PACIFIC groundwater GROUP

INTERIM AQUIFER PROTECTION REPORT
EASTSOUND, SAN JUAN COUNTY
WASHINGTON

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SIGNATURE

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1.0 INTRODUCTION

San Juan County's water resources are provided by local rainfall only and are characterized by the rain shadow created by the Olympic Mountains to the south and Vancouver Island to the west, by predominantly steep terrain and bedrock geology, by small watershed catchment areas, and by extensive shoreline. These conditions result in low rainfall, limited groundwater storage, and extensive runoff and discharge to the sea.

The town of Eastsound is located on a narrow portion of northern Orcas Island, Washington (Figure 1). Overdevelopment of the area's groundwater resources could result in problematic declines in groundwater levels and/or saltwater intrusion. The groundwater flow model presented in this report was developed to evaluate the long-term effects of the projected growth and resulting increased use of groundwater resources.

Elevated nitrate concentrations have been detected in the aquifer underlying Eastsound since the mid-1980s. Nitrate concentrations are variable throughout the Eastsound area, with higher concentrations detected at the Blanchard and Terrill Beach Road well fields where concentrations as high as 6.77 mg/L have been detected (Figure 2). While nitrate concentrations in the Eastsound area appear to be above natural background levels, concentrations have remained below the MCL (10 mg/L).

This project was authorized by the San Juan County Department of Health and Community Services in cooperation with the Eastsound Water Users Association. Funding was provided through a Department of Ecology Watershed Management Grant.

The work was performed, and this report prepared, using generally accepted hydrogeologic practices used at this time and in this vicinity, as limited by the established schedule and budget, for exclusive application to the Eastsound Aquifer Protection Assessment, and for the exclusive use of the San Juan Department of Health and Community Services and the Eastsound Water Users Association. This is in lieu of other warranties, express or implied.

1.1 SUMMARY OF FINDINGS

The following section presents a summary of the findings of this report. Results of the model analysis indicate that, in the year 2030 and 2040, the effects of increased pumpage will not inhibit current users from using their wells. Maximum groundwater declines in 2040 are estimated to be approximately 6.5 feet from current levels. However, given the geologic configuration of the basin, saltwater intrusion may become an issue. Further analysis is warranted to evaluate the potential.

All nitrate detections in the Eastsound aquifer are below the Ground Water Quality Criteria of 10 mg/L. The sources of elevated nitrate concentrations are likely septic tanks and land use practices. Elevated nitrate concentrations associated with septic tanks are likely due to high density of septic tanks near Blanchard Road or shallow depth to bedrock near Terrill Beach Road.

2.0 HYDROGEOLOGY

The geology of the Eastsound area of Orcas Island, WA is generally characterized by glacial deposits overlying and infilling a complex bedrock basin (Orr et al, 2002). Figures 3 through 6 present a cross section location map and geologic cross sections of the subject area.

2.1 GLACIAL DEPOSITS

The glacial deposits include heterogeneous glacial sediments deposited during the Vashon glaciation with lithologies ranging from sands and gravels to silts, clays, and till. The deposits are divided into relatively high- and low-permeability zones based on well log descriptions of subsurface materials. Intervals of silt, clay and till were included in the overlying low-permeability subunit while sands and gravels were generally included in the underlying unit. The distribution of high and low permeability zones in the three cross sections suggests that the upper half of the alluvial unit has relatively lower permeability than lower half, and that lower-permeability sediments are more common in the northeast portion of the study area.

2.2 BEDROCK

The undivided bedrock unit includes Jurassic to Cretaceous sedimentary, volcanic, and metamorphic rocks. The bedrock basin is likely the head of a pre-glacial drainage which was contiguous with East Sound before being partially filled with sediment during the last glaciation.

The bedrock unit forms a bowl beneath the Eastsound area with maximum depths of at least 100 feet below sea level (Figures 3 through 6). The bedrock basin appears to have an alluvium-filled outlet at a bedrock low beneath Crescent Beach Road flanked by bedrock highs to the east and west. The depth of the potential outlet is unconstrained. Bedrock outcrops along the northern edge of Orcas Island near the north end of Blanchard Road and north of Sunset Avenue indicate that bedrock is present at near sea-level, potentially forming a low-permeability barrier between the alluvial aquifer and seawater. However, the lateral continuity of this bedrock feature is unclear, and bedrock gaps could be locally significant.

2.3 GROUNDWATER OCCURANCE AND FLOW

Groundwater is present in varying amounts in both alluvial and bedrock units with significantly higher groundwater productivity in wells completed in the alluvial unit. Bedrock on Orcas Island is generally non-porous and water is principally present in small amounts in fractures.

Water levels are monitored at 8 locations in the Eastsound Area (Figure 7) (PGG, 2008). Section 4.1 presents the groundwater monitoring network. Depth to water ranges from artesian conditions to 93 feet below ground surface within the monitoring network. Groundwater elevations measured during the October, 2008, monitoring event ranged from 4.8 ft at EWUA #4 to 45.4 ft at the Greer well (NGVD 29). The Harlow well (Ecology well number AHH-580) is not part of the monitoring network, but had a reported water level elevation of approximately 120 ft at the time of drilling, suggesting elevated water levels in the area west of Eastsound. Groundwater elevation contours from October, 2008, are presented in Figure 2. This date was selected for plotting because the greatest number of data points was available. The water level in the Napa well was likely pumping at the time of measurement and therefore was estimated based on measurements collected during April, 2008.

2.3.1 Groundwater Flow Directions

Groundwater generally flows towards the town of Eastsound from the two uplands to the east and west. Groundwater converges near town creating a divide and continues to the north and south towards discharge areas near Crescent Beach and north of the airport. Groundwater contours and inferred flow directions are shown on Figure 7. The groundwater flow direction indicated by the contours may change as further points are added to the network.

Groundwater elevations at the Fisher, Clark and School wells suggests the groundwater divide runs from near the Greer well southwest towards the Clark well and just north of the Pearson well (Figure 7). Groundwater north of the divide discharges through a bedrock gap near the marina while groundwater south of the divide discharges through a bedrock gap near Crescent Beach.

2.3.2 Potential Surface Water Influences

Surface water can have a significant influence on groundwater where the water table is near the ground surface, or where travel times to groundwater are short. Small ponds and sea water are the primary potential sources of surface water influence in the Eastsound area; very few streams exist in the study area.

Low-permeability sediments in the upper portions of the alluvial aquifer reduce surface water influence in most of the Eastsound area. Small ponds scattered throughout the area appear to be perched features lacking a fully-saturated connection to the water table. There is increased potential for surface water influence on groundwater in areas where bedrock is close to the surface beneath ponds, or near the marina where the water table is near the ground surface.

Surface water influence by sea water intrusion is most likely north of the marina and along Crescent Beach. Under current conditions, sea water intrusion does not appear to occur along these areas. However, if pumping increases adequately relative to recharge, sea water intrusion could be an issue in the future (see Section 3.7.1).

2.4 RECHARGE

Groundwater recharge for San Juan County was estimated by the USGS in 2002 in Estimates of Ground-Water Recharge from Precipitation to Glacial-Deposit and Bedrock Aquifers on Lopez, San Juan, Orcas, and Shaw Islands, San Juan County, Washington. The USGS used two methods to estimate recharge:

- A daily near-surface water-balance method, the Deep Percolation Model (DPM), was used to simulate water budgets for the period October 1, 1996, through September 30, 1998 (water years 1997-98) for six small drainage basins—three on Lopez Island and one each on San Juan, Orcas, and Shaw Islands.
- A chloride mass-balance method that requires measurements of atmospheric chloride deposition, precipitation, streamflow, and chloride concentrations in ground water was used to estimate recharge to the glacial-deposit aquifers of Lopez Island.

Based on these two methods, the USGS estimated a recharge rate ranging from 2.5 inches to 5 inches per year in the Eastsound area. Variations in recharge are due to surficial soil type, vegetation, and amount and timing of precipitation.

The USGS model assumes that precipitation falling on bedrock dominated areas, such as Buck Mountain, does not infiltrate and contribute to recharge. This water is not accounted for in the USGS recharge budget for the alluvial aquifer. In practice, it is likely that the some of the precipitation infiltrates to, and then migrates along the bedrock-soil contact until it reaches the edge of the alluvial aquifer. At the edge of the alluvial aquifer, this range-front recharge can be an important component of the aquifer mass-balance.

PGG estimates that approximately 30,000 ft^3/day of water could be unaccounted for in the USGS model by not addressing range front recharge. PGG calculated a water balance for bedrock areas upgradient of the alluvial aquifer to estimate potential range front recharge. The spreadsheet water balance model incorporates values for the elevation, precipitation, latitude, and temperature to estimate recharge as inches of infiltration. The infiltration value multiplied by the watershed area was taken as an upper bound of the potential range front recharge. There is substantial uncertainty in the amount of range front recharge, and the distribution of range front recharge is likely to have spatial variability dependent on the shape of the underlying bedrock surface. Spreadsheet calculations for the bedrock uplands near Buck Mountain and southwest of Eastsound are included in Appendix A.

3.0 GROUNDWATER FLOW MODEL

A groundwater model of the Eastsound area was developed to improve understanding of groundwater flow in three dimensions, potential nitrate pathways and sources, and potential effects of increased pumping demand on capture zones and water levels.

3.1 MODELING APPROACH

A numerical model of the groundwater flow system was developed using the *MODFLOW 2000* program (Harbaugh et. al, 2000) and the commercially available graphical user interface *Groundwater Vistas*™ by Environmental Simulations, Inc. The numerical model simulates the groundwater flow system with a series of mathematical equations that describe the physical processes occurring in the system. The solution to a groundwater flow model is the spatial and temporal distribution groundwater elevations (heads). From the groundwater head solution, the model calculates groundwater fluxes to and from wells and model boundary conditions.

The model is intended to provide an assessment of groundwater flow, capture zones for EWUA production wells, and potential impacts of groundwater pumping under projected future demand scenarios. The model represents the groundwater flow system of the alluvial aquifer in the Eastsound area. Information on groundwater elevations (heads), aquifer hydraulic properties, ground-surface elevations, estimates of recharge, and estimates of average pumping were used as input to the model.

The model domain is limited to the alluvial aquifer in the bedrock basin beneath Eastsound. The regional geographic extent (domain) of the model is the extent of the alluvial aquifer in the Eastsound area, anticipated recharge areas for the aquifer, and outflow areas to the surrounding saltwater bodies.

3.2 MODEL DESIGN

A six-layer numerical model of the groundwater flow system was constructed to simulate vertical and horizontal groundwater flow in the alluvial deposits overlying the bedrock surface. Figure 8 presents the model domain, including grid, boundaries, and hydraulic conductivity zones. The model domain incorporates the Eastsound area, from their exposed bedrock outcrops to the east, Strait of Georgia to the north, President Channel to the west, and the town of Eastsound to the south. Natural features were used as edges of the model domain where possible. All bedrock units within the model domain are considered to be no-flow boundaries. The extent of bedrock was digitized from 100,000 scale geologic maps of the area (WDGER, 2005), and aerial photographs.

The model grid (Figure 8) consists of 60 rows and 118 columns, with 175-foot column width and 178 foot row width. The total area covered by the grid is 7.9 square miles, with 42,480 model cells. Large areas of the model were set as inactive cells where bedrock is present such that the active part of the model domain represents 50% of the model grid.

Layer thickness varies within the model domain with changes in the thickness of the alluvial aquifer. The bedrock surface (bottom of alluvium) is derived from the Rockworks geologic model of the Eastsound area. The surface elevation was assigned based on DEM elevations of the area interpolated to the grid nodes. Layer thickness for the six layers was uniformly distributed between the bedrock surface and ground surface. This resulted in variable layer thickness been the center of the model where alluvium is thickest and zero-thickness where bedrock crops out at the surface and cells were inactive. The model was divided into six layers to reduce numerical dispersion during anticipated particle and geochemical modeling, and to facilitate assignment of model parameters consistent with the vertically and horizontally variable geologic materials.

3.2.1 Aquifer Parameters

Two physical properties of the aquifer materials are needed for the MODFLOW simulation: hydraulic conductivity (K) which describes the permeability of the aquifer, and the storage coefficient (storativity) (S) which defines the ability of the aquifer to take in or release water in response to stresses imposed on the aquifer.

Hydraulic conductivity values within the model range from 0.005 ft/day to 50 ft/day. Maximum hydraulic conductivity values are estimated from EWUA pump test data (CR, 2001-2005) (Table 1). Minimum values were a result of model calibration.

Two storativity values were assigned in the model based on values reported in EWUA well testing reports (CR, 2001-2005), and calibration of the model. The default storativity value in the model is 0.0024. The area surrounding the Greer well is assigned a storativity of 0.0001 reflecting the tighter aquifer materials. The model is relatively insensitive to changes in storativity based on variations during model calibration.

All model layers were assigned an effective porosity of 0.25. Porosity is not used in MODFLOW simulations, but is used in MODPATH particle tracking (Section 3.4.1).

3.2.2 Recharge

A total recharge value of 125,902 ft^3/day was assigned to the model as the sum of infiltration and range-front recharge at the bedrock-alluvium contact. A value of 96,481 ft^3/day of infiltration recharge was assigned to the uppermost active model layer based on USGS recharge estimates (Orr, et al., 2000). An estimate of 29,240 ft^3/day of range front recharge was applied to the model based on PGG estimates of bedrock capture area, precipitation and evapotranspiration. Direct measurements of range-front recharge are not available.

The model does not account for all possible sources of recharge. Recharge from septic systems, streams and ponds are not included in the model.

3.2.3 Boundary Conditions

Constant head and no-flow boundary conditions are used in the Eastsound groundwater model. Figure 8 presents the locations of model boundaries. Constant head boundaries are indicated by blue cells and no-flow boundaries are indicated by black cells.

Constant head boundaries have a steady water level and allow water to flow in and out of the cell to maintain that water level. Constant head boundaries are assigned in the model where the alluvial aquifer contacts seawater and groundwater discharges from the system. Hydraulic conductivities in the constant head cells are equal to adjacent aquifer cells. A constant head of -0.8 ft (NGVD 29) is assigned as the mean low sea level. This value for sea level is an approximation and should be reevaluated in the future if the model is used to simulate saltwater intrusion.

No-flow boundary conditions have no head value and do not allow any groundwater flow in or out of the boundary. All cells in the model occupied by bedrock are given a no-flow condition. Bedrock is assumed to have minimal influence on the groundwater flow in the alluvial aquifer due to substantially lower hydraulic conductivity values.

3.2.4 Wells

Fourteen production, domestic, and inactive wells are included in the model as calibration targets and pumping locations (Tables 2 and 3). All wells used in the model are included in Appendix B. Water levels at fourteen production, domestic, and inactive wells are included in the model as calibration points (Table 2). Water levels were all measured on October 22, 2008, except for the Klein and Harlow (AHH-580) wells. Water levels for the Klein well were measured on March 14, 2001, and should be considered approximate because the well has not been surveyed and the measurement was collected on a different date. The water level for the Harlow well (AHH-580) was taken from the well log dated May 5, 2005. It is assumed that there are tens of feet of uncertainty in the water level at this well due to uncertainty in the well location, and accuracy of the water level measurement.

Pumping from EWUA production wells are modeled using 2007 data, the most current full-year of pumping data (Table 3). Total annual pumping for each well was averaged to a daily pumping rate for input into the steady state. Pumping is not evenly distributed among EWUA wells. For instance, pumping in 2007 at well EWUA #3R (5,776 ft^3/day) accounted for 63 percent of production, EWUA 1R (1,683 ft^3/day) accounted for 18 percent of production. Production at other operating EWUA production wells ranged from 7 ft^3/day to 690 ft^3/day. EWUA has expressed interest in reducing the load on EWUA 3R by shifting production to the Clark and Klein Well (P. Kamin, personal communication, 2008).

Pumping values in the MODFLOW model increase with projected demand for simulation of conditions in 2030 and 2040. EWUA projects a 3 percent increase in demand per year. Values shown in Table 3 reflect projected demand at each well based on that demand projection and constraints discussed in Section 3.5. Demand in 2020 is projected to be similar to demand in 2000 and is not modeled.

3.3 MODEL CALIBRATION

Calibration of the groundwater flow model refers to the process of varying certain model parameters within a range of possible values until the model-calculated heads most closely simulate field-measured heads. Calibrating a model is necessary to obtain a solution that responds as closely as possible to the natural system.

The steady state model uses 14 head values as calibration targets. Hydraulic conductivity is the primary calibration variable in the model. Recharge was not used as a calibration variable. The model has a tendency to predict values that are too low for the highest target water levels (Table 2), which tend to be completed at higher elevations. Vertical hydraulic conductivity was significantly reduced (0.0009 ft/day) to match water levels at the Greer well.

There are several statistical measures of the quality of model calibration to target values (Table 3). Residuals are calculated for each target as the difference between observed and modeled water levels at that point. The absolute residual mean (ARM) is a measure of how well the model matches all of the targets. Lower ARM values indicate a better calibration. The ARM for the model is 4.99 ft, reflecting a good fit to target values at 4.3 percent of the 116 ft range in target heads.

3.4 CURRENT CONDITIONS MODEL SIMULATION

Model results agree well with measured groundwater elevations as discussed in the previous section. Contoured simulated groundwater elevations for year 2007, model layer 4 are presented in Figure 9. Layer 4 is selected for presentation because it is closest to the screen interval of most of the EWUA production wells. Measured water levels at wells may not match potentiometric surface contours in Figure 9 due to vertical gradients between Layer 4 and the screened interval of the well.

Simulated groundwater elevations indicate a groundwater divide running from near the Greer well southwest towards the Clark well and just north of the Pearson well (Figure 9). Groundwater north of the divide discharges through a bedrock gap near the marina while groundwater south of the divide discharges through a bedrock gap near Crescent Beach. Similar contour patterns are observed in other model layers.

Model results indicate significant vertical gradients in areas underlain by low-permeability materials. Downward gradients result in groundwater flow paths that move steeply downwards through the upper model layers in southern and central Eastsound before moving laterally in the more transmissive aquifer materials towards discharge zones. Areas with steeper vertical gradients also result in locally high water levels. For example, head at the Greer well, screened in a lower permeability unit, is more than 30 feet higher than the Fisher well, which is screened in the deeper units with higher permeability.

3.4.1 Capture Zone Analysis

Capture zones for EWUA production wells are calculated based on the 2007 steady state modeling results. Capture zones for active production wells are estimated with reverse particle tracking using 50 particles. The particles were started at each well, distributed through the full screen interval, and tracked upgradient for 10-year travel times. The capture zone was then outlined using the travel paths of the particles. Capture zones are presented in Figure 10.

Capture zones for each of the EWUA wells were originally estimated by CR Hydrogeologic Consulting in the well completion report for each well (CR, 2001-2005). These capture zones were estimated using the US EPA WHPA (Version 2.2) GPTRAC analytical model. This methodology produces conservative estimates of capture zones. The capture zones presented in this report are intended for use in evaluating the source of elevated nitrate upgradient of the wells. Therefore, less conservative and more precise capture zones were produced.

Capture zones for most wells are generally narrower and longer than the capture zones prepared by CR Hydrogeologic Consulting (CR, 2001-2005). The difference reflects a combination of the wells pumping at a lower rate in the MODFLOW model than in the CR analysis, and a more detailed, multi-layer model of aquifer materials. Capture zones in the Terrell Beach well field are oriented approximately 30 degrees counterclockwise from the CR predictions. This difference is predominantly due to increased influence of range front recharge and Crescent Beach as a discharge area.

Changes to capture zones with projected increases in pumping demand are discussed in Sections 3.5.1 and 3.5.2.

3.5 EWUA PROJECTED DEMAND SIMULATIONS

The steady state model was modified in order to simulate future increased pumping demand. Water use is anticipated to increase at a rate of 3 percent per year (Paul Kamin, EWUA, pers comm. 2008). Private withdrawals are not expected to change significantly in the future because of restrictions on private well drilling in the Eastsound area.

Future demand was estimated by averaging water demand from 2001 to 2007 and assigning a 3 percent per year increase in demand through 2040. Projected demand for 2030 and 2040 are shown in Table 3. The average demand from 2001 through 2007 was 11,350 ft^3/day. Projected demand for 2030 and 2040 are approximately 22,400 ft^3/day and 30,100 ft^3/day, respectively. A constant pumping rate of 3000 ft^3/day was assigned to the School well. The School well is only used to irrigate the adjacent fields and is not connected to the distribution system. Therefore no increase in demand was imposed.

Pumping rates were assigned to existing EWUA production wells to meet projected demand (Paul Kamin, personal communication, 2008) assuming:

- No exceedances of well design capacity
- EWUA will bring the Clark and Klein wells on-line by 2030
- Wells in the Blanchard Well Field will be used primarily as a reserve supply
- Pumping is constant at the School well

The model also assumes that there are no changes to recharge through 2040 due to changes in land use, septic systems, drainage systems or artificial recharge.

3.5.1 2030 Demand Steady-State Pumping Simulation

Steady state water levels and flow are calculated for 2030 with a total EWUA pumping production of 24,400 ft^3/day (Tables 2 and 3). A constant pumping rate of 3000 ft^3/day was also assigned to the School well. EWUA production in 2030 includes reduced production at EWUA #3R and new production at the Klein and Clark Wells. The Clark well introduces substantial new production (10,000 ft^3/day) in the center of the Eastsound area accounting for 45% of projected EWUA demand. This new production is predicted to cause a 3.9-foot decline at the Clark well, 3.7-foot decline at the Ecology well, and 2.9-foot decline at the Fisher well under steady state conditions.

Groundwater contours for Layer 4 of are shown in Figure 10. Flow directions and the patterns of groundwater contours are generally similar to the 2007 steady state simulation. Water levels are modestly lower with declines of less than 3 feet observed at most wells (Table 2). The groundwater divide near the Clark and School wells migrates to the southeast as a result of increased production and resulting drawdown at the Clark well.

Ten-year capture zones for 2030 are similar to the 2007 capture zones (Figure 11). This reflects overall similar groundwater flow patterns with flow from uplands to the east and west to discharge zones in the north and south. The capture zone for the Clark well splits with capture from both uplands to the east and west. The actual capture zone for the Clark well is strongly influenced by the position of the groundwater divide.

3.5.2 2040 Demand Steady-State Pumping Simulation

Steady state water levels and flow are calculated for 2040 with a total EWUA pumping production of 30,104 ft^3/day (Tables 2 and 3). The increased demand results in increased production at most EWUA wells increases by year 2040. The Clark well continues to supply 57% of projected EWUA demand at 17,300 ft^3/day. An addiontal constant pumping rate of 3000 ft^3/day was assigned to the School well.

Groundwater elevation declines from 2030 to 2040 levels are less than 2 feet except at the Ecology and Clark wells which decline 2.5 feet and 2.6 feet, respectively. These declines reflect the distribution of increases in pumping.

Groundwater flow directions in 2040 are similar to 2007 and 2030 simulations (Figure 12). Again, the groundwater divide migrates further southeast towards Crescent Beach as pumping at the Clark well increases.

Ten-year capture zones are similar to the 2030 capture zones (Figure 13). This reflects overall similar groundwater flow patterns with flow from uplands to the east and west to discharge zones in the north and south. The capture zone for the Clark well splits with capture from both uplands to the east and west. The actual capture zone for the Clark well is strongly influenced by the position of the groundwater divide.

Water levels near the north end of the marina show declines to less than 0 ft NGVD (sea level is -0.8 ft NGVD in this model). Because of the uncertainties in geology in that area and because seawater is not explicitly modeled it is unclear if these water levels could be associated with seawater intrusion.

3.6 DISCUSSION OF INCREASED PUMPING DEMAND

Increased pumping demand through 2040 does not appear to exceed the capacity of the aquifer, although the potential for seawater intrusion near the marina and Crescent Beach has not been evaluated. Due to the sparsity of wells near Crescent Beach it is less likely to have saltwater intrusion problems than near the marina. Increased pumping demand, particularly at the Clark well, causes the groundwater divide to migrate to the southeast. Migration of the groundwater flow divide increases the capture zone of the groundwater discharging to the north.

3.7 SOURCES OF MODEL ERROR

Groundwater models require assumptions and simplifications of the hydrogeologic system. These assumptions and simplifications may result in introduction of error to the model. Further, models are limited by the data available. Collection of additional data will likely improve model results. Limitations of the Eastsound model include the following:

- Significant uncertainty with the subsurface geology remains. There are few wells with accessible logs in the area west of Eastsound, which is the ultimate groundwater source for production wells along Blanchard road. Additional geologic constraint and water level measurements in this area would bolster understanding of capture zones for production wells along Blanchard and Nina roads.
- There are few constraints on the geometry and size of gaps in the bedrock between seawater and the alluvial aquifer both north of the airport and Crescent Beach. A more robust evaluation of these areas would improve the estimates of groundwater flow out of the alluvial aquifer and the potential for seawater intrusion.
- The model is steady state. Actual groundwater levels and pumping are transient, not steady state. The assumption of steady state results in estimates of water levels that may be higher than would occur when pumping is greatest (summer) and lower than when pumping is smallest (winter).
- Growth was assumed to occur linearly between the current condition and 2020. Growth was assumed to occur uniformly and consistent with the current configuration of wells. Non-linear and non-uniform growth will produce variation from the conditions presented here.
- The model does not account for all possible sources of recharge. Recharge from septic systems, streams and ponds are not included in the model.
- The capture zones are preliminary estimates due to uncertainties in model calibration in the western portion of the model domain. Affected production wells include: EWUA 3R, EWUA 7A, EWUA 9, EWUA 12, and the Curtis Group B well.

3.7.1 Saltwater Intrusion Potential

Currently there is no indication of saltwater intrusion in the Eastsound area, and the model is not currently configured to simulate saltwater intrusion. However, three major aquifer-seawater contacts occur within the model area including the area near Crescent Beach, north of the marina and airport, and near Camp Orkila (Figure 3). One of the limiting factors affecting growth in groundwater pumpage in the long term is likely to be the effects of saltwater intrusion. Therefore, the following enhancements to the model are recommended to more accurately simulate potential effects of saltwater intrusion:

- Incorporate the SEAWAT package, which is designed to model groundwater transport with sea water, which has a higher density than most groundwater.
- Additional geologic information is required along the northern shoreline of the Eastsound area and along Crescent Beach to better constrain the depth and lithology of the alluvial aquifer as it contacts sea water.
- Additional water level measurements near Crescent Beach and northeast of the airport, to improve constraints on water levels near sea water boundaries with the alluvial aquifer. Sampling for chloride from these wells could also provide an early-warning for the alluvial aquifer.

4.0 GROUNDWATER QUALITY

Groundwater quality data for the Eastsound area is available from two sources. Nitrate concentration data has been collected by the Eastsound Water Users Association since 1974 (PGG, 2008) and two semi-annual samples were collected in 2008 by the San Juan County Department of Health and Community Services and PGG (PGG, 2008). The monitoring network is described in Section 4.1. Sodium and nitrate are the only two compounds detected above background concentrations in regular monitoring. Sodium and nitrate are described in Sections 4.2 and 4.3.

4.1 GROUNDWATER MONITORING NETWORK

San Juan County has developed a groundwater monitoring network to collect groundwater elevation and quality data. The Eastsound monitoring network currently includes eight groundwater quality and groundwater elevation monitoring wells in the vicinity of Eastsound (Figure 2). In Eastsound, the network was designed for the following data uses:

- Seawater intrusion evaluation
- Groundwater elevation trend analysis
- Groundwater flow model calibration
- Water quality sampling

All wells are screened in the primary aquifer. The monitoring locations were selected based on availability, access, spatial distribution, and availability of prior sampling data.

The Eastsound monitoring network currently includes the Clark, Curtis, EWUA#1, EWUA #4, EWUA #5, Fischer, Greer, NAPA, Pearson, and School wells (Figure 2). Groundwater samples are collected semi-annually from each well and analyzed for total alkalinity, bicarbonate alkalinity, carbonate, dissolved calcium, chloride, fluoride, hydroxide, nitrate, specific conductance, sulfate, magnesium, potassium, and sodium by Analytical Resources Incorporated of Tukwila, WA. Samples were collected on April 23 and October 21, 2008.

In addition, Solinst Levelogger transducers are used to record hourly groundwater level measurements. A barometric datalogger (Barologger) is installed in EWUA #5 for barometric compensation of transducer water level measurements.

4.2 SODIUM

Sodium was analyzed as part of the San Juan County monitoring program (Section 4.1). The recommended level for sodium is less than 20 mg/L (WAC 173-200 Guidance). This criterion is based on EPA recommendations for persons on a low-sodium diet (USEPA, 2003).

Sodium concentrations in the Eastsound wells were above 20 mg/L in six of the ten wells monitored. The concentrations ranged from 10.7 to 52.7 mg/L and are within the range of naturally occurring sodium.

4.3 NITRATE

All nitrate detections are below the GWQC of 10 mg/L (WAC 173-200). However, nitrate concentrations elevated above background have been detected in Eastsound wells at concentrations up to 6.8 mg/L (Figure 14). Maximum concentrations in the Terrill Beach well field range from 1.2 mg/L to 2.5 mg/L. Concentrations in the Blanchard well field range from 0.5 mg/L to 6.8 mg/L. Nitrate concentrations in the center of the study area are lower with most wells non-detect and a maximum value of 1.3 mg/L at the School well.

The spatial distribution of nitrate detections presented in Figure 2 indicates that elevated nitrate detections are localized. Concentrations appear to be higher in well fields along the edges of the study area. Wells along Blanchard Road draw water from the uplands to the west. The School well is in the middle of the study area. EWUA #1 and EWUA #8 are located in the east end of the study area and derive water from uplands to the east.

Elevated nitrate concentrations are not likely from the same source given the distribution of elevated nitrate and capture zones Localized sources and transport are also suggested by the observation that adjacent wells often have significantly different nitrate concentrations. Potential sources are discussed in Section 6.

5.0 NITRATE FATE AND TRANSPORT

Nitrogen is subjected to a variety of chemical, physical, and biological removal and transformation mechanisms as it moves through the subsurface. In general, nitrogen removal is greatest in low permeability soils with shallow water tables; however, the hydraulic performance of septic drainfields in those conditions is poor and may cause surface expression of septic effluent.

Organic forms of nitrogen (e.g., leaves, twigs) are generally not very soluble in water, so they are retained in the soil. As these materials decompose, the organic nitrogen compounds are broken down over time to the inorganic ammonium and nitrate forms. Both forms are water soluble and therefore available for uptake by plants. The ammonium form is positively charged so it tends to adsorb on cation exchange sites in the soil, rather than leach below the root zone. In contrast, nitrate is negatively charged and is much less likely to adsorb on soil particles; consequently, nitrate can rapidly leach below the root zone to the water table. Under oxidizing conditions, most of the inorganic nitrogen is in the more mobile nitrate form. If anoxic (no oxygen) conditions are encountered and dissolved carbon is present, denitrification may remove a portion of the migrating nitrate – otherwise the nitrate moves at the speed of the groundwater and is preserved.

Since lawn fertilizers and septic effluent contain high nitrogen concentrations, groundwater nitrate problems commonly result from urbanization, especially where wastewater is disposed through septic drainfields. Data available for the Eastsound project area are consistent with this trend, suggesting significant nitrate loads to groundwater in some areas.

Flows through saturated soils tend to follow larger pores. Water passing through large pores receives limited exposure to soil particle surfaces thereby limiting the treatment capability of the soil matrix. Water discharged from a septic drainfield constructed at or near the water table is likely to still contain organic and untreated inorganic contaminants when it reaches the water table.

Septic drainfields have optimal hydraulic performance when several feet of unsaturated soil occur between the drainfield and the water table – and the generation of nitrate in that soil treatment process has just been accepted by environmental regulators except in special cases. Recent focus on marine water dissolved oxygen levels in places such as Hood Canal, Puget Sound, Budd Inlet, Henderson Inlet, and Chesapeake Bay has increased attention on alternatives to standard on-site septic system designs that tend to create nitrate.

The following bullets summarize some findings of other researchers:

- The US Geological Survey (Cox, Simonds, Doremus, Huffman, and Defawe, 2005) studied nitrate fate and transport in shallow glacial aquifers of the Nooksack River Basin in northern Washington. Findings regarding nitrate included documentation of high rates of denitrification as groundwater approaches receiving surface water.
- The University of Washington and Tacoma-Pierce County Health Department (1994) studied septic nitrate fate and transport in coarse outwash soils above the water table. They found high total nitrogen concentrations within the septic tanks (70 mg/L) but high denitrification rates (50% to 70%) within and below the drainfield.
- J. Eliasson (2002) summarized literature on nitrate fate and transport for the Washington State Department of Health. He found that denitrification is common and rapid when ni-

trate-containing groundwater flows within a few feet of land surface as a result of the presence of increased carbon content of shallow soils and groundwater and that dissolved carbon from septic effluent may promote denitrification in nitrate plumes from upgradient sources.

- B.W. Drost and others of the US Geological Survey (1998) sampled wells in northern Thurston County and found a strong correlation between elevated groundwater nitrate concentrations and methylene blue active substances (MBAS). MBAS are found in household wastewater as detergent residues, and septic drainfields are believed to be the major source of MBAS to groundwater. These results suggest that septic systems are the dominant groundwater nitrate source in unsewered areas of Thurston County.

6.0 POTENTIAL SOURCES

Numerous sources can introduce nitrate to groundwater in urban and rural areas. According to the Center for Watershed Protection (Schueler, 1999), potential sources of nitrate in urban areas include:

- Sanitary sewer overflows
- Leaking sanitary sewers
- Combined sewer overflows
- Illicit sanitary connections or dumping into storm drains
- Point source discharges (e.g., industrial wastewater outfalls)
- Septic systems
- Landfills
- Marinas
- Pets (e.g., dogs and cats)
- Urban wildlife (e.g., rats, raccoons, pigeons, gulls, ducks, geese)
- Rural wildlife (e.g., beaver, muskrats, deer, waterfowl)
- Livestock (e.g., cattle, horses, poultry)
- Landscaped areas and croplands (e.g., fertilizer, compost, leaves)
- Nitrogen-fixing plants

Possible sources listed above were evaluated in light of the study area land uses, soils, hydrology, and water quality data. The purpose of this evaluation was to identify potential sources likely to be significant, or not significant, in the study area. The results of this initial evaluation are described below.

- Sanitary sewer overflows do not appear to be a source in the study area. Eastsound Sewer District was contacted to obtain information about potential for sanitary sewer leaks and overflows. The District has no knowledge of any sanitary sewer overflows in the study area.
- Sanitary sewer leaks are unlikely to be significant in the study area. According to Eastsound sewer maintenance staff, the sewer pipes are relatively new (1979), PVC force mains which have a low potential for leakage.
- Combined sewer overflows are not a source because there are no combined sewers in the study area.
- Illicit sanitary connections or dumping into the storm drains do not appear to be significant sources in the study area. There is no history of illicit connections.
- Point sources can be permitted to discharge pollutants through the National Pollutant Discharge Elimination System (NPDES) and State Waste Discharge permits. Individual NPDES permits are required for process water discharges from industrial facilities. Individual permits are tailored to each site. Since the mid-1990s, NPDES permits have been required for stormwater discharges from certain types of industrial facilities (e.g., vehicle maintenance facilities, gravel mines, junk yards). Most of the industrial stormwater discharge permits are general (vs. individual)

permits. General permits are designed to cover certain categories of industrial facilities and are not tailored to each facility. Industrial sites that discharge a combination of process water and stormwater are usually covered by an individual NPDES permit. No NPDES permits are currently on file with the EPA within the study area.

- Most of the Eastsound study area is serviced by sewers and therefore would not be impacted by discharge from septic tanks. However, two of the three areas impacted by nitrate are at the edges of the sewered area and capture water from unsewered areas. Septic tanks are the most likely source of elevated nitrate in the Blanchard and Terrill Beach well fields. This should be verified by collecting samples for anthropogenic tracer compounds such as caffeine, SSRIs, and bacterial DNA samples.
- Landfills do not appear to be a significant source because the only landfill on Orcas Island is well outside of the study area.
- Marinas are not likely to be a significant source because the marina is down gradient of the well fields.
- Pets and urban wildlife are not likely a source of elevated nitrate given the low density of development in the area
- Rural wildlife may be a significant source in the study area. The study area includes wetlands and forested riparian areas that likely provide habitat for waterfowl, rodents, raccoons, and other wildlife species.
- Livestock do not appear to be a significant source of nitrogen or bacteria in the study area.
- Cropped or landscaped areas have the potential to be sources of nitrate in the study area. Infiltration from fertilized areas can contain elevated nutrient concentrations in dissolved and particulate forms. In areas with permeable soils, excessive fertilizer application can result in leaching of nitrate to groundwater. The School well is located adjacent to a number of fields that may be currently or previously fertilized. The upper 17 feet of the School well are logged as brown silty clay suggesting the presence of an aquitard beneath the field which would likely inhibit downward migration of nitrate.
- Nitrogen-fixing plants do not appear to be a significant nitrate source to groundwater in the study area. However, no specific studies have been completed regarding this potential source.

Based on this initial evaluation, the project team determined that the following are potentially significant sources nitrate in the Eastsound study area:

- Septic systems
- Cropped/Landscaped areas

Of the sources listed above, septic systems are the most likely sources of nitrate for the Blanchard and Terrill Beach well field. Elevated nitrate at the Blanchard well field is likely due to the high density of septic systems upgradient to the west. Elevated nitrate in the vicinity of the Terrill Beach well field is likely due to septic systems installed over shallow bedrock upgradient. The shallow bedrock would tend to reduce the amount of treatment by those septic systems. The source of nitrate in the School well is unknown, but may be associated with fertilization of the surrounding fields.

7.0 RECOMMENDATIONS

The following actions are recommended to improve understanding of the Alluvial Aquifer system:

Groundwater Monitoring

- Expand water level monitoring to include Harlow (or other wells to the west) and Klein Wells.
- Survey wells west of Eastsound and collect a water level snapshot to locate groundwater divide.

- Collect samples of caffeine, SSRI, DNA & other anthropogenic indicators from nitrate-impacted wells.

Geologic / Hydrogeologic Constraints

- Improve geologic constraints on bedrock-alluvial geometry along Crescent beach, south of the Outlook inn, and along the north shore of the Eastsound area. The objective is to describe the depth of alluvial deposits over bedrock
- Improve estimates of the range-front recharge mass balance along Buck Mountain, and potential nitrate concentrations of range front recharge.
- Conduct a 24 hour pump test at Greer prior to using as a production well. Model calibration of hydraulic conductivity suggests that production at the Greer well may be limited. It is probably screened in a sandy lens in an otherwise low hydraulic conductivity unit.
- Improve nitrate source estimates of anthropogenic sources such as septic systems and storm sewers.
- Incorporate land use changes into groundwater planning. The distribution of pavement and mitigation of stormwater runoff can impact groundwater recharge.

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Table 1. Aquifer Parameter Values From Pump Tests

Eastsound, Washington

Well	Transmissivity gpd/ft	Sustained Yield gpm	Storage Coefficient	Screened Interval ft	Hydraulic Conductivity ft/day	Data Source
School Well	38,500	70	0.005	31	166.0	CR
Clark Well	9,200	150	0.001	90	13.7	CR
Klein	1,500	18	0.0001	15	13.4	CDM
EWUA 3R	7,500	35	0.008	15.5	64.7	CR
EWUA 1R	3,800	14	0.0001	15	33.9	CR
Well 12	10,000	75	0.00001	20	66.8	AGI
Average			*0.0024*		*59.7*	

All values from well completion reports prepared by CR Hydrogeologic, AGI and CDM consulting.

Hydraulic conductivity calculated from transmissivity and screened interval.

Table 2. Modeled Water Levels and Calibration Statistics

Eastsound, Washington

		Current Conditions			Computed Future Heads		Calculated Declines		
Name	**Layer**	**Observed**	**Computed**	**Residual**	**2030**	**2040**	**2007-2030**	**2030-2040**	**Comment**
Head Observations (feet)									
AHH 580 - Harlow	4	120	83.20	*36.80*	82.54	82.18	0.7	0.4	Location and water level from well log; calibration fit considered approximate.
Beemer-Minnis	5	8.97	12.05	*-3.08*	9.61	8.02	2.4	1.6	
Curtis	4	4.79	8.29	*-3.50*	7.18	6.45	1.1	0.7	Group B supply well
Ecology	3	12.54	11.79	*0.75*	8.08	5.60	3.7	2.5	
EWUA - Clark	4	10.02	11.51	*-1.49*	7.66	5.06	3.9	2.6	
EWUA #13 - Klein	6	4	7.65	*-3.65*	4.62	3.60	3.0	1.0	Water level from pump test, not at same time as other water levels
EWUA #1R	6	22.87	24.67	*-1.80*	22.05	20.66	2.6	1.4	
EWUA #4	4	5.75	5.46	*0.29*	4.59	3.97	0.9	0.6	Well no longer in service
EWUA #5 - Blanchard	4	7.46	9.26	*-1.80*	7.94	7.11	1.3	0.8	
Fisher	3	9.68	10.84	*-1.16*	7.91	6.00	2.9	1.9	Private well, not in service
Greer	3	45.4	39.31	*6.09*	37.17	36.27	2.1	0.9	Observed head present within screened interval of well in model; vertical gradients
Patty	4	33	27.05	*5.95*	24.63	23.32	2.4	1.3	Private well
Pearson	6	25.05	26.22	*-1.17*	23.76	22.13	2.5	1.6	Observed artesian flow
School Well	4	10.54	12.87	*-2.33*	9.98	8.12	2.9	1.9	Use limited to May through September.
Calibration Statistics									
Residual Mean				*2.14*	--	--			
Residual Stdandard Deviation				*10.06*	--	--			
Sum of Squares				*1479.36*	--	--			
Absolute Residual Mean				*4.99*	--	--			
Minimum Residual				*-3.65*	--	--			
Maximum Residual				*36.80*	--	--			
Range in Target Values				*116*	--	--			
(Standard Deviation) / (Range)				*0.087*	--	--			

All observed water levels colleted September, 2008 except as noted.

All values in feet.

Calibration statistics are not calculated for future demand water level estimates.

Table 3. EWUA Pumping History and Projected Demand

Eastsound, Washington

	Capacity	Capacity	Observed Pumping									Projected Demand	
Well	**gpm**	**cfd**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**Average**	**2030**	**2040**
Well 1R	0	0	0	0	0	0	0	0	0	1,683	--	1,680	1,780
Well 2 (S02)	0	0	883	997	1,896	1,157	1,956	2,162	1,812	0	--	0	0
Well 5 (S05)	0	0	0	0	777	1,058	557	50	1	7	--	30	34
Well 7A (S07)	0	0	1,267	1,385	1,145	1,405	1,212	2,214	780	664	--	1,000	1,000
Well 8 (S08)	0	0	670	610	827	417	894	1,002	594	404	--	800	800
Well 9 (S09)	0	0	0	0	0	0	0	0	0	690	--	0	0
Well 10 (S10)	0	0	773	523	0	0	0	0	0	0	--	0	0
Well 12 (S12)	0	0	10,580	9,921	7,745	7,297	5,451	3,010	521	0	--	690	690
Well 3R (S13) aka Well 13	0	0	0	0	0	0	0	2,720	5,304	5,776	--	5,200	5,200
Klein (EWUA Well 12)	18	3,465	0	0	0	0	0	0	0	0	--	3,000	3,300
Clark	100	19,251	0	0	0	0	0	0	0	0	--	10,000	17,300
EWUA Sum			14,173	13,437	12,391	11,334	10,071	11,157	9,012	9,223	--	22,400	30,104
EWUA Calculated Demand (3% per year)			14,173	13,437	12,391	11,334	10,071	11,157	9,012	9,225	11,350	22,400	30,104
Calc Demand (gpm)			89	85	80	74	68	73	62	63	74	132	172
Total Recharge			96,927	96,928	96,929	96,930	96,931	96,932	96,933	96,934	96,931	96,934	96,934
Percent of Recharge to Pumping			18%	17%	16%	15%	13%	15%	12%	13%	15%	26%	34%

All Units CFD to match MODFLOW model dimensions (feet, days), except as labeled otherwise for comparison.

Table 4. Nitrate Data Collected by EWUA, 1974-2007

Eastsound, Washington

	Terrill Beach Well Field			Blanchard Well Field			Nina Lane
Date	**Well #2**	**Well #8**	**Well #12**	**Well #5**	**Well #7**	**Well #9**	**Well #3R**
1974				U			
1975				0.1			
1981				0.1	0.5		
1984					0.7		
1988					0.9		
1991				0.4			
1995				U	4.5	U	
1996				0.5	1.8	0.5	
1997				U	1.1	U	
November, 1998	1.00	U	0.60	U	0.60		
December, 1999	1.01	1.13	0.63	U	1.75		
July, 2000	1.22	2.50	0.85	0.88	2.40		
July, 2001							
December, 2002	1.44	3.02	0.77	0.54	6.77		
October, 2003	2.00	2.00	1.00	U	2.00		
July, 2004							U
September, 2004	1.36	1.23	0.69		5.82		
December, 2004					3.90		
March, 2005					1.62		
June, 2005					1.86		
September, 2005	1.63	2.23	1.13	0.11	1.60		U
December, 2005			2.21	U	1.20		U
March, 2006					2.78		
April, 2006			1.83		3.63		
June, 2006				U	1.19		
August, 2006					1.3		
September, 2006	1.48	2.16	U		2.28		
October, 2006					2.67		
December, 2006					2.09		
December, 2006					3.68		
January, 2007					4.8		
February, 2007					1.95		
March, 2007					2.26		
April, 2007					1.91		
May, 2007					1.55		
June, 2007					1.73		
July, 2007			1.28	U	1.61		
August, 2007			1.60	U	1.55		
September, 2007	1.4	2.0	1.54	0.31	1.7		U
February, 2006					2.26		
Average of Detections	*1.4*	*2.0*	*1.2*	*0.4*	*2.3*	*0.5*	*U*
Maximum	*2.0*	*3.0*	*2.2*	*0.9*	*6.8*	*0.5*	*U*

U indicates non-detect.

Blank indicates no data

Table 5. Eastsound Groundwater Concentrations, April 23, 2008

San Juan County, Washington

Constituent	**Units**	**GWQC** [1]	**Clark**	**Curtis**	**EWUA #1R**	**EWUA #3R**	**EWUA #5**	**Fischer**	**Greer**	**NAPA**	**Pearson**	**School**
Chloride	mg/L	250	33.8	26.7	18	29.1	25.1	29.5	25.1	18.4	27.4	14.5
Nitrate as N	mg/L as N	10	0.1U	5	2.5	0.1U	0.1U	0.1U	0.1U	0.1U	0.1U	1.3
Sodium	mg/L	20 [2]	**29.6**	19	12.7	**30.4**	**26.9**	**22.8**	18.6	**26.1**	**52.7**	10.8

Bolded values are above their corresponding GWQC

[1] Ground water quality criteria (GWQC) as reported in WAC 173-200, also inlcudes maximum contaminant levels reported in WAC 246-290-310.

[2] The EPA has established a recommended level of 20 mg/L for sodium as a level of concern for those consumers that me be restricted for daily sodium intake in their diets.

U = Compound not detected

Note: EWUA Well 3R is also referred to as EWUA 13.

Table 6. Eastsound Groundwater Concentrations, October 21, 2008

San Juan County, Washington

Constituent	Units	GWQC[1]	Curtis	EWUA #1R	EWUA #3R	EWUA #5	Greer	Pearson
Chloride	mg/L	250	25.2	18	25.1	25.9	22.2	26.2
Nitrate as N	mg/L as N	10	4.7	2.4	0.1U	0.1U	0.1U	0.1U

[1] Ground water quality criteria (GWQC) as reported in WAC 173-200, also inlcudes maximum contaminant levels reported in WAC 246-290-310.

U = Compound not detected

Note: EWUA Well 3R is also referred to as EWUA 13.

Sodium not analyzed this event.

🟥 Study Area

County Line

2006 NRCS Orthophoto

0 Miles 4

N

Figure 1

Vicinity Map

JS0713

PgG

Figure 2

Eastsound
Maximum Nitrate Concentrations

SAN JUAN COUNTY
AQUIFER PROTECTION REPORT
JS0713

EWUA #1R
2.5 ●

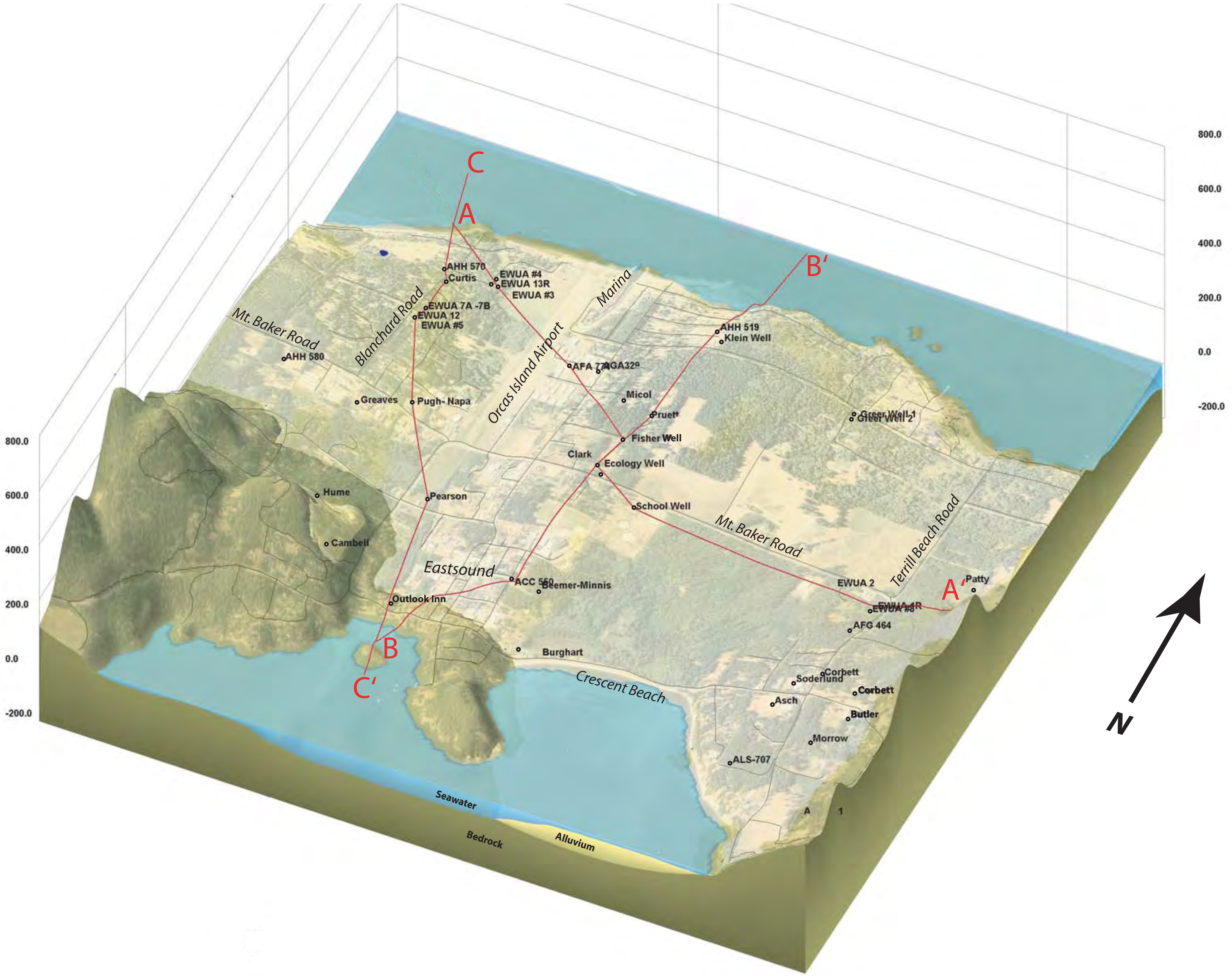
Current Monitoring Well Locations
Maximum Nitrate Concentration, mg/L -

ND = No Data
U = Non-Detect (<0.1 mg/L)

0 Feet 2,000

N

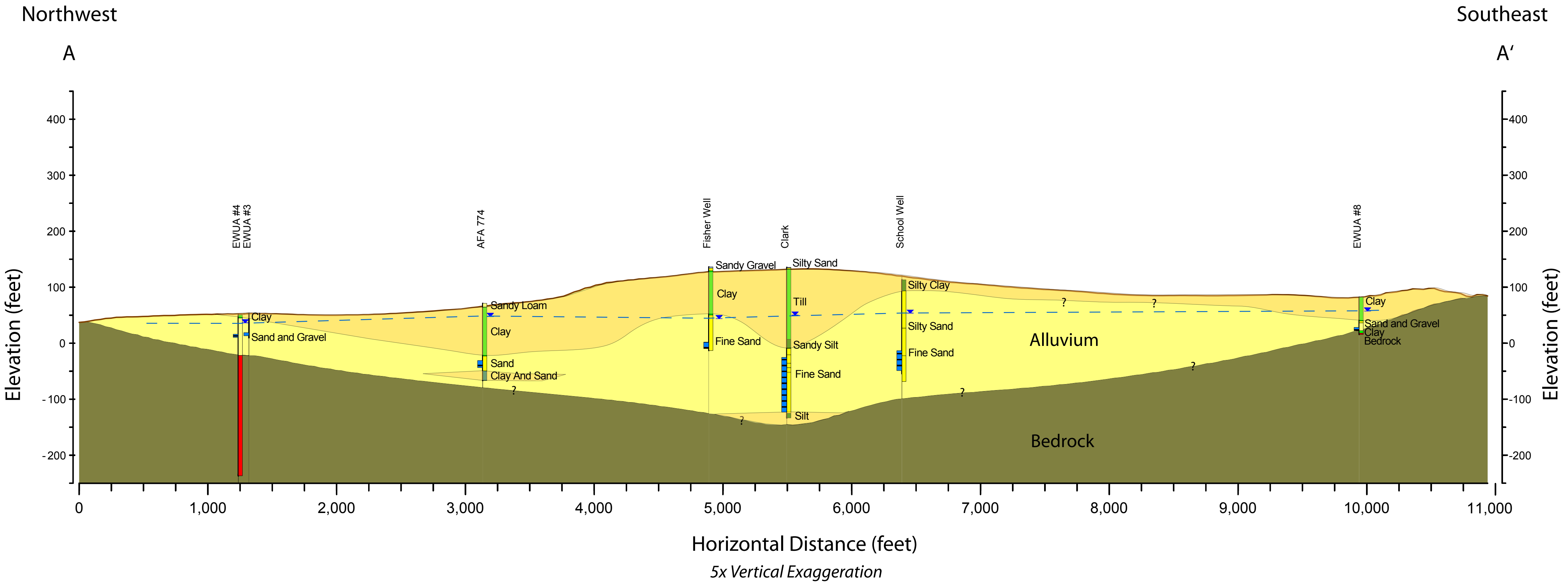
2006 NRCS Orthophoto



5x Vertical Exaggeration

Figure 3. Locations of Cross Sections
Eastsound, Washington
San Juan County

PGG



Stratigraphic Legend

H | L **Alluvium:** Alluvium is subdivided into higher (H; yellow) and lower (L; salmon) permeability units. Higher permabiliity units are predominanly fine to medium sand with gravelly intervals. Lower permability units are characterized by the predominance of clay, silt, siltbound sand and gravel, and glacal till.

▨ **Bedrock:** Undifferentiated Mesozoic bedrock.

Well Log Legend

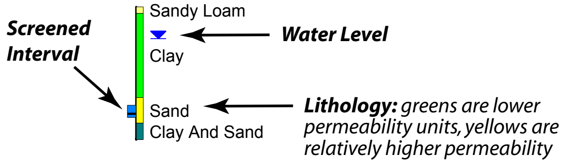
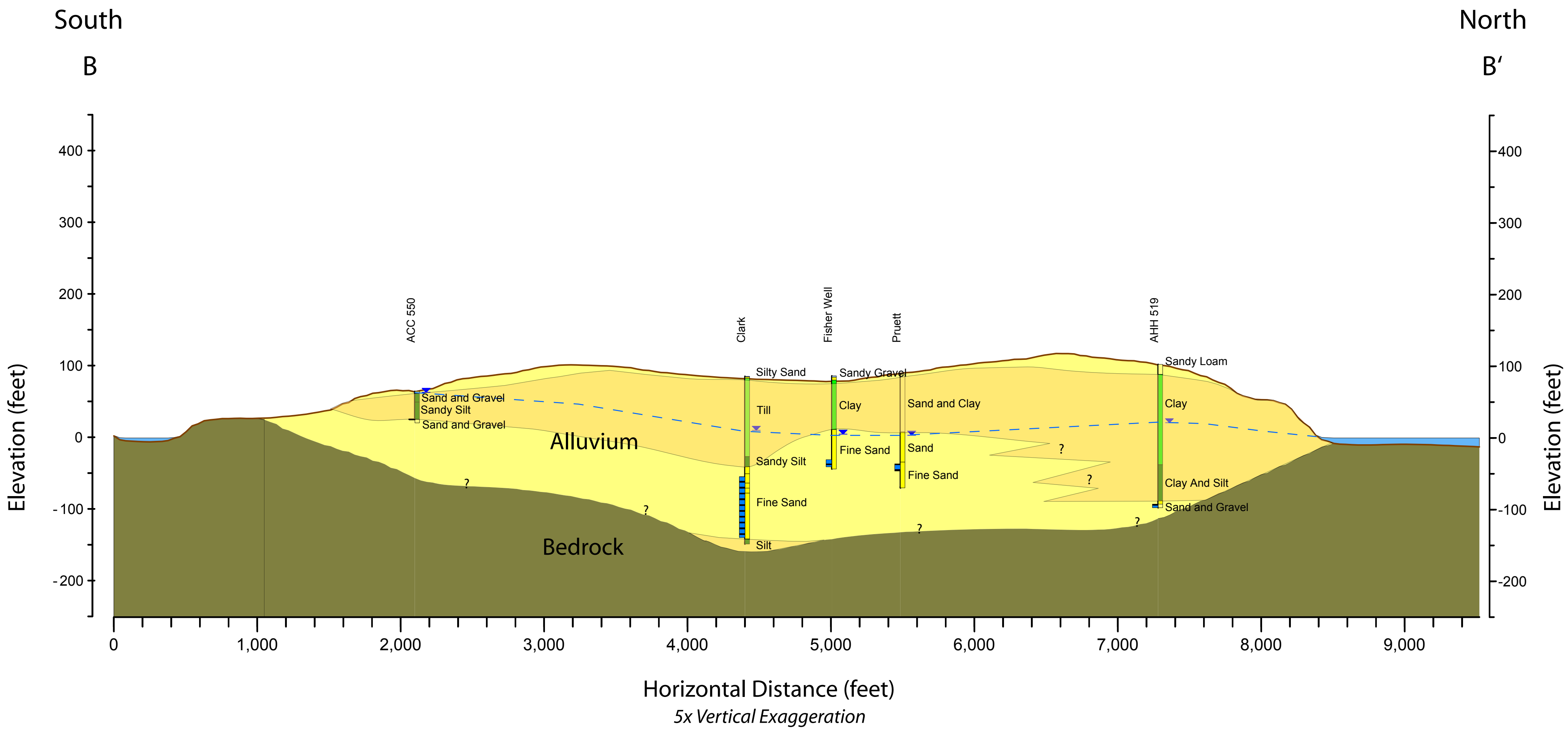


Figure 4. Geologic Cross Section A-A'
Eastsound, Washington
San Juan County



Stratigraphic Legend

H | L **Alluvium:** Alluvium is subdivided into higher (H; yellow) and lower (L; salmon) permeability units. Higher permabiliity units are predominanly fine to medium sand with gravelly intervals. Lower permability units are characterized by the predominance of clay, silt, siltbound sand and gravel, and glacal till.

▨ **Bedrock:** Undifferentiated Mesozoic bedrock.

Well Log Legend

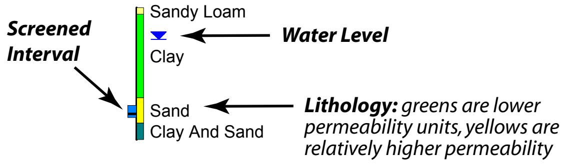
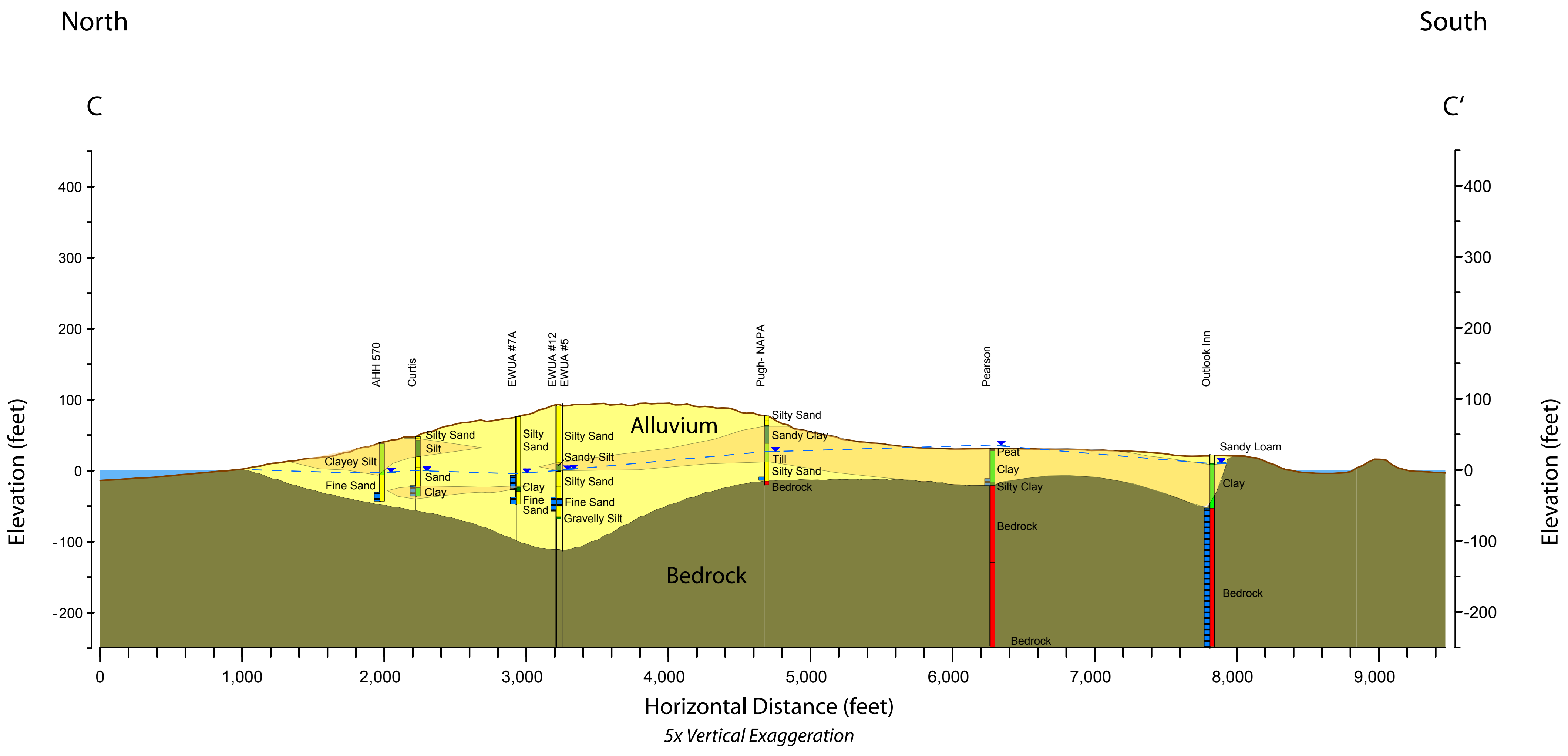


Figure 5. Geologic Cross Section B-B′
Eastsound, Washington
San Juan County



Stratigraphic Legend

H 🟨 L 🟧	**Alluvium:** Alluvium is subdivided into higher (H; yellow) and lower (L; salmon) permeability units. Higher permabiliity units are predominanly fine to medium sand with gravelly intervals. Lower permability units are characterized by the predominance of clay, silt, siltbound sand and gravel, and glacal till.
🟫	**Bedrock:** Undifferentiated Mesozoic bedrock.

Well Log Legend

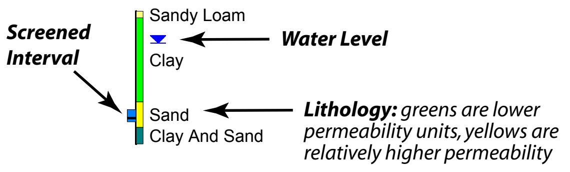


Figure 6. Geologic Cross Section C-C′
Eastsound, Washington
San Juan County

Figure 7

Eastsound Conceptual Groundwater Flow October 2008

Aquifer Protection Report

PgG

Greer
45.4
● Well Locations

— Groundwater Elevation Contours
(Dashed where infered)

Note:
The NAPA well appeared to be pumping during measurement so the reading from 4/24/08 was substituted.

Elevations in NGVD29

0 Feet 2,000

N

2006 NRCS Orthophoto

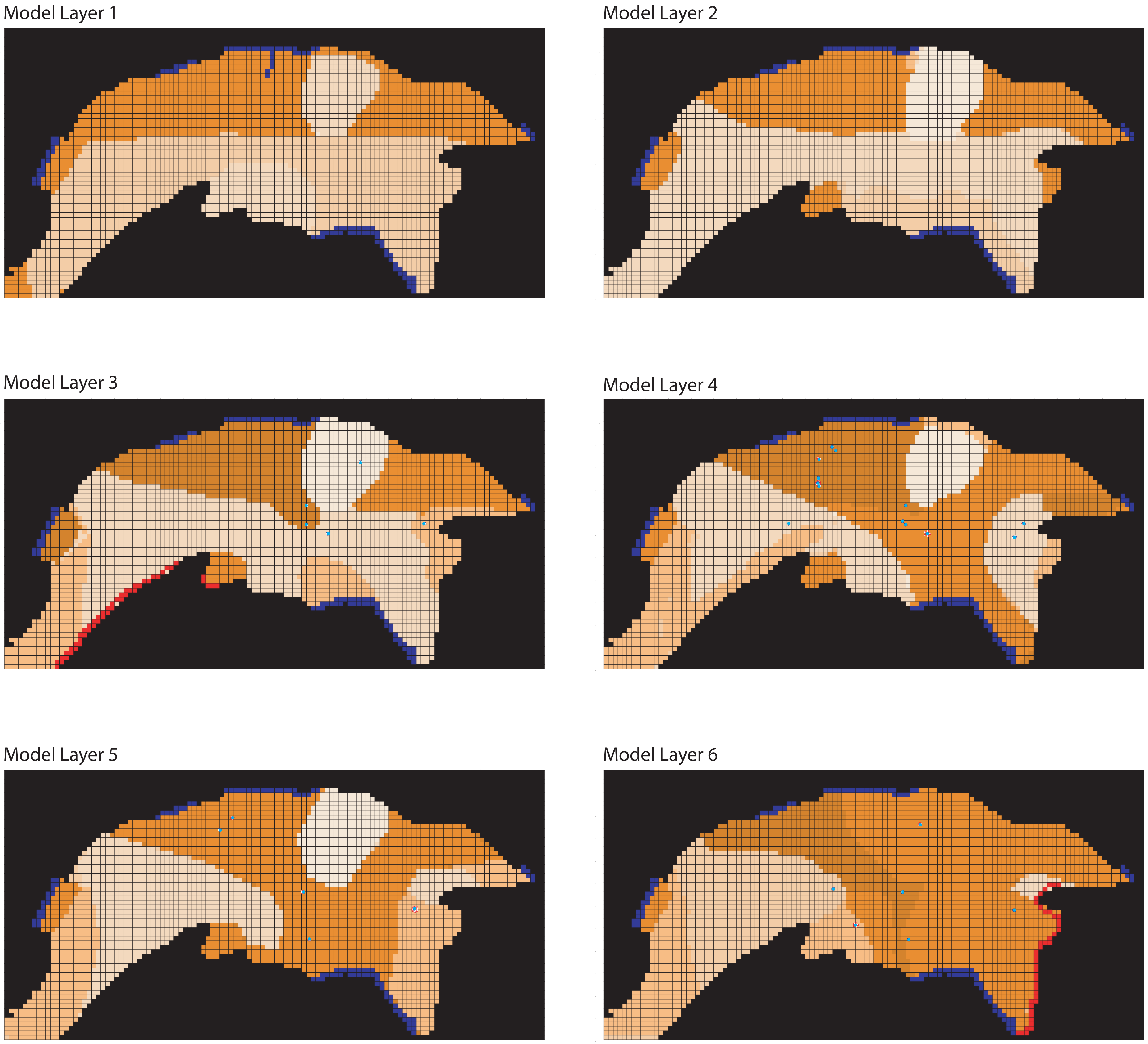


Figure 8. MODFLOW Model Setup
Eastsound, Washington
Aquifer Protection Report

Hydraulic Conductivity Zones

▨ Kh = 0.09 ft/day; Kz = 0.0009 ft/day
▨ Kh = 0.1 ft/day; Kz = 0.01 ft/day
▨ Kh = 1 ft/day; Kz = 0.3 ft/day
▨ Kh = 5 ft/day; Kz = 1 ft/day
▨ Kh = 10 ft/day; Kz = 2 ft/day
▨ Kh = 20 ft/day; Kz = 4 ft/day
▨ Kh = 30 ft/day; Kz = 10 ft/day

Boundary Conditions

🟦 Constant Head Boundary
🟥 Range-Front Recharge Zone
⬛ No-Flow Cell

● Well Location

Figure 9

2007 Modeled Groundwater Contours

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

● Well Locations

→ Groundwater Flow Directions

Layer 4 Groundwater Contours

— 10 Foot Contours

— 2 Foot Contours

Note:
Water Level contours in Layer 4 may not match water levels of wells due to vertical hydraulic gradients.

N

0 Feet 2,000

2006 NRCS Orthophoto

Figure 10

2007 Modeled
Steady State Capture Zones

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

PgG

● Well Locations

10-Year Capture Zones

Capture Zone Envelopes

2006 NRCS Orthophoto

Figure 11

2030 Modeled Groundwater Contours

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

● Well Locations

→ Groundwater Flow Directions

Layer 4 Groundwater Contours

— 10 Foot Contours

— 2 Foot Contours

Note:
Water Level contours in Layer 4 may not match water levels of wells due to vertical hydraulic gradients.

N

0 Feet 2,000

2006 NRCS Orthophoto

Figure 12

2030 Modeled
Steady State Capture Zones

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

PgG

2006 NRCS Orthophoto

Figure 13

2040 Modeled Groundwater Contours

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

● Well Locations

➔ Groundwater Flow Directions

Layer 4 Groundwater Contours

━ 10 Foot Contours

─ 2 Foot Contours

Note:
Water Level contours in Layer 4 may not match water levels of wells due to vertical hydraulic gradients.

N

0 Feet 2,000

2006 NRCS Orthophoto

Figure 14

2040 Modeled Steady State Capture Zones

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

● Well Locations
—— 10-Year Capture Zones
- - - Capture Zone Envelopes

N

0 Feet 2,000

2006 NRCS Orthophoto

Figure 15.
Capture Zones and
Distribution of Septic Systems

AQUIFER PROTECTION REPORT
SAN JUAN COUNTY
DECEMBER 2008
JS0713

APPENDIX A
RANGE FRONT RECHARGE ESTIMATES

Recharge / Water Balance for the Eastsound Model Area

Vegetation Data	
Type of Land Cover	mature conifers
Rooting Depth	36 in
Priestly Taylor "Alpha"	N/A
Average Annual Fractional Foliar Cover	N/A
Average Annual Foliar Interception Capacity	N/A
Net Surface Albedo Value	N/A

Weather Station Data		
Nearest Weather Station	OLGA 2 SE	
Average Precipitation	28.9	in/yr
Avg Annual Temperature	57.1	°F
Latitude	48.62	°N
Longitude	122.8	°W
Elevation	80	feet msl

Soil and Water Data		
Avg. Soil Available Water Capacity (AWC)	0.15	inch/inch within root zone, based on SCS soil descriptions.
Ratio of Site:Weather-Station Precipitation	114%	of official station, based on Thomas estimate for study area
Resulting "Effective" Precipitation (P)	33.0	in/yr (annual average)
Portion of "P" going to immediate runoff*	0%	of effective precipitation, based on high permeability of soils..
Rate of Snow Ablation (SA)	N/A	
Snowmelt Rate Coefficieint	N/A	
Depth to Till (Not Used in Model)	100	
Till Thickness (Not Used in Model)	10	
Vertical Hydraulic Conductivity of Till	N/A	
Porosity of Perched Aquifer	N/A	
Darcy Flow Coefficient for Perched Aquifer	N/A	

Method of Estimating Potential Evapotranspiration: Blaney Criddle (BC) ▼

Priestly Taylor Canopy Interception: Not Modeled ▼

Snowpack: Not Modeled ▼

Till Perching: Not Modeled ▼

RECHARGE CALCULATOR:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS	
Evaporation Estimates														
Monthly Temp (T, °F)	39.3	41.6	44.5	48.7	53.4	57.2	59.9	60.0	56.7	50.8	44.4	40.9	49.8	Avg. T, °F
Monthly Temp (T, °C)	4.1	5.3	6.9	9.3	11.9	14.0	15.5	15.5	13.7	10.4	6.9	4.9	9.9	Avg. T, °C
Blaney Criddle Crop Factor (k)	0.63	0.73	0.86	0.85	0.52	0.53	0.53	0.53	0.50	0.80	0.78	0.64	0.66	(Avg k)
Blaney Criddle % of Annual Light (d)	0.062	0.064	0.082	0.091	0.105	0.107	0.108	0.099	0.085	0.076	0.063	0.058	1.00	Avg d)
Priestly Taylor Net Radiation (RN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(RN)
Potential Evapotranspiration (PET)	0.57	0.79	1.43	2.00	1.76	2.16	2.44	2.24	1.59	1.73	0.99	0.61	18.29	(PET)
Water Balance														
Effective Precipitation (P)	4.46	3.19	2.73	2.13	1.79	1.53	0.92	1.16	1.90	3.34	4.83	5.01	33.00	(P)
Interception Loss (IL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(IL)
Average Snowpack Storage (SS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	- - -	(SS)
Snowpack Ablation (SA)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(SA)
Snowmelt (SM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(SM)
AvailableThroughfall (ATF)	4.46	3.19	2.73	2.13	1.79	1.53	0.92	1.16	1.90	3.34	4.83	5.01	33.00	(ATF)
Runoff (RO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(RO)
Infiltration (I)	4.46	3.19	2.73	2.13	1.79	1.53	0.92	1.16	1.90	3.34	4.83	5.01	33.00	(I)
Average Soil Moisture in Soil Profile (SW)	5.38	5.37	5.35	5.33	5.34	5.02	4.03	3.30	3.58	4.84	5.37	5.38	4.86	(SW)
Soil Moistue Deficit (PET-P)	0.00	0.00	0.00	0.00	0.00	0.63	1.51	1.08	0.00	0.00	0.00	0.00	3.22	(PET-P)
Actual Evapotranspiration (AET)	0.57	0.79	1.43	2.00	1.76	2.16	2.12	1.52	1.10	1.59	0.99	0.61	16.62	(AET)
Shallow Recharge (RS)**	3.89	2.42	1.31	0.16	0.03	0.00	0.00	0.00	0.00	0.37	3.82	4.38	16.38	(RS)
Perched Subflow (PS)***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(PS)
Deep Recharge (RD)***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(RO)

ANNUAL SUMMARY	**P**	**IL**	**SM**	**ATF**	**RO**	**I**	**PET**	**AET**	**RS**	**PS**	**RD**
	33.00	**N/A**	**N/A**	**33.00**	**0.00**	**33.00**	**18.29**	**16.62**	**16.38**	**N/A**	**N/A**

NOTES:

All values used in the Evaporation Estimates, Water Balance, and Annual Summary are in inches unless otherwise noted.

Abbreviations used in the annual summary are defined in the Evaporation Estimates and Water Balance.

* Modeled runoff consists of the sum of the fixed percentage of effective precipitation going to runoff and any infiltration rejected when saturation reaches the land surface.

** For the non-perched condition, shallow recharge is the water that exits the bottom of the root zone. For the perched condition, it is the water added to the shallow, perched aquifer. Shallow recharge can be negative if perched conditions extend up into the root zone and plant transpiration removes significant amounts of water from the shallow aquifer.

*** Deep recharge is water that flows through the till layer. Perched subflow is lateral, saturated flow above the till layer to adjacent discharge points.

Recharge / Water Balance for the Eastsound Model Area

Vegetation Data	
Type of Land Cover	mature conifers
Rooting Depth	36 in
Priestly Taylor "Alpha"	N/A
Average Annual Fractional Foliar Cover	N/A
Average Annual Foliar Interception Capacity	N/A
Net Surface Albedo Value	N/A

Weather Station Data		
Nearest Weather Station	OLGA 2 SE	
Average Precipitation	28.9	in/yr
Avg Annual Temperature	57.1	^{o}F
Latitude	48.62	^{o}N
Longitude	122.8	^{o}W
Elevation	80	feet msl

Soil and Water Data		
Avg. Soil Available Water Capacity (AWC)	0.15	inch/inch within root zone, based on SCS soil descriptions.
Ratio of Site:Weather-Station Precipitation	123%	of official station, based on Thomas estimate for study area
Resulting "Effective" Precipitation (P)	35.5	in/yr (annual average)
Portion of "P" going to immediate runoff*	0%	of effective precipitation, based on high permeability of soils..
Rate of Snow Ablation (SA)	N/A	
Snowmelt Rate Coefficieint	N/A	
Depth to Till (Not Used in Model)	100	
Till Thickness (Not Used in Model)	10	
Vertical Hydraulic Conductivity of Till	N/A	
Porosity of Perched Aquifer	N/A	
Darcy Flow Coefficient for Perched Aquifer	N/A	

Method of Estimating Potential Evapotranspiration: Blaney Criddle (BC) ▼

Priestly Taylor Canopy Interception: Not Modeled ▼

Snowpack: Not Modeled ▼

Till Perching: Not Modeled ▼

RECHARGE CALCULATOR:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTALS	
Evaporation Estimates														
Monthly Temp (T, ^{o}F)	39.3	41.6	44.5	48.7	53.4	57.2	59.9	60.0	56.7	50.8	44.4	40.9	49.8	Avg. T, ^{o}F
Monthly Temp (T, ^{o}C)	4.1	5.3	6.9	9.3	11.9	14.0	15.5	15.5	13.7	10.4	6.9	4.9	9.9	Avg. T, ^{o}C
Blaney Criddle Crop Factor (k)	0.63	0.73	0.86	0.85	0.52	0.53	0.53	0.53	0.50	0.80	0.78	0.64	0.66	(Avg k)
Blaney Criddle % of Annual Light (d)	0.062	0.064	0.082	0.091	0.105	0.107	0.108	0.099	0.085	0.076	0.063	0.058	1.00	Avg d)
Priestly Taylor Net Radiation (RN)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(RN)
Potential Evapotranspiration (PET)	0.57	0.79	1.43	2.00	1.76	2.16	2.44	2.24	1.59	1.73	0.99	0.61	18.29	(PET)
Water Balance														
Effective Precipitation (P)	4.80	3.44	2.93	2.29	1.93	1.64	0.99	1.25	2.05	3.60	5.19	5.39	35.50	(P)
Interception Loss (IL)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(IL)
Average Snowpack Storage (SS)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	- - -	(SS)
Snowpack Ablation (SA)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(SA)
Snowmelt (SM)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(SM)
AvailableThroughfall (ATF)	4.80	3.44	2.93	2.29	1.93	1.64	0.99	1.25	2.05	3.60	5.19	5.39	35.50	(ATF)
Runoff (RO)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(RO)
Infiltration (I)	4.80	3.44	2.93	2.29	1.93	1.64	0.99	1.25	2.05	3.60	5.19	5.39	35.50	(I)
Average Soil Moisture in Soil Profile (SW)	5.38	5.37	5.35	5.33	5.34	5.08	4.16	3.46	3.82	5.05	5.37	5.38	4.92	(SW)
Soil Moistue Deficit (PET-P)	0.00	0.00	0.00	0.00	0.00	0.51	1.44	0.99	0.00	0.00	0.00	0.00	2.95	(PET-P)
Actual Evapotranspiration (AET)	0.57	0.79	1.43	2.00	1.76	2.16	2.19	1.53	1.17	1.65	0.99	0.61	16.84	(AET)
Shallow Recharge (RS)**	4.23	2.66	1.52	0.32	0.16	0.00	0.00	0.00	0.00	0.82	4.18	4.76	18.66	(RS)
Perched Subflow (PS)***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(PS)
Deep Recharge (RD)***	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	(RO)

ANNUAL SUMMARY	**P**	**IL**	**SM**	**ATF**	**RO**	**I**	**PET**	**AET**	**RS**	**PS**	**RD**
	35.50	**N/A**	**N/A**	**35.50**	**0.00**	**35.50**	**18.29**	**16.84**	**18.66**	**N/A**	**N/A**

NOTES:

All values used in the Evaporation Estimates, Water Balance, and Annual Summary are in inches unless otherwise noted.

Abbreviations used in the annual summary are defined in the Evaporation Estimates and Water Balance.

* Modeled runoff consists of the sum of the fixed percentage of effective precipitation going to runoff and any infiltration rejected when saturation reaches the land surface.

** For the non-perched condition, shallow recharge is the water that exits the bottom of the root zone. For the perched condition, it is the water added to the shallow, perched aquifer. Shallow recharge can be negative if perched conditions extend up into the root zone and plant transpiration removes significant amounts of water from the shallow aquifer.

*** Deep recharge is water that flows through the till layer. Perched subflow is lateral, saturated flow above the till layer to adjacent discharge points.

APPENDIX B
PROJECT WELL LOGS

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

185345

37-2W-11R

WATER WELL REPORT

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

WASHINGTON STATE DEPARTMENT OF ECOLOGY

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

● Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ________

CURRENT

Notice of Intent No. W189956

Unique Ecology Well ID Tag No. ALQ041

Water Right Permit No. Supplemental to all EWUA GW Rights

Property Owner Name Gary Clark

Well Street Address Mt Baker Road & Deye Ln

City Eastsound County San Juan

Location SE 1/4-1/4 SE 1/4 Sec 11 Twn 37 R 2 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. 271144004

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 234 ft.

Depth of completed well 230 ft.

CONSTRUCTION DETAILS

Casing Installed:

☑ Welded 12 " Diam. from +.5 ft. to 130 ft.

☐ Liner installed 8 " Diam. from +2 ft. to 140 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

Type 304 SS Model No. ____

Diam. 8-inch Slot size 30 from See Attached ft. to ___ ft.

Diam. ___ Slot size ___ from Comp.Design ft. to ___ ft.

Gravel/Filter packed: ☑ Yes ☐ No ☐ Size of gravel/sand ____

Materials placed from 230 ft. to 86 ft.

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

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? ____ Depth of strata ____

Method of sealing strata off ____

PUMP: Manufacturer's Name ____

Type: ____ H.P. ____

WATER LEVELS: Land-surface elevation above mean sea level approx 80 ft.

Static level 73.80 ft. below top of well Date 5/14/05

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? CR Hydrogeo.

Yield: 87 gal./min. with 17.35 ft. drawdown after 24 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
1	78.80	15	76.35	120	74.35
5	77.20	30	75.60	180	74.06
10	76.84	60	74.88	1445	73.76

Date of test 5/15/05 - 5/16/05

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 51 F Was a chemical analysis made? ☑ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Topsoil	0	1
Brn Silty Sand, some Gravel	1	3
Glacial Till (hardpan)	3	112
Gry. Sandy Silt	112	126
v. fine Gry. Sand, WB (dirty)	126	136
v. fine Gry. Sand with cemented layers	136	149
v. fine - fine Gry. Sand, WB	149	156
Gry. Silty Sand, WB, (tight)	156	163
v. fine to fine Gry. Sand, WB	163	213
fine to med Gry. Sand with Shell Fragments, WB	213	227
Gry. Silt	227	234
LOG FOR EWUA - Clark Production Well		
Prepared by CR Hydrogeologic Consulting		

RECEIVED
JUL 28 2005
DEPT OF ECOLOGY

Start Date 4/19/05 Completed Date 5/16/05

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) Randy Holt

Driller/Engineer/Trainee Signature ____

Driller or trainee License No. 1099

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

Drilling Company Holt Drilling | Boart Longyear

Address Po Box 1890

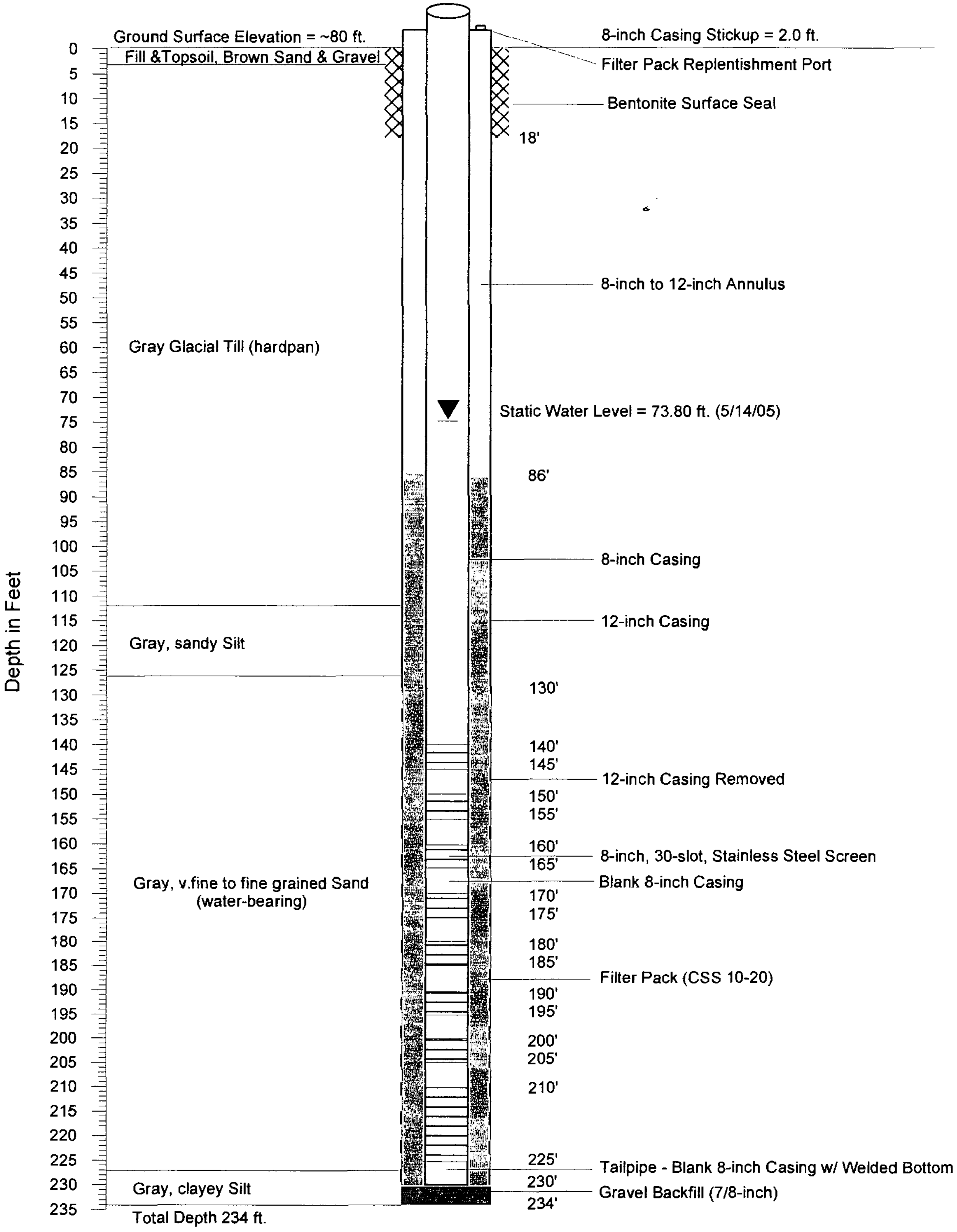
City, State, Zip Milton WA 98354

Contractor's Registration No. BoartLC055PZ Date 7-20-05

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 3/05) **The Department of Ecology does NOT warranty the Data and/or Information on this Well Report.**

EWUA - Clark Production Well
Lithologic Log and Completion Design



CR	EWUA Clark Production Well c:\clark\clarklog&designf.grf	EWUA - Clark Production Well Lithologic Log and Completion Design	Figure 2

37-2W-11L

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

121665

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No __WE00536___
Well ID No ___AGQ153_____
Water Permit No ____________
Tax Parcel No __271157004____

1 **OWNER** Name _____BARTON & SHELLEY CURTIS___ Address ___125 SEAVIEW STREET, EASTSOUND, WA 98245_______

2 **LOCATION OF WELL** County____SAN JUAN______________NE_1/4__SW_1/4 Sec_11_ T_37_ N , R _2_ W M

2a **STREET ADDRESS OF WELL** (or nearest address) _____BLANCHARD ROAD, EASTSOUND, WA 98245______________

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 _X_ Driven ___
Reconditioned ___ Rotary ___ Jetted ___

5 **DIMENSIONS** Diameter of Well _____6________ inches
Drilled __84___ feet Depth of completed well _____84_______ ft

6 **CONSTRUCTION DETAILS**
Casing Installed __6__" Diam from __+1___ft to __69__ft
Welded _X_ ______" Diam from _______ft to _______ft
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
__________ perforation from _________ft to _________ft
__________ perforation from _________ft to _________ft
__________ perforation from _________ft to _________ft

Screens Yes ____ No _X__
Manufacturer's Name _____JOHNSON____________________
Type ____STAINLESS______________ Model No ____________
Diam __6____ Slot size_0 008_ from ___69__ft to __74___ft
Diam __6____ Slot size_0 010_ from ___74__ft to __84___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 _____60________ft
Static level ___47____ft below top of well Date 8/16/02__
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 __10__ft drawdown after _1 5_hrs
Airtest _9 0__ gal /min with stem set at ______ft for ______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 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 SILTY SAND & PEBBLES	0	5
BROWN SANDY SILT	5	28
BROWN FINE SAND	28	43
BROWN CLAYEY SAND	43	61
BROWN FINE SAND (WATER BEARING)	61	72
BROWN FINE TO MEDIUM SAND (H2O BEARING)	72	84
BROWN CLAY	84	-

RECEIVED
OCT 21 2002
DEPT OF ECOLOGY

Work Started _8/3/02______ Completed __8/16/02_____

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

NAME __MARTEL WELL DRILLING______________
(Person, Firm, or Corporation) (Type or Print)

Address _P O BOX 905, FRIDAY HARBOR, WA 98250 ______

(Signed) ____________ License No _2438_
Contractor's Registration Number _MARTEWD044PA_ Date _8/23/02______

(USE ADDITIONAL SHEETS IF NECESSARY)

File Original with
Department of Ecology
Second Copy - Owner's Copy
Third Copy - Driller's Copy

WATER WELL REPORT

STATE OF WASHINGTON

Notice of Intent W102548
UNIQUE WELL I.D. # AER 014
Water Right Permit No. G1 * 03683C

(1) **OWNER:** Name East Sound water users Assoc Address P.O. Box 115 East Sound wa. 98245

(2) **LOCATION OF WELL:** County San Juan NW 1/4 NE 1/4 Sec 13 T 37 N.R. 2W WM
(2a) **STREET ADDRESS OF WELL:** (or nearest address) Corner of terril Beach Rd & Mt Baker Rd.
TAX PARCEL NO.: 271350025 37-2W-13B

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

(4) **TYPE OF WORK:** Owner's number of well (if more than one) 1R
☑ New Well ☐ Deepened ☐ Reconditioned ☐ Decommission
Method: ☐ Dug ☑ Cable ☐ Rotary ☐ Bored ☐ Driven ☐ Jetted

(5) **DIMENSIONS:** Diameter of well 12 X 8 inches
Drilled 55 feet. Depth of completed well 55 ft.

(6) **CONSTRUCTION DETAILS**
Casing Installed:
☑ Welded 12" Diam. from 1.5 ft. to 36 ft.
☐ Liner installed 8" Diam. from 3 ft. to 36 ft.
☐ Threaded " Diam. from ft. to ft.

Perforations: ☐ Yes ☑ No
Type of perforator used
SIZE of perforations in. by in.
perforations from ft. to ft.

Screens: ☑ Yes ☐ No ☐ K-Pac Location welded to Pipe
Manufacturer's Name Johnson
Type Model No.
Diam. 7 Slot Size .20 from 51 ft. to 36 ft.
Diam. Slot Size from ft. to ft.

Gravel/Filter packed: ☑ Yes ☐ No ☐ Size of gravel/sand .10-20
Material placed from 54 ft. to 24 ft.

Surface seal: ☑ Yes ☐ No To what depth? 35 ft.
Material used in seal Neat cement 5% 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 39 ft.
Static level 1 ft. below top of well Date 7-14-2000
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.
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 36 gal./min. with 22 ft. drawdown after 20 min ~~hrs.~~
Airtest 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 or DECOMMISSIONING PROCEDURE DESCRIPTION**
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.*

MATERIAL	FROM	TO
Sand, Brn, med	0	5
Tan clay Rocks & Gravel	5	15
Blue clay, Big Rocks	15	36
Silty Sand - Brn,		
Becoming Slightly courser		
with Depth -	36	49
Sand, Course Gravel,		
Small Rocks - Grey	49	55
Silt Bound or Cemented		

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JUL 20 2000
Department of Ecology

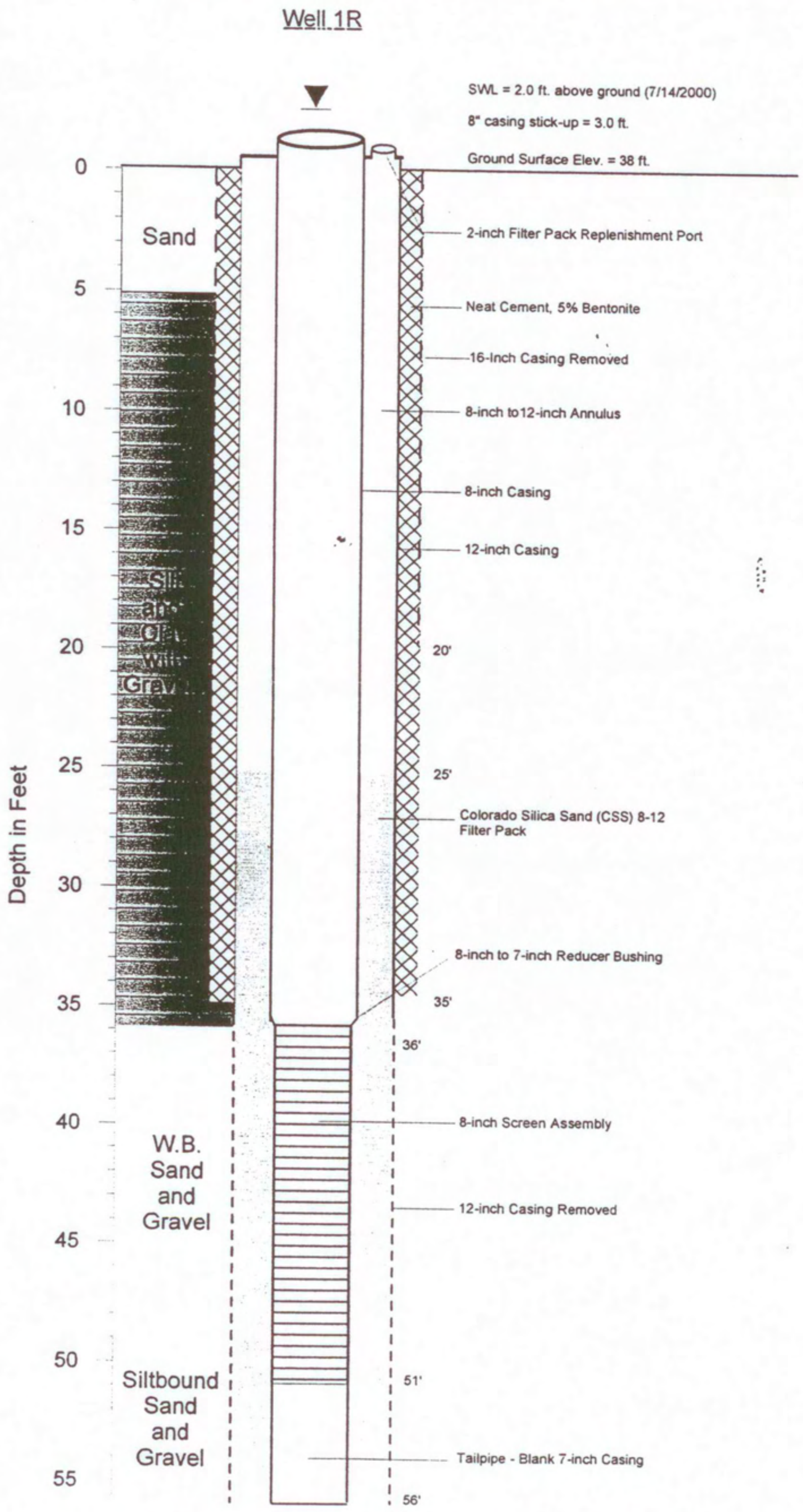
Work Started 8-16-99 Completed 7-16-2000

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.

Type or Print Name Mark Sawyer License No. 2461
(Licensed Driller/Engineer)
Trainee Name License No.
Drilling Company M. Sawyer Drilling & Pump Svc Inc
(Signed) Mark Saw License No. 2461
(Licensed Driller/Engineer)
Address 621 obstruction pass Rd Olga wa.
Contractor's Registration No. MSAWYDS055NB Date 7-17-2000

(USE ADDITIONAL SHEETS IF NECESSARY)



CR

EWUA
Well 1R Report
c:\eastsound\well1r\lthcmp.grf

Well 1R Lithologic Log and Completion Diagram

Figure 2

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

SWL

EWUAA4

WATER WELL REPORT

STATE OF WASHINGTON

Application No. 10786 #4

Permit No. 10586

(1) OWNER: Name EAST. SOUND WATER USER Address P.O. Box 115 EAST SOUND Wash. 98245

(2) LOCATION OF WELL: County SAN JUAN — SE ¼ NW ¼ Sec. 11 T. 37 N., R. 2W. W.M.

Bearing and distance from section or subdivision corner 240' NORTH AND 500 Feet East from Govt Lot 3, Sec 11

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

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 250 ft. Depth of completed well 35 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8" Diam. from 0 ft. to 63 ft.
Threaded ☐ " Diam. from ft. to ft.
Welded ☒ " Diam. from ft. to ft.

Perforations: Yes ☒ No ☐
Type of perforator used
SIZE of perforations 1 in. by 3/4 in.
perforations from ft. to ft.
perforations from ft. to ft.
perforations from ft. to ft.

Screens: Yes ☒ No ☐
Manufacturer's Name Johnson
Type Stainless Steel Model No.
Diam. 8 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? ft.
Material used in seal
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 6 ft. below top of well Date April 1972
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 35 gal./min. with 12 ft. drawdown after 4 hrs.
Artesian flow g.p.m. Date March 20 1972
Temperature of water Was a chemical analysis made? Yes ☐ No ☒ [✓ No]

OK

(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
Clay	0	5
Sand Gravel	5	63
Rock	63	187'
No Water in Rock	63	250'
Well Was Pulled Back To 63 feet and perforated At 35 feet in Sand and Gravel. Rock Hole Was filled With Sand and Gravel.		

SWL = 6

Work started March 15 1972 completed April 1 1972

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 GEORGE H. BROWN Well Drilling Deer Harbor, Washington (Person, firm, or corporation) (Type or print)

Address

[Signed] George H Brown (Well Driller)

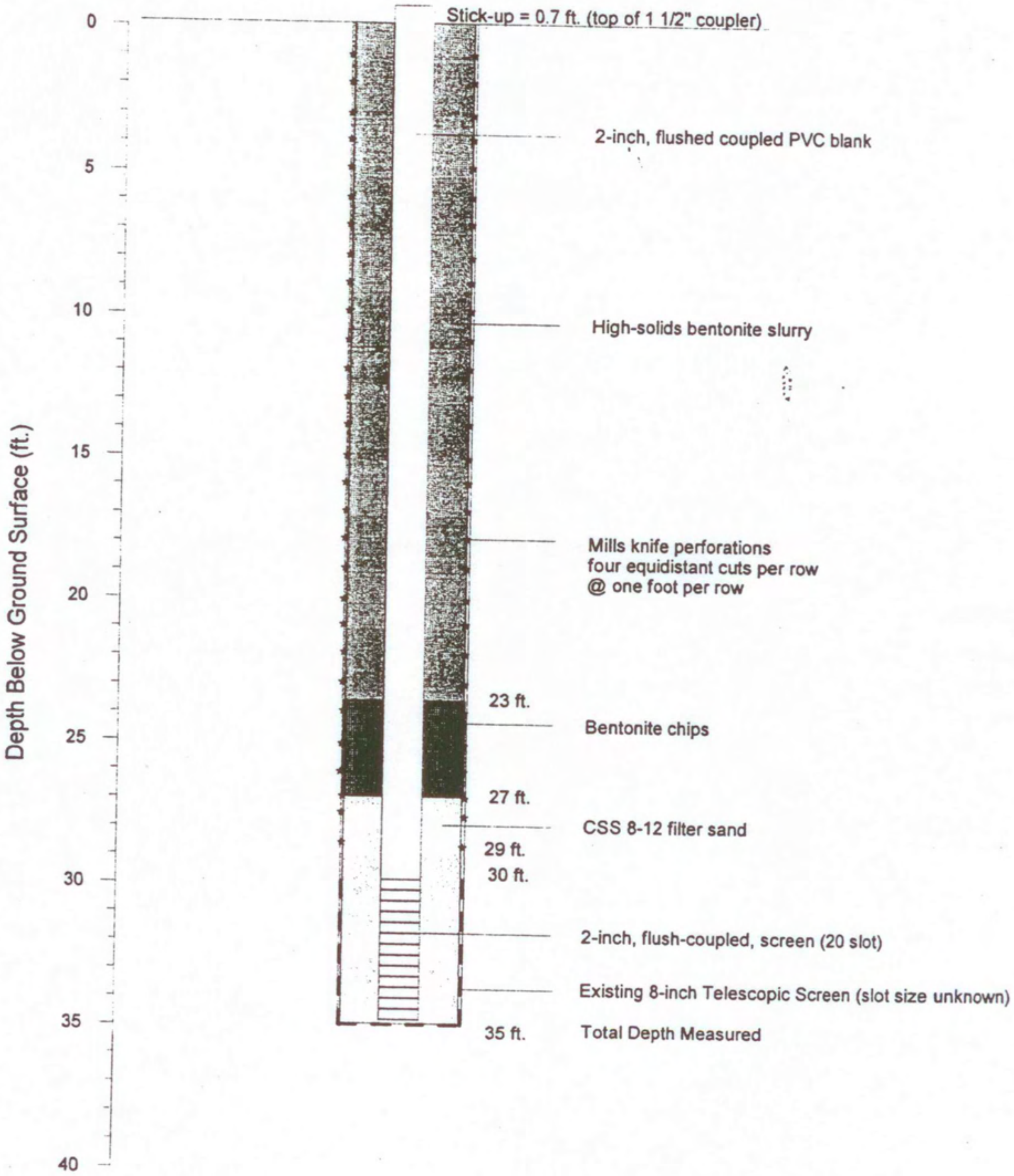
License No. Date Nov 25, 1972

(USE ADDITIONAL SHEETS IF NECESSARY)

S.F. No. 7356—OS—(Rev. 4-71).

3

EWUA Well 4
Conversion Construction Details



CR Hydrogeologic Consulting

Conversion date 5/3/04

File Original and First Copy with Department of Ecology
Second Copy — Owner's Copy
Third Copy — Driller's Copy 37/2W/11/P

WATER WELL REPORT EWUA#5

STATE OF WASHINGTON

37/02W – 11P
Application No.
Permit No.

(1) OWNER: Name EAST SOUND WATER DEP. Address ORCAS, WASHINGTON 98245

(2) LOCATION OF WELL: County San Juan (Buena Vista Hts.) site 14 ¼ ..... ¼ Sec ..... T ..... N., R ..... W.M.

Bearing and distance from section or subdivision corner SE¼ SW¼ Sec 11, T37N, R2W

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

(4) TYPE OF WORK: Owner's number of well (if more than one) 5 74
New well ☑ Method: Dug ☐ Bored ☐
Deepened ☐ Cable ☑ Driven ☐
Reconditioned ☐ Rotary ☐ Jetted ☐

(5) DIMENSIONS: Diameter of well 8 inches.
Drilled 120 ft. Depth of completed well 115 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 8 " Diam. from +2 ft. to 105 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 Cook
Type ..... Model No.
Diam. 8" Slot size 80 from 105 ft. to 115 ft.
Diam. ..... Slot size ..... from ..... ft. to ..... ft.

Gravel packed: Yes ☑ No ☐ Size of gravel:
Gravel placed from 118 ft. to 115 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.... 105 ft.
Static level 90 ft. below top of well Date 8/24/74
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 ☐ If yes, by whom? M Martel

Yield: gal./min. with	ft. drawdown after	hrs.
" 65 "	20 "	8 "
" "	"	"

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.
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
Sandy top soil	0	2
sand & small rocks	2	6
brown clay & sand	6	90
blue clay	90	107
thin layer of gravel on clay		
3 to 5 gpm		
water baring sand	107	114
clay	114	118
water & fine sand	118	120

Work started 2/1/, 1974 Completed 8/27/, 1974

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 Martel Well Drilling Inc.
(Person, firm, or corporation) (Type or print)

Address Box 55 Friday Harbor 98250

[Signed]
(Well Driller)

License No. 0292 Date 9/4/, 1974

(USE ADDITIONAL SHEETS IF NECESSARY)

S. F. No. 7356—OS—(Rev. 4-71).

Fisher Well

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

ENTERED

WATER WELL REPORT
STATE OF WASHINGTON

Start Card No. W102527
UNIQUE WELL I.D. # AEC764
Water Right Permit No. 37-2W-11R

(1) **OWNER:** Name Ed Sullivan Address P.O. Box 1018 East Sound Wa 98245

(2) **LOCATION OF WELL:** County SAN Juan . SWE 1/4 SWE 1/4 Sec 11 T. 37 N., R 2W W.M.
SE SE

(2a) **STREET ADDRESS OF WELL** (or nearest address) Mt Baker Hwy.

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

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

(5) **DIMENSIONS:** Diameter of well 6 inches.
Drilled 130 feet. Depth of completed well 127 ft.

(6) **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from +1.5 ft. to 120 ft.
Welded ☑ " Diam. from ft. to ft.
Liner installed ☐ " Diam. from ft. to ft.
Threaded ☐

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
Type Model No.
Diam. 5 Slot size .04 from 117 ft. to 127 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 Bentoik
Did any strata contain unusable water? Yes ☐ No ☑
Type of water? Depth of strata
Method of sealing strata off

(7) **PUMP:** Manufacturer's Name Areo moter
Type: T5-12 H.P. 1/2

(8) **WATER LEVELS:** Land-surface elevation above mean sea level 90 ft.
Static level 80 ft. below top of well Date 11-12-98
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 15 gal./min. with stem set at 126 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
TOP Soil	0	2
Sand & Gravel	2	6
Tan Clay	6	17
Blue Clay	17	62
Silty Blue Clay	62	75
Fine Grey Sand	75	130

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FEB 23 1999
DEPT OF ECOLOGY

Work Started 11-6, 19. Completed 11-9, 19 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 M.Sawyer Drilling & Pump Svc Inc (PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address HC Box 160 olga Wa 98279
(Signed) Mark (WELL DRILLER) License No. 2461
Contractor's Registration No. MSAWYDS055ND Date 12-20, 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.

ECY 050-1-20 (9/93)

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

WATER WELL REPORT

37/2/12J

STATE OF WASHINGTON

Start Card No : 074937
Water Permit No ________

1. **OWNER :** Name: HARRY GREER Address: P.O. BOX 136, EASTSOUND, WA 98245.

2. **LOCATION OF WELL :** County SAN JUAN , NE 1/4 SE 1/4 Sec 12 T 37 N., R 2 W.M.

2a. **STREET ADDRESS OF WELL** (or nearest address) ANDERSEN ROAD

3. **PROPOSED USE:** _X_ Domestic ___ Industrial ___ Municipal ___
___ Irrigation ___ Test Well ___
___ DeWater

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JUN 18 1993
DEPT. OF ECOLOGY

4. **TYPE OF WORK:** Owner's number of well (if more than one) ________
Abandoned ___ New Well _X_ Method: Dug
Deepened ___ Cable _X_ Driven ___
Reconditioned ___ Rotary ___ Jetted ___

5. **DIMENSIONS:** Diameter of well 6 inches.
Drilled 101 feet. Depth of completed well 101 ft

6. **CONSTRUCTION DETAILS:**
Casing installed: 5 " Diam. from +1 ft. to 91 ft.
Welded _X_ ___ " Diam. from ___ ft. to ___ ft.
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.
___ perforation from ___ ft to ___ ft.
___ perforation from ___ ft to ___ ft.
___ perforation from ___ ft to ___ ft.

Screens: Yes _X_ No ___
Manufacturer's Name JOHNSON
Type STAINLESS Model No ___
Diam 6 Slot size 18 from 91 ft. to 101 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 60 ft
Static level 56 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 12.0 gal./min. with 2 ft. drawdown after 1 hrs
Airtest ___ gal./min. with stem set at ___ ft. for ___ hrs
Artesian flow ___ g.p.m. Date ___
Temperature of water ___ Was a chemical analysis made? 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
LIGHT BROWN SAND	0	1
LIGHT BROWN CLAYEY SILTY GRAVEL	1	36
GREY SILT	36	90
GREY MEDIUM SAND & SMALL GRAVEL	90	101

Work started : MAY 16, 1993. Completed : MAY 19, 1993.

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.

NAME : MARTEL WELL DRILLING INC.
(Person, Firm, Or Corporation) (Type Or Print)

Address : P.O. BOX 905, FRIDAY HARBOR, WA 98250.

(Signed) Al Martel Liscense No. : 0541
(Well Driller)

Contractor's Registration Number : MARTEWD121QZ Date : MAY 19, 1993

(USE ADDITIONAL SHEETS IF NECESSARY)

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

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

WATER WELL REPORT

37/2/12J

STATE OF WASHINGTON

Start Card No [redacted]
Water Permit No ________

1. **OWNER :** Name: HARRY GREER Address: P.O. BOX 136, EASTSOUND, WA 98245.

2. **LOCATION OF WELL :** County SJ . NE 1/4 SE 1/4 Sec 12 T 37 N., R 2 W.M.

2a. **STREET ADDRESS OF WELL** (or nearest address) NORTH BEACH, ORCAS ISLAND.

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) ________
Abondoned ___ New Well X Method: Dug ___ Bored ___
Deepened ___ Cable X Driven ___
Reconditioned ___ Rotary ___ Jetted ___

5. **DIMENSIONS:** Diameter of well 6 inches.
Drilled 89 feet. Depth of completed well 89 ft

6. **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from +1 ft. to 84 ft.
Welded X ___ " Diam. from ___ ft. to ___ ft.
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.
______ perforation from ______ ft to ______ ft.
______ perforation from ______ ft to ______ ft.
______ perforation from ______ ft to ______ ft.

Screens: Yes X No ___
Manufacturer's Name SMITH
Type STAINLESS Model No ________
Diam 6 Slot size 20 from 84 ft. to 89 ft.
Diam ___ Slot size ___ from ___ ft. to ___ ft.

Gravel packed: Yes ___ No X Size of gravel ______
Gravel placed from ______ ft. to ______ ft.

Surfact Seal: Yes X 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 70 ft
Static level 52 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 12.0 gal./min. with 1 ft. drawdown after 2 hrs
Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs
Artesian flow ______ g.p.m. Date ______
Temperature of water ___ Was a chemical analysis made? 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
BROWN SILTY SAND & GRAVEL	0	8
BROWN CLAYEY SAND & GRAVEL	8	38
GREY CLAYEY SILT	38	82
GREY COARSE SAND & SMALL GRAVEL	82	89

RECEIVED
DEC 21 1992
DEPT. OF ECOLOGY

Work started : NOVEMBER 29, 1992. Completed : DECEMBER 4, 1992.

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.

NAME : MARTEL WELL DRILLING INC.
(Person, Firm, Or Corporation) (Type Or Print)

Address : P.O. BOX 905, FRIDAY HARBOR, WA 98250.

(Signed) ________ Liscense No. : 1923
(Well Driller)

Contractor's Registration Number : MARTEWD121DZ Date : DECEMBER 4, 1992.

(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

ENTERED

STATE OF WASHINGTON NAPA WELL

Start Card No. W106223
Well ID No. ACW193
Water Permit No. ______
Tax Parcel No. ______

1. **OWNER:** Name: PERRY & MARY PUGH Address: P.O. BOX 92, EASTSOUND, WA 98245
2. **LOCATION OF WELL:** County SAN JUAN SE 1/4 SW 1/4 Sec 11 T 37 N., R 2 W.M.

37-2E-11P

2a. **STREET ADDRESS OF WELL** (or nearest address) MT BAKER RD

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 _X_ Driven ___
Reconditioned ___ Rotary ___ Jetted ___

5. **DIMENSIONS:** Diameter of Well 6 inches.
Drilled 97 *feet. Depth of completed well* 91 *ft.*

6. **CONSTRUCTION DETAILS:**
Casing installed: 6 " Diam. from +1 ft. to 86 ft.
Welded _X_ ___ " Diam. from ___ ft. to ___ ft.
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.
___ perforation from ___ ft. to ___ ft.
___ perforation from ___ ft. to ___ ft.
___ perforation from ___ ft. to ___ ft.

Screens: Yes _X_ No ___
Manufacturer's Name JOHNSON
Type STAINLESS Model No. ______
Diam. 6 Slot size 12 from 86 ft. to 91 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 NEAT CEMENT
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 82 ft.
Static level 60 ft. below top of well Date: 3/23/99
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 1500 gal./DAY. with 25 ft. drawdown after 2 hrs.
Airtest ___ gal./min. with stem set at ___ ft. for ___ hrs.
Artesian flow ___ g.p.m. Date ______
Temperature of water ___ *Was a chemical analysis made? Yes* ___ No _X_

10. ***WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION***
Formation: Describe 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 SILTY CLAYEY SAND & GRAVEL	0	6
BROWN SILTY SAND	6	14
GRAY SANDY CLAY	14	39
GRAY TILL	39	65
GRAY SILTY SAND (SMALL AMT H2O)	65	92
GRAY ROCK	92	97
(HOLE BACKFILLED TO 91 FT WITH BENTONITE CHIPS)		

RECEIVED
JUN 14 1999
DEPT OF ECOLOGY

SALINITY TEST ______ PPM

Work Started: 3/11/99 Completed: 3/23/99.

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

NAME : MARTEL WELL DRILLING
(Person, Firm, or Corporation) (Type or Print)

Address : P.O. BOX 905, FRIDAY HARBOR, WA 98250.

(Signed) Dave ______ License No. : 2483
Contractor's
Registration Number : MARTEWD044PA Date: ______

(USE ADDITIONAL SHEETS IF NECESSARY)

37-2W-14 #

Please print, sign and return to the Department of Ecology

WASHINGTON STATE DEPARTMENT OF ECOLOGY

Water Well Report

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

Construction/Decommission 172910

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ______

Current Notice of Intent No. W 182465

Unique Ecology Well ID Tag No. AHH572

Water Right Permit No. ______

Property Owner Name Beemer & Minnis

Well Street Address ______

City East Sound County San Juan

Location SE 1/4-1/4 NE 1/4 Sec 14 Twn 37 R 2 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. ______

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 113 ft.

Depth of completed well 113 ft.

CONSTRUCTION DETAILS

Casing Installed:

☑ Welded 6" Diam. from +1 ft. to 98 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

Type Telescoping Model No. ______

Diam. 6 Slot size 6 from 98 ft. to 103 ft.

Diam. 6 Slot size 8 from 103 ft. to 113 ft.

Gravel/Filter packed: ☐ Yes ☑ No ☐ Size of gravel/sand ______

Materials placed from ______ ft. to ______ ft.

Surface Seal: : ☑ Yes ☐ No To what depth? ~~38~~ 23

Material used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☑ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP: Manufacturer's Name ______

Type: ______ H.P. ______

WATER LEVELS: Land-surface elevation above mean sea level 60 ft.

Static level 35 ft. below top of well Date 3-11-05

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 30+ gal./min. with 15 ft. drawdown after 2 hrs.

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

Artesian flow ______ g.p.m. Date ______

Temperature of water ______ Was a chemical analysis made? ☐ 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
light brown clayey gravel	0	3
Tan silt, sand, gravel and cobble till	3	13
Gray clayey silt, sand & gravel	13	84
Gray silty sand w/ clay lenses	84	87
Gray fine sand	87	111
Gray clayey silt, sand & grabel	111	113

RECEIVED

MAY 25 2005

DEPT OF ECOLOGY

Start Date 3-1-05 Completed Date 3-11-05

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) Ken Engle

Driller/Engineer/Trainee Signature Ken Engle

Driller or trainee License No. 1390

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

Drilling Company M. Sawyer Drilling & Pump Svc Inc

Address 77 EJ Young Rd

City, State, Zip Olga WA. 98279

Contractor's Registration No. MSAWYDS055NJ3 Date 4-25-05

Ecology is an Equal Opportunity Employer.

ECY 050-1-20 (Rev 2/03)

37-2W-14A

WATER WELL REPORT

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

Construction/Decommission (x in circle) 149033

☒ Construction

○ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number* ______

CURRENT Notice of Intent No W175758

Unique Ecology Well ID Tag No AHH 533

Water Right Permit No ______

Property Owner Name Steve Pearson

Well Street Address Enchanted Forrest Rd

City Eastsound County San Juan

Location NE 1/4 1/4 NE 1/4 Sec 14 Twn 37 R 2 EWM [✓ WWM] circle one

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

Long Deg ______ Long Min/Sec ______

Tax Parcel No 271412007

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 380 ft

Depth of completed well 62 ft

CONSTRUCTION DETAILS

Casing Installed ☒ Welded 6" Diam from +2 ft to 102 ft

☐ Liner installed ______ Diam from ______ ft to ______ ft

☒ Threaded PVC 4" Diam from +1 ft to 62 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 4 Slot Size 10 from 52 ft to 62 ft

Diam ______ Slot Size ______ from ______ ft to ______ ft

Gravel/Filter packed ☒ Yes ☐ No ☐ Size of gravel/sand 10-20

Materials placed from 25 ft to 62 ft

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

Materials used in seal Bentonite

Did any strata contain unusable water? ☐ Yes ☐ No

Type of water? ______ Depth of strata ______

Method of sealing strata off ______

PUMP Manufacturer's Name ______

Type ______ H P ______

WATER LEVELS Land-surface elevation above mean sea level 54 ft

Static level 0 ft below top of well Date ______

Artesian pressure ______ lbs per square inch Date ______

Artesian water is controlled by CAP (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 1.4 gal /min with stem set at ______ ft for ______ hrs

Artesian flow .3 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
Fill	0	1
Pete	1	3
Blue Clay	3	48
Silt & Blue Clay	48	52
Rock Soft /	52	160
Caving –		
Sand Stone	160	380
Hydrofractured &		
well caved in 2 Days		
later – casing cut at		
63' [illegible] Bottom of		
Hole Abandond with		
Bentonite – 4" PVC installed		
with 10 ft of Screen &		
Gravel Packed – steel casing		
Pulled to 25'		

RECEIVED

MAY 13 2004

DEPT OF ECOLOGY

Start Date 2-5-04 Completed Date 4-12-04

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) Mark Sawyer

Driller/Engineer/Trainee Signature

Driller or Trainee License No 2461

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

Drilling Company M Sawyer Drilling & Pump Service

Address 621 obstruction Pass Rd

City, State, Zip Olga wa 98279

Contractor's Registration No MSawyDS055wr Date 5-11-04

Ecology is an Equal Opportunity Employer ECY 050 1 20 (Rev 4/01)

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

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

181460

37-2W-13D

WASHINGTON STATE DEPARTMENT OF ECOLOGY

WATER WELL REPORT

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

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

● Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____________

CURRENT
Notice of Intent No. WE03427

Unique Ecology Well ID Tag No. ALQ042

Water Right Permit No. Supplemental to all EWUA GW Rights

Property Owner Name Eastsound School District

Well Street Address Mt Baker Road @ Buck Park

City Eastsound County San Juan

Location NW1/4-1/4 NW1/4 Sec 13 Twn 37 R 2 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. P271322002

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 158 ft.
Depth of completed well 146 ft.

CONSTRUCTION DETAILS

Casing Installed: ☑ Welded 6 " Diam. from +2 ft. to 110 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
Type 304 SS Model No. ______
Diam. 6" PS Slot size 6 from 110 ft. to 120 ft.
Diam. 6"PS Slot size 4 from 120 ft. to 140 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
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 approx 60 ft.
Static level 53.63 ft. below top of well Date 6/14/05
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? CR Hydrogeo.
Yield: 73 gal./min. with 26.98 ft. drawdown after 24 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
1	78.80	15	76.35	120	74.35
5	77.20	30	75.60	180	74.06
10	76.84	60	74.88	1445	73.76

Date of test 6/14/05 - 6/15/05
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 51 F Was a chemical analysis made? ☑ Yes ☐ No

CONSTRUCTION OR DECOMMISSION PROCEDURE

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

MATERIAL	FROM	TO
Brn. Silty Clay	0	17
Brn. Silty Sand	17	75
Brn. fine to med. Sand	75	118
Gry. v. fine to fine Sand	118	158
LOG FOR EWUA - Eastsound School Well		
Prepared by CR Hydrogeologic Consulting		

RECEIVED
JUL 28 2005
DEPT OF ECOLOGY

Start Date 5/10/05 Completed Date 6/15/05

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) Randy Holt
Driller/Engineer/Trainee Signature
Driller or trainee License No. 1099

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

Drilling Company Holt Drilling/Boart Longyear
Address PO Box 1890
City, State, Zip Milton WA 98354
Contractor's Registration No. BOARTLL2055PZ Date 7-20-05

Ecology is an Equal Opportunity Employer.

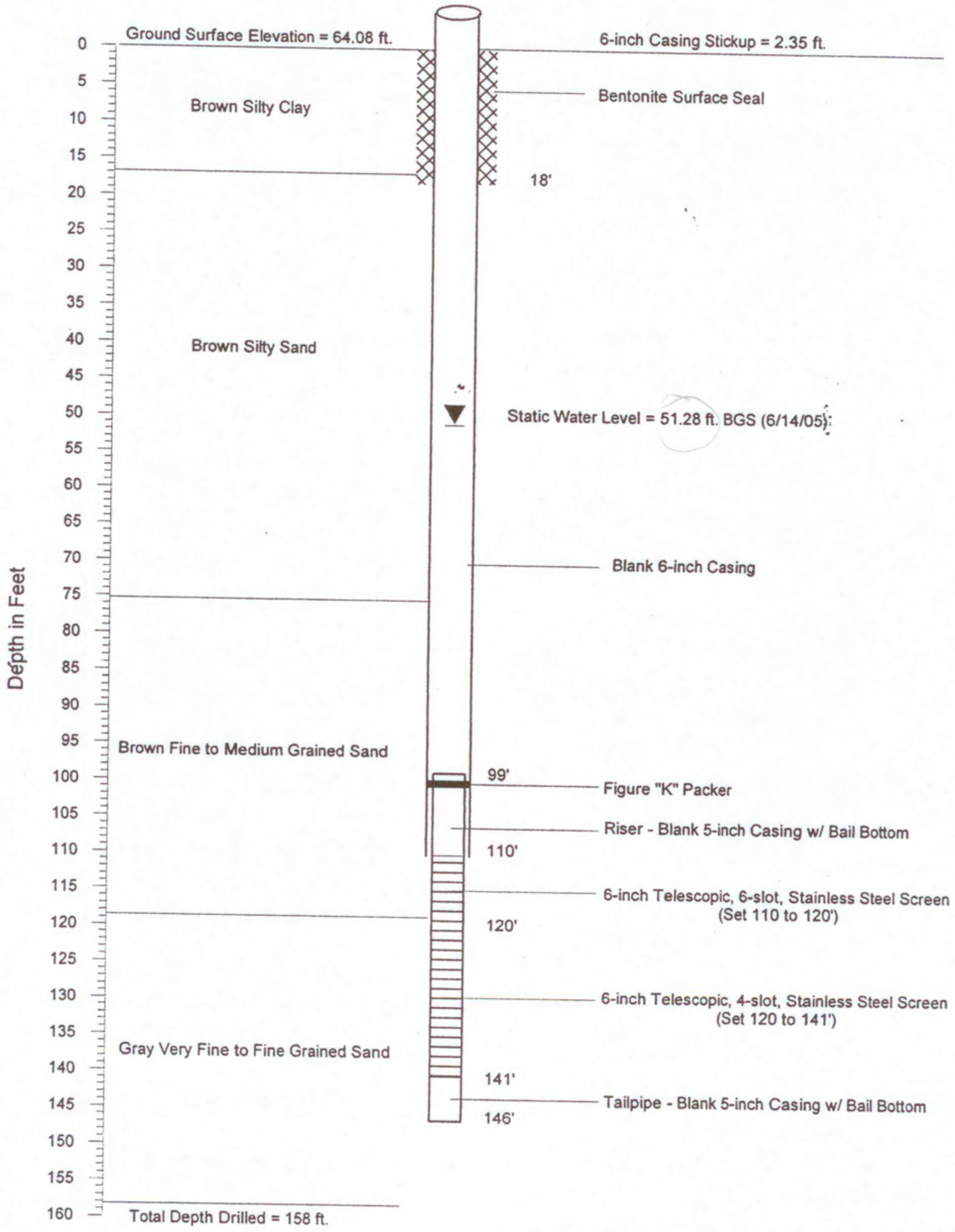
ECY 050-1-20 (Rev 3/05)

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

School Well

ALB 042

Eastsound School Well
Lithologic Log and Completion Design



CR	EWUA Eastsound School Well c:\OISD\esschoollog&designf.grf	Eastsound School Well Lithologic Log and Completion Design	Figure 2

37-2W-140

Please print, sign and return to the Department of Ecology

Water Well Report

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

Construction/Decommission 172920

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

Current Notice of Intent No. W182485
Unique Ecology Well ID Tag No. AHH580
Water Right Permit No. ______
Property Owner Name Rob Harlow
Well Street Address 1725 Mt Baker Rd
City East Sound County San Juan
Location NW 1/4-1/4 NW 1/4 Sec 14 Twn 37 R 2 ☐ 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. 271422008002

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 85 ft.
Depth of completed well 85 ft.

CONSTRUCTION DETAILS
Casing Installed: ☒ Welded 6" Diam. from +1.5 ft. to 75 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 74'
Manufacturer's Name John
Type Stainless Steel Model No. ______
Diam. 5 Slot size 20 from 80 ft. to 85 ft.
Diam. 5 Slot size 16 from 75 ft. to 80 ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 23 ft.
Material used in seal Bentonite
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? ______ Depth of strata ______
Method of sealing strata off ______

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

WATER LEVELS: Land-surface elevation above mean sea level 135 ft.
Static level 40 ft. below top of well Date 5-5-05
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 20 gal./min. with 15 ft. drawdown after 3 hrs.
Airtest ______ gal./min. with stem set at ______ ft. for ______ hrs.
Artesian flow ______ g.p.m. Date ______
Temperature of water ______ Was a chemical analysis made? ☐ 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
Sandy Loam	0	2
Tan Gravel w/Sand	2	6
tan Silty Clay w/ Sand & Gravel	6	16
Grey Gravely Clay	16	56
Grey Gravely Clay w/ lenses of med Coarse Sand	56	60
Grey Gravely clay	60	68
Grey Gravely tight Clay	68	77
Gravel med Coarse Sand	77	84
grey med-Coarse Silty Sand w/Clay lenses	84	85

RECEIVED
MAY 25 2005
DEPT OF ECOLOGY

Start Date 4-29-05 Completed Date 5-5-05

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) Ken Engle
Driller/Engineer/Trainee Signature Ken Engle
Driller or trainee License No. 1390

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

Drilling Company M. Sawyer Drilling & Pump Svc
Address 77 EJ Young Rd
City, State, Zip Olga WA 98279
Contractor's Registration No. MSAW4DS055NB Date 5-17-05

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

37-2W-12R

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

137862

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No __WE00631____
Well ID No ____AKY639______
Water Permit No ____________
Tax Parcel No __271244001_____

1 **OWNER:** Name _____ALEXANDRINA PATTY_______ Address ___P O BOX 1661, EASTSOUND, WA 98245___________

2 **LOCATION OF WELL:** County_____SAN JUAN_______________SE_1/4__SE_1/4 Sec_12_ T_37_ N , R _2_ W M

2a **STREET ADDRESS OF WELL** (or nearest address) _____TERRILL BEACH ROAD, EASTSOUND, WA 98245___________

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 _X_ Driven ___
Reconditioned ___ Rotary ___ Jetted ___

5. **DIMENSIONS:** Diameter of Well _____6________ inches
Drilled __43___ feet Depth of completed well ______43________ ft

6. **CONSTRUCTION DETAILS:**
Casing installed: __6___" Diam from __+1___ft. to __38__ft
Welded _X_ ______" Diam from _______ft to _______ft
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
___________ perforation from __________ft to __________ft
___________ perforation from __________ft to __________ft
___________ perforation from __________ft to __________ft

Screens: Yes ____ No _X__
Manufacturer's Name ___JOHNSON______________________
Type ___STAINLESS_______________ Model No ____________
Diam ___6___ Slot size___12__ from __38___ft to __43___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 _____40_______ft
Static level ___8_____ft below top of well Date 8/14/03_
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 __4___ gal /min with __22__ft drawdown after _1 5_hrs
Airtest ______ gal /min with stem set at ______ft for _____hrs
Artesian flow __________ g p m Date ____________
Temperature of water _____ Was a chemical analysis made? Yes ___ No _X_

10 **WELL LOG or ABANDONMENT PROCEDURE DESCRIPTION**

Formation Describe 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
DARK BROWN SANDY LOAM	0	1
LIGHT BROWN SILTY SAND	1	5
LIGHT BOOWN SILTY CLAY	5	16
GRAY SILTY CLAY	16	37
GRAY MEDIUM SAND & SMALL GRAVEL	37	43
GRAY TILL	43	-

RECEIVED
AUG 25 2003
DEPT OF ECOLOGY

Work Started _8/2/03______ Completed __8/14/03_____

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

NAME ___MARTEL WELL DRILLING__________________
(Person, Firm, or Corporation) (Type or Print)

Address _P O BOX 905, FRIDAY HARBOR, WA 98250 _____

(Signed) ________________ License No _2438_
Contractor's Registration Number _MARTEWD044PA_ Date· __8/20/03______

(USE ADDITIONAL SHEETS IF NECESSARY)

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

32-2W-12E

95885

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. 121739
UNIQUE WELL I D # AFR934
Water Right Permit No

(1) **OWNER** Name Eastsound Water Users Association Address PO Box 115, Eastsound, WA 98245

(2) **LOCATION OF WELL** County San Juan - SW 1/4 NW 1/4 Sec 12 T 37 N R 2W WM

(2a) **STREET ADDRESS OF WELL** (or nearest address) 1,000' east of intersections @ North Beach Rd. and Bartel Rd.

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

(4) **TYPE OF WORK** Owner's number of well (If more than one) Klein Test Well 13
Abandoned ☐ New well XX Deepened ☐ Reconditioned ☐
Method Dug ☐ Cable ☒ Rotary ☐ Bored ☐ Driven ☐ Jetted ☐

(5) **DIMENSIONS** Diameter of well 8 inches
Drilled 230 feet. Depth of completed well 228 ft

(6) **CONSTRUCTION DETAILS**
Casing installed 8 " Diam from +2 ft to 210 ft
Welded ☐ Diam from ft to ft
Liner installed ☐ Diam from ft to ft
Threaded ☐

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 XX No ☐
Manufacturer's Name Johnson
Type 304 Stainless Steel Model No
Diam 7" Slot size 0.010 from 210 ft to 220 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
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 approx. 120 ft
Static level 118.65 ft below top of well Date 3/14/01
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 XX No ☐ If yes, by whom? CDM
Yield 42.5 gal/min with 63.42 ft drawdown after 29.5 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
1	170.51	20	143.19	120	136.29
5	151.04	40	140.40	240	134.20
10	145.75	60	138.79	480	132.54

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 10°C Was a chemical analysis made? Yes XX 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
Topsoil	0	2
Brn sand & gravel w/cobbles, dry	2	10
Brn sand, some silt, weathered, dry	10	49
Gray sandy silt	49	57
Gray hard clay	57	65
Brn sandy silt	65	74
Brn sand, clean, dry	74	78
Brn-grn sandy silt	78	86
Grn sandy silt, hard	86	106
Grn silty clay	106	113
Grn silty clay, some Sand/Grvl Seams	113	141
Gray clay	141	167
Gray siltbound sand & gravel	167	170
Gray siltbound sand/grvl, silt sms	170	200
Interbedded lyrs of siltbound grvl and w-bearing sand seams	200	208
Fine-Coarse sand & gravel	208	211
Siltbound sand & gravel	211	213
Fine-Coarse sand & gravel, w-brng	213	220
Siltbound snd & grvl w/w-b sand	220	230

RECEIVED
MAY 10 2001
DEPT OF ECOLOGY

EIVED
10 2001
F ECOLOGY

Work Started 2/13/2001, 19 Completed 3/15/2001, 19

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 Holt Drilling Inc (PERSON FIRM OR CORPORATION) (TYPE OR PRINT)
Address PO Box 1890
(Signed) (WELL DRILLER) License No 1099
Contractor's Registration No HOLTDI 1360G Date 4/18, 19 01

(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

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