.2	85	70-130			
	BROMACIL	0.89	1	ug/L	525.2	89	70-130			
	BUTACHLOR	0.96	1	ug/L	525.2	96	70-130			
	DI(ETHYLHEXYL)-ADIPATE	0.91	1	ug/L	525.2	91	70-130			

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Laboratory Fortified Blank

Reference Number: 10-15791
Report Date: 11/11/10

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525_101025	DI(ETHYLHEXYL)-PHTHALATE	0.9	1	ug/L	525.2	90	70-130		LFB	
	DIELDRIN	9.1	10	ug/L	525.2	91	70-130			
	ENDRIN	9.6	10	ug/L	525.2	96	70-130			
	EPTC	0.97	1	ug/L	525.2	97	70-130			
	FLUORENE	1	1	ug/L	525.2	100	70-130			
	HEPTACHLOR	8.6	10	ug/L	525.2	86	70-130			
	HEPTACHLOR EPOXIDE	8.5	10	ug/L	525.2	85	70-130			
	HEXACHLOROBENZENE	1.03	1	ug/L	525.2	103	70-130			
	HEXACHLOROCYCLO-PENTADIENE	0.97	1	ug/L	525.2	97	70-130			
	LINDANE (BHC - GAMMA)	9.3	10	ug/L	525.2	93	70-130			
	METHOXYCHLOR	7.9	10	ug/L	525.2	79	70-130			
	METOLACHLOR	1	1	ug/L	525.2	100	70-130			
	METRIBUZIN	0.75	1	ug/L	525.2	75	70-130			
	MOLINATE	0.98	1	ug/L	525.2	98	70-130			
	PERYLENE-D12 (Surr)	90		%	525.2		70-130			
	PROPACHLOR	1.02	1	ug/L	525.2	102	70-130			
	PYRENE-D10 (Surr)	97		%	525.2		70-130			
	TERBACIL	0.74	1	ug/L	525.2	74	70-130			
	TRIPHENYLPHOSPHATE (Surr)	100		%	525.2		70-130			
531_101020	3-HYDROXYCARBOFURAN	3.8	4	ug/L	531.2	95	70-130		LFB	
	ALDICARB	3.4	4	ug/L	531.2	85	70-130			
	ALDICARB SULFONE	4.1	4	ug/L	531.2	103	70-130			
	ALDICARB SULFOXIDE	4.3	4	ug/L	531.2	108	70-130			
	BDMC (SURR)	94		%	531.2		70-130			
	CARBARYL	3.7	4	ug/L	531.2	93	70-130			
	CARBOFURAN	3.5	4	ug/L	531.2	88	70-130			
	METHIOCARB	3.8	4	ug/L	531.2	95	70-130			
	METHOMYL	4.1	4	ug/L	531.2	103	70-130			
	OXYMAL	4.5	4	ug/L	531.2	113	70-130			
	PROPOXUR (BAYGON)	3.2	4	ug/L	531.2	80	70-130			
531_101020	3-HYDROXYCARBOFURAN	9.8	10	ug/L	531.2	98	70-130		LFB	
	ALDICARB	9.4	10	ug/L	531.2	94	70-130			
	ALDICARB SULFONE	11.2	10	ug/L	531.2	112	70-130			
	ALDICARB SULFOXIDE	11.6	10	ug/L	531.2	116	70-130			

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531_101020	BDMC (SURR)	81		%	531.2		70-130		LFB	
	CARBARYL	10.5	10	ug/L	531.2	105	70-130			
	CARBOFURAN	10.2	10	ug/L	531.2	102	70-130			
	METHIOCARB	9.5	10	ug/L	531.2	95	70-130			
	METHOMYL	11.1	10	ug/L	531.2	111	70-130			
	OXYMAL	11.9	10	ug/L	531.2	119	70-130			
	PROPOXUR (BAYGON)	9.3	10	ug/L	531.2	93	70-130			
531_101020	3-HYDROXYCARBOFURAN	68.9	75	ug/L	531.2	92	70-130		LFB	
	ALDICARB	61.7	75	ug/L	531.2	82	70-130			
	ALDICARB SULFONE	80.6	75	ug/L	531.2	107	70-130			
	ALDICARB SULFOXIDE	80	75	ug/L	531.2	107	70-130			
	BDMC (SURR)	102		%	531.2		70-130			
	CARBARYL	71.6	75	ug/L	531.2	95	70-130			
	CARBOFURAN	67.7	75	ug/L	531.2	90	70-130			
	METHIOCARB	67.2	75	ug/L	531.2	90	70-130			
	METHOMYL	78	75	ug/L	531.2	104	70-130			
	OXYMAL	81.5	75	ug/L	531.2	109	70-130			
	PROPOXUR (BAYGON)	63.6	75	ug/L	531.2	85	70-130			
531_101020	3-HYDROXYCARBOFURAN	34.5	40	ug/L	531.2	86	70-130		LFB	
	ALDICARB	30.5	40	ug/L	531.2	76	70-130			
	ALDICARB SULFONE	41	40	ug/L	531.2	103	70-130			
	ALDICARB SULFOXIDE	40.8	40	ug/L	531.2	102	70-130			
	BDMC (SURR)	88		%	531.2		70-130			
	CARBARYL	36.1	40	ug/L	531.2	90	70-130			
	CARBOFURAN	33.5	40	ug/L	531.2	84	70-130			
	METHIOCARB	30.7	40	ug/L	531.2	77	70-130			
	METHOMYL	40.3	40	ug/L	531.2	101	70-130			
	OXYMAL	42.6	40	ug/L	531.2	107	70-130			
	PROPOXUR (BAYGON)	31.7	40	ug/L	531.2	79	70-130			
547_101109	GLYPHOSATE	161	150	ug/L	547	107	68-140		LFB	
547_101109	GLYPHOSATE	51	50	ug/L	547	102	68-140		LFB	
547_101109	GLYPHOSATE	88	100	ug/L	547	88	68-140		LFB	

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547_101109	GLYPHOSATE	25	25	ug/L	547	100	68-140		LFB	
548_101018	ENDOTHALL	20.3	20	ug/L	548.1	102	70-130		LFB	
549_101018	DIQUAT	2.52	2	ug/L	549.2	126	70-130		LFB	
alk_101015	ALKALINITY	102	100	mg/L	SM2320 B	102	70-130		LFB	
	ALKALINITY	102	100	mg/L	SM2320 B	102	80-120			
alk_101015	ALKALINITY	101	100	mg/L	SM2320 B	101	70-130		LFB	
	ALKALINITY	101	100	mg/L	SM2320 B	101	80-120			
alk_101015	ALKALINITY	102	100	mg/L	SM2320 B	102	70-130		LFB	
	ALKALINITY	102	100	mg/L	SM2320 B	102	80-120			
CNISE_101022	CYANIDE, FREE	0.054	0.050	mg/L	SM4500-CN F	108	80-120		LFB	
CNISE_101022	CYANIDE, FREE	0.053	0.050	mg/L	SM4500-CN F	106	80-120		LFB	
h2s_101019	HYDROGEN SULFIDE	0.12	0.1	mg/L	SM4500-S2 F	120	85-115		LFB	
NH3-101021	AMMONIA	1.56	1.50	mg/L	SM4500-NH3 G	104	70-130		LFB	
OPHOS-101014	ORTHO-PHOSPHATE	0.99	1.00	mg/L	SM4500-P F	99	80-120		LFB	
TOC_101021	TOTAL ORGANIC CARBON	1.05	1.00	mg/L	SM5310 B	105	90-110		LFB	
TSS_101020	TOTAL SUSPENDED SOLIDS	480	500	mg/L	SM2540 D	96	80-120		LFB	
TSS_101020	TOTAL SUSPENDED SOLIDS	490	500	mg/L	SM2540 D	98	80-120		LFB	

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Low Level Laboratory Fortified Blank

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515.4_101019	2,4 - D	0.16	0.125	ug/L	515.4	128	50-150		LFBD	
	2,4 - DCAA (SURR)	105		%	515.4		70-130			
	2,4 DB	0.32	0.5	ug/L	515.4	64	50-150			
	2,4,5 - TP (SILVEX)	0.13	0.125	ug/L	515.4	104	50-150			
	2,4,5 T	0.11	0.125	ug/L	515.4	88	50-150			
	3,5 - DICHLOROBENZOIC ACID	0.12	0.125	ug/L	515.4	96	50-150			
	ACIFLUORFEN	0.16	0.125	ug/L	515.4	128	50-150			
	BENTAZON	0.27	0.5	ug/L	515.4	54	50-150			
	DALAPON	0.63	0.5	ug/L	515.4	126	50-150			
	DCPA (ACID METABOLITES)	0.15	0.125	ug/L	515.4	120	50-150			
	DICAMBA	0.1	0.125	ug/L	515.4	80	50-150			
	DICHLORPROP	0.11	0.125	ug/L	515.4	88	50-150			
	DINOSEB	0.12	0.125	ug/L	515.4	96	50-150			
	PENTACHLOROPHENOL	0.13	0.125	ug/L	515.4	104	50-150			
	PICLORAM	0.105	0.125	ug/L	515.4	84	50-150			
531_101020	3-HYDROXYCARBOFURAN	0.96	1	ug/L	531.2	96	50-150		LFBD	
	ALDICARB	0.75	1	ug/L	531.2	75	50-150			
	ALDICARB SULFONE	0.96	1	ug/L	531.2	96	50-150			
	ALDICARB SULFOXIDE	1.2	1	ug/L	531.2	120	50-150			
	BDMC (SURR)	93		%	531.2		70-130			
	CARBARYL	1	1	ug/L	531.2	100	50-150			
	CARBOFURAN	1.15	1	ug/L	531.2	115	50-150			
	METHIOCARB	0.77	1	ug/L	531.2	77	50-150			
	METHOMYL	0.98	1	ug/L	531.2	98	50-150			
	OXYMAL	1.1	1	ug/L	531.2	110	50-150			
	PROPOXUR (BAYGON)	0.68	1	ug/L	531.2	68	50-150			
531_101020	3-HYDROXYCARBOFURAN	1.2	1	ug/L	531.2	120	50-150		LFBD	
	ALDICARB	1.1	1	ug/L	531.2	110	50-150			
	ALDICARB SULFONE	1.4	1	ug/L	531.2	140	50-150			
	ALDICARB SULFOXIDE	1.5	1	ug/L	531.2	150	50-150			
	BDMC (SURR)	97		%	531.2		70-130			
	CARBARYL	1.2	1	ug/L	531.2	120	50-150			
	CARBOFURAN	1.1	1	ug/L	531.2	110	50-150			
	METHIOCARB	1.2	1	ug/L	531.2	120	50-150			

*Notation:

% Recovery = (Result of Analysis)/(True Value) * 100

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Portland OR
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503.682.7802

SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Low Level Laboratory Fortified Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
531_101020	METHOMYL	1.4	1	ug/L	531.2	140	50-150		LFBD	
	OXYMAL	1.3	1	ug/L	531.2	130	50-150			
	PROPOXUR (BAYGON)	1.3	1	ug/L	531.2	130	50-150			
547_101109	GLYPHOSATE	7.5	10	ug/L	547	75	50-150		LFBD	
547_101109	GLYPHOSATE	8.2	10	ug/L	547	82	50-150		LFBD	

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Laboratory Reagent Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	QC Limits	Qualifier	Type*	Comment
200.7-101021B	ALUMINUM	ND		mg/L	200.7		0.00000		LRB	
	CALCIUM	ND		mg/L	200.7		0.50000			
	HARDNESS as Calcium Carbonate	ND		mg/L	200.7		10.0000(			
	IRON	ND		mg/L	200.7		0.05000			
	IRON	ND		mg/L	200.7		0.05000			
	MAGNESIUM	ND		mg/L	200.7		0.05000			
	MANGANESE	ND		mg/L	200.7		0.00100			
	POTASSIUM	ND		mg/L	200.7		0.50000			
	SILICA	ND		mg/L	200.7		0.05000			
	SODIUM	ND		mg/L	200.7		1.00000			
200.8_101028	ANTIMONY	ND		mg/L	200.8		0.00100		LRB	
	ARSENIC	ND		mg/L	200.8		0.00500			
	BARIUM	ND		mg/L	200.8		0.01000			
	BERYLLIUM	ND		mg/L	200.8		0.00100			
	CADMIUM	ND		mg/L	200.8		0.00100			
	CHROMIUM	ND		mg/L	200.8		0.00100			
	COPPER	ND		mg/L	200.8		0.01000			
	LEAD	ND		mg/L	200.8		0.00100			
	MANGANESE	ND		mg/L	200.8		0.00100			
	NICKEL	ND		mg/L	200.8		0.00100			
	SELENIUM	ND		mg/L	200.8		0.00100			
	SILVER	ND		mg/L	200.8		0.00100			
	THALLIUM	ND		mg/L	200.8		0.00100			
	URANIUM	ND		mg/L	200.8		0.00000			
	ZINC	ND		mg/L	200.8		0.02000			
CNISE_101022	CYANIDE, FREE	ND		mg/L	SM4500-CN F		0.01000		LRB	
COLOR_101014	COLOR	ND		CU	SM2120 B		5.00000		LRB	
I101014A	CHLORIDE	ND		mg/L	300.0		0.10000		LRB	

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Laboratory Reagent Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
I101014A	FLUORIDE	ND		mg/L	300.0		0.10000		LRB	
	NITRATE-N	ND		mg/L	300.0		0.10000			
	NITRITE-N	ND		mg/L	300.0		0.00000			
	SULFATE	ND		mg/L	300.0		0.10000			
	TOTAL NITRATE/NITRITE	ND		mg/L	300.0		0.10000			
NH3-101021	AMMONIA	ND		mg/L	SM4500-NH3 G		0.05000		LRB	
OPHOS-101014	ORTHO-PHOSPHATE	ND		mg/L	SM4500-P F		0.10000		LRB	
TSS_101020	TOTAL SUSPENDED SOLIDS	ND		mg/L	SM2540 D		1.00000		LRB	
TURB_101014	TURBIDITY	ND		NTU	180.1		0.02000		LRB	

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
200.7-101021B	ALUMINUM	ND		mg/L	200.7		0.00000		MB	
	CALCIUM	ND		mg/L	200.7		0.50000			
	HARDNESS as Calcium Carbonate	ND		mg/L	200.7		0.82000			
	IRON	ND		mg/L	200.7		0.01000			
	IRON	ND		mg/L	200.7		0.01000			
	MAGNESIUM	ND		mg/L	200.7		0.05000			
	MANGANESE	ND		mg/L	200.7		0.00130			
	POTASSIUM	ND		mg/L	200.7		0.50000			
	SILICA	ND		mg/L	200.7		0.05000			
	SODIUM	ND		mg/L	200.7		0.25000			
245.1_101022	MERCURY	ND		mg/L	245.1		0.00013		MB	
508_101025	AROCLOR 1016	ND		ug/L	508.1		0.03000		MB	
	AROCLOR 1221	ND		ug/L	508.1		0.03000			
	AROCLOR 1232	ND		ug/L	508.1		0.03000			
	AROCLOR 1242	ND		ug/L	508.1		0.03000			
	AROCLOR 1248	ND		ug/L	508.1		0.03000			
	AROCLOR 1254	ND		ug/L	508.1		0.03000			
	AROCLOR 1260	ND		ug/L	508.1		0.03000			
	PCBS (Total Aroclors)	ND		ug/L	508.1		0.03000			
	TETRACHLORO-M-XYLENE (SURR)	94		%	508.1		0.00000			
	TOXAPHENE	ND		ug/L	508.1		0.03000			
515.4_101019	2,4 - D	ND		ug/L	515.4		0.03000		MB	
	2,4 - DCAA (SURR)	115		%	515.4					
	2,4 DB	ND		ug/L	515.4		0.03000			
	2,4,5 - TP (SILVEX)	ND		ug/L	515.4		0.03000			
	2,4,5 T	ND		ug/L	515.4		0.03000			
	3,5 - DICHLOROBENZOIC ACID	ND		ug/L	515.4		0.03000			
	ACIFLUORFEN	ND		ug/L	515.4		0.03000			
	BENTAZON	ND		ug/L	515.4		0.06000			
	DALAPON	ND		ug/L	515.4		0.50000			

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
515.4_101019	DCPA (ACID METABOLITES)	ND		ug/L	515.4		0.03000		MB	
	DICAMBA	ND		ug/L	515.4		0.03000			
	DICHLORPROP	ND		ug/L	515.4		0.10000			
	DINOSEB	ND		ug/L	515.4		0.06000			
	PENTACHLOROPHENOL	ND		ug/L	515.4		0.03000			
	PICLORAM	ND		ug/L	515.4		0.03000			
524_101019	1,1 - DICHLOROETHANE	ND		ug/L	524.2		0.12000		MB	
	1,1 - DICHLOROETHYLENE	ND		ug/L	524.2		0.12000			
	1,1 - DICHLOROPROPENE	ND		ug/L	524.2		0.12000			
	1,1,1 - TRICHLOROETHANE	ND		ug/L	524.2		0.12000			
	1,1,1,2 - TETRACHLOROETHANE	ND		ug/L	524.2		0.12000			
	1,1,2 - TRICHLOROETHANE	ND		ug/L	524.2		0.12000			
	1,1,2,2 - TETRACHLOROETHANE	ND		ug/L	524.2		0.12000			
	1,2 - DICHLOROETHANE	ND		ug/L	524.2		0.12000			
	1,2 - DICHLOROPROPANE	ND		ug/L	524.2		0.12000			
	1,2,3 - TRICHLOROBENZENE	ND		ug/L	524.2		0.12000			
	1,2,3 - TRICHLOROPROPANE	ND		ug/L	524.2		0.12000			
	1,2,4 - TRIMETHYLBENZENE	ND		ug/L	524.2		0.12000			
	1,2,4, - TRICHLOROBENZENE	ND		ug/L	524.2		0.12000			
	1,2-DIBROMO-3-CHLOROPROPANE	ND		ug/L	524.2		0.00000			
	1,3 - DICHLOROPROPANE	ND		ug/L	524.2		0.12000			
	1,3,5 - TRIMETHYLBENZENE	ND		ug/L	524.2		0.12000			
	2,2 - DICHLOROPROPANE	ND		ug/L	524.2		0.12000			
	BENZENE	ND		ug/L	524.2		0.12000			
	BROMOBENZENE	ND		ug/L	524.2		0.12000			
	BROMOCHLOROMETHANE	ND		ug/L	524.2		0.12000			
	BROMODICHLOROMETHANE	ND		ug/L	524.2		0.12000			
	BROMOFORM	ND		ug/L	524.2		0.12000			
	BROMOMETHANE	ND		ug/L	524.2		0.12000			
	CARBON TETRACHLORIDE	ND		ug/L	524.2		0.12000			
	CHLOROBENZENE	ND		ug/L	524.2		0.12000			
	CHLORODIBROMOMETHANE	ND		ug/L	524.2		0.12000			
	CHLOROETHANE	ND		ug/L	524.2		0.12000			
	CHLOROFORM	ND		ug/L	524.2		0.12000			

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
524_101019	CIS - 1,2 - DICHLOROETHYLENE	ND		ug/L	524.2		0.12000		MB	
	CIS - 1,3 - DICHLOROPROPENE	ND		ug/L	524.2		0.12000			
	DIBROMOMETHANE	ND		ug/L	524.2		0.12000			
	ETHYLBENZENE	ND		ug/L	524.2		0.12000			
	ETHYLENE DIBROMIDE (EDB)	ND		ug/L	524.2		0.00000			
	HEXACHLOROBUTADIENE	ND		ug/L	524.2		0.12000			
	ISOPROPYLBENZENE	ND		ug/L	524.2		0.12000			
	M - DICHLOROBENZENE	ND		ug/L	524.2		0.12000			
	M/P - XYLENE	ND		ug/L	524.2		0.12000			
	METHYL TERT-BUTYL ETHER	ND		ug/L	524.2		0.25000			
	METHYLENE CHLORIDE	ND		ug/L	524.2		0.50000			
	N - BUTYLBENZENE	ND		ug/L	524.2		0.12000			
	N - PROPYLBENZENE	ND		ug/L	524.2		0.12000			
	NAPHTHALENE	ND		ug/L	524.2		0.12000			
	O - CHLOROTOLUENE	ND		ug/L	524.2		0.12000			
	O - DICHLOROBENZENE	ND		ug/L	524.2		0.12000			
	O - XYLENE	ND		ug/L	524.2		0.12000			
	P - CHLOROTOLUENE	ND		ug/L	524.2		0.12000			
	P - DICHLOROBENZENE	ND		ug/L	524.2		0.12000			
	P - ISOPROPYLTOLUENE	ND		ug/L	524.2		0.12000			
	SEC - BUTYLBENZENE	ND		ug/L	524.2		0.12000			
	STYRENE	ND		ug/L	524.2		0.12000			
	T - 1,2 - DICHLOROETHYLENE	ND		ug/L	524.2		0.12000			
	TERT - BUTYLBENZENE	ND		ug/L	524.2		0.12000			
	TETRACHLOROETHYLENE	ND		ug/L	524.2		0.12000			
	TOLUENE	ND		ug/L	524.2		0.12000			
	TRANS- 1,3 - DICHLOROPROPENE	ND		ug/L	524.2		0.12000			
	TRICHLOROETHYLENE	ND		ug/L	524.2		0.12000			
	TRICHLOROFLUOROMETHANE	ND		ug/L	524.2		0.12000			
	VINYL CHLORIDE	ND		ug/L	524.2		0.12000			
525_101025	1,3-DIMETHYL-2-NITROBENZENE (Surr)	86		%	525.2				MB	
	4,4-DDE	ND		ug/L	525.2		0.03000			
	ACETOCHLOR	ND		ug/L	525.2		0.03000			
	ALACHLOR	ND		ug/L	525.2		0.03000			

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
525_101025	ALDRIN	ND		ug/L	525.2		0.03000		MB	
	ATRAZINE	ND		ug/L	525.2		0.03000			
	BENZO(A)PYRENE	ND		ug/L	525.2		0.03000			
	BROMACIL	ND		ug/L	525.2		0.03000			
	BUTACHLOR	ND		ug/L	525.2		0.03000			
	CHLORDANE, TECHNICAL	ND		ug/L	525.2		0.03000			
	DI(ETHYLHEXYL)-ADIPATE	ND		ug/L	525.2		0.03000			
	DI(ETHYLHEXYL)-PHTHALATE	ND		ug/L	525.2		0.40000			
	DIELDRIN	ND		ug/L	525.2		0.03000			
	ENDRIN	ND		ug/L	525.2		0.03000			
	EPTC	ND		ug/L	525.2		0.03000			
	FLUORENE	ND		ug/L	525.2		0.03000			
	HEPTACHLOR	ND		ug/L	525.2		0.03000			
	HEPTACHLOR EPOXIDE	ND		ug/L	525.2		0.03000			
	HEXACHLOROBENZENE	ND		ug/L	525.2		0.03000			
	HEXACHLOROCYCLO-PENTADIENE	ND		ug/L	525.2		0.03000			
	LINDANE (BHC - GAMMA)	ND		ug/L	525.2		0.03000			
	METHOXYCHLOR	ND		ug/L	525.2		0.03000			
	METOLACHLOR	ND		ug/L	525.2		0.03000			
	METRIBUZIN	ND		ug/L	525.2		0.03000			
	MOLINATE	ND		ug/L	525.2		0.03000			
	PENTACHLOROPHENOL	ND		ug/L	525.2		0.03000			
	PERYLENE-D12 (Surr)	72		%	525.2					
	PROPACHLOR	ND		ug/L	525.2		0.03000			
	PYRENE-D10 (Surr)	92		%	525.2					
	SIMAZINE	ND		ug/L	525.2		0.03000			
	TERBACIL	ND		ug/L	525.2		0.03000			
	TRIPHENYLPHOSPHATE (Surr)	108		%	525.2					
531_101020	3-HYDROXYCARBOFURAN	ND		ug/L	531.2		0.50000		MB	
	ALDICARB	ND		ug/L	531.2		0.25000			
	ALDICARB SULFONE	ND		ug/L	531.2		0.40000			
	ALDICARB SULFOXIDE	ND		ug/L	531.2		0.25000			
	BDMC (SURR)	86		%	531.2		0.00000			
	CARBARYL	ND		ug/L	531.2		0.50000			

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360.671.0688

Portland OR
Microbiology/Chemistry
9150 SW Pioneer Ct Ste W- 97070
503.682.7802

SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
531_101020	CARBOFURAN	ND		ug/L	531.2		0.45000		MB	
	METHIOCARB	ND		ug/L	531.2		1.00000			
	METHOMYL	ND		ug/L	531.2		0.25000			
	OXYMAL	ND		ug/L	531.2		1.00000			
	PROPOXUR (BAYGON)	ND		ug/L	531.2		0.25000			
531_101020	3-HYDROXYCARBOFURAN	ND		ug/L	531.2		0.50000		MB	
	ALDICARB	ND		ug/L	531.2		0.25000			
	ALDICARB SULFONE	ND		ug/L	531.2		0.40000			
	ALDICARB SULFOXIDE	ND		ug/L	531.2		0.25000			
	BDMC (SURR)	86		%	531.2		0.00000			
	CARBARYL	ND		ug/L	531.2		0.50000			
	CARBOFURAN	ND		ug/L	531.2		0.45000			
	METHIOCARB	ND		ug/L	531.2		1.00000			
	METHOMYL	ND		ug/L	531.2		0.25000			
	OXYMAL	ND		ug/L	531.2		1.00000			
	PROPOXUR (BAYGON)	ND		ug/L	531.2		0.25000			
547_101109	GLYPHOSATE	ND		ug/L	547		3.00000		MB	
548_101018	ENDOTHALL	ND		ug/L	548.1		5.00000		MB	
549_101018	DIQUAT	ND		ug/L	549.2		0.50000		MB	
ec_101018	ELECTRICAL CONDUCTIVITY	ND		uS/cm	SM2510 B		2.50000		MB	
ec_101018	ELECTRICAL CONDUCTIVITY	ND		uS/cm	SM2510 B		2.50000		MB	
ec_101018	ELECTRICAL CONDUCTIVITY	ND		uS/cm	SM2510 B		2.50000		MB	
ec_101018	ELECTRICAL CONDUCTIVITY	ND		uS/cm	SM2510 B		2.50000		MB	
h2s_101019	HYDROGEN SULFIDE	ND		mg/L	SM4500-S2 F		0.00000		MB	

*Notation:

% Recovery = (Result of Analysis)/(True Value) * 100

NA = Indicates % Recovery could not be calculated.

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Method Blank

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
h2s_101019	HYDROGEN SULFIDE	ND		mg/L	SM4500-S2 F		0.00000		MB	
NH3-101021	AMMONIA	ND		mg/L	SM4500-NH3 G		0.05000		MB	
OPHOS-101014	ORTHO-PHOSPHATE	ND		mg/L	SM4500-P F		0.10000		MB	
tds_101020	TOTAL DISSOLVED SOLIDS	ND		mg/L	SM2540 C		0.00000		MB	
	TOTAL DISSOLVED SOLIDS	ND		mg/L	SM2540 C		2.50000			
tds_101020	TOTAL DISSOLVED SOLIDS	ND		mg/L	SM2540 C		0.00000		MB	
	TOTAL DISSOLVED SOLIDS	ND		mg/L	SM2540 C		2.50000			
TOC_101021	TOTAL ORGANIC CARBON	ND		mg/L	SM5310 B		0.12000		MB	

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Quality Control Sample

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
200.7-101021B	ALUMINUM	1.03	1	mg/L	200.7	103	85-115		QCS	
	IRON	1.01	1	mg/L	200.7	101	85-115			
	IRON	1.01	1	mg/L	200.7	101	85-115			
	MANGANESE	1.02	1	mg/L	200.7	102	85-115			
	SILICA	10.4	10.7	mg/L	200.7	97	85-115			
200.7-101021B	CALCIUM	20.7	20	mg/L	200.7	104	85-115		QCS	
	HARDNESS as Calcium Carbonate	132	132.3	mg/L	200.7	100	85-115			
	MAGNESIUM	19.6	20	mg/L	200.7	98	85-115			
	POTASSIUM	20.5	20	mg/L	200.7	103	85-115			
	SODIUM	20.2	20	mg/L	200.7	101	85-115			
200.8_101028	ANTIMONY	0.041	0.040	mg/L	200.8	103	85-115		QCS	
	ARSENIC	0.040	0.040	mg/L	200.8	100	85-115			
	BARIUM	0.040	0.040	mg/L	200.8	100	85-115			
	BERYLLIUM	0.039	0.040	mg/L	200.8	98	85-115			
	CADMIUM	0.039	0.040	mg/L	200.8	98	85-115			
	CHROMIUM	0.037	0.040	mg/L	200.8	93	85-115			
	COPPER	0.040	0.040	mg/L	200.8	100	85-115			
	LEAD	0.038	0.040	mg/L	200.8	95	85-115			
	MANGANESE	0.038	0.040	mg/L	200.8	95	85-115			
	NICKEL	0.040	0.040	mg/L	200.8	100	85-115			
	SELENIUM	0.039	0.040	mg/L	200.8	98	85-115			
	SILVER	0.039	0.040	mg/L	200.8	98	85-115			
	THALLIUM	0.036	0.040	mg/L	200.8	90	85-115			
	ZINC	0.040	0.040	mg/L	200.8	100	85-115			
245.1_101022	MERCURY	0.00311	0.00314	mg/L	245.1	99	85-115		QCS	
531_101020	3-HYDROXYCARBOFURAN	68.1	73.3	93%	531.2	93	70-130		QCS	
	ALDICARB	27.7	33.4	83%	531.2	83	70-130			
	ALDICARB SULFONE	49.1	45.9	107%	531.2	107	70-130			
	ALDICARB SULFOXIDE	36.6	40.1	91%	531.2	91	70-130			
	BDMC (SURR)	97		%	531.2		70-130			

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Quality Control Sample

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
531_101020	CARBARYL	79.6	87.7	91%	531.2	91	70-130		QCS	
	CARBOFURAN	20.8	25.4	82%	531.2	82	70-130			
	METHIOCARB	84.8	95.3	89%	531.2	89	70-130			
	METHOMYL	21.4	20	107%	531.2	107	70-130			
	OXYMAL	46.8	41.7	112%	531.2	112	70-130			
	PROPOXUR (BAYGON)	42.7	51.6	83%	531.2	83	70-130			
547_101109	GLYPHOSATE	75	64	ug/L	547	117	68-140		QCS	
547_101109	GLYPHOSATE	156	155	ug/L	547	101	68-140		QCS	
CNISE_101022	CYANIDE, FREE	0.256	0.280	mg/L	SM4500-CN F	91	80-120		QCS	
COLOR_101014	COLOR	10	10	CU	SM2120 B	100	80-120		QCS	
ec_101018	ELECTRICAL CONDUCTIVITY	150	147.2	uS/cm	SM2510 B	102	80-120		QCS	
ec_101018	ELECTRICAL CONDUCTIVITY	150	147.2	uS/cm	SM2510 B	102	80-120		QCS	
ec_101018	ELECTRICAL CONDUCTIVITY	150	147.2	uS/cm	SM2510 B	102	80-120		QCS	
ec_101018	ELECTRICAL CONDUCTIVITY	149	147.2	uS/cm	SM2510 B	101	80-120		QCS	
I101014A	CHLORIDE	31.2	30.0	mg/L	300.0	104	80-120		QCS	
	FLUORIDE	2.58	2.50	mg/L	300.0	103	80-120			
	NITRATE-N	2.61	2.50	mg/L	300.0	104	80-120			
	NITRITE-N	2.66	2.50	mg/L	300.0	106	70-130			
	SULFATE	31.4	30.0	mg/L	300.0	105	80-120			
	TOTAL NITRATE/NITRITE	5.27	5.00	mg/L	300.0	105	80-120			
NH3-101021	AMMONIA	1.55	1.62	mg/L	SM4500-NH3 G	96	70-130		QCS	

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SAMPLE INDEPENDENT QUALITY CONTROL REPORT

Quality Control Sample

Reference Number: 10-15791
Report Date: 11/11/10

Batch	Analyte	Result	True Value	Units	Method	% Recovery	Limits	QC Qualifier	Type*	Comment
OPHOS-101014	ORTHO-PHOSPHATE	0.49	0.49	mg/L	SM4500-P F	100	80-120		QCS	
tds_101020	TOTAL DISSOLVED SOLIDS	478	500	mg/L	SM2540 C	96	70-130		QCS	
	TOTAL DISSOLVED SOLIDS	478	500	mg/L	SM2540 C	96	80-120			
tds_101020	TOTAL DISSOLVED SOLIDS	496	500	mg/L	SM2540 C	99	70-130		QCS	
	TOTAL DISSOLVED SOLIDS	496	500	mg/L	SM2540 C	99	80-120			
TOC_101021	TOTAL ORGANIC CARBON	2.85	2.70	mg/L	SM5310 B	106	90-110		QCS	
TURB_101014	TURBIDITY	0.99	1.00	NTU	180.1	99	80-120		QCS	

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FORM: QC Independent

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SAMPLE DEPENDENT QUALITY CONTROL REPORT

Duplicate, Matrix Spike/Matrix Spike Duplicate and Confirmation Result Report

Reference Number: 10-15791
Report Date: 11/11/2010

Duplicate

Batch	Sample	Analyte	Result	Duplicate Result	Units	%RPD	Limits	QC Qualifier	Type	Comments
200.7-101021B										
	35259	IRON	0.26	0.25	mg/L	3.9	0-20		DUP	
	35259	SODIUM	80.8	80.3	mg/L	0.6	0-20		DUP	
	35259	HARDNESS as Calcium Carbonate	5.46	5.16	mg/L	5.6	0-20		DUP	
	35259	IRON	0.26	0.25	mg/L	3.9	0-20		DUP	
	35409	IRON	0.97	0.97	mg/L	0.0	0-20		DUP	
	35409	SODIUM	4.65	4.55	mg/L	2.2	0-20		DUP	
	35409	HARDNESS as Calcium Carbonate	41.5	41.3	mg/L	0.5	0-20		DUP	
	35409	IRON	0.97	0.97	mg/L	0.0	0-20		DUP	
	35409	MANGANESE	0.059	0.062	mg/L	5.0	0-20		DUP	
	35694	CALCIUM	53.2	52.8	mg/L	0.8	0-20		DUP	
	35694	SODIUM	85.3	85.1	mg/L	0.2	0-20		DUP	
	35694	HARDNESS as Calcium Carbonate	230	229	mg/L	0.4	0-20		DUP	
	35694	MAGNESIUM	23.6	23.6	mg/L	0.0	0-20		DUP	
	35694	POTASSIUM	1.08	1.08	mg/L	0.0	0-20		DUP	
200.8_101028										
	35204	BARIUM	0.004	0.004	mg/L	0.0	0-20		DUP	
	35204	MANGANESE	0.004	0.004	mg/L	0.0	0-20		DUP	
	35204	ZINC	0.005	0.005	mg/L	0.0	0-20		DUP	
	35398	BARIUM	0.004	0.004	mg/L	0.0	0-20		DUP	
	35398	MANGANESE	0.141	0.141	mg/L	0.0	0-20		DUP	
	35729	ARSENIC	0.022	0.022	mg/L	0.0	0-20		DUP	
	35729	BARIUM	0.018	0.018	mg/L	0.0	0-20		DUP	
	35729	MANGANESE	0.030	0.030	mg/L	0.0	0-20		DUP	
	36256	ARSENIC	0.011	0.011	mg/L	0.0	0-20		DUP	
	36256	BARIUM	0.072	0.071	mg/L	1.4	0-20		DUP	
	36256	MANGANESE	0.001	0.001	mg/L	0.0	0-20		DUP	
	36256	ZINC	0.007	0.007	mg/L	0.0	0-20		DUP	

%RPD = Relative Percent Difference

NA = Indicates %RPD could not be calculated

Matrix Spike (MS)/Matrix Spike Duplicate (MSD) analyses are used to determine the accuracy (MS) and precision (MSD) of a analytical method in a given sample matrix. Therefore, the usefulness of this report is limited to samples of similar matrices analyzed in the same analytical batch.

Only Duplicate sample with detections are listed in this report

Duplicate

Batch	Sample	Analyte	Result	Duplicate Result	Units	%RPD	Limits	QC Qualifier	Type	Comments
245.1_101022										
508_101025										
	37311	AROCLOR 1260	1.04	0.98	ug/L	5.9	0-45		DUP	DCBP equiv= 1.36 ug/L
	37311	TETRACHLORO-M-XYLENE (SURR)	80	87	%	8.4	0-45		DUP	
549_101018										
alk_101015										
	35209	ALKALINITY	194	194	mgCaCO3/L	0.0	0-50		DUP	
	35209	ALKALINITY	194	194	mgCaCO3/L	0.0	0-45		DUP	
	35398	ALKALINITY	80	79	mg CaCO3/L	1.3	0-50		DUP	
	35398	ALKALINITY	80	79	mg CaCO3/L	1.3	0-45		DUP	
	35398	ALKALINITY	80	79	mgCaCO3/L	1.3	0-50		DUP	
	35398	ALKALINITY	80	79	mgCaCO3/L	1.3	0-45		DUP	
	35398	BICARBONATE	80	79	mg CaCO3/L	1.3	0-45		DUP	
CO2_101015										
COLOR_101014										
EC_101018										
	34908	ELECTRICAL CONDUCTIVITY	905	906	uS/cm	0.1	0-20		DUP	
	35206	ELECTRICAL CONDUCTIVITY	228	228	uS/cm	0.0	0-20		DUP	
	35401	ELECTRICAL CONDUCTIVITY	343	342	uS/cm	0.3	0-20		DUP	
h2s_101019										
I101014A										
	35288	NITRATE-N	1	1.02	mg/L	2.0	0-20		DUP	
	35288	CHLORIDE	1.6	1.6	mg/L	0.0	0-20		DUP	
	35299	CHLORIDE	14	14	mg/L	0.0	0-20		DUP	
	35398	FLUORIDE	0.11	0.11	mg/L	0.0	0-20		DUP	
	35398	CHLORIDE	3.6	3.5	mg/L	2.8	0-20		DUP	
	35398	SULFATE	3.4	3.3	mg/L	3.0	0-20		DUP	
NH3-101021										
	35157	AMMONIA	24.2	23.0	mg/L	5.1	0-50		DUP	
	35281	AMMONIA	0.18	0.19	mg/L	5.4	0-50		DUP	
	36021	AMMONIA	0.06	0.06	mg/L	0.0	0-50		DUP	
OPHOS-101014										
	35398	ORTHO-PHOSPHATE	0.04	0.04	mg/L	0.0	0-50		DUP	
PH_101014										

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Duplicate

Batch	Sample	Analyte	Result	Duplicate Result	Units	%RPD	Limits	QC Qualifier	Type	Comments
	35409	HYDROGEN ION (pH)	7.29	7.33	pH Units	0.5	0-50		DUP	
	35449	HYDROGEN ION (pH)	8.36	8.37	pH Units	0.1	0-50		DUP	
tds_101020										
	35941	TOTAL DISSOLVED SOLIDS	122	115	mg/L	5.9	0-50		DUP	
	35941	TOTAL DISSOLVED SOLIDS	122	115	mg/L	5.9	0-20		DUP	
TOC_101021										
	34996	TOTAL ORGANIC CARBON	15.8	16.1	mg/L	1.9	0-50		DUP	
	35283	TOTAL ORGANIC CARBON	1.18	1.18	mg/L	0.0	0-50		DUP	
	35302	TOTAL ORGANIC CARBON	0.86	0.84	mg/L	2.4	0-50		DUP	
	35515	TOTAL ORGANIC CARBON	1.00	1.00	mg/L	0.0	0-50		DUP	
	35958	TOTAL ORGANIC CARBON	1.10	1.13	mg/L	2.7	0-50		DUP	
TSS_101020										
	35303	TOTAL SUSPENDED SOLIDS	4	4	mg/L	0.0	0-45		DUP	
	35873	TOTAL SUSPENDED SOLIDS	770	810	mg/L	5.1	0-45		DUP	
TURB_101014										
	35403	TURBIDITY	6.08	6.15	NTU	1.1	0-20		DUP	

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ENCO ANALYTICAL LABORATORIES

Matrix Spike

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Type	Comments
200.7-101021B															
	34997	IRON	ND	0.47	0.52	0.50	mg/L	**94**	**104**	70-130	**10.1**	0-60		LFM	
	34997	IRON	ND	0.47	0.52	0.50	mg/L	**94**	**104**	70-130	**10.1**	0-60		LFM	
	34997	MANGANESE	0.002	0.48	0.52	0.50	mg/L	**96**	**104**	70-130	**8.0**	0-60		LFM	
	35259	IRON	0.26	0.76	0.72	0.50	mg/L	**100**	**92**	70-130	**8.3**	0-60		LFM	
	35259	SODIUM	80.8	89.0	89.2	10.5	mg/L	**78**	**80**	70-130	**2.4**	0-60		LFM	
	35259	HARDNESS as Calcium Carbonate	5.46	69.3	69.6	69.5	mg/L	**92**	**92**	70-130	**0.5**	0-60		LFM	
	35259	IRON	0.26	0.76	0.72	0.50	mg/L	**100**	**92**	70-130	**8.3**	0-60		LFM	
	35409	IRON	0.97	1.80	1.74	0.50	mg/L	**166**	**154**	70-130	**7.5**	0-60	IM	LFM	
	35409	SODIUM	4.65	14.3	14.6	10.5	mg/L	**92**	**95**	70-130	**3.1**	0-60		LFM	
	35409	HARDNESS as Calcium Carbonate	41.5	107	109	69.5	mg/L	**94**	**97**	70-130	**3.0**	0-60		LFM	
	35409	IRON	0.97	1.80	1.74	0.50	mg/L	**166**	**154**	70-130	**7.5**	0-60	IM	LFM	
	35409	MANGANESE	0.059	0.54	0.55	0.50	mg/L	**96**	**98**	70-130	**2.1**	0-60		LFM	
	35694	IRON	ND	0.48	0.47	0.50	mg/L	**96**	**94**	70-130	**2.1**	0-60		LFM	
	35694	ALUMINUM	ND	0.47	0.49	0.50	mg/L	**94**	**98**	70-130	**4.2**	0-50		LFM	
	35694	CALCIUM	53.2	62.3	61.1	10.5	mg/L	**87**	**75**	70-130	**14.1**	0-50		LFM	
	35694	SODIUM	85.3	93.3	92.2	10.5	mg/L	**76**	**66**	70-130	**14.8**	0-60	IS	LFM	
	35694	HARDNESS as Calcium Carbonate	230	292	287	69.5	mg/L	**89**	**82**	70-130	**8.4**	0-60		LFM	
	35694	MAGNESIUM	23.6	33.1	32.6	10.5	mg/L	**90**	**86**	70-130	**5.4**	0-50		LFM	
	35694	POTASSIUM	1.08	16.0	15.8	15.0	mg/L	**99**	**98**	70-130	**1.3**	0-50		LFM	
	35694	IRON	ND	0.48	0.47	0.50	mg/L	**96**	**94**	70-130	**2.1**	0-60		LFM	
200.8_101028															
	35204	ARSENIC	ND	0.0108		0.010	mg/L	**108**		70-130	**NA**	0-60		LFM	
	35204	BARIUM	0.004	0.014		0.010	mg/L	**100**		70-130	**NA**	0-60		LFM	
	35204	CADMIUM	ND	0.0098		0.010	mg/L	**98**		70-130	**NA**	0-60		LFM	
	35204	CHROMIUM	ND	0.010		0.010	mg/L	**100**		70-130	**NA**	0-60		LFM	
	35204	SELENIUM	ND	0.0107		0.010	mg/L	**107**		70-130	**NA**	0-60		LFM	
	35204	BERYLLIUM	ND	0.010		0.010	mg/L	**100**		70-130	**NA**	0-60		LFM	
	35204	NICKEL	ND	0.0096		0.010	mg/L	**96**		70-130	**NA**	0-60		LFM	
	35204	ANTIMONY	ND	0.0108		0.010	mg/L	**108**		70-130	**NA**	0-60		LFM	
	35204	THALLIUM	ND	0.009		0.010	mg/L	**90**		70-130	**NA**	0-60		LFM	
	35204	MANGANESE	0.004	0.012		0.010	mg/L	**80**		70-130	**NA**	0-60		LFM	
	35204	SILVER	ND	0.0096		0.010	mg/L	**96**		70-130	**NA**	0-60		LFM	
	35204	ZINC	0.005	0.015		0.010	mg/L	**100**		70-130	**NA**	0-60		LFM	
	35204	LEAD	ND	.0094		0.010	mg/L	**94**		70-130	**NA**	0-60		LFM	
	35204	COPPER	0.0036	0.013		0.010	mg/L	**94**		70-130	**NA**	0-60		LFM	

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ANALYTICAL LABORATORIES

Matrix Spike

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Type	Comments
	35398	ARSENIC	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	BARIUM	0.004	0.014		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	CADMIUM	ND	0.0097		0.010	mg/L	97		70-130	NA	0-60		LFM	
	35398	CHROMIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	SELENIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	BERYLLIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	NICKEL	ND	0.009		0.010	mg/L	90		70-130	NA	0-60		LFM	
	35398	ANTIMONY	ND	0.011		0.010	mg/L	110		70-130	NA	0-60		LFM	
	35398	THALLIUM	ND	0.0091		0.010	mg/L	91		70-130	NA	0-60		LFM	
	35398	MANGANESE	0.141	0.147		0.010	mg/L	60		70-130	NA	0-60	IS	LFM	
	35398	SILVER	ND	0.0092		0.010	mg/L	92		70-130	NA	0-60		LFM	
	35398	ZINC	0.001	0.011		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35398	URANIUM	ND	0.0098		0.010	mg/L	98		70-130	NA	0-50		LFM	
	35398	LEAD	ND	0.0094		0.010	mg/L	94		70-130	NA	0-60		LFM	
	35398	COPPER	ND	0.0095		0.010	mg/L	95		70-130	NA	0-60		LFM	
	35729	ARSENIC	0.022	0.033		0.010	mg/L	110		70-130	NA	0-60		LFM	
	35729	BARIUM	0.018	0.028		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35729	CADMIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35729	CHROMIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35729	SELENIUM	ND	0.012		0.010	mg/L	120		70-130	NA	0-60		LFM	
	35729	BERYLLIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	35729	NICKEL	ND	0.0094		0.010	mg/L	94		70-130	NA	0-60		LFM	
	35729	ANTIMONY	ND	0.011		0.010	mg/L	110		70-130	NA	0-60		LFM	
	35729	THALLIUM	ND	0.0095		0.010	mg/L	95		70-130	NA	0-60		LFM	
	35729	MANGANESE	0.030	0.039		0.010	mg/L	90		70-130	NA	0-60		LFM	
	35729	SILVER	ND	0.0095		0.010	mg/L	95		70-130	NA	0-60		LFM	
	35729	ZINC	ND	0.011		0.010	mg/L	110		70-130	NA	0-60		LFM	
	35729	LEAD	ND	0.0099		0.010	mg/L	99		70-130	NA	0-60		LFM	
	35729	COPPER	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	36256	ARSENIC	0.011	0.021		0.010	mg/L	100		70-130	NA	0-60		LFM	
	36256	BARIUM	0.072	0.080		0.010	mg/L	80		70-130	NA	0-60		LFM	
	36256	CADMIUM	ND	0.0095		0.010	mg/L	95		70-130	NA	0-60		LFM	
	36256	CHROMIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	36256	SELENIUM	0.002	0.013		0.010	mg/L	110		70-130	NA	0-60		LFM	
	36256	BERYLLIUM	ND	0.010		0.010	mg/L	100		70-130	NA	0-60		LFM	
	36256	NICKEL	ND	0.009		0.010	mg/L	90		70-130	NA	0-60		LFM	

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EDGE ANALYTICAL LABORATORIES

Matrix Spike

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Type	Comments
	36256	ANTIMONY	ND	0.011		0.010	mg/L	110		70-130	NA	0-60		LFM	
	36256	THALLIUM	ND	0.009		0.010	mg/L	90		70-130	NA	0-60		LFM	
	36256	MANGANESE	0.001	0.0091		0.010	mg/L	81		70-130	NA	0-60		LFM	
	36256	SILVER	ND	0.009		0.010	mg/L	90		70-130	NA	0-60		LFM	
	36256	ZINC	0.007	0.018		0.010	mg/L	110		70-130	NA	0-60		LFM	
	36256	LEAD	ND	0.0093		0.010	mg/L	93		70-130	NA	0-60		LFM	
	36256	COPPER	0.004	0.012		0.010	mg/L	80		70-130	NA	0-60		LFM	
245.1_101022															
	35407	MERCURY	ND	0.00166	0.00161	0.00167	mg/L	99	96	70-130	3.1	0-60		LFM	
	36128	MERCURY	ND	0.00157	0.00157	0.00167	mg/L	94	94	70-130	0.0	0-60		LFM	
	36256	MERCURY	ND	0.00157	0.00157	0.00167	mg/L	94	94	70-130	0.0	0-60		LFM	
515.4_101019															
	35160	2,4 - D	ND	2.75	3.22	2.5	ug/L	110	129	70-130	15.7	0-30		LFM	
	35160	2,4,5 - TP (SILVEX)	ND	2.73	3.14	2.5	ug/L	109	126	70-130	14.0	0-30		LFM	
	35160	PENTACHLOROPHENOL	ND	2.52	3.07	2.5	ug/L	101	123	70-130	19.7	0-30		LFM	
	35160	DALAPON	ND	5.2	5.8	5	ug/L	104	116	70-130	10.9	0-30		LFM	
	35160	DINOSEB	ND	2.62	2.94	2.5	ug/L	105	118	70-130	11.5	0-30		LFM	
	35160	PICLORAM	ND	3.02	2.33	2.5	ug/L	121	93	70-130	25.8	0-30		LFM	
	35160	DICAMBA	ND	2.63	3.06	2.5	ug/L	105	122	70-130	15.1	0-30		LFM	
	35160	DCPA (ACID METABOLITES)	ND	2.37	2.51	2.5	ug/L	95	100	70-130	5.7	0-30		LFM	
	35160	2,4 DB	ND	2.46	2.59	2.5	ug/L	98	104	70-130	5.1	0-30		LFM	
	35160	2,4,5 T	ND	2.66	3	2.5	ug/L	106	120	70-130	12.0	0-30		LFM	
	35160	BENTAZON	ND	2.07	2.31	2.5	ug/L	83	92	70-130	11.0	0-30		LFM	
	35160	DICHLORPROP	ND	2.55	2.89	2.5	ug/L	102	116	70-130	12.5	0-30		LFM	
	35160	ACIFLUORFEN	ND	3.3	3.71	2.5	ug/L	132	148	70-130	11.7	0-30	AH	LFM	
	35160	3,5 - DICHLOROBENZOIC ACID	ND	2.65	3.06	2.5	ug/L	106	122	70-130	14.4	0-30		LFM	
	35160	2,4 - DCAA (SURR)	96	95	97		%		NA	70-130	NA	0-30		LFM	
525_101025															
	34887	ENDRIN	ND	10		10	ug/L	100	NA	70-130	NA	0-60		LFM	
	34887	LINDANE (BHC - GAMMA)	ND	9.1		10	ug/L	91	NA	70-130	NA	0-60		LFM	
	34887	METHOXYCHLOR	ND	8.1		10	ug/L	81	NA	70-130	NA	0-60		LFM	
	34887	ALACHLOR	ND	0.88		1	ug/L	88	NA	70-130	NA	0-60		LFM	
	34887	ATRAZINE	ND	0.71		1	ug/L	71	NA	70-130	NA	0-60		LFM	
	34887	BENZO(A)PYRENE	ND	0.85		1	ug/L	85	NA	70-130	NA	0-60		LFM	
	34887	DI(ETHYLHEXYL)-ADIPATE	ND	0.91		1	ug/L	91	NA	70-130	NA	0-60		LFM	
	34887	DI(ETHYLHEXYL)-PHTHALATE	ND	1		1	ug/L	100	NA	70-130	NA	0-60		LFM	

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ANALYTICAL LABORATORIES

Matrix Spike

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Type	Comments
	34887	HEPTACHLOR	ND	8.9		10	ug/L	89	NA	70-130	NA	0-60		LFM	
	34887	HEPTACHLOR EPOXIDE	ND	8.7		10	ug/L	87	NA	70-130	NA	0-50		LFM	
	34887	HEXACHLOROBENZENE	ND	0.96		1	ug/L	96	NA	70-130	NA	0-60		LFM	
	34887	HEXACHLOROCYCLO-PENTADIENE	ND	0.91		1	ug/L	91	NA	70-130	NA	0-60		LFM	
	34887	ALDRIN	ND	8.1		10	ug/L	81	NA	70-130	NA	0-60		LFM	
	34887	BUTACHLOR	ND	0.9		1	ug/L	90	NA	70-130	NA	0-60		LFM	
	34887	DIELDRIN	ND	9.25		10	ug/L	93	NA	70-130	NA	0-60		LFM	
	34887	METOLACHLOR	ND	0.94		1	ug/L	94	NA	70-130	NA	0-60		LFM	
	34887	METRIBUZIN	ND	0.77		1	ug/L	77	NA	70-130	NA	0-60		LFM	
	34887	PROPACHLOR	ND	0.96		1	ug/L	96	NA	70-130	NA	0-60		LFM	
	34887	4,4-DDE	ND	9.7		10	ug/L	97	NA	70-130	NA	0-60		LFM	
	34887	ACETOCHLOR	ND	0.86		1	ug/L	86	NA	70-130	NA	0-60		LFM	
	34887	EPTC	ND	0.92		1	ug/L	92	NA	70-130	NA	0-60		LFM	
	34887	MOLINATE	ND	0.91		1	ug/L	91	NA	70-130	NA	0-60		LFM	
	34887	TERBACIL	ND	0.83		1	ug/L	83	NA	70-130	NA	0-60		LFM	
	34887	BROMACIL	ND	0.83		1	ug/L	83	NA	70-130	NA	0-60		LFM	
	34887	FLUORENE	ND	0.95		1	ug/L	95	NA	70-130	NA	0-60		LFM	
	34887	1,3-DIMETHYL-2-NITROBENZENE (Surr	91	99			%		NA	70-130	NA	0-60		LFM	
	34887	PYRENE-D10 (Surr)	89	98			%		NA	70-130	NA	0-60		LFM	
	34887	PERYLENE-D12 (Surr)	77	93			%		NA	70-130	NA	0-60		LFM	
	34887	TRIPHENYLPHOSPHATE (Surr)	120	99			%		NA	70-130	NA	0-60		LFM	
531_101020															
	34889	OXYMAL	ND	4.2	4.4	4	ug/L	105	110	70-130	4.7	0-50		LFM	
	34889	CARBOFURAN	ND	3.5	3.6	4	ug/L	88	90	70-130	2.8	0-50		LFM	
	34889	ALDICARB SULFOXIDE	ND	4.2	4.1	4	ug/L	105	103	70-130	2.4	0-50		LFM	
	34889	ALDICARB SULFONE	ND	4.1	4.2	4	ug/L	103	105	70-130	2.4	0-50		LFM	
	34889	METHOMYL	ND	4.1	4.1	4	ug/L	103	103	70-130	0.0	0-50		LFM	
	34889	3-HYDROXYCARBOFURAN	ND	3.4	3.8	4	ug/L	85	95	70-130	11.1	0-50		LFM	
	34889	ALDICARB	ND	3.5	3.2	4	ug/L	88	80	70-130	9.0	0-50		LFM	
	34889	CARBARYL	ND	3.75	3.6	4	ug/L	94	90	70-130	4.1	0-50		LFM	
	34889	PROPOXUR (BAYGON)	ND	3.2	3.3	4	ug/L	80	83	70-130	3.1	0-50		LFM	
	34889	METHIOCARB	ND	3.4	3.7	4	ug/L	85	93	70-130	8.5	0-50		LFM	
	34889	BDMC (SURR)	91	80	80		%		NA	70-130	NA	0-50		LFM	
547_101109															
	35160	GLYPHOSATE	ND	49		50	ug/L	98	NA	68-140	NA	0-60		LFM	
	36185	GLYPHOSATE	ND	59		50	ug/L	118	NA	68-140	NA	0-60		LFM	

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Reference Number: 10-15791
Report Date: 11/11/2010

ANALYTICAL LABORATORIES

Matrix Spike

Batch	Sample	Analyte	Result	Spike Result	Duplicate Spike Result	Spike Conc	Units	Percent Recovery MS	Percent Recovery MSD	Limits	%RPD	Limits	QC Qualifier	Type	Comments
548_101018															
	34886	ENDOTHALL	ND	7.2		20	ug/L	**36**	**NA**	60-140	**NA**	0-60	ME	LFM	
	35156	ENDOTHALL	ND	5		20	ug/L	**25**	**NA**	60-140	**NA**	0-60	ME	LFM	
549_101018															
	34886	DIQUAT	ND	2.49		2	ug/L	**125**	**NA**	70-130	**NA**	0-60		LFM	
	35398	DIQUAT	ND	2.48		2	ug/L	**124**	**NA**	70-130	**NA**	0-60		LFM	
CNISE_101022															
	35694	CYANIDE, FREE	ND	0.050	0.047	0.050	mg/L	**100**	**94**	80-120	**6.2**	0-60		LFM	
h2s_101019															
	35398	HYDROGEN SULFIDE	ND	1.00		1.0	mg/L	**100**		70-130	**NA**	0-50		LFM	
I101014A															
	35288	FLUORIDE	ND	1.06		1.00	mg/L	**106**	**NA**	80-120	**NA**	0-60		LFM	
	35288	NITRATE-N	1	2.03		1.00	mg/L	**103**	**NA**	80-120	**NA**	0-60		LFM	
	35288	CHLORIDE	1.6	2.6		1.00	mg/L	**100**	**NA**	80-120	**NA**	0-60		LFM	
	35299	NITRITE-N	ND	1.08		1.00	mg/L	**108**	**NA**	70-130	**NA**	0-50		LFM	
	35299	NITRATE-N	ND	0.95		1.00	mg/L	**95**	**NA**	80-120	**NA**	0-60		LFM	
	35299	CHLORIDE	14	15		1.00	mg/L	**100**	**NA**	80-120	**NA**	0-60		LFM	
	35398	FLUORIDE	0.11	1.08		1.00	mg/L	**97**	**NA**	80-120	**NA**	0-60		LFM	
	35398	NITRITE-N	ND	1.01		1.00	mg/L	**101**	**NA**	70-130	**NA**	0-50		LFM	
	35398	NITRATE-N	ND	1		1.00	mg/L	**100**	**NA**	80-120	**NA**	0-60		LFM	
	35398	TOTAL NITRATE/NITRITE	ND	2.01		2.00	mg/L	**101**	**NA**	80-120	**NA**	0-60		LFM	
	35398	CHLORIDE	3.6	4.5		1.00	mg/L	**90**	**NA**	80-120	**NA**	0-60		LFM	
	35398	SULFATE	3.4	5.2		2.00	mg/L	**90**	**NA**	80-120	**NA**	0-60		LFM	
NH3-101021															
	35290	AMMONIA	0.13	1.13		1.00	mg/L	**100**		70-130	**NA**	0-50		LFM	
	35303	AMMONIA	0.06	1.07		1.00	mg/L	**101**		70-130	**NA**	0-50		LFM	
	36022	AMMONIA	ND	1.04		1.00	mg/L	**104**		70-130	**NA**	0-50		LFM	
	36025	AMMONIA	25.0	68.4		40.0	mg/L	**109**		70-130	**NA**	0-50		LFM	
OPHOS-101014															
	35398	ORTHO-PHOSPHATE	0.04	1.11	1.09	1.00	mg/L	**107**	**105**	70-130	**1.9**	0-50		LFM	
TOC_101021															
	34996	TOTAL ORGANIC CARBON	15.8	20.1	19.8	4.00	mg/L	**108**	**100**	65-135	**7.2**	0-70		LFM	
	35302	TOTAL ORGANIC CARBON	0.86	5.29	5.36	4.00	mg/L	**111**	**113**	65-135	**1.6**	0-70		LFM	
	35958	TOTAL ORGANIC CARBON	1.10	5.56	5.69	4.00	mg/L	**112**	**115**	65-135	**2.9**	0-70		LFM	

%RPD = Relative Percent Difference

NA = Indicates %RPD could not be calculated

Matrix Spike (MS)/Matrix Spike Duplicate (MSD) analyses are used to determine the accuracy (MS) and precision (MSD) of a analytical method in a given sample matrix. Therefore, the usefulness of this report is limited to samples of similar matrices analyzed in the same analytical batch.

Only Duplicate sample with detections are listed in this report

Qualifier Definitions

Reference Number: 10-15791
Report Date: 11/11/10

Qualifier	Definition
AH	Result was high for this analyte in the end standard, indicating an increase in detector response. No detection of this analyte was found in samples, therefore no further action taken.
IJ	An estimated concentration, below calibration curve but above method detection limit.
IM	Matrix induced bias assumed
IS	The ratio of the spike concentraion to sample background was too low to meet performance criteria
ME	Matrix spike shows a possible matrix induced bias. The LFB was within acceptance limits, results for this compound is suspect as biased low.

Note: Some qualifier definitions found on this page may pertain to results or QC data which are not printed with this report.

Chain of Custody / Analysis Request (Please complete all applicable shaded sections)

11875

Report to:	Golder Associates Inc/Lake Osweg	Bill to:	Andrea Cornette
Ship Address:	9 Monroe Parkway, Suite 270	Address:	Same address
City:	Lake Oswego St: OR Zip: 97035	City:	St: Zip:
Attn:	Kenny Janssen	Phone:	FAX:
Phone:	503.607-1820 FAX: 607-1825	P.O.#:	Attn:
Email:	Kenny_Janssen@golder.com	☐ Visa ☐ M/C ☐ A/E	Expires /
Project	Drinking Water Yelm WA Thurston Co	Card#:	

For Lab Use Only
Ref # 10-15791

Check Regulatory Program
- ☐ Safe Drinking Water Act
- ☐ Clean Water Act
- ☐ RCRA / CERCLA
- ☐ Other

ANALYTICAL LABORATORIES
1620 S. Walnut St.
Burlington, WA 98233
1.800.755.9295

805 W. Orchard Dr. Suite 4
Bellingham, WA 98225

Attn: Log-In - Refer to TABLE 1 for analyses requested (2 pages)

Instructions
1. Use one line per sample Location.
2. Be specific in analysis requests.
3. *(NEW)* **List each metal individually** *(NEW)*
4. Check off analyses to be performed for each sample Loaction.
5. Enter number of containers.

Turn Around Time Required
- ☒ Standard
- ☐ Half-time (50% surcharge)
- ☐ Quickest (100% surcharge) Phone Call Req.
- ☐ Emergency (Phone Call Req.)

Analyses Requested

CO011875

	Field ID	Location	Grab/ Comp.	Sample Matrix*	Date	Time	Bacteria (HPC)	Ca, Mg, K, Hardness, Uranium	Corrosivity, CO2,	E. Coli, Total Coliforms	Fe, Mn dissolved	Gross a/b	IOCTOT	MBAS (Surfactants)	Number of Containers	Special Instructions Conditions on Receipt
1	SW1AID1310	Yelm, WA	X	Water GW	10/13/10	1130	☒	☒	☒	☒	☒	☒	☒	☒		*Please lab filter dissolved Fe/Mn*
2							☐	☐	☐	☐	☐	☐	☐	☐		
3							☐	☐	☐	☐	☐	☐	☐	☐		
4							☐	☐	☐	☐	☐	☐	☐	☐		
5							☐	☐	☐	☐	☐	☐	☐	☐		
6							☐	☐	☐	☐	☐	☐	☐	☐		
7							☐	☐	☐	☐	☐	☐	☐	☐		
8							☐	☐	☐	☐	☐	☐	☐	☐		
9							☐	☐	☐	☐	☐	☐	☐	☐		
10							☐	☐	☐	☐	☐	☐	☐	☐		

10-15791
35398

Sampled by: Phone: FAX: Email: Total Containers

Sample Receipt Request (Must include FAX or Email) ☒ see e-mail above

* **W** - water **SW** - surface water **WW** - waste water **OL** - oil
DW - drinking water **GW** - Ground water **S** - soil Other_____

Relinquished by	Date	Time	Received by	Date	Time
Eric Lee	10/13/10	14:00	HH	10/14/10	0911

	Yes	No	N/A
Custody seals intact UPS	☐	☐	☑
Sample temp 0.8 C satisfactory	☑	☐	☐
Samples received intact	☐	☐	
Chain of custody & labels agree	☐	☐	

FORM: COC 01-06-2009

Chain of Custody / Analysis Request (Please complete all applicable shaded sections)

11875

Report to:	Golder Associates Inc/Lake Osweg	Bill to:	**For Lab Use Only**
Ship Address:	9 Monroe Parkway, Suite 270	Address:	Ref #
City:	Lake Oswego St: OR Zip: 97035	City: St: Zip:	**Check Regulatory Program**
Attn:	Kenny Janssen	Phone: FAX:	☐ Safe Drinking Water Act
Phone:	503.607-1820 FAX: 607-1825	P.O.#: Attn:	☐ Clean Water Act
Email:	Kenny_Janssen@golder.com	☐ Visa ☐ M/C ☐ A/E Expires /	☐ RCRA / CERCLA
Project	Drinking Water Yelm WA Thurston Co	Card#:	☐ Other

EDGE ANALYTICAL LABORATORIES
1620 S. Walnut St.
Burlington, WA 98233
1.800.755.9295

805 W. Orchard Dr. Suite 4
Bellingham, WA 98225

Instructions

1. Use one line per sample Location.
2. Be specific in analysis requests.
3. *(NEW)* **List each metal individually** *(NEW)*
4. Check off analyses to be performed for each sample Loaction.
5. Enter number of containers.

Turn Around Time Required

- ☒ Standard
- ☐ Half-time (50% surcharge)
- ☐ Quickest (100% surcharge) Phone Call Req.
- ☐ Emergency (Phone Call Req.)

Analyses Requested

CO011875

	Field ID	Location	Grab/ Comp.	Sample Matrix*	Date	Time	Odor	Radium 226/228	Radon 222	Silica, pH, O-Phos	Sulfide	TOC	TSS	VOC 524.2	Number of Containers	Special Instructions Conditions on Receipt
1	SW1A 101310	Yelm, WA	Grab	GW	10/13/10	1130	☑	☑	☑	☑	☑	☑	☑	☑		
2							☐	☐	☐	☐	☐	☐	☐	☐		
3							☐	☐	☐	☐	☐	☐	☐	☐		
4							☐	☐	☐	☐	☐	☐	☐	☐		
5							☐	☐	☐	☐	☐	☐	☐	☐		
6							☐	☐	☐	☐	☐	☐	☐	☐		
7							☐	☐	☐	☐	☐	☐	☐	☐		
8							☐	☐	☐	☐	☐	☐	☐	☐		
9							☐	☐	☐	☐	☐	☐	☐	☐		
10							☐	☐	☐	☐	☐	☐	☐	☐		

Sampled by: Phone: FAX: Email: Total Containers

Sample Receipt Request (Must include FAX or Email) ☒ See email above

* **W** - water **SW** - surface water **WW** - waste water **OL** - oil
DW - drinking water **GW** - Ground water **S** - soil Other_____

Relinquished by	Date	Time	Received by	Date	Time
Elyse Chen	10/13/10	14:00			

	Yes	No	N/A
Custody seals intact	☐	☐	☐
Sample temp_____C satisfactory	☐	☐	☐
Samples received intact	☐	☐	
Chain of custody & labels agree	☐	☐	

FORM: COC 01-06-2009

Chain of Custody / Analysis Request (Please complete all applicable shaded sections)

11875

Report to:	Golder Associates Inc/Lake Osweg	Bill to:	**For Lab Use Only**
Ship Address:	9 Monroe Parkway, Suite 270	Address:	Ref #
City:	Lake Oswego St: OR Zip: 97035	City: St: Zip:	**Check Regulatory Program**
Attn:	Kenny Janssen	Phone: FAX:	☐ Safe Drinking Water Act
Phone:	503.607-1820 FAX: 607-1825	P.O.#: Attn:	☐ Clean Water Act
Email:	Kenny_Janssen@golder.com	☐ Visa ☐ M/C ☐ A/E Expires /	☐ RCRA / CERCLA
Project	Drinking Water Yelm WA Thurston Co	Card#:	☐ Other

EDGE ANALYTICAL LABORATORIES
1620 S. Walnut St.
Burlington, WA 98233
1.800.755.9295

805 W. Orchard Dr. Suite 4
Bellingham, WA 98225

ATTN: LOG-IN - Refer to TABLE 1 FOR analyses requested (Pages 1-3)

Instructions

1. Use one line per sample Location.
2. Be specific in analysis requests.
3. *(NEW)* **List each metal individually** *(NEW)*
4. Check off analyses to be performed for each sample Loaction.
5. Enter number of containers.

Turn Around Time Required

- ☒ Standard
- ☐ Half-time (50% surcharge)
- ☐ Quickest (100% surcharge) Phone Call Req.
- ☐ Emergency (Phone Call Req.)

CO011875

	Field ID	Location	Grab/ Comp.	Sample Matrix*	Date	Time	Analyses Requested: 515.4 - Washington DR WA	525.2	531	547 (Glyphosate)	548 (Endothall)	549 (Diquat)	Alka Total, Bicarb	Ammonia	Number of Containers	Special Instructions Conditions on Receipt
1	SW1A101510	Yelm, WA	Grab	GW	10/13/10	1130	☑	☑	☑	☑	☑	☑	☑	☑		
2							☐	☐	☐	☐	☐	☐	☐	☐		
3							☐	☐	☐	☐	☐	☐	☐	☐		
4							☐	☐	☐	☐	☐	☐	☐	☐		
5							☐	☐	☐	☐	☐	☐	☐	☐		
6							☐	☐	☐	☐	☐	☐	☐	☐		
7							☐	☐	☐	☐	☐	☐	☐	☐		
8							☐	☐	☐	☐	☐	☐	☐	☐		
9							☐	☐	☐	☐	☐	☐	☐	☐		
10							☐	☐	☐	☐	☐	☐	☐	☐		

Sampled by: Phone: FAX: Email: Total Containers

Sample Receipt Request (Must include FAX or Email) ☒ See email above

* **W** - water **SW** - surface water **WW** - waste water **OL** - oil
DW - drinking water **GW** - Ground water **S** - soil Other_____

Relinquished by	Date	Time	Received by	Date	Time
Esl Reel	10/18/10	14:00			

	Yes	No	N/A
Custody seals intact	☐	☐	☐
Sample temp_____C satisfactory	☐	☐	☐
Samples received intact	☐	☐	
Chain of custody & labels agree	☐	☐	

FORM: COC 01-06-2009

At Golder Associates we strive to be the most respected global group of companies specializing in ground engineering and environmental services. Employee owned since our formation in 1960, we have created a unique culture with pride in ownership, resulting in long-term organizational stability. Golder professionals take the time to build an understanding of client needs and of the specific environments in which they operate. We continue to expand our technical capabilities and have experienced steady growth with employees now operating from offices located throughout Africa, Asia, Australasia, Europe, North America and South America.

Africa	+ 27 11 254 4800
Asia	+ 852 2562 3658
Australasia	+ 61 3 8862 3500
Europe	+ 356 21 42 30 20
North America	+ 1 800 275 3281
South America	+ 55 21 3095 9500

solutions@golder.com
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Golder Associates Inc.
9 Monroe Parkway, Suite 270
Lake Oswego, OR 97035 USA
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