
Hydrogeology and Potential for Groundwater Recharge and Storage on Alluvial Fans in the Yakima Basin

Part 2: Assessing Potential for Managed Aquifer Recharge on the Manastash Alluvial Fan: A Geochemical Analysis

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EXECUTIVE SUMMARY

Securing the future water supply for agriculture, domestic use, instream flow and habitat in the Yakima Basin is the focus of coordinated efforts under the Yakima Basin Integrated Plan (YBIP). Managed aquifer recharge (MAR) is a sustainable and cost-effective approach to store water underground for recovery or supplementation of instream flows during seasonal dry periods or drought. This project characterized the hydrogeology, aquifer stratigraphy, and geochemistry of two large alluvial fan aquifers in the Yakima Basin to assess their potential for groundwater recharge and storage (Fig. 1).

We analyzed the physical characteristics and hydrology of the Ahtanum Creek alluvial fan in the Yakima Valley and Manastash Creek alluvial fan in the Kittitas Valley to provide the foundation for an informed decision about the implementation of MAR projects. We combined existing data from wells logs, maps and reports with new data on sediment

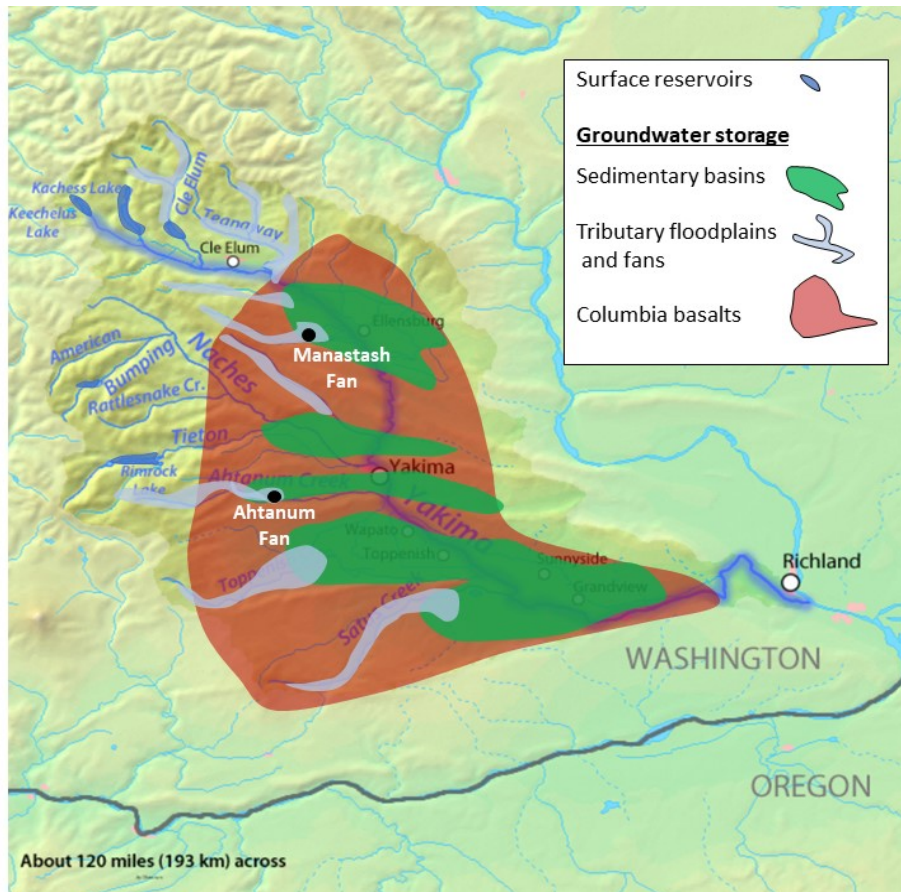


Figure 1. Map of alluvial fans and sedimentary basins in the Yakima River Basin. Schematic map of potential groundwater storage reservoirs in alluvial fans and sedimentary basins in the Yakima River Basin. The Ahtanum and Manastash Creek alluvial fans are labeled.

characteristics, water levels and geochemistry to identify areas with suitable permeability rates, head space and surface water penetration into the unconfined aquifer.

The two chapters of this report cover the potential for MAR and the locations of promising recharge sites on each of the alluvial fans by addressing the following:

- The effects of the physical properties of the alluvial fan and the human-built water infrastructure on groundwater recharge and storage.
- The use of geochemistry to interpret general patterns of infiltration and mixing of surface water with groundwater.
- Identifying locations for potential storage at different points on the alluvial fans and estimating the travel time of stored water to nearby streams.

Part 1 (see Volume 1 of the Project Report). Hydrogeochemical Characterization of the Ahtanum Alluvial Fan for Managed Aquifer Recharge

Part 1 of this project report (see Volume 1) evaluates the recharge potential of the Ahtanum Creek alluvial fan within the lower Ahtanum Sub-Basin by integrating geologic, hydraulic, and geochemical data. Four main hydrogeologic units (unconsolidated, semi-consolidated, consolidated basin-fill deposits, and Columbia River Basalt aquifers) were identified from stratigraphic analysis of well logs across seven transects spanning the active fan surfaces and elevated alluvial terraces of the alluvial fan.

Stable isotope ($\delta^{18}\text{O}$, δD) and major ion analyses of 25 groundwater and eight surface-water samples defined six hydrochemical groups (A-F) exhibiting various degrees of surface-water and groundwater interaction. Groups A, B, D, and E show heavy to moderate isotopic and nitrate (NO_3^-) signatures indicative of some modern surface-water recharge. Group A, located in the active floodplain, is associated with highly transmissive unconsolidated to semi-consolidated units and well-drained soils, supporting both rapid infiltration and long-term storage. Groups B and D, in semi-consolidated and consolidated units and well-drained soils along the anticlinal ridges, offer moderate infiltration and extended retention potential. Group E, near the fan apex in shallow fractured basalt units overlain by excessively drained soils, presents characteristics suitable for distribution of flow and long-term storage.

Groups C and F display isotopically lighter and chemically evolved chemistries, indicating minimal recharge from surface water at present. Group C, located in the mid-to-downstream sections of the active alluvial fan, includes consolidated aquifer units overlain by poorly drained soils. Group F includes wells in two deep, sedimentary interbeds within the Columbia River Basalt bedrock in the upstream reaches of the elevated alluvial terrace.

The results highlight the upstream reaches of the active fan and the mid-fan aquifer units along the northern and southern slopes of the anticlinal ridges as optimal regions for surface-water infiltration recharge through MAR, while deeper consolidated units are more

appropriate for long-term groundwater storage. Units C and E are less suitable for recharge through passive infiltration but may present opportunities for long-term storage through alternative recharge methods.

Part 2 (This Volume). Assessing Potential for Managed Aquifer Recharge on the Manastash Alluvial Fan: A Geochemical Analysis

Part 2 of this project report (this volume) evaluates the Manastash alluvial fan located west of Ellensburg, Washington as a potential region for two MAR methods: Shallow Aquifer Recharge (SAR) and Aquifer Storage and Recovery (ASR). Six subsurface lithologic cross-sections were developed from well logs and geologic maps to characterize hydrogeologic relationships. Water levels within Manastash Creek and two unused wells were monitored using in situ devices to identify surface/groundwater level correlations. Major ion, trace element, and stable isotope geochemistry of 22 groundwater and nine surface water samples were analyzed to further support surface water/groundwater interactions and classify groundwater groupings.

Three groundwater hydrochemical groups were identified: Group 1 has high to medium sodium values suggesting older waters; Group 2 is from sedimentary wells with light isotopic signatures suggesting little-to-no influence from surface water; and Group 3 has intermediate to heavy stable isotope signatures indicating influence from surface water diverted from the Yakima River and Manastash through irrigation canals. Sedimentary wells with evidence of strong surface-water influence (Group 3) were combined with soil infiltration and drainage data, tax parcel information, and estimated seepage velocity calculations to identify four suitable locations for SAR along the outer fan boundary. Wells in the southeastern part of the fan and near Manastash Creek also showed evidence of surface-water influence. A region of concentrated basalt wells and tax parcel data were combined to identify one potential location for ASR at the fan apex. A potential barrier to groundwater flow was identified by abrupt changes in hydrochemical groups on either side of a probable fault. Suitability analysis results identified specific locations to be further assessed for MAR on the Manastash alluvial fan.

Part 2. Assessing Potential for Managed Aquifer Recharge on the Manastash Alluvial Fan: A Geochemical Analysis

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INTRODUCTION

Managed aquifer recharge (MAR) is one sustainable and cost-effective approach to store water underground for recovery during seasonal dry periods or drought (Dillon et al., 2019). Previous studies have used existing data, modeling, and field investigations to identify sites within the Yakima basin or sub-basins with promising potential for shallow aquifer recharge (SAR) (Anderson et al., 2009; Gibson and Campana, 2018; Kittitas Reclamation District, 2020). In SAR, the stored groundwater would naturally discharge and contribute water to streamflow or be available for extraction through wells during the drier summer periods.

Alluvial fans, sedimentary features located where water from confined valleys meet broad valley floors, are optimal for aquifer recharge due to their thick layers of alluvial cobbles, gravel, and highly permeable sand which allow for effective downward infiltration and wide-range lateral dispersion. Alluvial fans also contain paleochannels of unconsolidated material which remain after hydrologic reorientation, providing pathways of preferential flow (Figure 2) (Ventra, 2018).

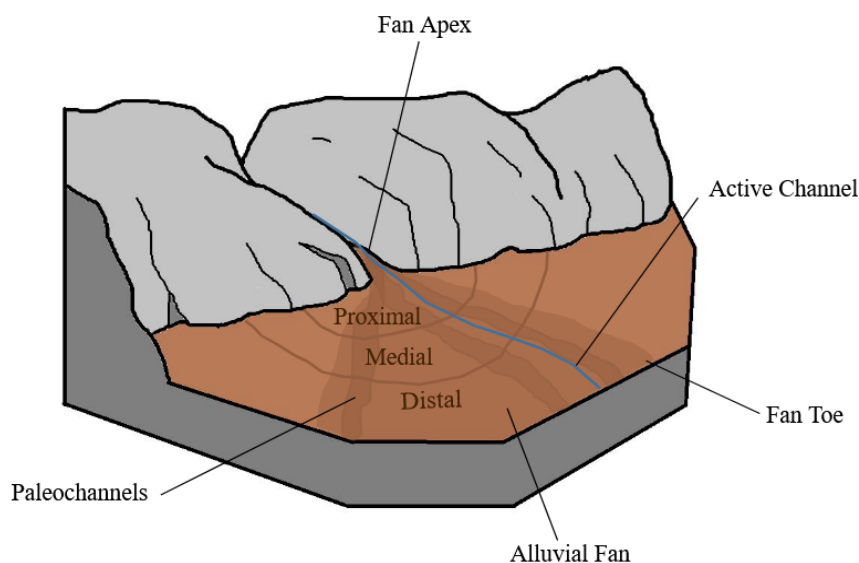


Figure 2. Alluvial fan graphic indicating the development process from the valley opening in the proximal region to the fan toe in the distal region.

The Manastash alluvial fan (Figure 3) was identified in the geospatial analysis of Gibson and Campana (2018) as an area with high potential for MAR. Their analysis included a weighted overlay approach that incorporated slope, land use, lithology, transmissivity, and depth to static water, examined at a basin scale. Our project was undertaken to better characterize the hydrogeology of the Manastash fan and to identify preferred locations for MAR.



Figure 3. Manastash alluvial fan. Location of Manastash fan is shown in Figure 1. The fan enters the Kittitas valley from the west. The South Branch Canal (KRD) flows along the base of the hills and crosses Manastash Creek where it enters the valley. Current and former channels of Manastash Creek diverge down the fan, although not all sustain surface water flow.

Manastash Fan Study Site

Manastash Creek is a major tributary to the Yakima River with a drainage of approximately 100 mi². The creek forms a large alluvial fan where it enters the southwestern portion of the Kittitas Valley. With nearly 30 miles of suitable habitat for salmonid species dependent on clear, cold water to spawn, the quantity and quality of water within this watershed is vital. Previous development of diversions and dams once threatened the lives of anadromous species within the creek. However, the Manastash Creek Restoration Project reestablished natural habitat structure through infrastructure redevelopment and restorative efforts (KCCD, 2021).

Manastash Creek alluvial fan spans approximately 13 square miles in a traditional west-set alluvial fan shape (Figure 3). In May 2011, a rare, large flooding event occurred on the alluvial fan affecting local infrastructure and private residences. Although Manastash Creek experiences high flows during snowmelt periods (around 170 cfs), this event exhibited flows far beyond the typical range and deposited 1,200 cubic yards of sediment. This event resulted in significant streambed rise, subsequently causing flowing water to exceed bank height (Watershed, 2011). Exploring groundwater/surface water interactions within the study site has the potential to support future flood management endeavors by Kittitas County Conservation District and other local agencies.

Tax parcel classifications within the study site includes agricultural land (8.73 mi²), residential parcels (3.34 mi²), undeveloped or not presently used land (0.84 mi²), miscellaneous land (transportation, government, and school properties) (0.4 mi²), and recreational and public gathering areas (0.05 mi²) (Figure 4) (Kittitas County Geographic Information System, 2018).

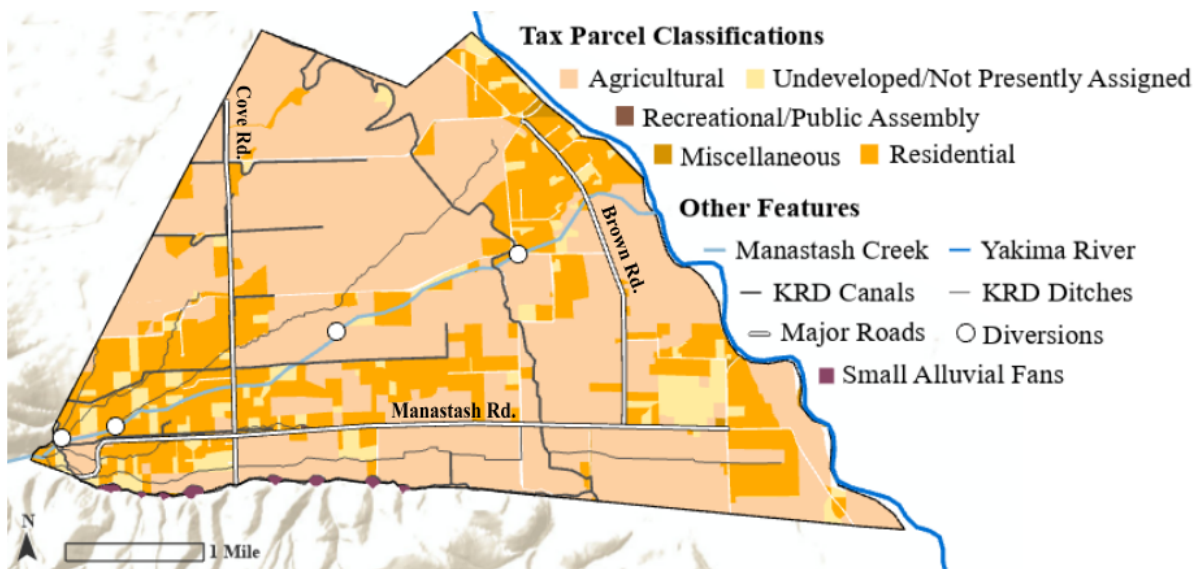


Figure 4. Manastash alluvial fan characteristics including tax parcels sourced from Kittitas County GIS (2018), major roadways, irrigation ditches, diversions, and small alluvial fans on the southern border. Three main roads, Manastash Rd., Brown Rd., and Cove Rd., are also included.

Manastash farmers contribute to the Yakima Basin's \$4.5 billion agricultural industry through the production of hay and beef (Tebb, 2017). Developed on a low-lying, arid, shrub steppe ecosystem, this region requires irrigation water for agricultural needs. Many farmers within this region depend upon annual operation of the Kittitas Reclamation District (KRD) canals which divert water from the Yakima River for irrigation between April and September. KRD was established in 1911 and operates a network of ditches, canals (both lined and unlined), pipelines, and diversions with fish screens within the study site (Figure 4) (Kittitas Reclamation District, 2020). A second Yakima-derived canal, Westside canal, runs north-to-south just west of Manastash Road. It is collaboratively operated by KRD and Westside Irrigation district. In addition, water is diverted from Manastash Creek through an older water right. The original Manastash Canal was constructed in 1872 and served 1,700 acres.

Geology

Manastash Alluvial Fan is located on the western portion of the Columbia Plateau where a large volume of flood basalts accumulated between 17 and 6 million years ago. Volcaniclastic interbeds were deposited between basalt flows during periods of quiescence, collectively referred to as the Ellensburg Formation (Bentley et al., 1983). Within the western portion of the Columbia Plateau geologic province, there is a series of west-trending ridges developed through faults and folds known as the Yakima Fold Belt Sub province (Drost et al. 1990). The Manastash Anticline, defined as a fold hinge, borders the southern end of the alluvial fan, following the outline of the Kittitas Subbasin before trending west (Kelsey et al., 2017).

Surficial geology of the Manastash Alluvial Fan (Figure 5) is characterized by Quaternary deposits and loess with overlay thick layers of sand, gravel, and other fine-grained material. Much like other subbasins within the Yakima Basin, the youngest sediments were transported and deposited by snowmelt through tributary systems which originate in surrounding regions of higher elevation. The fan is bordered and underlain by Columbia River Basalts containing Miocene lava flow layers derived from fissure points east of the Columbia Plateau. In a hydrogeologic summary of this region, Vaccaro et al. (2009) characterized the subsurface unit thicknesses of the Kittitas Basin as alluvial deposits from 0-100 feet; loess, alluvial fan, glacial terrace, and Thorp gravel deposits from 0-790 feet; and Ellensburg Formation and undefined sedimentary deposits from 0-2,040 feet. Cumulatively, the basin fill thickness ranges from 0 to 2,120 feet with an average of 500 feet (Vaccaro et al., 2009).

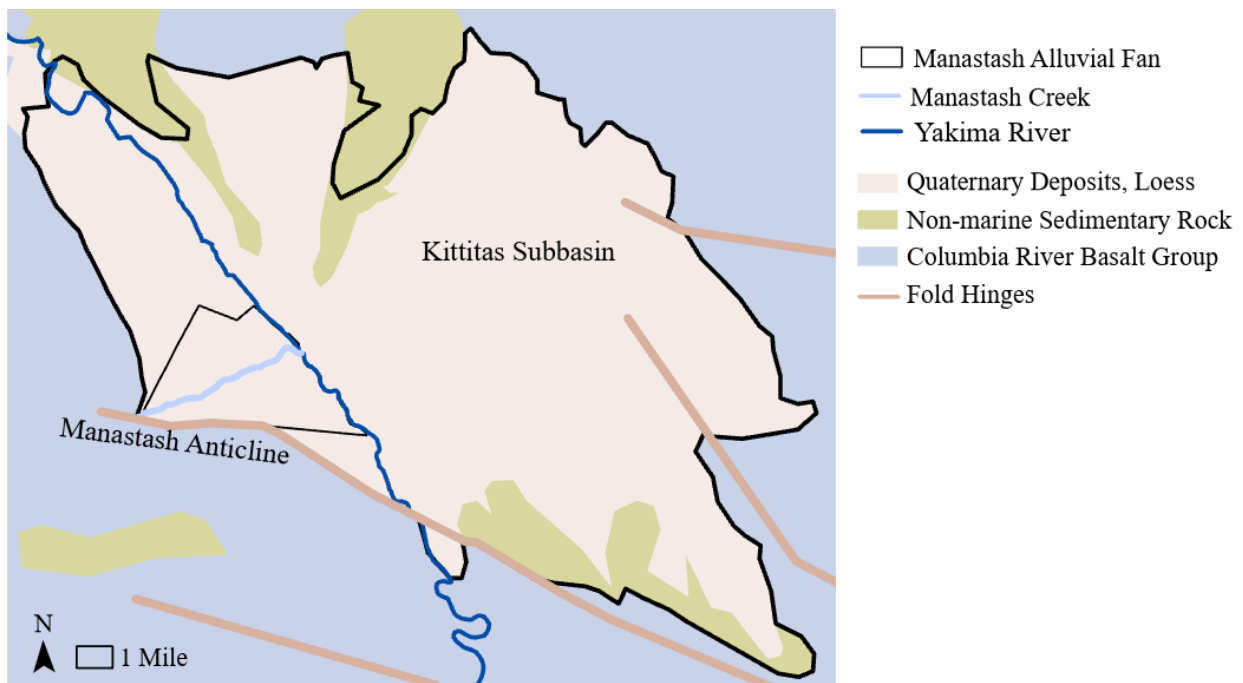


Figure 5. Surficial geology of the Kittitas Subbasin including geologic units and fold hinges which make up the Yakima Fold and Thrust Belt. Figure modified from Ely et al. (2011).

The Washington Geology Portal identifies a fault running alongside the Manastash Anticline, eventually cutting north-west through the Manastash alluvial fan (USGS, 2016). Although further details of this fault are not yet published, Washington Geological Survey (WGS) employees are currently remapping the region and have confirmed the oblique, dextral, reverse, west-dipping nature of the fault line. Their most recent research indicates the presence of two additional faults within proximity (Figure 6). One proposed model suggests this grouping is a fault splay, although a fault stepover model is also being considered. Cross-sections developed within this report apply the fault splay model.

Additionally, work in another Central Washington University master's thesis (Wilbur, 2025) involves characterizing subsurface geology beneath the fan using a gravimeter. For this study, gravitational field measurements were taken throughout the Manastash alluvial fan to further characterize fault lines and determine depths of stratigraphic layers (Sadowski, 2025). Results from this work will determine lithologic contacts far below the cross-sections within our study.

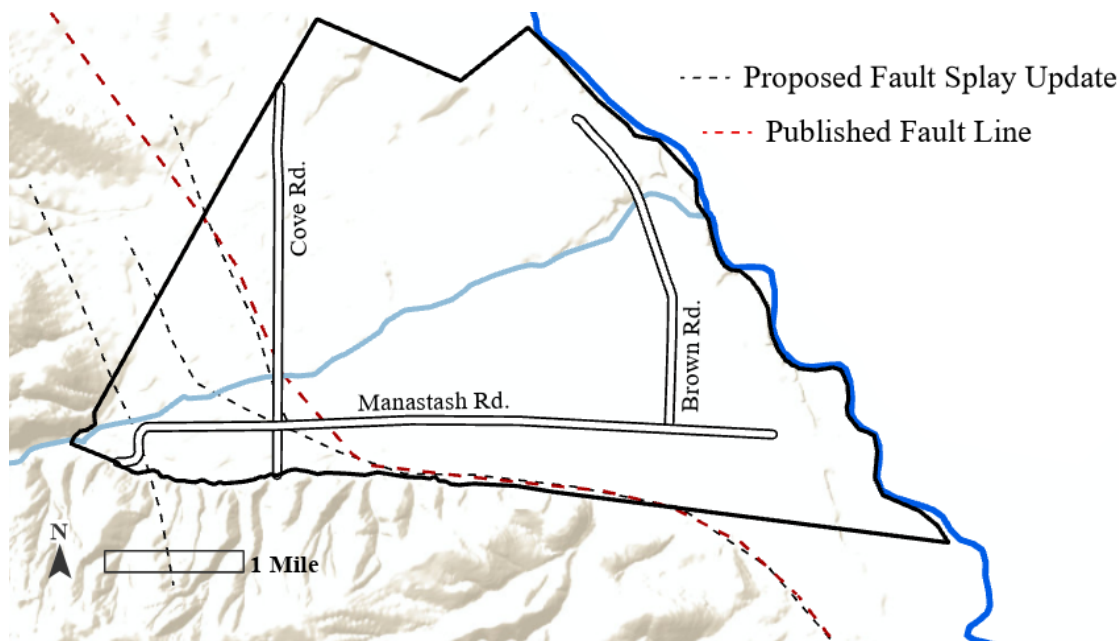


Figure 6. Map of faults in Manastash alluvial fan. Includes original Washington Geological Survey fault line and new proposed fault splay model currently under study. Original fault line sourced from USGS (2016). New proposed fault line sourced from Sadowski (2025).

Geochemistry for Groundwater Analysis

Stable isotope ratios of hydrogen and oxygen and major ions are commonly used to in hydrology to characterize and trace water. As part of the water molecule, H and O isotopes are conservative tracers that move with the water molecule.

The delta notation is commonly used within stable isotope geochemistry for low-mass elements. This convention represents the relative difference in ratios between a sample and a standard:

$$\delta = \left(\frac{R_{smp} - R_{std}}{R_{std}} \right) \times 1000,$$

δ is $\delta^{18}\text{O}$ for oxygen isotope measurements and δD for hydrogen isotope measurement and R is $\frac{^{18}\text{O}}{^{16}\text{O}}$ for oxygen and $\frac{\text{D}}{\text{H}}$ for hydrogen; smp = sample and std = standard; for water this is an ocean water standard, V-SMOW.

When analyzing stable isotope results, samples are classified as “heavy” or “light” based on the δD and $\delta^{18}\text{O}$. These measures can be represented on an x-y plot which allows for visualization of groupings by relative isotopic composition (Figure 6). Groupings can be used to indicate water sources, movement, and mixing. For example, Yakima River water and irrigation sourced from the Yakima River tends to have the heaviest isotopic values within the Yakima Basin as indicated in Figure 7 (Vaccaro et al., 2009).

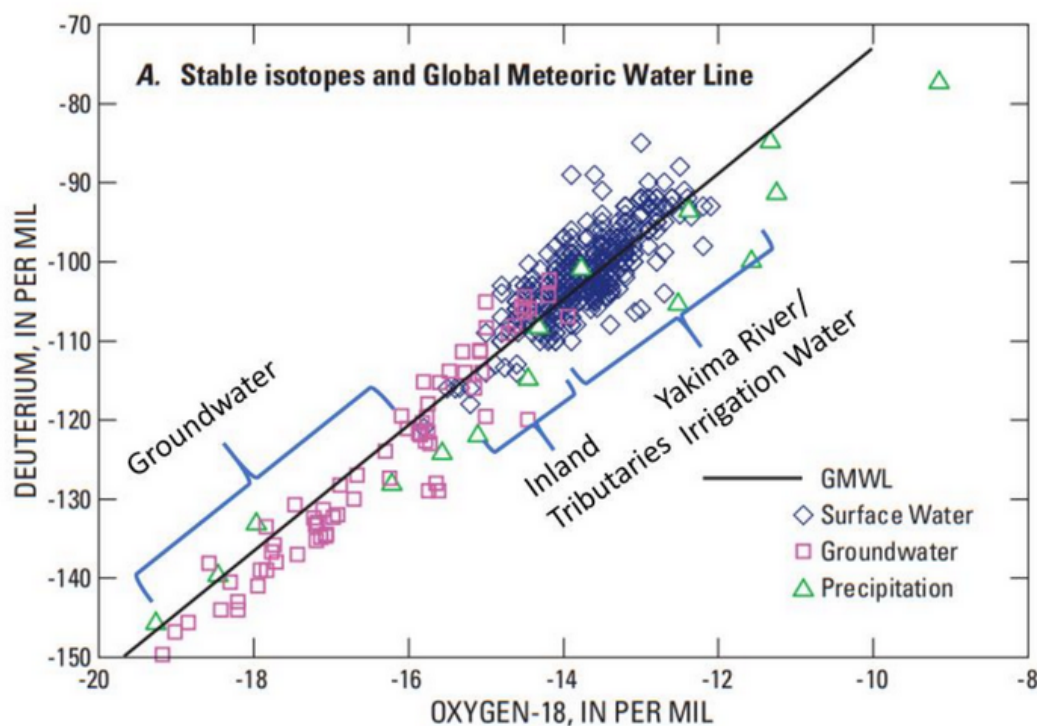


Figure 7. δD - $\delta^{18}\text{O}$ plot of water in the Yakima River basin (modified from Vaccaro et al., 2009). Shows distinct difference between Yakima River water, inland tributaries and some regional groundwater.

Major ions, made up of negatively charged anions and positively charged cations, characterize the chemical composition of water samples. Major ions account for most of the total dissolved solids within groundwater samples and are derived from various sources such as sediment/rock interactions and anthropogenic pollution. Major ion chemistry of groundwater

samples can be used to understand flow, rock interaction, age, and human influences on water bodies. Additionally, major ion data can aid in classifying water sources and groupings. Piper diagrams are commonly used to compare proportions of major ions within water samples and place them within hydrochemical facies (Figure 8). When applied to this diagram, waters from deep basalts are commonly classified as sodium bicarbonate type with higher concentrations of sodium while water from shallow, sedimentary wells are commonly classified as calcium magnesium bicarbonate types (Hearn et al., 1985).

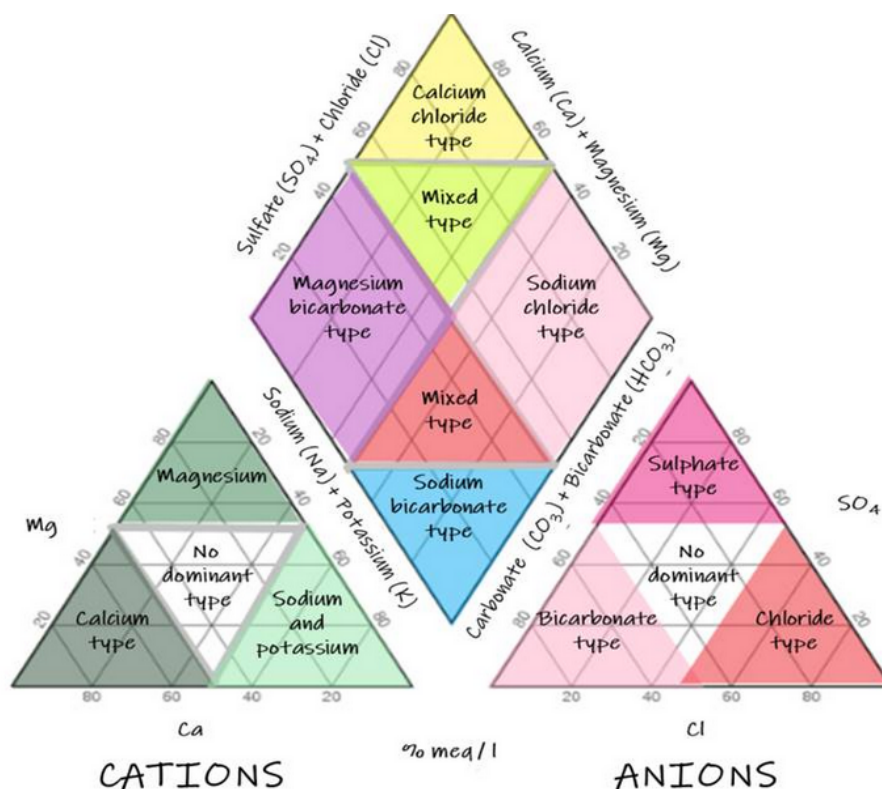


Figure 8. Piper diagram with hydrochemical facies boundaries. Cations are indicated in the lower left triangle, and anions are in the lower right triangle, with all ions projected in the center diamond. From Montoya (2023).

Previous Work

This research builds upon the efforts of previous master's theses overseen by Carey Gazis within the Central Washington University Department of Geological Sciences. One example is Sleeper (2020) who examined three study sites in the Yakima River Basin, one of which was the Kittitas Valley, where the Manastash alluvial fan is located. Sleeper used geochemical data to analyze potential for groundwater storage by using stable isotope and major ion geochemistry, similar to the methods applied within this report. Another notable study by Taylor and Gazis (2014) conducted geochemical analysis across the Kittitas Valley to group waters with similar chemical compositions. This study, which included 26 well samples and 24 surface water samples, resulted

in the identification of hydrochemical groups indicative of influence from aquifer lithology and from surface water and irrigation practices. Sample locations from Taylor and Gazis (2014) overlap with those in this research, providing the potential for data comparison.

Gibson and Campana (2018) conducted a spatial assessment for Shallow Aquifer Recharge (SAR) and Aquifer Storage and Recovery (ASR) within the Yakima Basin through a weighted overlay model, system dynamics model, and multiple spatial aquifer assessments with consideration of stream depletion timing and climate change. Upon applying this method to six structural Yakima River Basin subbasins, the Manastash Creek alluvial fan was ranked 4-5 on a scale of 0-5 for SAR (with 5 being the most suitable). Two locations within the fan apex were identified as well-suited locations for ASR.

Multiple studies have been conducted by the USGS characterizing the hydrogeology of the Yakima Basin including Vaccaro et al. (2009) (and references therein) which describes aquifer characteristics and flow systems within the basin and Ely et al. (2011) which provides a regional three-dimensional groundwater model of the Yakima Basin.

An overall MAR assessment for the Yakima Basin was prepared for Kittitas Reclamation District by EA Engineering, Science, and Technology, Inc., Gregory Geologic LLC, and Jacobs Engineering in 2021 with the purpose of identifying and ranking MAR project locations and quantifying water availability and instream benefits. Within this report, required criteria for MAR projects included property access, suitable hydrology, water availability, water quality, instream and outstream benefits, infrastructure availability, operational risk, and permitting. Each location was allocated a score based on each criterion, resulting in 20 top-ranking locations throughout the basin (EA Engineering et al., 2021).

Currently, KRD is conducting a study with Washington Department of Ecology and Jacobs Engineering to identify groundwater infiltration effects of the Tributary Supplementation Program (TSP) which diverts water from the Yakima River through KRD canal systems into Manastash Creek to prevent seasonal drying. This research includes creek flow monitoring, the installation of in-stream piezometers, and manual well water measurements.

Determining MAR Suitability

Sallway et al. (2019) identify five categories of suitability factors for MAR application: aquifer (storage capacity, storage/flow, flow capacity, residence time); surface (geology, hydrology, geomorphology, soils, land use); water quality (groundwater, surface water), hydrometeorology (precipitation, runoff); and management (economical, impact assessment). Factors considered within suitability analyses are dependent upon intended MAR application methods. For instance, ASR conducted within a deep, confined basalt aquifer via well injection would not be affected by surface soil conditions. In this case, there would be more weight on residence time to ensure accurate prediction of water retention for future extraction and aquifer capacity to determine water storage volume available (Sallway et al., 2019).

Time required for water storage is unique to each project's specific needs. Short-term storage (3-6 months) would be appropriate for storing excess snowmelt in spring to support

agricultural irrigation needs and instream flow, while long-term storage (a year or more) would be applied to support communities preparing for an upcoming drought year or predicted period of water resource shortage. One example of long-term storage is an ASR project in Roseville, California which applied water to a confined aquifer between December 2005 and April 2006 and later extracted an estimated 35 percent of the injected water from July 2007 to February 2008. In total, applied water was stored within the aquifer for 438 days before extraction (Izbicki et al., 2010).

When exploring the possibility of MAR through flood application, it is important to consider permeability, or how easily water can flow through to underlying aquifers. A study located in the San Joaquin Valley, California applied the Soil Agricultural Groundwater Banking Index (SAGBI) to its MAR suitability analysis which considers percolation and root zone residence time. To earn high suitability rankings, locations must have soils with deep percolation allowing water to pass the root zone (approximately 5 feet) and must have a root zone residence time appropriate for local crops to prevent negative agricultural repercussions (Marwaha et al., 2021). Similarly, soil infiltration rates (largely controlled by permeability) and soil drainage (downward and lateral movement of water throughout a soil profile) can be used to predict the results of MAR flood application in select locations (United States Department of Agriculture, 2024).

Study Purpose

This study aims to characterize subsurface geologic makeup, seasonal groundwater/surface water interactions, and hydrochemical groundwater groups. Findings are combined with existing tax parcel and soil data to identify suitable locations for SAR, and tax parcel and basalt well locations to identify suitable locations for ASR. This research is the first of many steps to apply MAR within the study site. With suitable locations in mind, future studies will be needed for MAR application including, but not limited to manual static water level measurements, aquifer tests and pilot tests.

METHODS

Quality Assurance

A Quality Assurance Project Plan (QAPP, 2024) was approved for this project through the Washington State Department of Ecology. That document contains details about field and laboratory methods and quality assurance/quality control procedures.

Analysis of Subsurface Geology

Twenty-five georeferenced well logs were used to create six transect lines across the study site. Each geolocated well was cross-referenced with the address on file through the Department of Ecology Well Report Viewer to ensure geographic accuracy (Washington Department of Ecology, 2025). Wells used to collect geochemical water samples were projected onto the nearest transect to be included in cross-sectional representations. It is important to note that well log

descriptions are highly variable between well drillers and interpretations were made when assigning stratigraphic classifications as described below. Original well logs used to develop cross-sections can be found in Appendix A.

Well depths and drilled layers were inferred from well logs, neighboring wells, and general knowledge of local geology. For example, original stratigraphic layers written as “rock” could be inferred as basalt if located near neighboring wells with basalt identified at a similar elevation. Once final lithologic layers and contact points were determined, elevation was calculated by subtracting layer depths from surface elevation and used to develop nine conceptual cross-sections.

Groundwater Elevation and Streamflow Measurements

HOBO Water Level Logger pressure transducers were installed in two unused, shallow wells within the research site parameters to track seasonal water levels and temperature (Figure 9, Table 1).

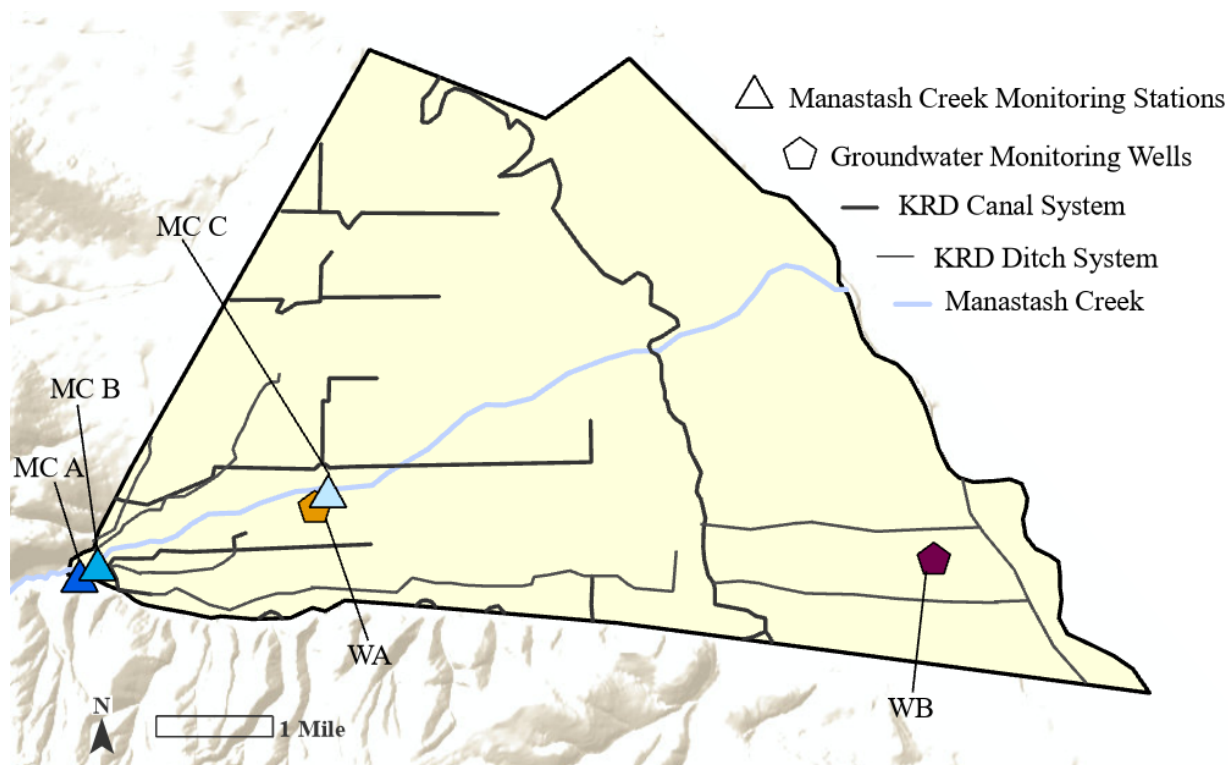


Figure 9. Locations of monitoring sites on the Manastash alluvial fan, including three stream level monitoring stations (MC A, MC B, and MC C) near the fan apex and two monitoring wells (WA and WB).

Table 1. Information on Monitoring Wells A and B

Well ID	Transducer Installation Date	Transducer Depth from Land Surface (ft)	Well Depth (ft)	Depth to Water Table (ft)	Well type	Decimal Latitude	Decimal Longitude
WA	11/8/2023	12.9	11.5	8.35	Shallow Sedimentary	46.9757	120.6460
WB	7/1/2024	27.8	29.9	8.47	Shallow Sedimentary	46.9702	120.5706

Upon installation, well depth and depth to the water table were measured using an electric water level tape. When data was downloaded, depth to water table was measured again and compared to transducer readings to check device accuracy. Barometric pressure corrections were made using data from the Kittitas County Airport. Both transducers logged at a 15-minute interval and were offloaded every three months. Since neither well contained an accompanying well log, nearby well logs were used to predict lithologic makeup.

Streamflow (cfs) was calculated using established rating curves based on pressure data collected by instream loggers installed by KCCD and Washington Department of Ecology (Swanson, 2025; Washington Department of Ecology, 2025). Local precipitation data was collected from Kittitas County Airport through the US Department of Commerce National Weather Service online portal and combined with groundwater levels and streamflow to create hydrographs representing seasonal changes and variations in hydrologic correlations (United States Department of Commerce, 2024).

Water Sample Collection and Geochemical Analysis

A total of 31 water samples were collected for geochemical analysis (Table 2, Figure 10). Correlated well logs for sampled wells are provided in Appendix B. For wells without available logs, nearby well logs are included and labeled accordingly.

A total of 22 groundwater samples were collected from domestic wells. Although locations were highly dependent upon willing volunteers, sample locations were distributed across the alluvial fan. Some samples were collected directly from the wellhead pump, others from the nearest spigot. Water was purged until stabilized values were reached for: temperature ($\pm 0.1^{\circ}\text{C}$), pH (± 0.1 standard units), conductivity ($\pm 10 \mu\text{ohms/cm}$), and dissolved oxygen ($\pm 0.2 \text{ mg/L}$). Once stabilized, dissolved oxygen, pH, and conductivity were measured using the respective meters; YSI DO Pro probe, OAK ION 110 Series pH Meter, and Thermo Scientific Orion conductivity meter. Two samples were collected from each well, one filtered (0.45-micron) and one unfiltered. Samples were stored in polyethylene bottles and refrigerated.

Additionally, 9 surface water samples were collected from the Yakima River, Manastash Creek, KRD canals, a KRD ditch, and a natural spring near the fan apex. Representative fan

distribution was considered when choosing locations, although property access was a recurring limitation. Two water samples were collected from each location using the same methods as described for groundwater sample.

Table 2. Groundwater, spring and surface water sampling locations and descriptions.

Sample Name	Water Type	Lithology	Decimal Latitude	Decimal Longitude	Well Log ID	Well depth (ft)*	Drill Static Water Level (ft)
Basalt Wells							
MAN24_GW_04	Groundwater	Basalt	46.96668	120.66594	NB Well tag ID-ABX048	100*	
MAN24_GW_09	Groundwater	Basalt	46.98261	120.66057	AGB098	235	71
MAN24_GW_11	Groundwater	Basalt	46.97470	120.64686	NB Well tag ID-ACE959	201*	
MAN24_GW_13	Groundwater	Basalt	46.96762	120.65354	NB Well log-ID 116672	160*	
MAN24_GW_17	Groundwater	Basalt	46.97137	120.64975	APT313	264	131
MAN24_GW_19	Groundwater	Basalt	46.96930	120.65282	ACL657	261	-2
MAN24_GW_22	Groundwater	Basalt?	46.97527	120.64583	NB Well tag ID-BJB809	200*	
Sedimentary Wells							
MAN24_GW_01	Groundwater	Sedimentary	46.97026	120.57059	NB Well log -ID 113144	200*	
MAN24_GW_02	Groundwater	Sedimentary	46.97537	120.64427	APG130	230	111
MAN24_GW_03	Groundwater	Sedimentary	46.99559	120.58631	NB Well log ID-116338	240*	
MAN24_GW_05	Groundwater	Sedimentary	47.00124	120.63252	NB Well tag ID-BQH676	250*	
MAN24_GW_06	Groundwater	Sedimentary	47.01489	120.62357	ABI861	400	22
MAN24_GW_07	Groundwater	Sedimentary	47.00118	120.62489	BAP396	245	50
MAN24_GW_08	Groundwater	Sedimentary	47.00189	120.59553	NB Well tag ID-ACL892	180*	
MAN24_GW_10	Groundwater	Sedimentary	46.99639	120.65441	NB Well tag ID- APG215	130*	
MAN24_GW_12	Groundwater	Sedimentary	46.97015	120.62385	ALF394	140	35
MAN24_GW_14	Groundwater	Sedimentary	46.97586	120.56690	NB Well tag ID-ABJ260	300*	
MAN24_GW_15	Groundwater	Sedimentary	46.96632	120.62512	AHK605	162	115
MAN24_GW_16	Groundwater	Sedimentary	46.97631	120.62995	BJA293	223	110
MAN24_GW_18	Groundwater	Sedimentary	46.97994	120.57037	117949	170	60
MAN24_GW_20	Groundwater	Sedimentary	46.98547	120.59555	NB Well tag ID-AHK972	100*	
MAN24_GW_21	Groundwater	Sedimentary	46.97688	120.57483	BAN922	173	28
Spring							
MAN24_SW_08_SP	Spring		46.97490	120.64747	-	-	-
Surface Water							
MAN24_SW_07_RIV	Yakima River		46.97797	120.56718	-	-	-
MAN24_SW_01_CR	Manastash Creek		46.97029	120.67329	-	-	-
MAN24_SW_03_CR	Manastash Creek		46.98754	120.60526	-	-	-
MAN24_SW_04_CR	Manastash Creek		46.99454	120.59044	-	-	-
MAN24_SW_02_CR	Manastash Creek		46.97599	120.64555	-	-	-
MAN24_SW_05_CAN	KRD Canal		46.96546	120.65116	-	-	-
MAN24_SW_06_CAN	KRD Canal		47.00068	120.61663	-	-	-
MAN24_SW_09_DIT	KRD Ditch		46.99972	120.62589	-	-	-

NB= nearby well log, no well log available for sampled well

* estimated depth based on nearby well

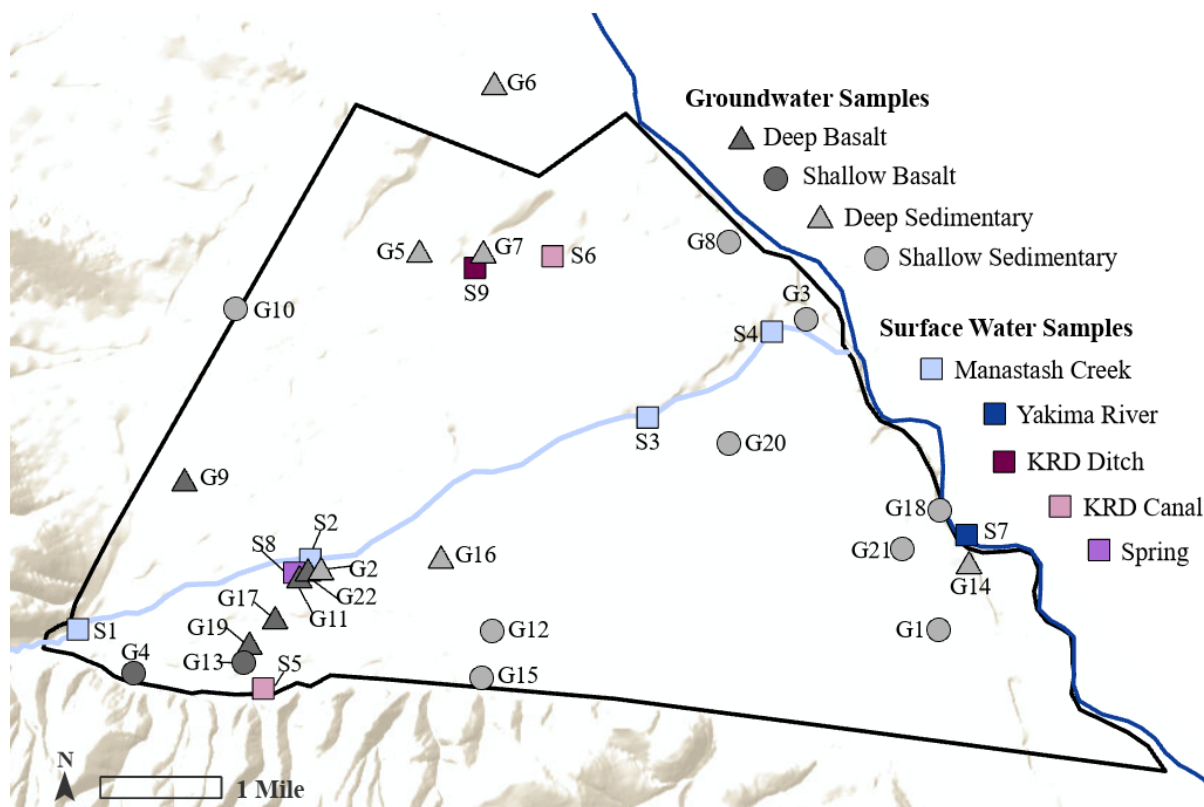


Figure 10. Map of surface water and groundwater sampling. Groundwater well symbols depend on lithology in which well is finished (basalt or sedimentary) and depth. Wells designated as shallow have depths < 200 feet while deep wells have depths $\geq$ 200 feet.

Unfiltered samples were used to measure alkalinity in the laboratory within one week of sample collection using the Gran titration method (Barringer, 1966). Major anions (fluoride, chloride, sulfate, nitrate, phosphate) and cations (sodium, magnesium, potassium, calcium) were measured using the Thermo Scientific Dionex ICS-5000+ Ion Chromatograph in the Murdock Lab at Central Washington University. Trace elements (aluminum, iron, arsenic, lead, zinc) were measured by the Agilent 8900 Triple Quad Inductively Coupled Mass Spectrometer (ICP-MS), also in the CWU Murdock Lab. Uncertainties for major ion and trace element analyses are $\pm 10\%$. Quality control methods were applied to ensure accuracy of data including check standards, replicate samples, matrix spikes, and dilutions for samples when values were outside of the calibration range. The major ion charge balance was assessed using the cation, anion, and alkalinity data. In this quality control method, the charge balance error (CBE) target is $\pm 10\%$.

Stable isotope ratios were measured for filtered samples using the Picarro L2130 Water Isotope Analyzer in the Murdock Lab. After every six samples, a quality control standard and a replicate unknown sample were measured. Results are calibrated using three internal laboratory standards and are reported in the standard δ notation described earlier. The uncertainty in the stable isotope measurements is ± 0.1 per mil for $\delta^{18}\text{O}$ and ± 1 per mil for δD .

Hydrochemical water groups were determined based on comparisons of stable isotope data, Piper diagram, and Factor Analysis, sodium concentrations, and nitrate concentrations. Factor Analysis is a multivariate data analysis method in which many variables are projected onto a set of axes that represent “factors” which explain statistical variation within the dataset. This analysis was conducted using XLSTAT and JMP software.

RESULTS

Subsurface Lithological Cross-Sections

Transect locations, developed from geolocated well logs are shown in Figure 11. These figures also include projected sampled wells indicated with the same symbology from Figure 10. Cross-sections representing subsurface lithology for each transect are provided in Figures 11-12. For the purpose of these cross-sections, stratigraphic descriptions from well logs were simplified into six categories: soil, cobbles/gravel, cobbles/gravel cemented, clay, sandstone, and basalt. Transects A-A', A-B', and A-C' (Figures 11) run west to east, intersecting a northward cutting fault splay at the fan apex. Transects D-D', E-E', and F-F' (Figures 12) run north to south across the fan perpendicular to Manastash Creek and parallel to the Yakima River. Points of intersection are annotated on each cross-section with an “x” (for transect intersection). Manastash Creek intersection is shown with a blue triangle. Dotted lines indicate regions of uncertainty due to gaps in well log data.

Cross-sections A, B, and C (Figures 12) indicate a downward slope of basalt contact from the fan apex to the distal region. In cross-sections A and B, there is an increase in sediment thickness as the basalt surface becomes lower in elevation eastward. Clay and sandstone layers are present in cross-sections A and B above the basalt from 0.5 to 3 miles with a sandstone interbed in cross-section A from 2 to 3 miles. There was no clay or sandstone observed in wells within cross-section C.

Mapped reverse faults are consistent with shifts in basalt surface elevations observed in wells near each fault. All three faults are present within cross-sections A and B, and two are present within cross-section C. Cross-sections D, E, and F (Figures 13) further support the pattern of eastward decreasing basalt elevation and thickening sedimentary rocks and deposits within the alluvial fan and identify interbeds within the basalt in some locations where wells penetrate to basalt depths.

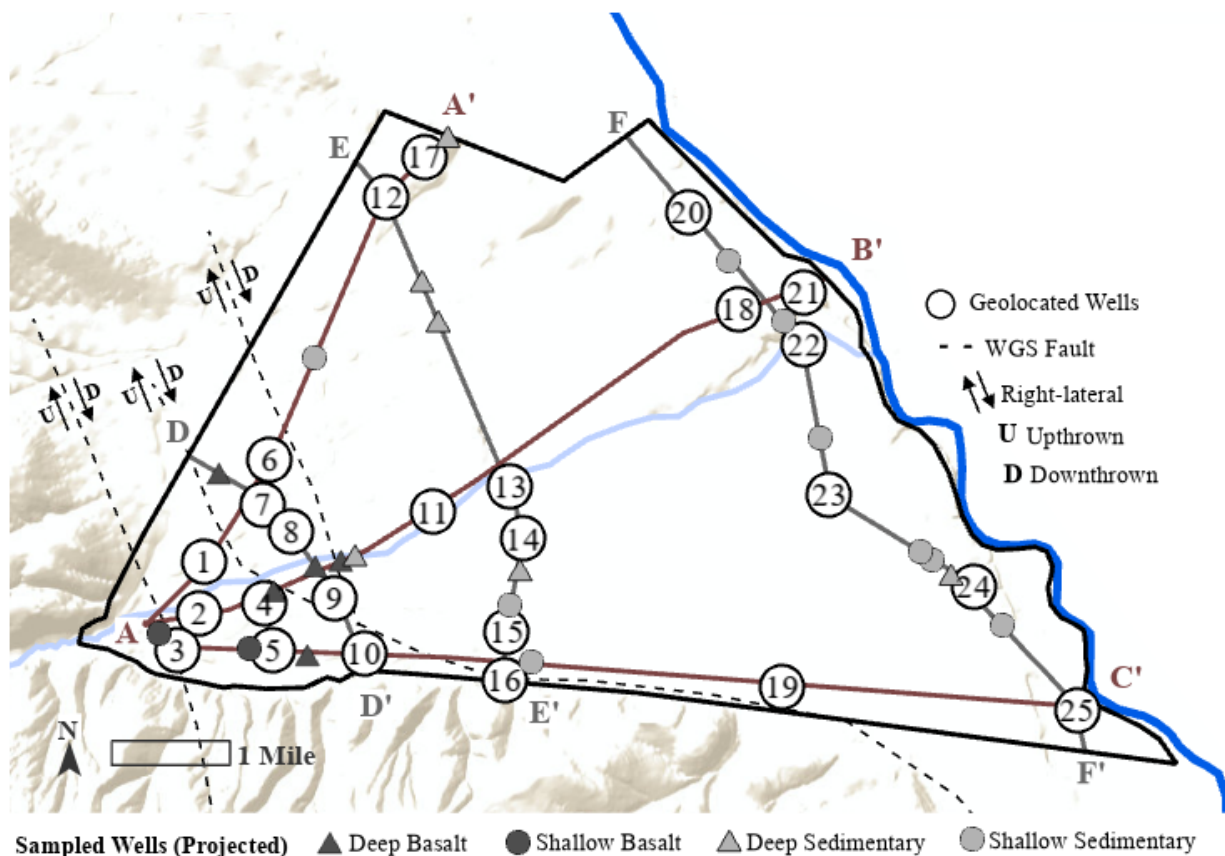


Figure 11. Map showing six transect lines used to create subsurface cross-sections within the Manastash Alluvial fan (Figures 11 and 12). The twenty-two sampled wells are projected onto the nearest transect line. Fault data from Sadowski (2025). Well data from Washington Department of Ecology (2025).

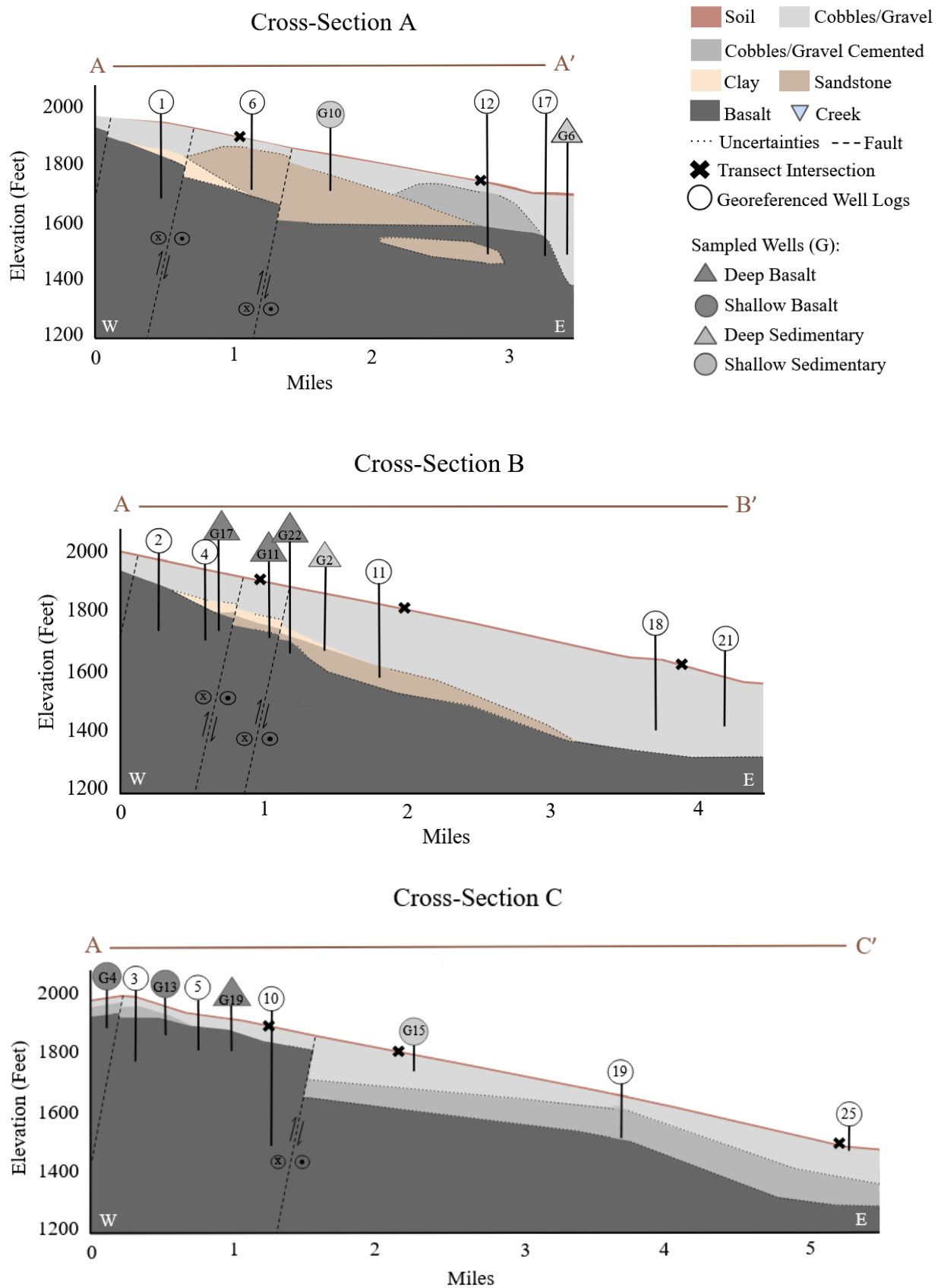


Figure 12. Cross sections A, B, and C (see Figure 10). Deep wells are > 200 ft.

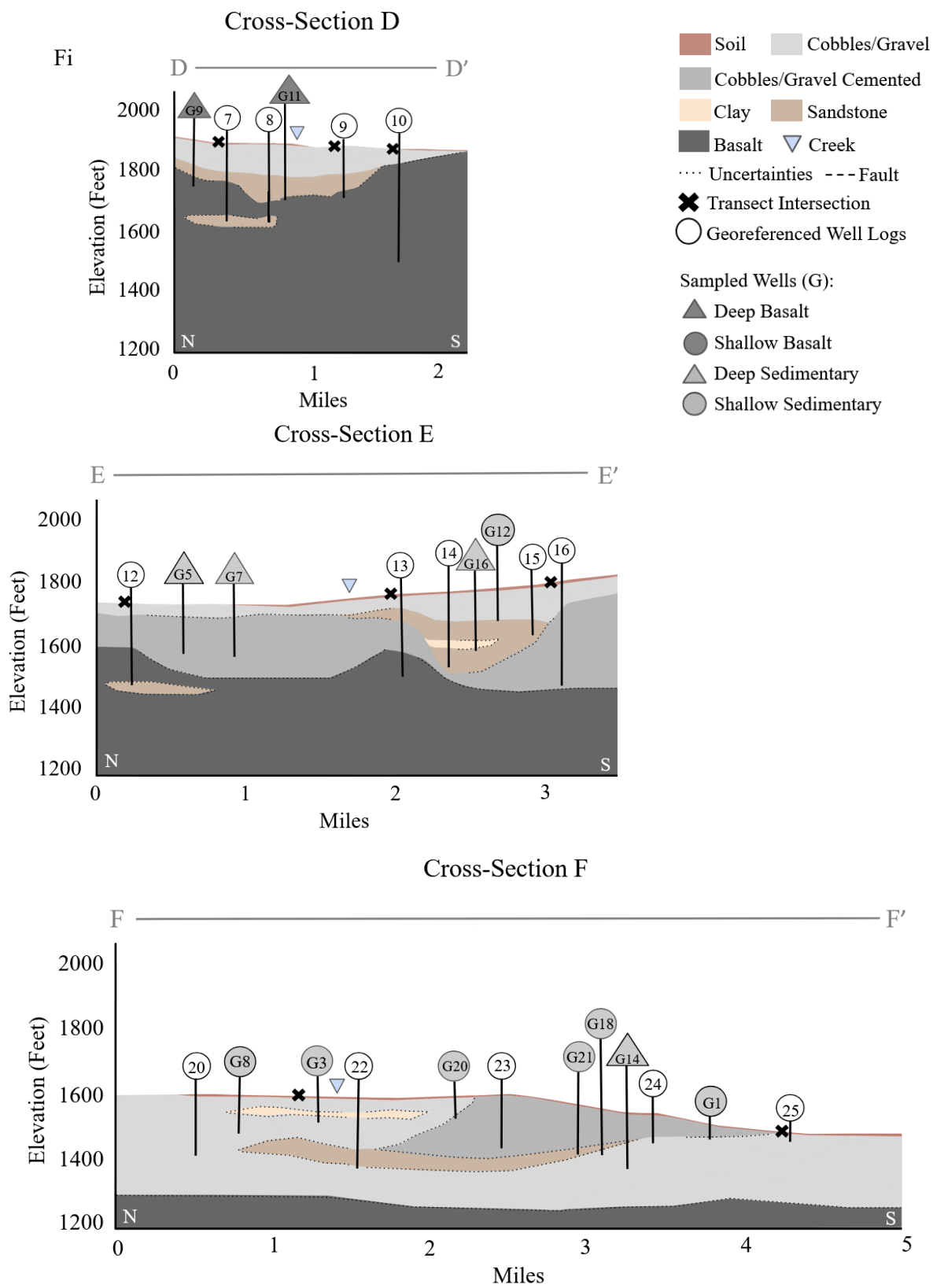


Figure 13. Cross sections D, E, and F (see Figure 10). Deep wells are > 200 ft.

Surface Water and Groundwater Hydrographs

Time series hydrographs of Manastash Creek flow and groundwater levels are provided in Figure 14. Manastash Creek flow, in cubic feet per second, ranges from 6 cfs in the summer months to over 400 cfs during spring snowmelt in May 2023. Groundwater depths from well A collected between November 2023 and January 2025 range from 9 to 11 feet below land surface, while Well B groundwater level ranges from 7 to 16 feet below land surface between July 2024 to January 2025.

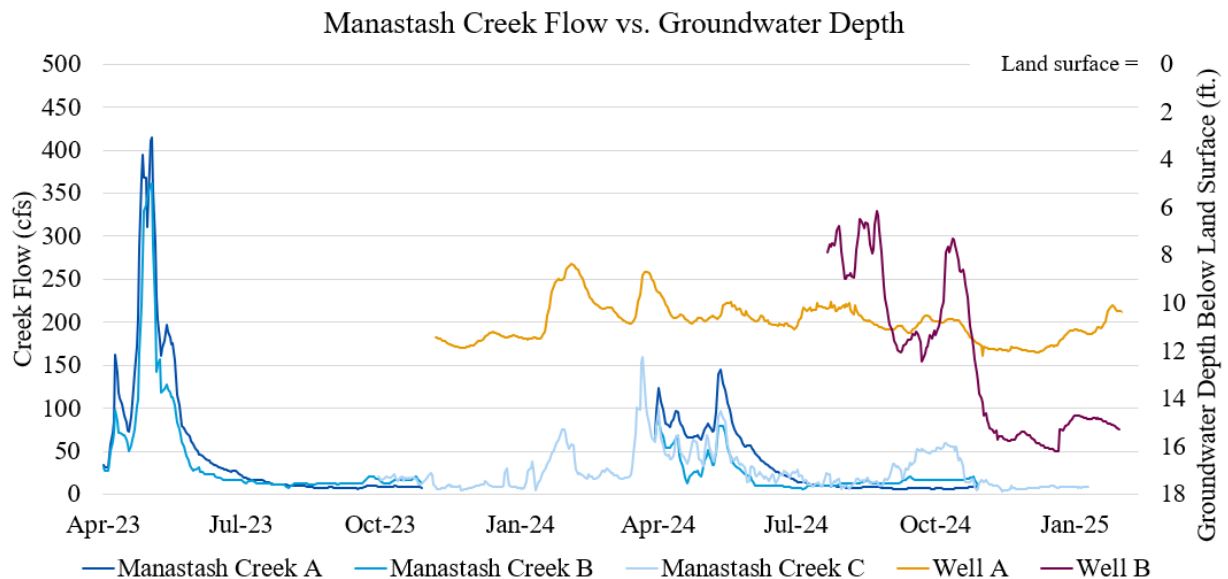


Figure 14. Time series hydrograph including data from three Manastash Creek monitoring stations and two monitoring wells.

Geochemical Data

Geochemical data is presented in Table 3 (major ion and titratable alkalinity data) and Table 4 (field measurements, stable isotope, and trace element data).

Table 3. Major ion data for groundwater and surface water samples, including calculated charge balance error (CBE).

Sample Name	Alkalinity	F	Cl	SO ₄	NO ₃	PO ₄	Na	Mg	K	Ca	CBE
	ppm CaCO ₃	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%
Basalt Wells											
MAN24_GW_04	85.4	0.2	4.3	3.6	2.1	bdl	19.5	6.3	5.0	10.5	-0.4
MAN24_GW_09	62.3	0.2	2.4	2.6	2.5	bdl	10.7	7.2	3.2	10.5	5.3
MAN24_GW_11	56.7	0.1	2.3	2.8	1.9	bdl	5.4	6.9	2.6	12.5	4.4
MAN24_GW_13	64.5	0.1	5.7	1.9	2.4	bdl	18.8	4.8	4.5	10.0	5.6
MAN24_GW_17	73.6	0.1	2.0	1.6	0.5	0.5	12.1	7.7	4.0	13.6	7.3
MAN24_GW_19	76.2	0.1	3.3	0.0	0.3	bdl	26.1	3.4	4.1	7.3	4.6
MAN24_GW_22	61.7	0.1	3.9	3.1	3.3	bdl	4.7	6.5	2.7	13.3	-2.0
Sedimentary Wells											
MAN24_GW_01	49.0	0.1	5.8	6.4	26.8	bdl	4.7	6.2	3.0	14.7	-7.3
MAN24_GW_02	45.6	0.1	1.8	3.6	0.8	bdl	5.4	6.0	2.5	11.0	8.5
MAN24_GW_03	54.5	0.4	2.7	4.2	7.5	bdl	6.1	7.7	1.8	24.1	18.3
MAN24_GW_05	86.1	0.2	4.3	5.1	5.3	bdl	11.6	10.8	2.9	17.4	4.4
MAN24_GW_06	67.1	0.2	1.9	3.1	1.3	bdl	20.1	1.7	1.6	11.7	2.3
MAN24_GW_07	58.0	0.1	3.8	5.5	0.3	bdl	13.7	4.4	2.6	16.6	11.6
MAN24_GW_08	82.8	0.5	7.8	6.6	11.6	bdl	5.8	10.0	4.7	18.4	-4.4
MAN24_GW_10	218.0	0.2	4.5	7.5	6.5	bdl	19.3	25.0	4.7	38.1	0.2
MAN24_GW_12	41.6	0.3	22.3	3.5	4.5	bdl	4.1	4.7	19.4	9.6	-5.1
MAN24_GW_14	68.3	0.2	5.6	5.3	12.5	bdl	5.5	8.3	3.5	17.1	-1.6
MAN24_GW_15	59.6	0.2	1.3	2.8	1.8	0.3	8.3	6.5	4.1	11.2	5.2
MAN24_GW_16	58.9	0.3	1.6	1.6	1.2	0.4	4.5	6.6	3.0	11.7	1.0
MAN24_GW_18	83.6	0.6	1.9	3.0	3.2	0.4	6.0	9.0	2.3	17.4	-0.9
MAN24_GW_20	60.4	0.1	0.9	1.6	0.6	bdl	5.0	6.3	1.6	11.3	-0.5
MAN24_GW_21	73.6	0.1	2.0	2.0	2.2	bdl	5.7	8.5	2.1	15.6	2.7
Spring											
MAN24_SW_08_SP	32.1	0.1	3.8	2.2	1.5	bdl	4.5	3.9	1.6	10.0	9.1
Surface Waters											
MAN24_SW_07_RIV	22.0	0.1	1.8	1.4	0.3	bdl	1.9	3.0	0.7	6.0	5.3
MAN24_SW_01_CR	35.6	0.1	0.6	1.6	0.3	bdl	2.8	3.2	1.2	7.7	-0.9
MAN24_SW_03_CR	22.0	0.1	2.0	2.0	0.6	bdl	3.0	2.4	0.9	7.1	8.0
MAN24_SW_04_CR	32.0	0.1	2.4	1.6	1.6	bdl	3.0	2.7	1.0	7.6	-3.7
MAN24_SW_02_CR	25.3	0.1	1.8	1.6	0.6	bdl	2.8	2.1	0.8	6.6	-0.4
MAN24_SW_05_CAN	11.2	0.1	4.2	1.6	0.2	bdl	2.8	0.7	0.4	4.6	-0.2
MAN24_SW_06_CAN	26.0	0.3	3.3	2.1	2.0	bdl	2.5	2.9	1.7	6.5	-4.0
MAN24_SW_09_DIT	38.9	0.1	3.3	2.7	1.4	0.4	4.2	3.7	1.1	12.6	5.6

bdl = below detection limit

Table 4. Field measurements, stable isotope, and trace element data for groundwater and surface water samples. Field measurements include temperature, pH, conductivity, and dissolved oxygen (DO).

Sample Name	Field Measurements				Stable Isotope		Trace Element			
	Temp	pH	Cond	DO	$\delta^{18}\text{O}$	δD	Fe	As	Pb	Zn
Basalt Wells	°C		uS/cm	mg/L			ppb	ppb	ppb	ppb
MAN24_GW_04	14.1	8.0	145	6.1	-15.8	-117.4	bdl	0.7	0.1	36.1
MAN24_GW_09	12.9	7.5	125	6.3	-16.8	-127.3	26.7	0.5	0.2	104.3
MAN24_GW_11	12.4	7.6	110	7.4	-15.1	-110.3	12.2	0.4	0.1	53.1
MAN24_GW_13	17.1	7.3	137	4.0	-15.5	-116.0	218.9	0.2	0.5	72.0
MAN24_GW_17	16.0	7.5	143	3.5	-16.9	-126.5	260.7	0.5	0.1	6.4
MAN24_GW_19	21.2	7.5	151	1.8	-17.7	-133.9	59.7	0.1	0.4	1.6
MAN24_GW_22	11.4	7.4	124	11.0	-13.9	-103.5	48.0	0.1	0.2	22.7
Sedimentary Wells										
MAN24_GW_01	16.2	7.4	249	4.5	-13.4	-97.5	40.1	0.3	bdl	27.8
MAN24_GW_02	19.5	7.7	110	5.4	-15.9	-116.1	7.4	0.5	0.1	32.7
MAN24_GW_03	16.4	7.1	82	7.5	-15.0	-109.4	17.0	1.2	0.6	53.6
MAN24_GW_05	14.1	7.6	168	7.7	-16.4	-125.5	47.8	2.0	0.1	6.3
MAN24_GW_06	15.8	8.0	122	7.1	-17.3	-131.0	5.6	3.0	0.4	12.6
MAN24_GW_07	16.8	8.1	119	3.5	-16.7	-127.1	14.2	3.1	0.4	12.7
MAN24_GW_08	14.1	7.1	156	8.0	-13.6	-98.9	bdl	0.3	0.8	17.7
MAN24_GW_10	14.9	7.5	331	2.5	-14.2	-105.7	70.2	0.3	0.1	3.7
MAN24_GW_12	15.7	7.0	229	7.8	-13.1	-94.8	20.7	0.1	0.1	15.2
MAN24_GW_14	15.3	6.9	138	5.4	-13.4	-97.8	23.2	0.2	0.9	17.9
MAN24_GW_15	17.4	7.3	116	9.5	-15.1	-111.2	5.3	0.7	0.1	47.3
MAN24_GW_16	15.0	7.5	97	6.4	-15.9	-116.3	129.9	0.2	0.7	7.5
MAN24_GW_18	17.0	7.7	140	10.0	-16.1	-118.3	17.8	1.4	0.1	24.3
MAN24_GW_20	16.1	7.4	108	6.6	-16.3	-119.6	9.4	0.8	0.1	7.0
MAN24_GW_21	14.1	7.6	138	6.0	-16.2	-119.5	7.3	1.1	0.1	9.6
Spring										
MAN24_SW_08_SP	13.0	6.8	81	9.9	-13.3	-96.6	31.8	0.1	0.0	3.5
Surface Waters										
MAN24_SW_07_RIV	18.0	7.0	34	9.6	-14.1	-101.6	31.7	0.4	bdl	6.4
MAN24_SW_01_CR	16.7	7.2	72	9.7	-15.2	-111.2	75.8	0.1	bdl	3.1
MAN24_SW_03_CR	17.6	7.0	60	9.6	-14.3	-103.5	52.4	0.2	bdl	7.3
MAN24_SW_04_CR	19.9	7.2	63	9.0	-14.3	-103.2	141.2	0.2	0.1	1.1
MAN24_SW_02_CR	23.6	7.1	56	9.2	-14.6	-105.8	57.8	0.3	bdl	2.9
MAN24_SW_05_CAN	19.6	7.0	25	9.0	-13.2	-95.1	14.8	0.2	bdl	0.8
MAN24_SW_06_CAN	18.8	6.9	39	8.5	-13.9	-100.3	100.5	0.4	0.2	22.3
MAN24_SW_09_DIT	26.7	7.5	86	13.2	-12.3	-89.8	320.7	0.5	0.1	5.2

bdl = below detection limit

Stable isotope values for groundwater and surface water samples are represented on a $\delta^{18}\text{O}$ - δD plot (Figure 15). $\delta^{18}\text{O}$ values range from -18 to -12 and δD values range from -140 to -80. Two local meteoric water lines (LMWL), from Taylor and Gazis (2016) are included on the graph for comparison.

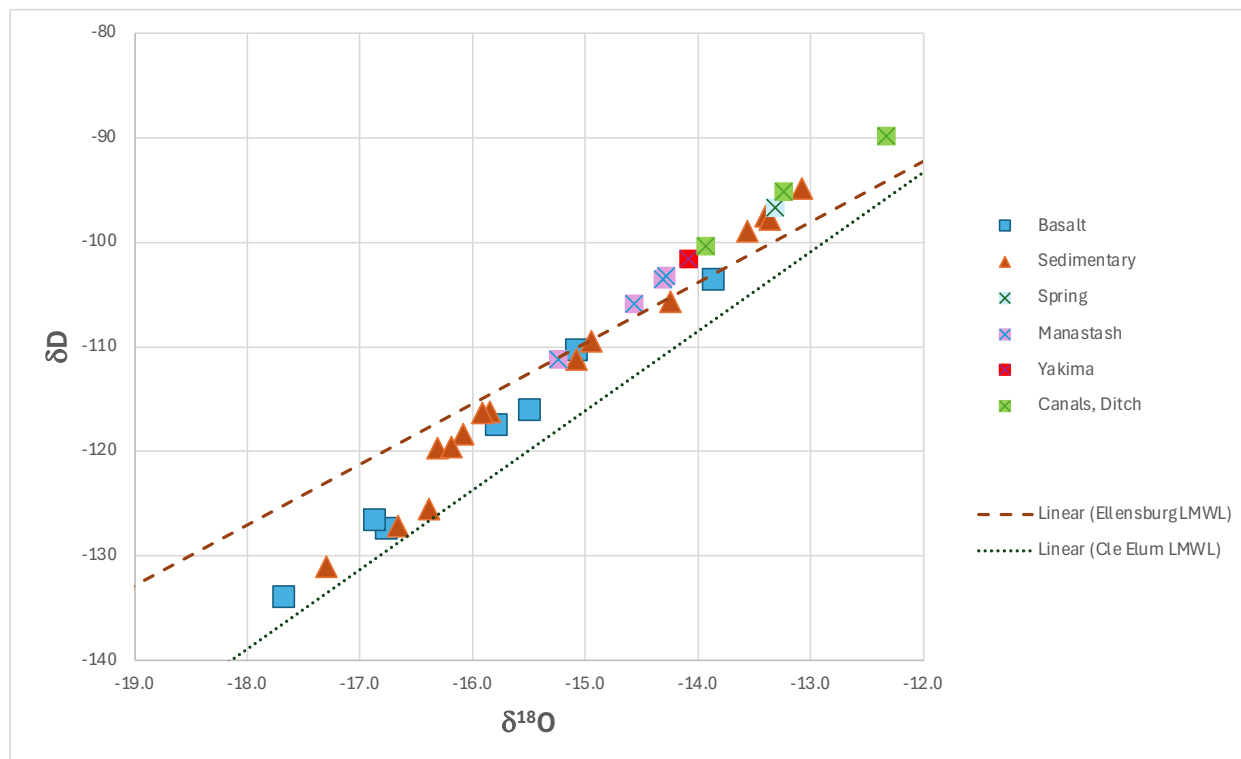


Figure 15. Stable isotope plot (δD versus $\delta^{18}\text{O}$) for all samples. Different groundwater wells (basalt and sedimentary) are shown as well as spring water and surface water samples. Local meteoric water lines for Ellensburg and Cle Elum (from Taylor and Gazis 2016) are shown for reference.

Major ions (Ca, Mg, Na, K, Cl, SO₄) including alkalinity values (HCO₃ + CO₃) are plotted on a Piper diagram for relative concentration comparisons of water samples (Figure 16). Relative proportions of major cations are represented on the lower left ternary plot and major anions are represented on the lower right ternary plot. The center diamond plot indicates combined values of both cations and anions.

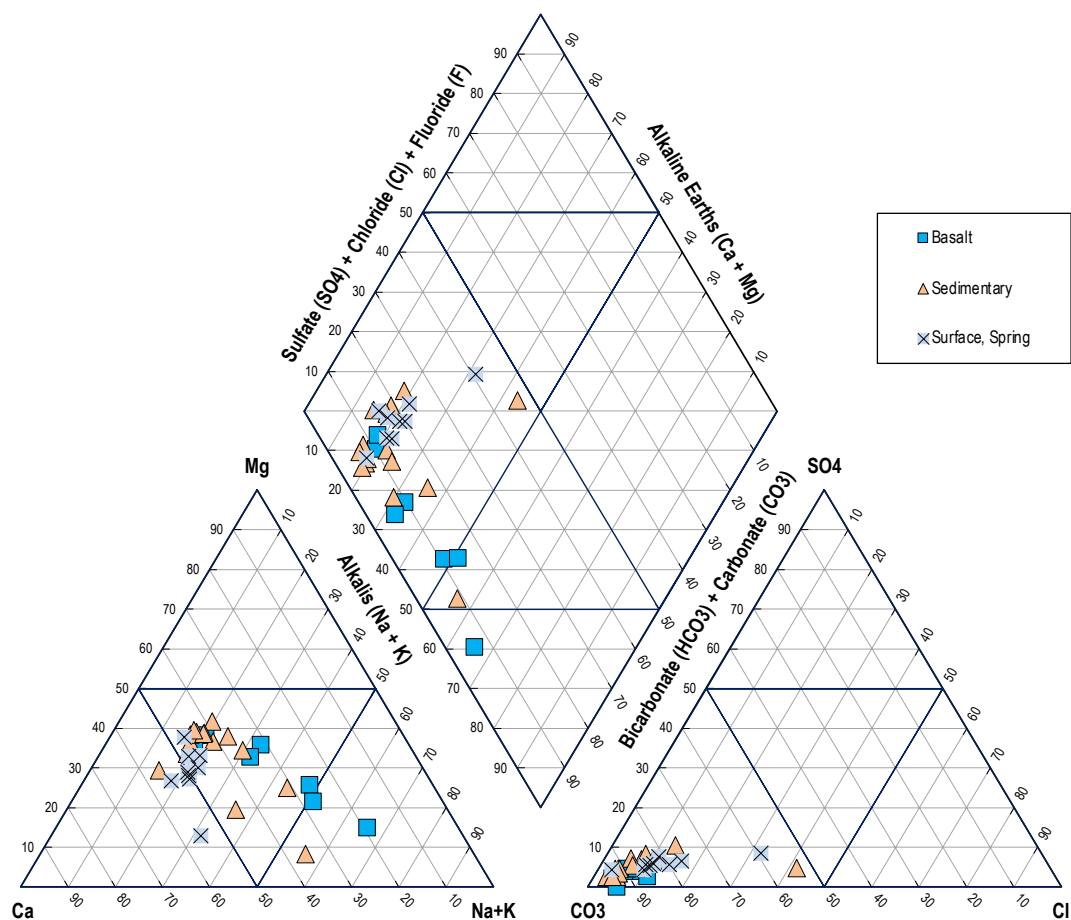


Figure 16. Piper diagram representing relative major ion compositions for all samples.

Factor Analysis applied to the major ion and stable isotope data resulted in four factors that explain 75% of the variance. Factor loadings are given in Table 5. The first factor is dominated by Mg, alkalinity (predominantly HCO₃), NO₂, and Ca; while the second factor is dominated by the stable isotope ratios, NO₃, and SO₄ and has a strong negative loading for Na.

Table 5. Factor loading for factor analysis that includes major ions and stable isotopes.

	Factor 1	Factor 2	Factor 3	Factor 4
% variance explained	28.86	24.56	17.1	4.74
Mg	0.964	0.228	0.030	-0.136
Alkalinity	0.952	-0.071	0.011	0.040
NO ₂	0.918	-0.285	0.125	0.246
Ca	0.861	0.267	-0.090	0.054
δD	0.092	0.895	0.384	0.171
δ ¹⁸ O	0.117	0.883	0.399	0.217
NO ₃	0.039	0.716	-0.001	0.103
Na	0.269	-0.710	-0.039	0.437
SO ₄	0.456	0.562	0.059	0.102
K	-0.080	0.044	0.995	0.046
Cl	-0.094	0.211	0.922	0.179
F	0.114	0.082	0.211	-0.040
PO ₄	-0.025	-0.125	-0.053	-0.457

DISCUSSION

Groundwater/Surface Water Interactions

Stable isotope data is useful for deciphering groundwater/surface water interaction, particularly in this region because the Yakima River is isotopically distinct from the typical groundwater. Hydrogen and oxygen isotopes are highly correlated. In this discussion we will use hydrogen isotope compositions (δD values) but the trends we describe apply to δ¹⁸O values as well. Previous research (Gazis and Taylor, 2016; Sleeper, 2020) has established that the Yakima River and irrigation water derived from the river are relatively heavy with hydrogen isotopic ratios between δD = -88 and δD = -97. Irrigation water tends to be slightly heavier (less negative δ values) than Yakima River water because of evaporation during transport through canals. Groundwaters in the region are isotopically distinct, generally falling into two groups: isotopically light groundwater in basalts with δD < -120, and shallower “resident” groundwater in the sedimentary overburden with intermediate hydrogen isotope values of -114 < δD < -116. Based on major ion concentrations and other studies of basalt groundwater, the isotopically light basalt groundwaters are interpreted to represent older waters which were recharged from an isotopically lighter source than current surface waters, likely due to a different climate and surface water configuration (Vlassopoulos et al., 2009). The intermediate groundwaters are considered to be younger, derived from more local sources such as nearby Yakima River tributaries.

Isotope data in this study (Figure 17) generally follow the same patterns observed in these previous studies in Kittitas Valley with some isotopically light waters in deeper wells, both basalt and sedimentary, some isotopically heavy waters similar in isotopic composition to the Yakima

River and irrigation canals and intermediate waters. For intermediate composition waters, the isotopic signatures could be primary and represent a resident groundwater that is some average of local recharge waters over a period of time, or they could be mixtures of heavier surface waters and lighter groundwaters. Manastash Creek is also intermediate in composition and may be dominating the isotopic composition of some of the nearby groundwater.

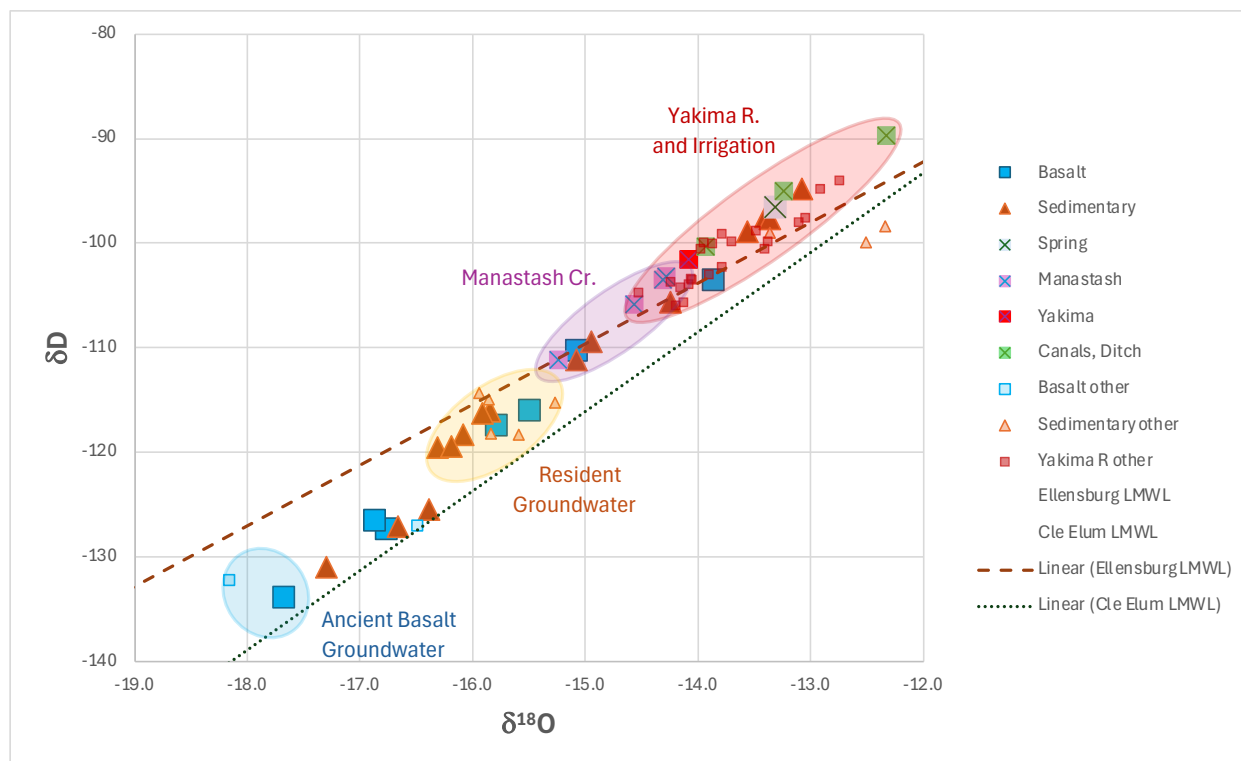


Figure 17. Stable isotope plot (δD versus $\delta^{18}O$) for all samples with interpreted isotope groups identified with shaded ellipses. Isotope data from Taylor and Gazis (2016) and Sleeper (2020) are also included as Basalt other and Sedimentary other. Local meteoric water lines for Ellensburg and Cle Elum (Taylor and Gazis, 2016) are shown for reference.

For the purposes of comparisons and mapping, samples were grouped based on their isotopic signature into the following groups: Very Light $\delta D < -124$; Light $-124 < \delta D < -115$; Intermediate $-115 < \delta D < -102$; Heavy $\delta D > -102$. Samples within these groupings are detailed in Table 6. The Very Light grouping contains exclusively deep wells ranging from 235 to 400 feet and generally corresponds to groundwater in deep basalt wells (e.g. Taylor and Gazis, 2016). The Heavy grouping has surface water and groundwater derived from the Yakima River. This group contains three shallow sedimentary wells (G1, G12, and G8), a deep sedimentary well (G14), and a deep basalt well (G22). Both deep wells (G14 and G22) are characterized based on a nearby well log. Therefore, it is possible that one or both of these wells are actually shallow sedimentary well. Groundwaters with isotopic compositions between the two end-member groups, labelled Light and Intermediate could either be a mixture of the two water types or a resident groundwater with a more local source of recharge.

Table 6. Stable isotope groupings of groundwater samples as shown in Figure 17.

Very Light	Light	Intermediate	Heavy
G7 Deep Sedimentary 245 ft	G20 Shallow Sedimentary 100 ft	G10 Shallow Sedimentary 130 ft	G1 Shallow Sedimentary 30 ft
G5 Deep Sedimentary 250 ft	G18 Shallow Sedimentary 170 ft	G3 Shallow Sedimentary 150 ft	G12 Shallow Sedimentary 140 ft
G6 Deep Sedimentary 400 ft	G21 Shallow Sedimentary 173 ft	G15 Shallow Sedimentary 162 ft	G8 Shallow Sedimentary 180 ft
G9 Deep Basalt 235 ft	G4 Shallow Basalt 100 ft	G11 Deep Basalt 201 ft	G14 Deep Sedimentary 300 ft
G19 Deep Basalt 261 ft	G13 Shallow Basalt 160 ft	S1 Manastash Creek	G22 Deep Basalt 200 ft
G17 Deep Basalt 264 ft	G16 Deep Sedimentary 223 ft	S2 Manastash Creek	S5 KRD Canal
	G2 Deep Sedimentary 230 ft	S3 Manastash Creek	S6 KRD Canal
		S4 Manastash Creek	S7 Yakima River
			S8 KRD Ditch
			S9 Spring

Very Light $\delta D < -124$; Light $-124 < \delta D < -115$; Intermediate $-115 < \delta D < -102$; Heavy $\delta D > -102$
Shaded boxes indicate wells for which depth is estimated based on nearby well log.

When these stable isotope groupings are plotted on a site map (Figure 18), some patterns can be seen. Samples with very light stable isotope values are concentrated on the western side of the fan. In contrast, intermediate samples that are classified as Light are all found south of Manastash Creek. Based on depth and aquifer type, these may be two distinct aquifers one near the fan apex (G4, G13, G2 and G16), and the other in the southeast part of the study area (G20, G21, G18). The Intermediate and Heavy samples include all surface waters as well as groundwaters from throughout the study area. These are generally located in farmed areas, and their isotopic compositions likely represent a large fraction of river and/or irrigation water.

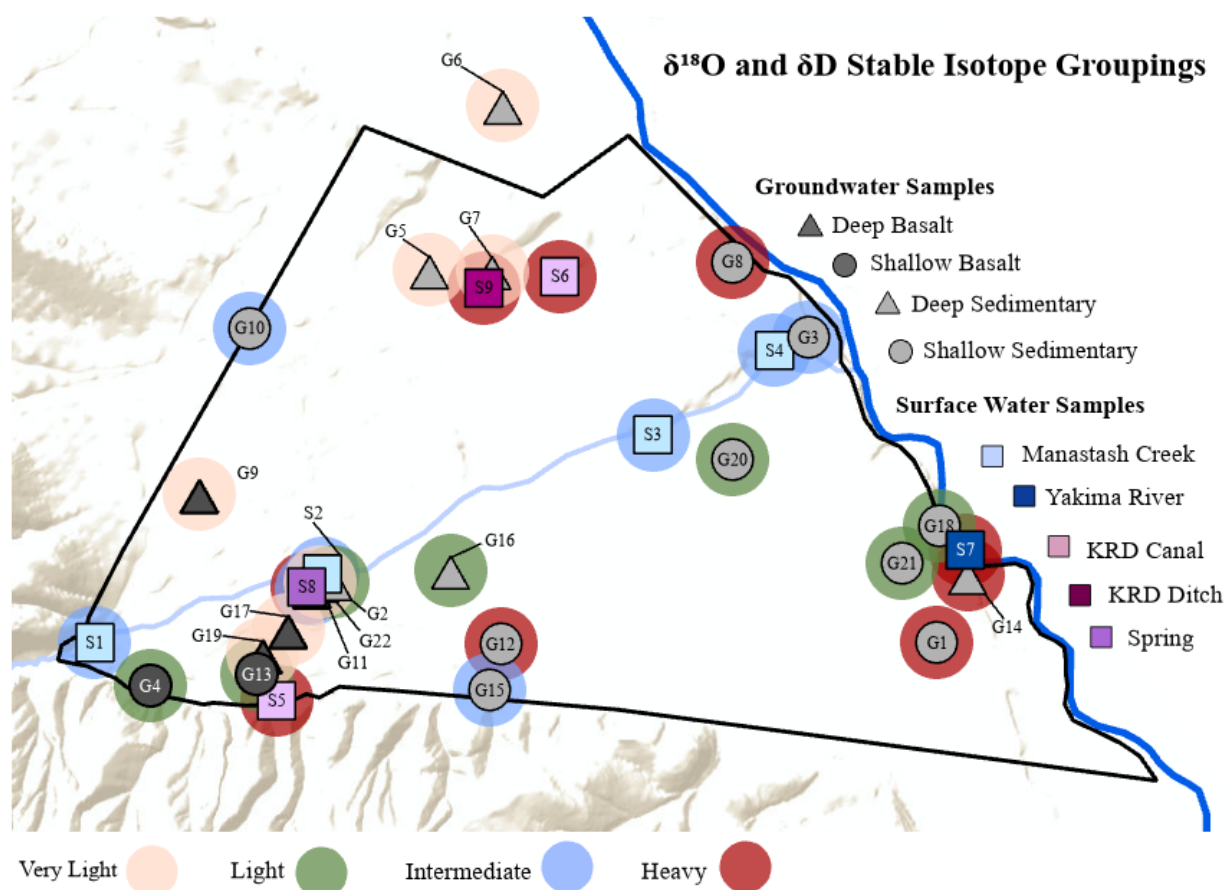


Figure 18. Map showing stable isotope groupings of surface waters and groundwaters. Groupings are defined in Table 6.

Interpretation of time series hydrographs provides additional context for surface/groundwater interaction. As shown on Figure 19, Manastash Creek flow and well A water levels share peaks in early February, April, and June 2024 suggesting hydraulic connectivity between Manastash Creek and the shallow aquifer near where well A (11.5 feet deep) is located, approximately 300 feet south of Manastash Creek. There is no correlation between Well A groundwater elevation and the KRD irrigation canals time of operation. There is also little-to-no

correlation between Well B and Manastash Creek, except possibly in October 2024. However, there is a clear correlation between KRD irrigation operation and Well B as we see a stark decline from 7 feet to 15 feet static water level when irrigation distribution is shut off. This strongly suggests surface water interaction within a shallow sedimentary aquifer on the south-east portion of the fan where Well B (a 30-foot deep well) is located. Groundwater fluctuation levels in Well B during the irrigation season could be explained by timing of irrigation and hay harvests in fields close to the well.

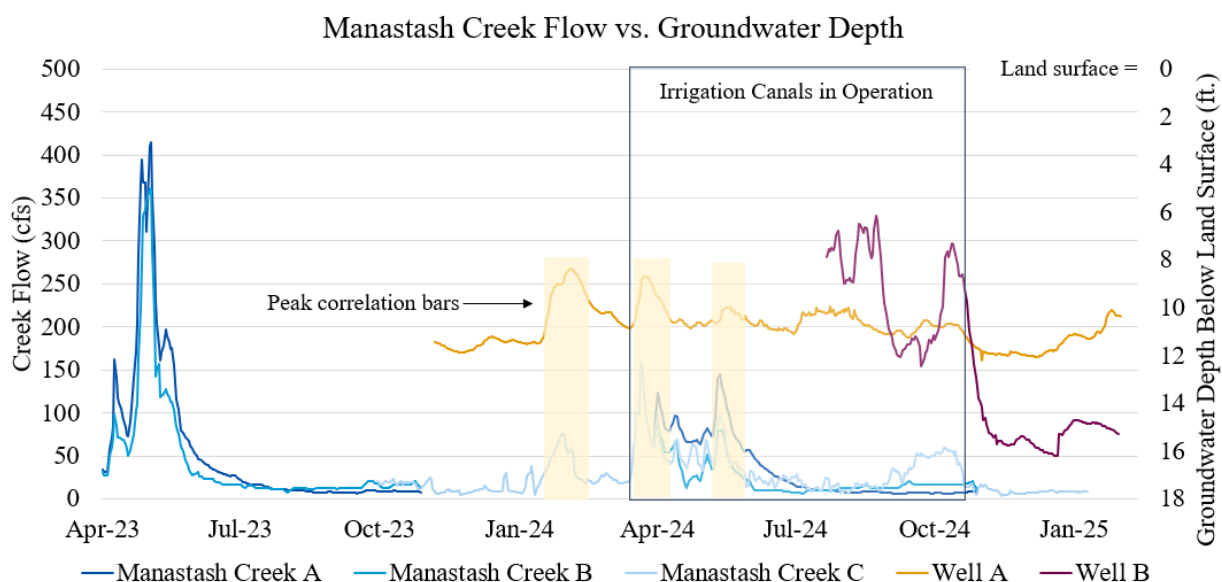


Figure 19. Time series hydrograph for Manastash Creek flow and groundwater levels within wells A and B with added interpretation. Yellow bars indicate peak correlation between groundwater depth and Manastash Creek flow. The black box indicates KRD canal time of operation.

Groundwater Hydrochemical Groups

Examination of results from the Piper diagram (Figure 19), Factor Analysis (FA) factor scores (Table 7), and nitrate/sodium values allow for conceptualization of distinct hydrochemical groups. From these groupings, one can infer aquifer connectivity (connecting aquifers of similar elevations and lithologic makeup) and water mixing between separate aquifer units.

Four groups were identified on the Piper diagram indicating waters with similar geochemical makeup including Ca, Mg, Na, K, Cl, and SO₄ concentrations (Figure 20). Samples within Group 1 (two shallow basalt, one deep sedimentary, and one shallow sedimentary) have high proportions of sodium. Samples within Group 2 (two deep basalt wells, one deep sedimentary, and one shallow sedimentary) are intermediate with equal proportions of the cation end members. Group 3, composed of primarily sedimentary wells and two deep basalt wells, is dominated by calcium and magnesium, in approximately equal proportions.

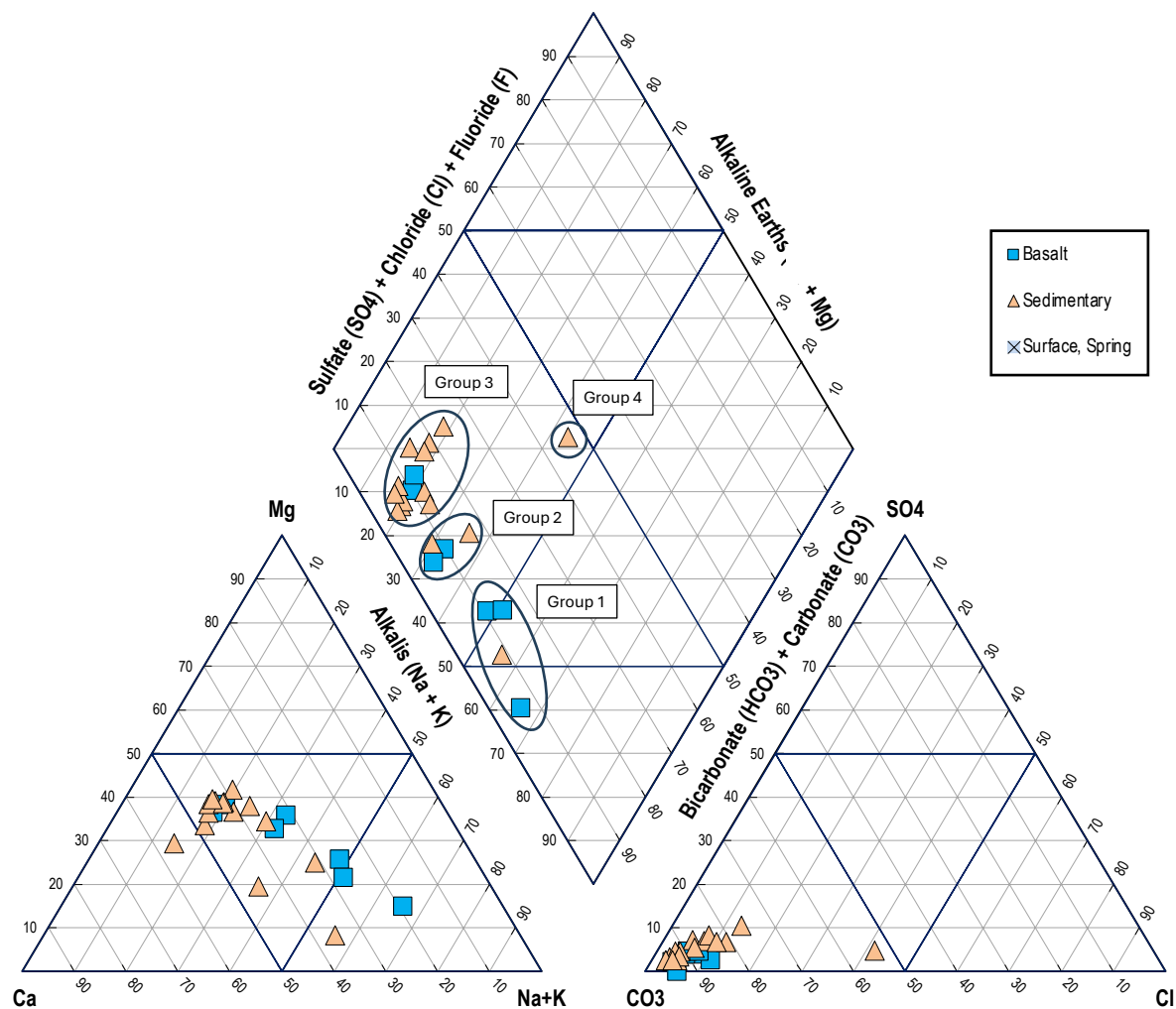


Figure 20. Piper diagram representing relative major ion and alkalinity values for groundwater samples with added interpretation indicating three major ion groupings.

Factor scores can also be used to discern similarities between samples and the chemical constituents that control these similarities. Table 7 presents scores for the first four factors in a Factor Analysis that included major ions and stable isotopes. Factor loadings for this analysis are given in Table 5. In Table 7, scores have conditional shading with red indicating higher scores and blue indicating low scores. High scores for sample GW-10 (factor 1) and GW-12 (factor 3) indicate that the chemistry of these samples has a strong influence on determining that factor. GW-10 is the sample with the highest conductivity, alkalinity, Ca, and Mg. It represents a concentrated version of the typical Ca-Mg bicarbonate type water, Group 3 on the Piper Diagram (Figure 20). GW-12 has anomalously high Cl and K and is also an outlier (Group 4) on the Piper Diagram. Because of its heavy isotope signature and slightly elevated nitrate concentration, this sample likely represents groundwater that is heavily influenced by irrigation water. This well is relatively shallow (130 ft deep) and located amidst hay farms on the south side of Manastash Road.

Table 7. Factor analysis scores for all groundwater samples. Factor loadings are given in Table 5.

Sample Name	Factor1	Factor2	Factor3	Factor4
Basalt Wells				
MAN24_GW_04	-0.11	-0.50	0.29	0.43
MAN24_GW_09	-0.03	-0.77	-0.10	-1.11
MAN24_GW_11	-0.37	0.69	-0.40	-0.65
MAN24_GW_13	-0.08	-0.73	0.06	2.72
MAN24_GW_17	0.14	-1.01	0.12	-1.00
MAN24_GW_19	-0.31	-2.11	0.08	1.04
MAN24_GW_22	-0.40	1.36	-0.48	0.93
Sedimentary Wells				
MAN24_GW_01	-0.82	2.08	-0.39	-0.36
MAN24_GW_02	-0.42	0.02	-0.40	-0.48
MAN24_GW_03	0.17	0.37	-0.66	1.29
MAN24_GW_05	0.80	-0.62	-0.14	-0.84
MAN24_GW_06	-0.96	-1.24	-0.69	0.59
MAN24_GW_07	-0.47	-0.84	-0.37	0.26
MAN24_GW_08	0.38	1.29	0.16	0.62
MAN24_GW_10	4.06	0.19	0.52	0.15
MAN24_GW_12	-0.87	0.22	4.25	-0.19
MAN24_GW_14	-0.08	1.64	-0.22	0.85
MAN24_GW_15	-0.35	0.40	0.02	-0.20
MAN24_GW_16	-0.45	0.15	-0.23	-1.49
MAN24_GW_18	0.28	-0.17	-0.36	-0.92
MAN24_GW_20	-0.31	-0.21	-0.61	-0.77
MAN24_GW_21	0.19	-0.22	-0.44	-0.87

Hydrochemical groupings from the Piper diagram were combined with PCA factor score groups, stable isotope composition groups, and sodium/nitrate values to sort all groundwater samples into three hydrochemical groups (Table 8). Groups were initially determined based on stable isotope values, classifying all groundwater samples with intermediate and heavy values (indicating interaction with the Yakima River, Manastash Creek, or the KRD ditch system) in Group 3. All samples with Very Light stable isotope signatures are placed in Group 1. The placement of samples with Light stable isotope signatures depends on a combination of factors

including their factor analysis scores, Piper Diagram group and nitrate and sodium concentrations (Table 8).

Table 8. Groundwater hydrochemical groups.

Hydrochemical Group	Stable Isotope*	FA High Score	FA Low Score	Major Ion Group	Sodium**	Nitrate^	Lithology	Well Depth
1								
G4	Light	4	2	1	High	Low	Basalt	100
G13	Light	4	2	1	High	Low	Basalt	160
G19	Very Light	4	2	1	High	Low	Basalt	261
G17	Very Light	3	2	2	Medium	Low	Basalt	264
G9	Very Light	2	3	2	Medium	Low	Basalt	235
G6	Very Light	4	2	1	High	Low	Sedimentary	400
G7	Very Light	4	2	2	Medium	Low	Sedimentary	245
G5	Very Light	1	4	3	Medium	Medium	Sedimentary	250
2								
G18	Light	1	4	3	Medium	Medium	Sedimentary	170
G21	Light	1	4	3	Low	Low	Sedimentary	173
G20	Light	2	4	3	Low	Low	Sedimentary	100
G2	Light	2	4	3	Low	Low	Sedimentary	230
G16	Light	2	4	3	Low	Low	Sedimentary	223
3								
G15	Intermediate	2	1	2	Medium	Low	Sedimentary	162
G11	Intermediate	2	4	3	Low	Low	Basalt	201
G10	Intermediate	1	4	3	High	Medium	Sedimentary	130
G3	Intermediate	4	3	3	Medium	Medium	Sedimentary	150
G22	Heavy	2	3	3	Low	Medium	Basalt	200
G1	Heavy	2	1	3	Low	High	Sedimentary	30
G8	Heavy	2	3	3	Low	High	Sedimentary	180
G14	Heavy	2	3	3	Low	High	Sedimentary	300
G12	Heavy	3	2	4	Low	Medium	Sedimentary	140

* Isotope classification from δD : Very Light <-125; Light -116 to -120; Intermediate -106 to -112; Heavy >-103

** Sodium classification: High > 15.0 ppm; Medium 5.0 to 15.0 ppm; Low <5.0 ppm

^ Nitrate classification: High > 10.0 ppm; Medium 3.0 to 10.0 ppm; Low <3.0 ppm

For nitrate, measured as NO_3 in mg/L, three groups were established based on value ranges: low (under 3.0 mg/L), mid (3.0 to 10.0 mg/L), and high (above 10.0 mg/L). High nitrates within the study site are likely due to agricultural practices and indicate recharge from irrigation water, therefore primarily medium and high nitrate levels within Group 3 further supports surface water interaction interpretations from stable isotope results. Sodium was also categorized into three groupings: low (under 5.0 ppm), mid (5.0 to 15.0 ppm) and high (above 15.0 ppm). Sodium values can be used to indicate age of groundwaters, with deeper, older waters typically having higher sodium concentrations as indicated in the geochemical findings of Steinkampf and Hears (1996). Group 1 contains samples with medium to high sodium values, which suggests that these are the oldest waters within the alluvial fan.

Groundwater hydrologic groupings are shown on a site map to explore spatial comparisons (Figure 21). Group 1, the largely “very light” stable isotope group, is concentrated on the north-western region of the fan. This group is characterized as primarily deep wells with low nitrates. Low nitrate values suggest that surface water is not reaching this groundwater group as there are agricultural parcels within the western region that are undoubtedly applying nitrate-rich fertilizers. Group 2 is concentrated on the southern portion of the fan with all samples south of Manastash Creek. This group is made up entirely of sedimentary wells with primarily medium sodium levels, and low nitrates interpreted as Ellensburg Formation groundwaters intermediate in age without much surface water influence. Group 3 is found throughout the fan in two distal regions and on the north and south boundaries of the easternmost medial region. This group strongly suggests surface water interaction through stable isotope geochemistry and nitrate values. The deepest observed well in Group 3 (G14) is believed to be 300 feet deep based on a nearby well, suggesting that surface water may be penetrating to this depth. The distribution of these sampled within Group 3 indicates the occurrence of KRD influenced groundwater recharge as that irrigation network transfers water throughout the study site.

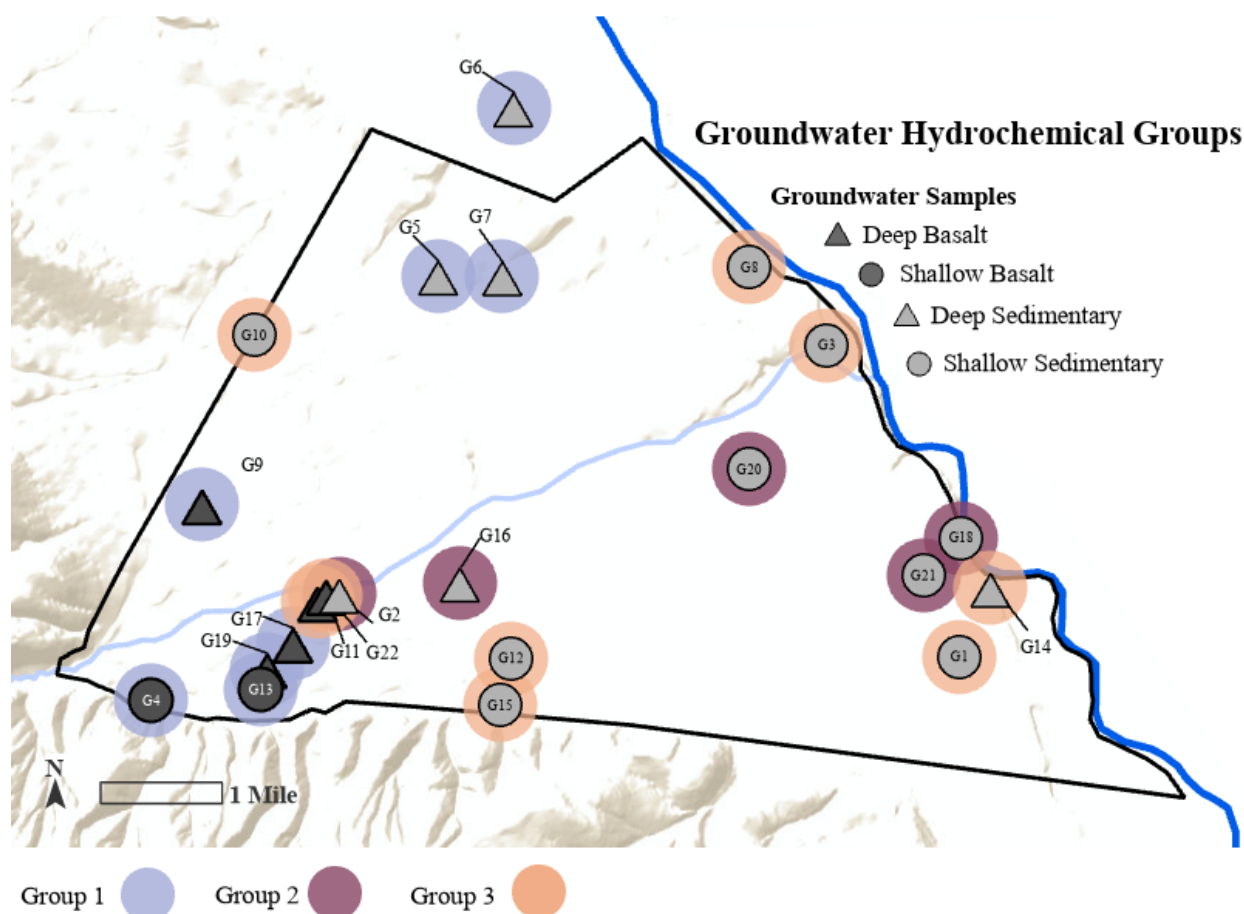


Figure 21. Representation of hydrochemical groups 1, 2, and 3 on the Manastash alluvial fan indicating spatial distribution of water types. Group 1 is concentrated in the north-western region while Group 2 is seen south of Manastash Creek. Samples within Group 3 are distributed throughout the fan.

Groundwater Connectivity and Barriers to Flow

Application of geochemical results are used to interpret groundwater connectivity and barriers to flow. Results from the groundwater hydrochemical grouping analysis were projected onto transect cross-sections using sampled well locations (Figure 11). Hydrologic groups (1, 2, or 3) are indicated on cross-sections (Figures 22 through 24) with the same color symbology as Table 8 and Figure 21.

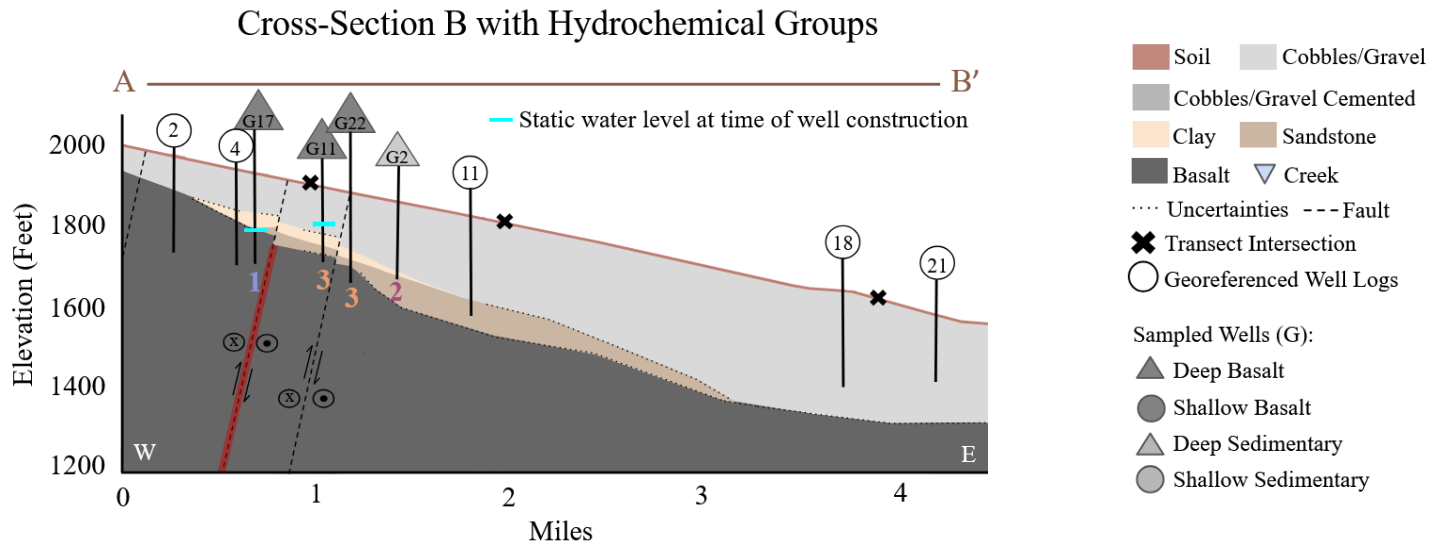


Figure 22. Cross-section B representing transect A-B' on Figure 10 with interpretation added from hydrochemical groups in Table 8. The location of Group 1 west of the second fault suggests a barrier to flow within the upper basalt layer.

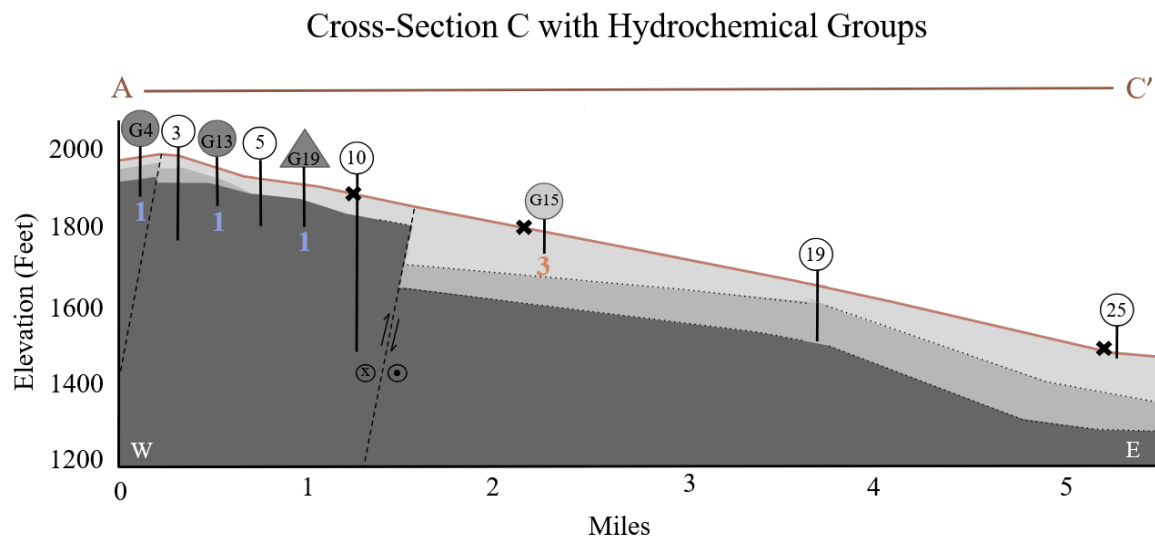


Figure 23. Cross-section C representing transect A-C' on Figure 10 with interpretation added from hydrochemical groups in Table 5. All water samples taken west of the second fault line fall into Group 1.

. When present in aquifer systems, faults can act as either barriers to or conduits for flow. Some fault lines, especially in basalt rocks, create a downward pathway for water to descend deeper than otherwise possible. In this case, water that might have once flowed laterally now descends downward (Newcomb, 1969).

Within cross-section B, an abrupt change in hydrochemical groups on either side of the center fault line (Group 1 on the western side and Group 3 on the eastern side) amongst two basalt wells of similar depth suggest a barrier to flow. Hydrochemically, G17 and G11 indicate great differences in iron values with G17 containing 261ppb and G11 containing 12 ppb. Well G17, constructed in April of 2007, is 264 feet deep with an initial static water level of 131 feet at the time of well construction. Well G11, constructed June of 1996, is 201 feet deep with an initial static water level of 116 feet at the time of construction. When including static water levels, it is important to consider seasonality and year of well construction. Wells G11 and G17 show a 15-foot difference in static water level which could be due to the 11-year difference in construction dates. Static water level differences could also be caused by a barrier to flow, indicating a notable difference in depth to water table in two wells approximately a quarter of a mile apart.

Cross-section C (Figure 23) indicates water from wells G4, G13, and G19 as Group 1 with no surface water interaction and a singular sedimentary well (G15) as Group 3 suggesting significant surface water interaction in the cobble/gravel layer from 1900 feet asl to 1700 feet asl. Homogeneity of hydrochemical groupings within the first mile of this transect further supports the barrier to flow presented within cross-section B (Figure 22) since the center fault barrier does not intersect cross-section C and no abrupt hydrochemical differences are present.

Cross-section F (Figure 24) indicates hydrochemical Group 3 in the cobbles/gravel sedimentary layer ranging from approximately 1500 to 1300 feet asl. This suggests that aquifers composed of cobbles and gravels within this region experience influence from surface waters except for those beneath a sandstone layer ranging from 0.75 miles to 3.75 miles across the transect. Both the cobbles/gravel portion beneath the sandstone layer (G21 and G 18) and the cemented cobble/gravel portion near mile 2 (G20) fall within hydrochemical Group 2 suggesting waters of moderate age and little surface water interaction.

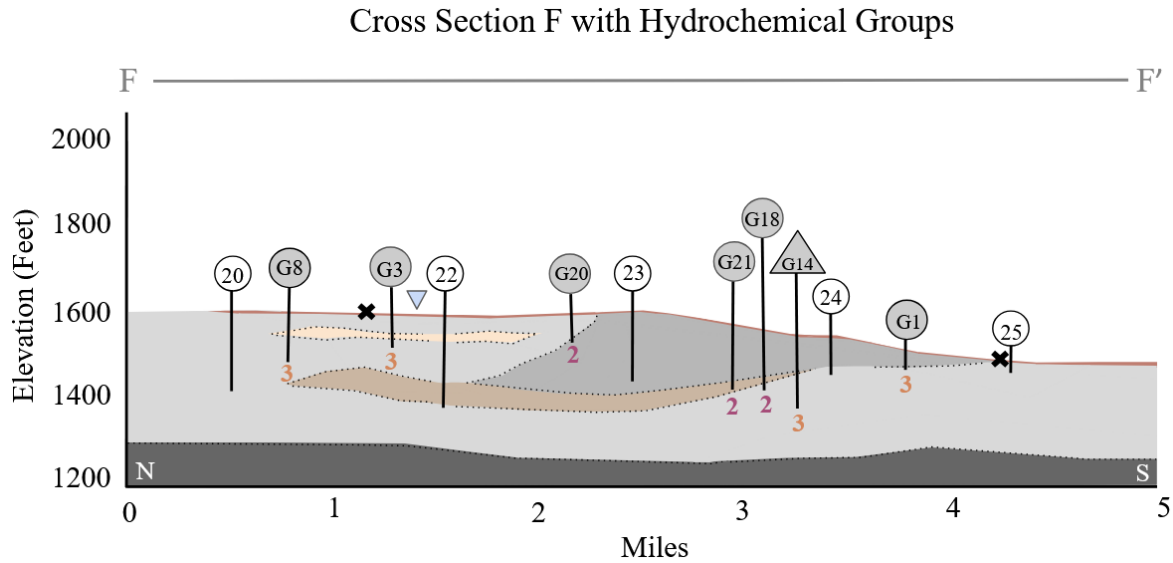


Figure 24. Cross-section F representing transect F-F' on Figure 10 with interpretation added from geochemical groups in Table 5.

Identifying Suitable MAR Locations

A geochemical findings summary map was developed which includes tax parcel boundaries to establish initial parameters for SAR and ASR suitability (Figure 25). First, polygons encompassing shallow aquifers with hydrochemical Group 3 waters were created to represent the minimum parameter of sedimentary aquifers with surface water influence. All wells within this classification were shallow (less than 200 feet deep), except for one (presumed) deep sedimentary well at 300 feet deep. We can infer that water applied on the surface in these locations will infiltrate downward, eventually contributing to groundwater supply, making these polygons indicators for SAR suitability. There were some additional shallow sedimentary wells which were not included in the polygons as they fell into hydrochemical Group 2.

Additionally, one polygon encompassing basalt wells was created at the fan apex, as this is where basalt wells are primarily located within the study site. Most wells at the apex were classified as Group 1 which indicates no surface water influence. Since ASR typically occurs in deep, confined, aquifers, these polygons indicate the most suitable locations for ASR.

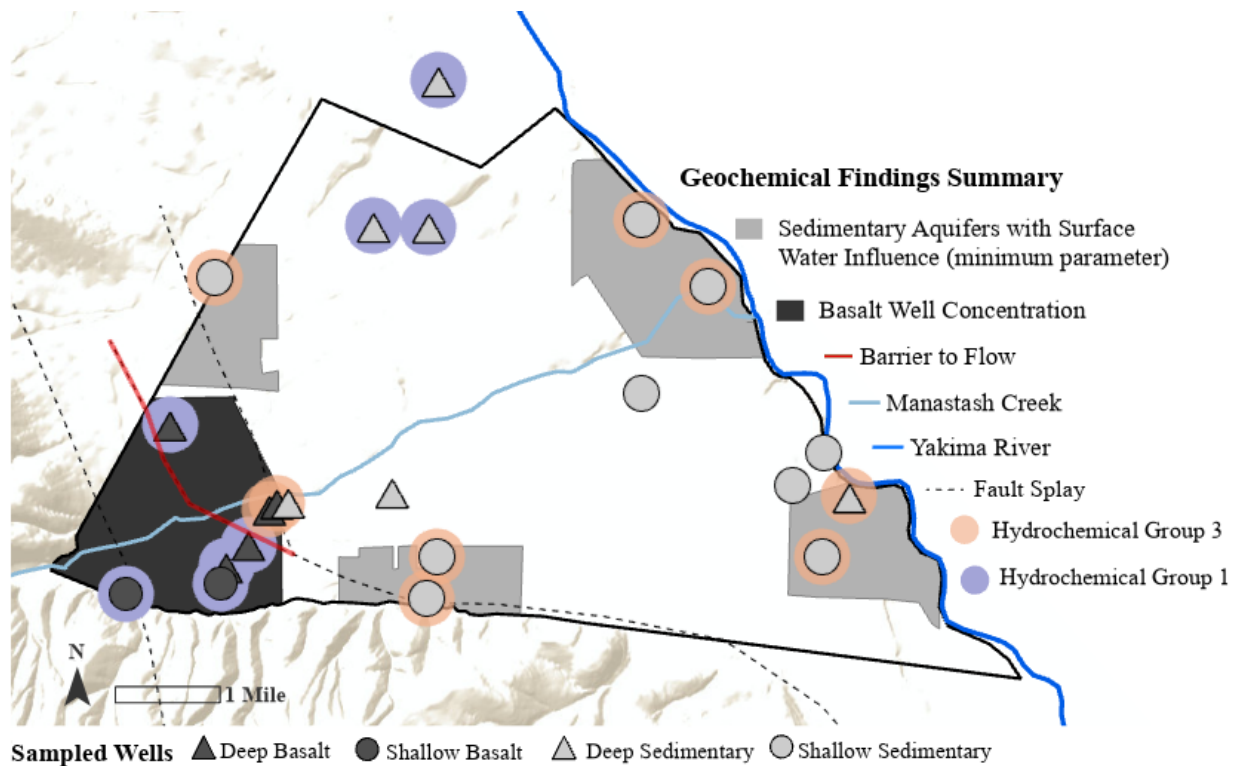


Figure 25. Site map representing a summary of geochemical findings from major ion, stable isotope, and sodium/nitrate values indicating regions with minimum sedimentary aquifer units with surface water influence, a barrier to flow, and a concentrated region of basalt wells indicating no surface water influence.

To further characterize suitable SAR locations, tax parcel information, soil data, and seepage velocity contours were applied to the geochemical findings with a summary map (Figure 26). For each category, a suitability ranking of 1 through 3 was applied (Table 9). Regions classified as suitability 1 were layered together on ArcGIS Pro, then clipped to the polygons representing sedimentary aquifers with surface water influence from Figure 25. Tax parcel information was sourced from Kittitas County Compass, an open-source GIS data portal (Kittitas County, 2025). The most suitable parcels were those with high likelihood for property access including undeveloped, agricultural, and recreational land. High ranking tax parcels and polygons from Figure 25 were used to determine suitable areas for general MAR application while soil data, sourced from the Natural Resources Conservation Service Web Soil Survey was applied to identify subregions suitable for flood application (NRCS, 2025). Since the effectiveness of flood application is dependent upon soil characteristics, regions of high to moderate infiltration and well to moderately well drained soils were indicated on the SAR suitability map (Figures 26) with brown polylines indicating regions appropriate for flood application.

Table 9. Suitability rankings for soil infiltration, soil drainage, and tax parcels used to determine potential MAR and ASR sites within the study location.

Suitability Ranking	Tax Parcels	Soil Infiltration	Soil Drainage
1	Undeveloped/ not presently used, agricultural, recreational/public gathering	High/moderate	Well/moderately well drained
2	Miscellaneous: transportation, government/educational services	Slow/combined	Somewhat poorly drained
3	Residential	Very slow	Poorly drained

Additionally, seepage velocity was calculated with the purpose of estimating the amount of time a water molecule would take to travel from a selected point to the Yakima River within sedimentary aquifers. To determine seepage velocity, the following equation was applied:

$$V = \frac{\left(\frac{\Delta H}{\Delta L} * K\right)}{n_e}$$

Where V = seepage velocity; K = hydraulic conductivity; $\frac{\Delta H}{\Delta L}$ = hydraulic head gradient; and n_e = effective porosity

Hydraulic gradient ($\Delta H/\Delta L$) was determined based on same-day hydraulic head measurements from the two monitoring wells within this study and is largely dependent on the surface elevation gradient across the fan. The appropriate hydrogeologic unit to use as reference for selecting hydraulic conductivity and effective porosity values was identified as “Kittitas Basin 2-unconsolidated” from a previous USGS study (Ely, 2011). Due to the heterogeneous nature of this unit, three iterations of seepage velocity calculations were conducted applying the lowest, median, and highest values for fair representation of sedimentary variation. Estimates of sediment hydraulic conductivity values were identified as ranging from 80 to 800 (Vaccaro, 2009). Effective porosity for the unit was estimated as a range from 0.13 (the lowest porosity of a primarily gravel-composed material) to 0.46 (the highest porosity for gravel constituents and coarse to fine sand) based on sediment porosities (Woessner, 2020). Final seepage velocity values are presented in Table 10.

Table 10. Summary of seepage calculations. Applied values and results based on seepage velocity equation (Equation 1).

Scenario	Hydraulic Gradient	Hydraulic Conductivity (ft/day)	Effective Porosity	Seepage Velocity (ft/day)	Seepage Velocity (ft/mo)
Scenario 1	0.02	80	0.13	12	320
Scenario 2	0.02	300	0.35	19	570
Scenario 3	0.02	800	0.46	35	890

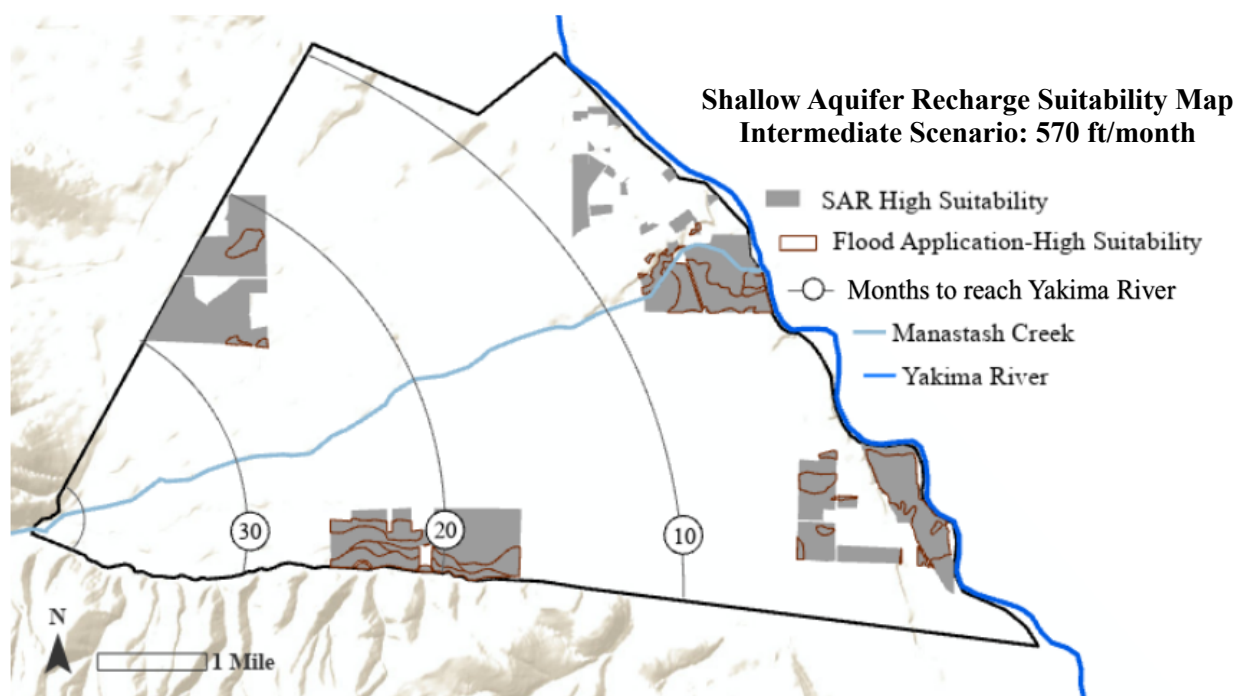


Figure 26. Map indicating suitable locations for SAR (including flood application) overlain with the intermediate scenario (scenario 2, seepage velocity of 570 ft/month).

Based on the SAR suitability map (Figures 26), the most suitable SAR locations are in four select locations on the outer boundary of the Manastash alluvial fan. Flood application is more feasible on the southern side of the fan with the highest feasibility on the south-east location and south mid-fan region. There is minimal flood application feasibility north of Manastash Creek due to inadequate soil infiltration and drainage.

An ASR suitability map (Figure 27) was developed by clipping suitable tax parcels to the basalt wells concentration polygon at the fan apex from Figure 25. The polygon was then modified to remove regions east of the fault line which indicates a barrier to flow. By combining geochemical and structural characteristics within the fan apex (confined waters, minimal surface water influence, and a barrier to flow), a grouping of parcels potentially suitable for ASR was identified. This finding overlapped with results from a MAR suitability study conducted within the Yakima Basin in 2018 which aimed to identify suitable locations for SAR and ASR using remote sensing methods. In this study, one region on the Manastash alluvial fan apex was identified as suitable for ASR, symbolized in Figure 27 with a red circle. This location, along with many others throughout the Yakima Basin, was determined based on slope, transmissivity, lithology, geology, land use, and depth to static water level as determined through a weighted overlay model, analytical recharge method, and stream depletion factor approach (Gibson and Campana, 2018). Since this study was conducted purely through remote sensing methods, it is beneficial to have supporting evidence from on-the-ground research.

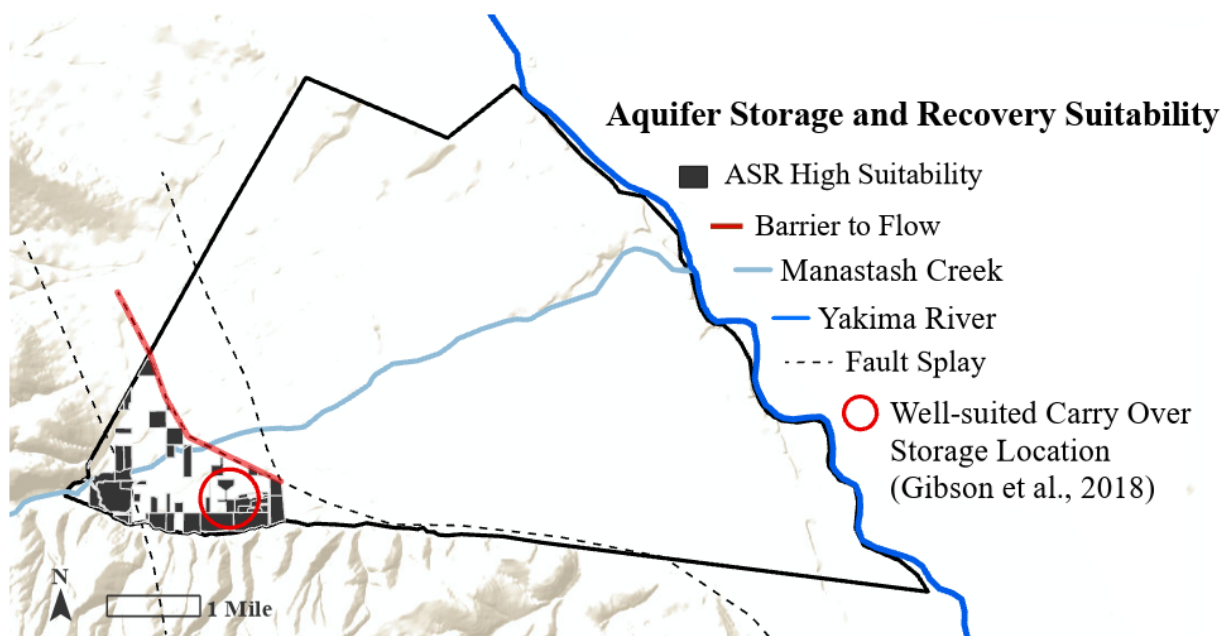


Figure 27. Map indicating the most suitable locations for ASR based on concentration of basalt wells, hydrochemical indicators of confinement, and proximity to a flow barrier.

One method utilized within the Gibson and Campana (2018) MAR research was depth to static water level. Since collecting in situ static water levels within sampled wells was not within this project's scope, static water levels were compiled from well log data (Appendix A and B) at time of construction. Most levels were derived directly from the accompanying well log, however, data from nearby well logs were applied when records were not available. Relative static water

level depths can be seen in Figure 28. The greatest depths to static water levels are seen near the fan apex except for two shallow basalt wells. The distal region of the fan made up of deep and shallow sedimentary wells indicate much shallower static water levels all below 50 feet. This data can be used to assist in determining suitable MAR locations in conjunction with SAR and ASR suitability maps. For example, regions with shallow static water levels (less than 10 feet) should be approached strategically as applying additional water could cause unnatural flooding or aquifer mounding, especially during irrigation periods when water tables are high.

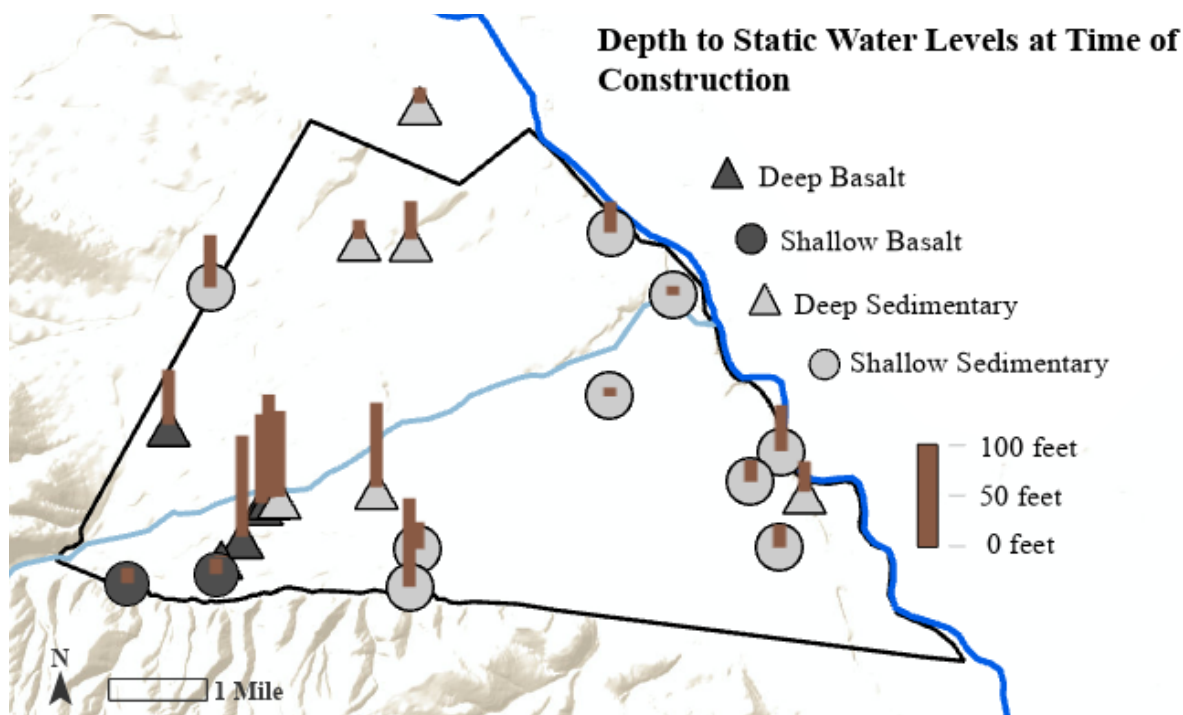


Figure 28. Map showing depth to static water level at time of construction for all sampled wells indicating deeper static water levels near the middle of the fan apex.

CONCLUSION

Results Summary

Through subsurface stratigraphic interpretation, surface and groundwater level monitoring, and geochemical analysis, five suitable locations for MAR were identified on the Manastash Alluvial Fan. Four locations suitable for SAR are distributed along the outer fan boundary (including subregions for flood application) and one ASR location is identified near the fan apex. When paired with geochemical results, subsurface lithologic cross-sections provided context for aquifer composition in relation to three hydrochemical groups indicating regions of aquifer connectivity or barriers to flow. This analysis process resulted in the identification of a potential barrier to flow at the middle fault splay at 0.5 miles indicated in cross-section B (Figure 22). This finding is supported by an abrupt change in groundwater chemistry from hydrochemical Group 1 (older waters with no surface water interaction) to Group 3 (heavy isotope values indicating surface water influence).

Surface and groundwater interactions were identified through stable isotope δ -values with intermediate and heavy values indicating surface water influence from the Yakima River, Manastash Creek, and KRD canals (Group 3). These waters are not confined to one region of the fan because water diverted from the Yakima River is transported by an extensive canal system throughout the Manastash fan. Influence of surface waters was also supported by time series hydrographs which indicated a strong correlation between Well B and KRD canal waters indicating canal influence on shallow aquifers in the south-eastern region of the fan. Additionally, Well A, indicated interactions between Manastash Creek and shallow aquifers near the Cove Rd./Manastash Creek intersection.

Considerations

This study is conceptual in nature, aimed to characterize aquifer composition and groundwater characteristics. Therefore, it is important to mention portions of research which depend upon interpretation or have the potential for alternative classifications. When constructing cross-sections from well logs, three sets of interpretations are made; one by the driller who filled out the form, one by the researcher interpreting the archived document, and one when drawing connection points on the cross-section. Because of this, cross-sections should be viewed as conceptual interpretations, not certain representations.

When reviewing static water levels within well logs, date of measurement should be considered as each log represents a unique well construction date within different years and seasons. Although combining static water levels can provide an understanding of aquifer connectivity or direction of flow, applying solely well log static water levels can result in skewed representations as water levels, especially in shallow, unconfined aquifers can change significantly month-to-month and year-to-year.

Finally, groundwater geochemical groupings based on major ions, stable isotope, sodium, and nitrate values could vary based on grouping methods. For example, if sodium concentrations were prioritized, some samples might shift into different groups. Similarly, more groups could be created to separate out samples which don't fit as well into groups or to connect samples that have similarities but are currently in different groups. Therefore, groupings within this study represent one of several outcomes for the geochemical data.

Future Work

In order to fill data gaps, more water samples should be collected, especially near the proposed barrier to flow, near proposed MAR sites, and in cross-section regions lacking geochemical data. This would allow for further interpretations of aquifer characteristics and hydrochemical groups. Although we have static water levels from time of well construction, it would be beneficial to collect groundwater level data within wells throughout the fan to provide consistent water level data throughout the seasons. This could be especially useful if water levels were taken before, during, and after irrigation season to track the influence of supplementation on groundwater.

Washington Department of Ecology, Kittitas Reclamation District, and Jacobs Engineering are involved with ongoing research to identify surface and groundwater connections on the Manastash alluvial fan, specifically between KRD canals and groundwater near Manastash Creek. Therefore, findings within this study will support KRD/Jacobs work in addition to other YBIP affiliated projects that might overlap with the western Kittitas subbasin. Additionally, data collected throughout this research will be compiled and shared with a network of organizations working on groundwater research within the YBIP. Pressure transducers installed at two wells on the study site will continue collecting data to support ongoing research on the Manastash alluvial fan and further develop time series hydrographs. This data will be useful for a continued understanding of the impacts of practices such as stream supplementation or canal lining.

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APPENDIX A

Well Logs Used to Develop Cross-Sections

DEPARTMENT OF
ECOLOGY
State of Washington

☐ Decommission $\implies$ Original installation NOI No.

Start Date 02-13-20 Completed Date 02-17-20

Well 2 on the cross-section transect map (Figure 11).

WATER WELL REPORT

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

Construction/Decommission ("x" in circle)

☐ Construction

☐ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number

102723

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 ☐ Dig ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS: Diameter of well 6 inches, drilled 200 ft.
Depth of completed well 200 ft.

CONSTRUCTION DETAILS

Casing ☒ Welded 8" Diam from +1 ft to 45 ft.
Installed: ☐ Liner installed 6" Diam from +2 ft to 100 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

Screen ☒ Yes ☐ No ☐ K-Pac Location

Manufacturer's Name

Type Model No.

Diam Slot Size from ft to ft

Diam Slot Size from ft to ft

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

Materials placed from ft to ft

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

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 ft

Static level 40' ft below top of well Date

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

Approx 30+ GPM, Air Lift

Date of test

Bailer test gal/min with ft drawdown after hrs

Articest 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

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) Billy Bolyard

Driller/Engineer/Trainee Signature

Driller or Trainee License No. 0997

If trainee, licensed driller's Signature and License no. 1335

CURRENT

Notice of Intent No. W148810

Unique Ecology Well ID Tag No. AFH 683

Water Right Permit No.

Property Owner Name

Well Street Address

City ell. County: Kittitas

Location NW 1/4 NW 1/4 Sec 13 Twp 17 R 17 EWM circle or WWM one

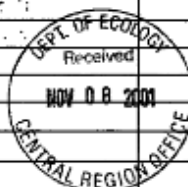
Lat/Long: (s, l, r still REQUIRED) Lat Deg Lat Min/Sec Long Deg Long Min/Sec

Tax Parcel 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
Basalt Rocks	0	4
Cemented Grav. + cobbles	4	18
Cemented Grav.	18	33
Brown Basalt	33	80
Black Basalt	80	134
Hard Black Basalt	134	188
Black Porous + Fractured Basalt with Water	188	200



Start Date 10/17/01 Completed Date 10/24/01

Drilling Company Waterman Well Drilling Inc

Address 106 Berriman Ln

City, State, Zip Selah WA 98942

Contractor's Registration No. WATCEW000008 10/26/01

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

Well 3 on the cross-section transect map (Figure 11).

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 _____

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 193 ft.
 Depth of completed well 193 ft.

CONSTRUCTION DETAILS
 Casing: ☒ Welded 6 " Diam. from +2 ft. to 42 ft.
 Installed: ☒ Liner installed 5 " Diam. from +2 ft. to 190 ft.
☐ Threaded 5 " Diam. from 0 ft. to 0 ft.

Perforations: ☒ Yes ☐ No
 Type of perforator used TORCH
 SIZE of perfs 9 in. by 1/4 in. and no. of perfs 30 from 170 ft. to 190 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 30 ft.
 Material used in seal BENTONITE
 Did any strata contain unsuitable 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 _____
 Static level 10 ft. below top of well Date 3/4/15
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (exp. 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 _____
 Bailor test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airstest 207 gal./min. with stem set at 180 ft. for 2 hrs.
 Artesian flow _____ p.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

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) KEVIN WAMSLEY Drilling Company HIDDEN RIVERS DRILLING
 Driller/Engineer/Trainee Signature _____ Address P.O. Box 891
 Driller or trainee License No. 1058 City, State, Zip SELAH, WA 98942
 If TRAINEE, Contractor's _____
 Driller's License No. _____ Registration No. HIDDER8840N Date 3/6/15
 Driller's Signature _____ Ecology is an Equal Opportunity Employer.

Start Date 2/28/15 Completed Date 3/6/15

DEPT OF ECOLOGY
 Received
 APR 20 2015
 CHANDLER APT. METER

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

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

Well 4 on the cross-section transect map (Figure 11).



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 _____

PROPOSED USE: ☐ DeWater ☒ Domestic ☐ Industrial ☐ Municipal ☐ 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 10.8 inches, drilled 10.8 ft.
 Depth of completed well 108 ft.

CONSTRUCTION DETAILS
 Casing: ☒ Welded 8" Diam. from 12 ft. to 48 ft.
 Installed: ☒ Liner installed 6" Diam. from 38 ft. to 108 ft.
☐ Threaded _____ Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No
 Type of perforator used SKILUSAN
 SIZE of perfs _____ in by _____ in and no. of perfs _____ from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____

Type _____ Model No. _____
 Diam _____ Slot size _____ from _____ ft. to _____ ft.
 Diam _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 18 ft.
 Material used in seal BENTONITE

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 _____
 Static level 32 ft. below top of well Date 9/22/15
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____

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

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

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Date of test _____

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

Airtest 20 gal./min. with stem set at 100 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

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

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) KEVIN L. WANSLEY

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 1058

If TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

CURRENT

Notice of Intent No. W-309972

Unique Ecology Well ID Tag No. BIN-865

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City E-BURG County KITTITAS

Location NE 1/4-1/4 NE 1/4 Sec 13 Twn 17 R 17 ☒ RWM or WWM circle cent

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

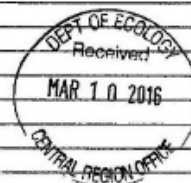
Still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 171713056-0002

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
DIRT	0	1
BLACK BASALT + GRAVEL	1	8
BROWN CLAY + BOULDERS	8	16
BASALT GRAVEL + CLAY	16	45
FRACTURED BLACK BASALT	45	56
BLACK BASALT + BROWN CLAY	56	94
FRACTURED BLACK BASALT	94	110
WATER		



Start Date 9/21/15 Completed Date 9/22/15

Drilling Company HIDDEN RIVERS DRILLING

Address P.O. BOX 891

City, State, Zip SEAHAM, WA 98942

Contractor's _____

Registration No. HINDE08840N Date 9/16/15

Ecology is an Equal Opportunity Employer.

Well 5 on the cross-section transect map (Figure 11).

WATER WELL REPORT

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

DEPARTMENT OF
ECOLOGY
State of Washington

Construction/Decommission ("x" in circle)

☒ Construction

☐ Decommission ORIGINAL INSTALLATION

Notice of Intent Number

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 183 ft.
Depth of completed well 180 ft.

CONSTRUCTION DETAILS
Casing ☒ Welded 6 Diam. from +3 ft. to 87 ft.
Installed: ☒ Liner installed 4 Diam. from -40 ft. to 180 ft.
☐ Threaded Diam. from ft. to ft.

Perforations: ☒ Yes ☐ No
Type of perforator used stick saw
SIZE of perfor 12 in. by 24 in. and no. of perfs 68 from 140 ft. to 180 ft.

Screen: ☐ Yes ☒ No ☐ E-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

Gravel/Filter pack: ☐ 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 unmanageable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

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

WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 35 ft. below top of well Date 8/11/18
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 at zero when pump turned off) (water level measured from well top to water level)
Time Water Level Time Water Level

Date of test
Bailer test gal/min. with ft. drawdown after hrs.
Airtest 25 gal/min. with stem set at 163 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. W315775

Unique Ecology Well ID Tag No. BJA275

Water Right Permit No.

Property Owner Name

Well Street Address

City Ellensburg County Kittitas

Location NE 1/4-1/4 NE 1/4 Sec 12 Twn 17 R 17 EVM ☒
(s, t, r SEB REQUIRED) Or WWM ☐

Lat/Long

Lat Deg

Lat Min/Sec

Long Deg

Long Min/Sec

Tax parcel No. (Required) 15416

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/cobbles	0	10
rock	10	16
Sandstone/rock	16	30
rock	30	45
Sandstone/rock	45	63
Sandstone	63	70
Sandstone/rock	70	78
rock	78	95
Sandstone/rock	95	101
broken rock	101	125
Sandstone	125	133
Sandstone/rock	133	172
Sandstone	172	176
Sandstone/rock	176	183

RECEIVED

AUG 30 2018
Dept of Ecology
Central Regional Office

Start Date 8/9/18 Completed Date 8/11/18

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 Jeremy Bach
Driller/Engineer/Trainee Signature
Driller or trainee License No. #2536
IF TRAINEE: Driller's License No:
Driller's Signature:

Drilling Company Bach Drilling Company
Address 3340 Wilson Creek Road
City, State, Zip Ellensburg, Wa 98926
Contractor's
Registration No. MIKEBDC942R6 Date

ECY 859-1-10 (Rev 02-2010) To request ADA accommodation including materials in a format for the visually impaired, call Ecology Water Resources Program at 360-487-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

Well 6 on the cross-section transect map (Figure 11).



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

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 <u>6</u> inches, drilled <u>198</u> ft. Depth of completed well <u>198</u> ft.	
CONSTRUCTION DETAILS Casing ☒ Welded <u>6"</u> Diam. from <u>+2 1/4</u> ft. to <u>162.5</u> ft. Installed: ☒ Liner installed <u>4 1/2"</u> Diam. from <u>158</u> ft. to <u>198</u> ft. ☐ Threaded _____ " Diam. From _____ ft. to _____ ft.	
Perforations: ☒ Yes ☐ No Type of perforator used <u>Saw cut</u> SIZE of perfs <u>1/8</u> in. by <u>8</u> in. and no. of perfs <u>81</u> from <u>158</u> ft. to <u>198</u> ft.	
Screens: ☐ Yes ☒ No ☐ K-Pac Location _____ Manufacturer's Name _____ Type _____ Model No. _____ Diam. _____ Slot size _____ from _____ ft. to _____ ft. Diam. _____ Slot size _____ from _____ ft. to _____ ft.	
Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____ Materials placed from _____ ft. to _____ ft.	
Surface Seal: ☒ Yes ☐ No To what depth? <u>19</u> ft. Material used in seal <u>Bentonite</u> 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 <u>1882</u> ft. Static level <u>134</u> ft. below top of well Date <u>10-02-15</u> Artesian pressure _____ lbs. per square inch Date _____ Artesian water is controlled by _____ (cap, valve, etc.)	
WELL TESTS: Drawdown is amount water level is lowered below static level Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____ Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs. Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs. Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs. Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level) Time Water Level Time Water Level Time Water Level _____ _____ _____ Date of test _____ Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs. Airstest <u>16</u> gal./min. with stem set at <u>197</u> ft. for <u>1</u> hrs. Artesian flow _____ g.p.m. Date <u>10-02-15</u> Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No	

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) Brett Phythian

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No. _____

Driller's Signature: _____

CURRENT

Notice of Intent No. WE 21547

Unique Ecology Well ID Tag No. BJB 809

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location SE1/4-1/4 SE1/4 Sec 12 Twn 17 R 17

(s, t, r Still REQUIRED)

EWM ☒

Or
WWM ☐

Lat/Long Lat Deg N 47 Lat Min/Sec 58.24

Long Deg W 120 Long Min/Sec 38.47

Tax Parcel No. (Required) 375133

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
Basalt cobbles, gravel	0	6
Brown hard clay, broken basalt	6	12
Broken basalt, clay WB	12	19
Brown clay, broken basalt	19	30
Broken basalt WB	30	39
Static = 12'		
Brown clay, broken basalt		
gravel, cobbles	39	83
Brown clay / sandstone	83	91
Brown clay, basalt gravel	91	94
Brown clay / sandstone	94	99
Brown clay, basalt pieces	99	104
Brown clay / sandstone	104	117
Brown clay, basalt pieces	117	123
Brown clay / sandstone	123	129
Broken basalt	129	138
Tan clay / sandstone w/ basalt layers	138	168
Fractured black basalt WB	168	192
Brown sandstone / clay	192	197
Fractured black basalt	197	198

Start Date 09-30-15

Completed Date 10-02-15

ECY 050-1-20 (Rev 02/10) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872.

Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

Well 9 on the cross-section transect map (Figure 11).



WATER WELL REPORT

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

Construction/Decommission (circle)

- ☒ Construction 150364
☐ Decommission ORIGINAL CONSTRUCTION Notice
of Intent Number _____

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

TYPE OF WORK Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned Method ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 8 inches drilled 375 ft
Depth of completed well 350 ft

CONSTRUCTION DETAILS
Casing ☒ Welded 8 Diam from +3 ft to 20 ft
Installed ☒ Liner installed 6 Diam from -4 ft to 320 ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☒ Yes ☐ No
Type of perforator used Skillsaw
SIZE of perfs 12 in by 1/4 in and no of perfs 200 from 280 ft to 320 ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer's Name _____ Model No _____
Type _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

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

Surface Seal ☒ Yes ☐ No To what depth? 20 ft
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 _____ ft
Static level 283 ft below top of well Date April 7, 2004
Artesian pressure na lbs per square inch Date _____
Artesian water is controlled by _____ (cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Recovery data (time taken as zero when pump turned off/water level measured from well top to water level)
Time Water Level Time Water Level Time Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Artest 22 gal/min with stem set at 355 ft for 2.5 hrs
Artesian flow na g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No W160545

Unique Ecology Well ID Tag No AKW 787

Water Right Permit No _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location 1/4 1/4 NW 1/4 Sec 18 Twn 17 R 18 EWM circle or one WWM

Lat/Long _____ Lat Deg _____ Lat Min/Sec _____

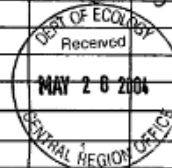
(s t r still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No 17-18-18020-0005

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
dirt, cobbles	0	10
broken rock	10	40
medium rock	40	200
hard rock	200	240
medium rock	240	340
broken rock	340	375



Start Date April 4, 2004 completed Date April 6, 2004

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) Mike Bach
Driller/Engineer/Trainee Signature Mike Bach
Driller or Trainee License No # 22

Drilling Company Bach Well Drilling
Address 3340 Wilson Creek
City State Zip Ellensburg WA 98926
Contractor's MIKE BACH 13304
Registration No _____ Date April 6 2004

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

Well 10 on the cross-section transect map (Figure 11).



WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

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

☐ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* _____

Current

Notice of Intent No. W160579

Unique Ecology Well ID Tag No. ALC-827

Water Right Permit No. _____

Property Owner Name

Well Street Address Hanson Rd

City E-Burg County KENTON

Location NE 1/4-1/4 NE 1/4 Sec 07 Twn 17 R 18 17W or circle

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

still REQUIRED) Long Day Long Min/Sec *HA*

Tax Parcel No. 17-18-07-055 m3

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
DIRT	0	2
GRAVE BROKEN BASALT	2	35
BROWN CLAY	35	90
CRACKED BROKEN CLAY	90	128
BROWN SANDSTONE CLAY	128	178
BROWN SANDSTONE CLAY	178	200
GRAVEL & WATER		



Start Date 11/2/03 Completed Date 11/7/05

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) CARLOS IV AMORIM Drilling Company HIDOPIN RABEIS DESUZA

Driller/Engineer/Trainee Signature Gregory W. Amos Address P.O. Box 993

Driller or trainee License No. 2428 City, State, Zip SEASIDE, CA 98942

IF TRAINEE, _____ Contractor's _____

Driller's License# No. _____ Registration No. HEDDER 9090R Date 11/8/05

Driver's Signature _____ Ecology is an Equal Opportunity Employer. ECY 050-1420 (Rev 2/01)

Well 11 on the cross-section transect map (Figure 11).

120939

WATER WELL REPORT

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

Construction/Decommission (x in circle)

☐ Construction

☐ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number _____

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

TYPE OF WORK Owner's number of well (if more than one) _____
☒ New Well ☐ Reconditioned Method ☐ Dug ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 240 ft
 Depth of completed well 240 ft

CONSTRUCTION DETAILS
 Casing ☒ Welded 6 Diam from +2 ft to 140 ft
 Installed ☒ Liner installed 4 Diam from -20 ft to 240 ft
☐ Threaded _____ Diam from _____ ft to _____ ft

Perforations ☒ Yes ☐ No
 Type of perforator used SAW
 SIZE of perfs 1/8 in by 2 in and no. of perfs 100 from 180 ft to 240 ft

Screens ☐ Yes ☐ No ☒ Pac Location _____
 Manufacturer's Name _____ Model No _____
 Type _____ Slot Size _____ from _____ ft to _____ ft
 Diam _____ Slot Size _____ from _____ ft to _____ ft

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

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

WATER LEVELS Land surface elevation above mean sea level _____ ft
 Static level 50 ft below top of well Date _____
 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 _____
 Bailor test _____ gal/min with _____ ft drawdown after _____ hrs
 Arrest 15 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

CURRENT
 Notice of Intent No W 160533
 Unique Ecology Well ID Tag No AHK 149
 Water Right Permit No _____

Property Owner Name _____
 Well Street Address _____
 City Ellensburg County Kittitas
 Location SE 1/4 1/4 SW 1/4 Sec 31 Twp 18 R 18 EWM circle or one WWM

Lat/Long _____ Lat Deg _____ Lat Min/Sec _____
 (s if still REQUIRED) Long Deg _____ Long Min/Sec _____
 Tax Parcel 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
Dirt - cobbles	0	25
CEMENT GRAVEL	25	130
SOFT BASALT	130	200
SANDSTONE	200	240

RECEIVED
 SEP 12 2002
 DEPT OF ECOLOGY
 FISCAL BUDGET
 SEP 11 11 16
 KITTITAS REGION OFFICE

Start Date 7-18 Completed Date 7-19-2002

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) MIKE BACH Drilling Company BACH Drilling Co
 Driller/Engineer/Trainee Signature Mike Bach Address 3340 Wilson Ct Rd
 Driller or Trainee License No 22 City State Zip Ellensburg, WA 98926
 Contractor's Registration No MIKEBDR133NY Date 7-19-2002
 Ecology is an Equal Opportunity Employer EGY 050 1 20 (Rev 4/01)

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

Well 12 on the cross-section transect map (Figure 11).

WATER WELL REPORT

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

Construction/Decommission (X in circle)

☒ Construction **150363**

☐ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number

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

TYPE OF WORK Owner's number of well (if more than one)
☒ New Well ☐ Reconditioned Method ☐ Dig ☐ Bored ☐ Driven
☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted

DIMENSIONS Diameter of well 6 inches drilled 280 ft
Depth of completed well 280 ft

CONSTRUCTION DETAILS

Casing ☒ Welded 6 Diam from +3 ft to 160 ft
Installed ☒ Liner installed 4 Diam from -5 ft to 280 ft
☐ Threaded Diam from _____ ft to _____ ft

Perforations ☒ Yes ☐ No
Type of perforator used SKILLSEW
SIZE of perfs 2 in by 1/4 in and no of perfs 200 from 250 ft to 280 ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

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

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

Materials used in seal Benlate

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

PUMP Manufacturer's Name _____

Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft

Static level 140 ft below top of well Date May 12, 2004

Artesian pressure na lbs per square inch Date _____

Artesian water is controlled by na (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
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Date of test _____

Bailer test _____ gal/min with _____ ft drawdown after _____ hrs

Artest 10-12 gal/min with stem set at 260 ft for 2 1/2 hrs

Artesian flow na gpm Date _____

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

CURRENT

Notice of Intent No W160587

Unique Ecology Well ID Tag No AKW 788

Water Right Permit No _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location NE 1/4 1/4 NE 1/4 Sec 7 Twn 17 R 18 EWM circle or one

Lat/Long _____ Lat Deg _____ Lat Min/Sec _____

REQUIRED Long Deg _____ Long Min/Sec _____

Tax Parcel No 17-18-07-050-0003

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
<u>loam</u>	<u>0</u>	<u>10</u>
<u>gravel</u>	<u>10</u>	<u>40</u>
<u>sandstone</u>	<u>40</u>	<u>75</u>
<u>cement gravel</u>	<u>75</u>	<u>153</u>
<u>rock</u>	<u>153</u>	<u>280</u>



Start Date May 7, 2004 Completed Date May 12, 2004

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) Mike Bach

Driller/Engineer/Trainee Signature Mike Bach

Driller or Trainee License No #22

Drilling Company Bach Well Drilling

Address 3340 Wilson Creek

City State Zip Ellensburg WA 98926

Contractor's MIKE BACH

Registration No _____ Date May 12, 2004

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

Well 13 on the cross-section transect map (Figure 11).



WATER WELL REPORT

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

Construction/Decommission ("x" in circle)

☒ Construction

☐ Decommission ORIGINAL CONSTRUCTION Notice

168935 of Intent Number

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 260 ft.
 Depth of completed well 260 ft.

CONSTRUCTION DETAILS

Casing ☒ Welded 6" Diam. from +3 ft. to 180 ft.
 Installed: ☐ Liner installed _____ Diam. from _____ ft. to _____ ft.
☐ Threaded _____ Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No

Type of perforator used _____

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

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

Manufacturer's Name _____

Type _____ Model No. _____

Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

Diam. _____ Slot Size _____ from _____ ft. to _____ ft.

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

Materials placed from _____ ft. to _____ ft.

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

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 _____ ft.

Static level 85 ft. below top of well Date March 17 2005

Artesian pressure _____ lbs. per square inch Date _____

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

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

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

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

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

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

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

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Date of test _____

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

Airtest 21 gal./min. with stem set at 240 ft. for 2 1/2 hrs.

Artesian flow _____ g.p.m. Date _____

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

CURRENT

Notice of Intent No. W171363

Unique Ecology Well ID Tag No. ALF415

Water Right Permit No. G

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location SW 1/4- 1/4 NE 1/4 Sec 7+8 Twn 17 R 18 EWM circle or one WWM

Lat/Long: _____ Lat Deg _____ Lat Min/Sec _____

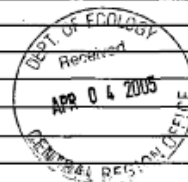
REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 17-18-08000+171807040

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
loam, cobbles	0	10
gravel	10	75
sandstone	75	85
clay	85	90
sandstone	90	95
gravel	95	150
clay	150	170
sandstone/gravel	170	220
sandstone	220	260



Start Date March 14 Completed Date March 16 2005

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) Jeremy Bush Drilling Company Bush Drilling Co

Driller/Engineer/Trainee Signature [Signature] Address 3340 Wilson Creek

Driller or Trainee License No. 2536 City, State, Zip Ellensburg WA 98926

If trainee, licensed driller's _____ Contractor's WKEB013304 Date March 16 2005

Signature and License no. _____ Registration No. _____

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

Well 14 on the cross-section transect map (Figure 11).

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

Construction/Decommission (λ in cycle)

Construction

☐ Decommission *ORIGINAL CONSTRUCTION Notice of Intent Number*

CURRENT

Notice of Intent No

Unique Ecology Well ID Tag No

Water Right Permit No

Property Owner Name

Well Street Address:

City E.L.

County

Location

Location NW 1/4 1/4 SW 1/4 Sec 20 Twn 18 R 18 WWM circle
or
one
33 WWM

Lat/Long

Lat Deg

Let $M_{\text{min}}(\text{Sec})$

(s,t,r still

REQUIRED)

Tax Parcel 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 Top Soil	0	4
Bolters	4	28
Gravel & Cobbles	28	45
Cemented Gravel	45	105
Brown clay & gravel	105	160
Soft Brown Sand	160	169
Brown clay & gravel	169	190
Cemented gravel	190	220
Brown clay & gravel	220	291
Cemented Sand & gravel	291	321
Sandy Brown clay	321	340 324

DEPT. OF ECOLOGY
Received
SEP 05 2003
CENTRAL REGION OFFICE

Start Date 8-8-03 Completed Date 8-18-03

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) Robert Lee

Driller/Engineer/Trainee Signature Robert LeeDriller or Trainee License No. 2675

If trainee, licensed driller's

Signature and License no

Drilling Company Waterman well Drilling

Address 106 Berri man lane

City State Zip Selah wa

City/State/Zip Meriden, CT 06460
Contractor's
Registration No. WATER WD 02308 Date 8-20-03

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

Well 16 on the cross-section transect map (Figure 11).

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. 216997

UNIQUE WELL I.D. #

Water Right Permit No.

(1) OWNER: Name _____ Address _____

LOCATION OF WELL: County KITITAS SE 1/4, NW 1/4 NE N 1/2 N Sec 31 T 18 N. R. 18 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) _____

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

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

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 430 feet. Depth of completed well 340 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +1 ft. to 296 ft.
Welded ☒ 4" Diam. from -5 ft. to 370 ft.
Liner installed ☐
Threaded ☐ Diam. from _____ ft. to _____ ft.

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

Screens: Yes ☒ No ☐
Manufacturer's Name JOHNSON
Type PRE-PACKED PVC Model No. _____
Diam. 5" Slot size 8" from -160 ft. to 170 ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.
Surface seal: Yes ☒ No ☐ To what depth? 20 ft.
Material used in seal BENTONITE
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
Static level 60' ft. below top of well Date 7/22/93
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: 20 gal./min. with _____ ft. drawdown after _____ hrs.
" ESTIMATED AIR LIFT 20 GPM "

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

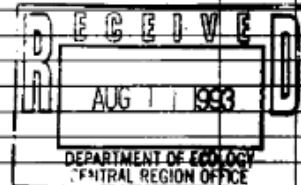
Date of test _____

Boiler test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Air test _____ gal./min. with steam 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
TOP SOIL	0	3
GRAVEL COBBLES	3	80
CLAY BROWN	80	120
GRAVEL COBBLES	120	200
CLAY LIGHT GRAY	200	230
GRAVEL COBBLES	230	260
BROKEN BASALT RED	260	296
BASALT HARD BLACK	296	315
BASALT LIGHT GRAY MEDIUM HARD	315	430



6" DRIVE SHOE UTILIZED

Work started 6/30/93, 19. Completed 7/22, 19 93

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 PONDEROSA DRILLING & DEVELOPMENT, INC.
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 BROADWAY SPOKANE, WA 99212

(Signed) Bart Moorhead License No. 2109
Driller's (WELL DRILLER) (BART MOORHEAD)

Registration BI*24BJE Date 7/90, 19 93

(USE ADDITIONAL SHEETS IF NECESSARY)

Well 17 on the cross-section transect map (Figure 11).

WATER WELL REPORT

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

Construction/Decommission ("x" in circle) 361655

○ Construction

☐ Decommission *ORIGINAL INSTALLATION* Notice
of Intent Number

CURRENT

Notice of Intent No. W-256222

Unique Ecology Well ID Tag No. BAN-917

Water Right Permit No. ~~333333~~ /

Property Owner Name

Well Street Address

City E-BURG County KITTITAS

Location N 1/4-1/4 NE 1/4 Sec 16 Twn 17 R 18 ~~SWM~~ circle

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

Still **REQUIRED**) Long Deg Long Min/Sec

Tax Parcel No. 17-18-16000-0024

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
DIRT	0	3
GRAVEL & COBBLES	3	15
BROWN CLAY & GRAVEL	15	24
BROWN CEMENTED GRAVEL	24	88
BROKEN BLACK BASALT	88	109
BROKEN BLACK BASALT	109	130
CLAY GRAVEL & WATER		

RECEIVED

NOV 17 2009

DEPARTMENT OF ECOLOGY - CENTRAL RECORDS OFFICE

Start Date 10/28/07 Completed Date 10/29/07

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

☐ Driller ☐ Engineer ☐ Trainee Name (Print) PRIMO WATTSLEY

Driller/Engineer/Trainee Signature

Driller or trainee License No.

IF TRAINEE

Driller's Licensed No.

Driller's Signature _____

Drilling Company HIDDEN RIVERS DESIGN INC

Address P.O. Box 891

City, State, Zip SEASIDE, WA 98742

Contractor's / /

Registration No. HINDEN 990K Date 10/29/07

Ecology is an Equal Opportunity Employer

Well 19 on the cross-section transect map (Figure 11).



WATER WELL REPORT

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

DEPARTMENT OF
ECOLOGY
STATE OF WASHINGTON

Construction/Decommission ("x" in circle)

☒ Construction 457684
☐ Decommission ORIGINAL INSTALLATION

Notice of Intent Number

PROPOSED USE: ☒ Domestic ☐ Industrial ☐ Municipal ☐ DeWater ☐ Irrigation ☐ Test Well ☐ Other					
TYPE OF WORK: Owner's number of well (if more than one) _____ ☒ New well ☐ Reconditioned Method: ☐ Dig ☐ Bored ☐ Driven ☐ Deepened ☐ Cable ☒ Rotary ☐ Jetted					
DIMENSIONS: Diameter of well <u>6</u> inches, drilled <u>188</u> ft. Depth of completed well <u>188</u> ft.					
CONSTRUCTION DETAILS					
Casing ☒ Welded <u>6"</u> Diam. from <u>+1 1/2</u> ft. to <u>186</u> ft.					
Installed: ☐ Liner installed _____ " Diam. from _____ ft. to _____ ft. ☐ Threaded _____ " Diam. From _____ ft. to _____ ft.					
Perforations: ☐ Yes ☒ No Type of perforator used _____					
SIZE OF PERFS _____ in. by _____ in. and no. of perfs _____ from _____ ft. to _____ ft.					
Screens: ☐ Yes ☒ No ☐ K-Pac Location _____					
Manufacturer's Name _____					
Type _____ Model No. _____					
Diam. Slot size _____ from _____ ft. to _____ ft.					
Diam. Slot size _____ from _____ ft. to _____ ft.					
Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____					
Materials placed from _____ ft. to _____ ft.					
Surface Seal: ☒ Yes ☐ No To what depth? <u>22</u> ft.					
Material used in seal <u>Bentonite</u>					
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 <u>1529</u> ft.					
Static level <u>41</u> ft. below top of well Date <u>07-02-12</u>					
Artesian pressure _____ lbs. per square inch Date _____					
Artesian water is controlled by _____ (cap, valve, etc.)					
WELL TESTS: Drawdown is amount water level is lowered below static level					
Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____					
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.					
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.					
Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.					
Recovery data (time taken as zero when pump turned off) (water level measured from well-top to water level)					
Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
Date of test _____					
Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.					
Airtest <u>15</u> gal./min. with stem set at <u>184</u> ft. for <u>1</u> hrs.					
Artesian flow _____ g.p.m. Date <u>07-02-12</u>					
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No					

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) Brett Phythian

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No. _____

Driller's Signature: [Signature]

CURRENT

Notice of Intent No. W 306626

Unique Ecology Well ID Tag No. BCF 925

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location NE1/4-1/4 SE1/4 Sec 32 Twn 18 R 18 EWM ☒

(s, t, r Still REQUIRED)

Or
WWM ☐

Lat/Long Lat Deg N 47 Lat Min/Sec 00.297

Long Deg W 120 Long Min/Sec 36.205

Tax Parcel No. (Required) 18-18-32 040-0004

CONSTRUCTION OR DECOMMISSION PROCEDURE		
Formation: Describe by color, character, size of material and structure, and the kind and nature of the material in each stratum penetrated, with at least one entry for each change of information. (USE ADDITIONAL SHEETS IF NECESSARY.)		
MATERIAL	FROM	TO
Brown clay, broken basalt	0	5
Loose broken basalt, cobbles	5	14
Dk. brown / red clay, broken basalt, cobbles WB @ 35-72	14	72
Tan cemented clay, broken basalt	72	84
Gray clay, broken basalt	84	103
Tan clay, gravel	103	116
Brown clay, bigger gravel WB	116	131
Tan gumbo clay	131	135
Gravels WB	135	140
Tan clay, gravel	140	152
Gravels WB	152	156
Tan clay, gravel	156	161
Gravel	161	162
Brown clay	162	168
Tight broken basalt	168	176
Tan clay, gravel	176	183
Round gravel WB	183	186
Tan clay, gravel	186	188

Start Date 06-29-12 Completed Date 07-02-12



Well 20 on the cross-section transect map (Figure 11).

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

90565

WATER WELL REPORT

STATE OF WASHINGTON

Water Right Permit No

Notice of Intent **W122113**

UNIQUE WELL ID # **AFH313**

(1) OWNER: Name

Address

(2) LOCATION OF WELL: County **KITTITAS**

(2a) STREET ADDRESS OF WELL (or nearest address) **276 GINNY LN E-BURG WA**

TAX PARCEL NO

NW 1/4 NE 1/4 Sec 04 T 17 N R 18 WM

(3) PROPOSED USE

☒ Domestic ☐ Industrial ☐ Municipal
☐ Irrigation ☐ Test Well ☐ Other
☐ DeWater

(4) TYPE OF WORK

Owner's number of well (if more than one)
☒ New Well Method ☐ Bored
☐ Deepened ☐ Dug ☐ Driven
☐ Reconditioned ☐ Cable ☐ Jetted
☐ Decommission ☒ Rotary

(5) DIMENSIONS:

Diameter of well **6** inches
Drilled **150** feet Depth of completed well **145** ft.

(6) CONSTRUCTION DETAILS:

Casing installed.

☒ Welded **6** " Diam from **+ 2** ft to **140** ft
☐ Liner installed " Diam from ft to 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
perforations from ft to ft
perforations from ft to ft

Screens:

☐ Yes ☒ No ☐ K-Pac Location

Manufacturer's Name

Type Model No
Diam Slot size from ft to ft
Diam Slot size from ft to ft

Gravel/Filter packed

☐ Yes ☒ No ☐ Size of gravel/sand

Material placed from ft to ft

Surface seal

☒ Yes ☐ No

To what depth? **20** ft

Material used in seal **BENTINITE**

Did any strata contain unusable water?

☐ Yes ☒ No

Type of water?

Depth of strata

Method of sealing strata off

(7) PUMP

Manufacturer's Name

Type HP

(8) WATER LEVELS

Land-surface elevation above mean sea level ft.

Static level **62** ft below top of well Date **9/25/2000**

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

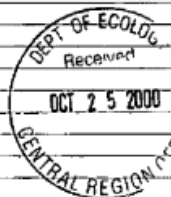
(10) WELL LOG or DECOMMISSIONING PROCEDURE DESCRIPTION:

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
TOP SOIL	0	6
GRAVEL AND CLAY LAYERS	6	30
LARGE GRAVEL AND CLAY LAYERS	30	60
GRAVEL AND CLAY TAN	60	135
AND SAND W/B	135	150

15 GPM @ 120

20 GPM @ 140



Work Started **9/25/2000**, 19 Completed **9/25/2000**, 19

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 **RICK POULIN** License No **942**
(Licensed Driller/Engineer)

Trainee Name License No

Drilling Company **RICK POULIN WELL DRILLING**

(Signed) *Rick Poulin* License No **942**
(Licensed Driller/Engineer)

Address **1301 LANCASTER RD SELAH, WA 98942**

Contractor's

Registration No **RICKPWD042J2** Date **9/29/00**, 19

Well 21 on the cross-section transect map (Figure 11).

DEPARTMENT OF
ECOLOGY
State of Washington

☐ Decommission $\implies$ Original installation NOI No.

Date: 3/10/2020

75

77



WATER WELL REPORT

Original & 1st copy - Ecology, 2nd copy - owner, 3rd copy - driller
E.C.O.L.O.G.Y.

Construction/Decommission ("x" in circle) 346656

☒ Construction

☐ Decommission ORIGINAL INSTALLATION Notice
of Intent Number _____

PROPOSED USE:		☐ Domestic	☐ Industrial	☐ Municipal	
☐ DeWater		☒ Irrigation	☐ Test Well	☐ Other	
TYPE OF WORK: Owner's number of well (if more than one) _____					
☒ New well		☐ Reconditioned			
☐ Deepened		Method: ☒ Dug ☐ Bored ☐ Driven			
		☐ Cable ☐ Rotary ☐ Jetted			
DIMENSIONS: Diameter of well <u>48</u> inches, drilled <u>16</u> ft.					
Depth of completed well <u>16</u> ft.					
CONSTRUCTION DETAILS:					
Casing: ☒ Welded		Diam. from <u>48</u> ft. to <u>15 1/2</u> ft.			
Installed: ☐ Liner installed		Diam. from _____ ft. to _____ ft.			
☐ Threaded		Diam. from _____ ft. to _____ ft.			
Perforations: ☒ Yes ☐ No					
Type of perforator used <u>torch</u>					
SIZE of perfs: <u>1</u> in. by <u>4</u> in. and no. of perfs <u>30</u> from <u>13 1/2</u> to <u>15 1/2</u>					
Screens: ☒ Yes ☐ No ☐ K-Pac Location _____					
Manufacturer's Name: _____					
Type _____ Model No. _____					
Diam. _____		Slot size _____ from _____ ft. to _____ ft.			
Diam. _____		Slot size _____ from _____ ft. to _____ ft.			
Gravel/Filter packed: ☐ Yes ☒ No ☐ Size of gravel/sand _____ ft.					
Materials placed from _____ ft. to _____ ft.					
Surface Seal: ☒ Yes ☐ No To what depth? <u>13 1/2</u> ft.					
Material used in seal <u>concrete + 10 MIX</u>					
Did any strata contain unusable water? ☐ Yes ☒ No					
Type of water? _____ Depth of strata _____					
Method of sealing strata off _____					
PUMP: Manufacturer's Name <u>no</u>					
Type: _____ H.P. _____					
WATER LEVELS: Land-surface elevation above mean sea level _____ ft.					
Static level <u>7 1/2</u> ft. below top of well Date <u>7/30/09</u>					
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? <u>David</u>					
Yield: <u>550</u> gal/min. with <u>5</u> ft. drawdown after <u>2</u> hrs.					
Yield: _____ gal/min. with _____ ft. drawdown after _____ hrs.					
Yield: _____ gal/min. with _____ ft. drawdown after _____ hrs.					
Recovery time (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
<u>8:00</u>	<u>12 1/2</u>	<u>1:01</u>	<u>8 1/2</u>		
Date of test <u>7/30/09</u>					
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 _____ Was a chemical analysis made? ☐ Yes ☒ No					

CURRENT

Notice of Intent No. W268900

Unique Ecology Well ID Tag No. But 475

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City Brensberg County Kittitas

Location S1/4-1/4-1/4 Sec 14 Twn 17 R18 EWM circle one

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

Still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 238733

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
Light Brown top Soil	0	4
Sand and gravel medium	4	8
COBBLE silt sand gravel	8	10
Sand and gravel large	10	12
COBBLES silt sand gravel	12	14
Sand and gravel large	14	16
COBBLES		

RECEIVED

JUL 23 2009

Dept of Ecology
WR-NWRO

RECEIVED

JUL 27 2009

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 7/20/09

Completed Date 7/30/09

Well 25 on the cross-section transect map (Figure 11).

APPENDIX B

Sampled Well Logs

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

STATE OF WASHINGTON

Start Card No. 33617

Water Right Permit No. _____

OWNER: Name _____

Address _____

(2) LOCATION OF WELL: County Kittitas SW 1/4 SE 10 T. 17 N. R. 18 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) (DAMMON & MANASTASH)

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

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 202 feet. Depth of completed well 202 ft.

(6) CONSTRUCTION DETAILS:

Casing installed: 6 " Diam. from +2 ft. to 138 ft.
Welded ☐ " Diam. from ft. to 138 ft.
Liner installed ☐ " Diam. from ft. to 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.

_____ perforations from _____ ft. to _____ ft.

_____ perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒

Manufacturer's Name _____

Type _____ Model No. _____

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

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

Gravel packed: Yes ☐ No ☒ Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

Surface seal: Yes ☒ No ☐ To what depth? 35 ft.

Material used in seal Bentonite

Did any strata contain unusable water? Yes ☐ No ☐

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____

Type _____ H.P. _____

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

Static level 30 ft. below top of well Date 8-25-89

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 _____

Ballot test _____ gal./min. with _____ ft. drawdown after _____ hrs.

Airtest 37 gal./min. with stem set at 180 ft. for 2 hrs.

Artesian flow _____ g.p.m. Date _____

(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 & COBBLES	H 0	4
RIVER ROCK & GRAVEL	H 4	25
WATER AT 18', 15-20 GPM		
CLAY & GRAVEL	H 25	36
SANDY GRAVEL	H 36	40
CLAY & GRAVEL	M 40	65
FINE SILTY SAND	S 65	75
CLAY & GRAVEL	H 75	78
COARSE SANDSTONE	H 78	80
GRAVEL	H 80	86
CLAY & CEMENTED GRAVEL	H 86	118
CLAY	VH 118	115
CEMENTED GRAVEL & SANDSTONE	H 115	120
CLAY GRAVEL SAND COBBLES	H 120	137
CLAY	H 137	159
CEMENTED SANDSTONE & GRAVEL	VH 159	190
SANDSTONE	H 190	192
SANDSTONE		192 203

ENTERED



Work started 8-18-89 19. Completed 8-25-89 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 RIEBE WELL DRILLING INC
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address PO Box 10866 Yakima WA 98909

(Signed) John Riebe License No. 0422
(WELL DRILLER)

Contractor's Registration No. 132F1 Date 8-28-89 19.

Nearby well log for sampled well G1.



WATER WELL REPORT

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

Construction/Decommission ("x" in circle)

☒ Construction 486093

☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 235 ft. Depth of completed well 230 ft.

CONSTRUCTION DETAILS
Casing: ☒ Welded 6 ft. Diam. from 118 ft. to 118 ft.
Installed: ☒ Liner installed 44 ft. Diam. from 118 ft. to 230 ft.
☐ Threaded 44 ft. Diam. from 118 ft. to 230 ft.

Perforations: ☒ Yes ☐ No
Type of perforator used SK-11 SAW
SIZE of perfor. in by 4 in. and no. of perfor. 117 from 190 to 230

Screens: ☒ Yes ☐ No ☐ K-Pac Location
Manufacturer's Name
Type Model No.
Diam. Slot size from ft. to ft.
Diam. Slot size from ft. to ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 26' ft.
Material used in seal Benona
Did any strata contain unusable water? ☐ Yes ☒ No
Type of water? Depth of strata
Method of sealing strata off

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

WATER LEVELS: Land-surface elevation above mean sea level ft.
Static level 111 ft. below top of well Date
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 up to water level)
Time Water Level Time Water Level Time Water Level
Approx 30 ft.
Date of test
Bailer test: gal./min. with ft. drawdown after hrs.
Airtest 30 gal./min. with stem set at 225 ft. for 1 hrs.
Artesian flow g.p.m. Date
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No

CURRENT

Notice of Intent No. W361160

Unique Ecology Well ID Tag No. APG 130

Water Right Permit No.

Property Owner Name

Well Street Address COVE ROAD

City Ell.

County Kittitas

Location NW 1/4-1/4 NW 1/4 Sec 7 Twn 17 R 18 EWM or WWM circle one

Lat/Long (s, t, r)

Lat Deg

Lat Min/Sec

Still REQUIRED

Long Deg

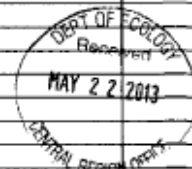
Long Min/Sec

Tax Parcel No. 955748/17-18-070580001

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 Br. m	0	3
1/2 cem. grav. Bl. Br. mH	3	7
1/2 cem. grav. cobb Br. mH	7	23
Bl. Br. H	23	85
grav. Cobbels Boulders	23	85
Bl. Br. VVH	85	93
grav. Cobbels Boulder	93	95
Clay tan m	95	103
sandstone Cem. Or. Cob. bbl. m	103	116
Cem. grav. bl. br. reg. h. t	116	131
Frac. Basalt Bl. VVH	131	174
Cem. grav. Bl. Br. H	174	205
1/2 cem. Gr. w. lene Br. H	205	219
Cem. grav. Bl. Br. H	219	235
Sandstone tan Br. m		



Start Date 5/1/2013

Completed Date 5/8/2013

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) J. Stevens

Driller/Engineer/Trainee Signature

Driller or trainee License No. 1385

If TRAINEE,

Driller's Licensed No.

Driller's Signature

Drilling Company

Address

City, State, Zip

Contractor's

Registration No.

Ecology is an Equal Opportunity Employer.

Waterman Well Drilling Inc

PO Box 246

Seahwa 98942

5/9/2013

Well log for sampled well G2

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

(1) OWNER: Name _____ Address Brown Rd., Ellensburg

" LOCATION OF WELL: County Kittitas - S 1/4 NE 1/4 Sec. 4 T. 17N. R. 18W.

_____ and distance from section or subdivision corner _____

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 245 ft. Depth of completed well 245 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from 12 ft. to 225 ft.
Threaded ☐ " Diam. from _____ ft. to _____ ft.
Welded ☒ " Diam. from _____ ft. to _____ ft.

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

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface seal: Yes ☒ No ☐ To what depth 20 ft.
Material used in seal Bentonite
Did any strata contain unusable water? Yes ☐ No ☒
Type of water? _____ Depth of strata _____
Method of sealing strata off _____

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

(8) WATER LEVELS: Land-surface elevation above mean sea level _____
Static level 12 ft. below top of well Date 10-29-87
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

Yield test: 50 gal./min. with 0 ft. drawdown after 2 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
SILT + COBBLES	0	12
Cemented COBBLES	12	50
Cemented GRAVEL	50	95
SANDSTONE	95	110
Cemented GRAVEL	110	180
LOOSE SAND + GRAVEL	180	200
SANDSTONE WITH GRAVEL	200	225
SANDSTONE WITH WATER	225	245

RECEIVED
OCT 24 1987

Work started 10-27, 1987 Completed 10-29, 1987

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 BACH DRILLING Co. (Person, firm, or corporation) (Type or print)
Address Box 1010 RT 5 - E.burg
(Signed) Glen M. Carls (Well Driller)
License No. 0836 Date 10-29, 1987

Nearby well log for sampled well G3.

Alant

WATER WELL REPORT

Start Card No. W048336
Unique Well I.D. # ABX048
Water Right Permit No.

STATE OF WASHINGTON

(1) OWNER: Address		(10) WELL LOG	
(2) LOCATION OF WELL: County KITTITAS (2a) STREET ADDRESS OF WELL (or nearest address),		1/4 NW 1/4 Sec 13 T 17 N., R 17 W	
(3) PROPOSED USE: DOMESTIC			
(4) TYPE OF WORK:	Owner's Number of well (if more than one) 1 Method: ROTARY	Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.	
(5) DIMENSIONS:	Diameter of well 6 inches Drilled 220 ft. Depth of completed well 220 ft.		
(6) CONSTRUCTION DETAILS:			
Casing installed:	6 " Dia. from +2 ft. to 53 ft. WELDED 4 " Dia. from -5 ft. to 220 ft. " Dia. from ft. to ft.		
Perforations: YES	Type of perforator used SKILL SAW SIZE of perforations 1/8 in. by 6 in. 40 perforations from 200 ft. to 220 ft. perforations from ft. to ft. perforations from ft. to ft.		
Screens: NO	Manufacturer's Name Type Diam. slot size from ft. to ft. Diam. slot size from ft. to ft.		
Gravel packed: NO	Size of gravel Gravel placed from ft. to ft.		
Surface seal: YES	To what depth? 18 ft. Material used in seal BENTONITE Did any strata contain unusable water? YES Type of water? CLOUDY Depth of strata 10 ft. Method of sealing strata off OVERBORE		
(7) PUMP: Manufacturer's Name	Type H.P.		
(8) WATER LEVELS:	Land-surface elevation Static level 20 ft. above mean sea level ... ft. Artesian Pressure lbs. per square inch Date 07/20/95 Artesian water controlled by		
(9) WELL TESTS: Drawdown is amount water level is lowered below static level.	Was a pump test made? NO If yes, by whom? Yield: gal./min with ft. drawdown after hrs.		
Recovery data	Time Water Level Time Water Level Time Water Level		
Date of test / /	Bailer test gal/min. ft. drawdown after hrs. Air test 26 gal/min. w/ stem set at 210 ft. for 1 hrs. Artesian flow g.p.m. Date Temperature of water Was a chemical analysis made? NO		
		MATERIAL TOPSOIL BASALT BOULDERS BASALT BOULDERS WITH WATER BROKEN BLACK BASALT MEDIUM BLACK BASALT HARD BLACK BASALT BASALT WITH CLAY HARD BLACK BASALT BLACK BASALT WITH WATER	
		FROM TO 0 10 10 50 50 55 55 92 92 164 164 171 171 200 200 220	
		Work started 07/19/95 Completed 07/20/95	
		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 PONDEROSA DRILLING (Person, firm, or corporation) (Type or print)	
		ADDRESS E 6010 BROADWAY	
		[SIGNED] <i>Ag. A. Kelly</i> License No. 2215	
		Contractor's Registration No. PO-WD-EI*248JE Date 07/19/95	

Nearby well log for sampled well G4.

WATER WELL REPORT

STATE OF WASHINGTON

Start Card No. W36399
UNIQUE WELL I.D. # ART861
Water Right Permit No. _____

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

(1) OWNER: Name _____ Address _____

(2) LOCATION OF WELL: County KITTITAS SE 18 N. 18 W. 30

(2a) STREET ADDRESS OF WELL (or nearest address) _____

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

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

(5) DIMENSIONS: Diameter of well 6" inches.
Drilled 400 feet. Depth of completed well 400 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6" Diam. from +2 ft. to 212 ft.
Welded ☒ 4" Diam. from 133 ft. to 400 ft.
Linear installed ☒
Threaded ☐ Diam. from _____ ft. to _____ ft.
Perforations: Yes ☒ No ☐
Type of perforator used SKILL SAW
SIZE of perforations 1/8 in. by 6 in.
188 perforations from 340 ft. to 400 ft.
_____ perforations from _____ ft. to _____ ft.
_____ perforations from _____ ft. to _____ ft.
Screens: Yes ☐ No ☒
Manufacturer's Name _____ Model No. _____
Type _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.
Surface seal: Yes ☒ No ☐ To what depth? 22 ft.
Material used in seal: CEMENT
Did any strata contain unuseable 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 _____ ft.
Static level FLOWING ft. below top of well Date 10/21/93
Artesian pressure TRICKLE lbs. per square inch Date _____
Artesian water is controlled by WELL SEAL CAP (Cap, valve, etc.)

(9) WELL TESTS: Drawdown is smallest water level is lowered below static level
Was a pump test made? Yes ☐ No ☒ If yes, by whom? _____
Yield: 20+ gal./min. with _____ ft. drawdown after _____ hrs.
-- ESTIMATED AIR LIFT 20+ GPM --
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 _____
Ballot test _____ gal./min. with _____ ft. drawdown after _____
Airtest _____ gal./min. with stem set at _____ ft. for _____
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 FINE SILT	0	7
HARD PAN AND BOULDERS	7	12
SAND GRAVEL SILT	12	55
WHITE SAND	55	60
SAND GRAVEL CLAY	60	85
BROWN CLAY	85	90
GRAVEL CLAY SAND	90	105
BROWN CLAY	105	110
DARK BROWN SAND GRAVEL & CLAY	110	125
LIGHT BROWN CLAY	125	139
BROWN SAND GRAVEL & CLAY	139	210
GRAY SAND GRAVEL W/CLAY	210	215
CEMENTED GRAVEL	215	287
SAND GRAVEL W/CLAY	287	295
RED CEMENTED GRAVEL W/SAND	295	302
TAN CLAY	302	310
GRAY SANDSTONE	310	313
CEMENTED GRAVEL	313	319
GRAVEL AND RED SANDSTONE	319	322
CEMENTED GRAVEL	322	343
GRAVEL W/GRAY SANDSTONE CLAY	343	352
CEMENTED GRAVEL	352	356
MULTI COLORED SANDSTONE W/WATER	356	400

6" DRIVE SHOE UTILIZED

Work started 10/14/93 19. Completed 10/21 19 93

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 PONDEROSA DRILLING & DEVELOPMENT, INC.
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)
Address E. 6010 BROADWAY SPOKANE, WA 99212
(Signed) Bob Britton License No. 0043
Constructor's (WELL DRILLER) (BOB BRITTON)
Date 10/26 19 93

(USE ADDITIONAL SHEETS IF NECESSARY)

Well log for sampled well G6.



WATER WELL REPORT

Original & 1" copy - Ecology, 2" copy - owner, 3" copy - driller

Construction/Decommission ("x" in circle) 313745

☒ Construction
☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number _____

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

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

DIMENSIONS: Diameter of well 6 inches, drilled 245 ft.
 Depth of completed well 245 ft.

CONSTRUCTION DETAILS
 Casing: ☒ Welded 6 Diam. from 13 ft. to 169 ft.
 Installed: ☒ Liner installed Diam. from 23 ft. to 245 ft.
☐ Threaded Diam. from _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No
 Type of perforations used Skillsaw
 Size of perfs. 1/2 in. by 1/4 in. and no. of perfs. 15 from 185 ft. to 245 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.
 Material used in seal benzoin/cement
 Did any strata contain unusable water? ☐ Yes ☒ No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

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

WATER LEVELS: Land-surface elevation above mean sea level _____ ft.
 Static level 50 ft. below top of well Date _____
 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 _____
 Bailor test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airstest 25 gal./min. with stem set at 225 ft. for 25 hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. W273669

Unique Ecology Well ID Tag No. BAP396

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location SW 1/4-1/4 SE 1/4 Sec 31 Twn 18 R 18 or circle sec

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

Still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 18-18-31000-0037

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	8
topsoil / rocks	8	22
gravel	22	42
sandstone / gravel	42	86
gravel	86	144
cemented gravel	144	223
gravel	223	245

RECEIVED

APR 30 2010

DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 3/31/10 Completed Date 4/2/10

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Jerry Ban Drilling Company Ban Drilling

Driller/Engineer/Trainee Signature _____ Address 3340 Wilson Creek

Driller or trainee License No. 2536 City, State, Zip Ellensburg WA 98926

Contractor's _____

Registration No. MTKEBVC942 Date 4/2/10

Driller's Signature _____ Ecology is an Equal Opportunity Employer.

Well log for sampled well G7.



WATER WELL REPORT

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

Construction/Decommission (x in circle)

☒ Construction

☐ Decommission ORIGINAL CONSTRUCTION Notice

of Intent Number

118966

CURRENT

Notice of Intent No

W154616

Unique Ecology Well ID Tag No

AGB098

Water Right Permit No

Property Owner Name

Well Street Address

City ELLENSBURG

County KITTITAS

Location NW 1/4 1/4 NW 1/4 Sec 12

Town 17 R 17

EWM circle or WWM one

Lat/Long

Lat Deg

Lat Min/Sec

(s, l, r still REQUIRED)

Long Deg

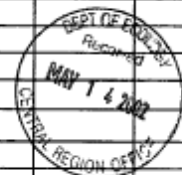
Long Min/Sec

Tax Parcel 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
topsoil Br m	0	2
Sand Gravel Cobbles		
Bl Br H	2	9
Cemented gravel		
Bl Br H	9	16
Cemented Gravel Cobbles		
Boulders Bl Br VH	16	67
Sandstone Br m	67	81
Cemented gravel Bl Br m	81	120
Cemented Gravel Cobbles		
Bl Br H	120	169
Sandstone Redis Br m	169	186
Cemented gravel Bl Br m	186	193
Sandstone Br m	193	195
Sandstone matrix m	195	235
Basalt Black H	235	



Start Date 5/8/02

Completed Date 5/9/02

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 235 ft

Depth of completed well 235 ft

CONSTRUCTION DETAILS

Casing ☒ Welded 6 Diam from +2 ft to 184

Installed ☐ Liner installed Diam from ft to ft

☐ Threaded Diam from ft to ft

Perforations ☐ Yes ☒ No

Type of perforator used

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

Screens ☐ Yes ☒ No ☐ K Pac Location

Manufacturer's Name

Type Model No

Diam Slot Size from ft to ft

Diam Slot Size from ft to ft

Gravel/Filter packed ☐ Yes ☐ No ☐ Size of gravel/sand

Materials placed from ft to ft

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

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 HP

WATER LEVELS Land surface elevation above mean sea level ft

Static level 71 ft below top of well Date 5/9/02

Artesian pressure lbs per square inch Date

Artesian water is controlled by (cap valve etc)

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

Was a pump test made? ☐ 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

Time Water Level Time Water Level Time Water Level

Time Water Level Time Water Level Time Water Level

Time Water Level Time Water Level Time Water Level

Date of test

Bailer test gal/min with ft drawdown after hrs

Artesian 40-45 gal/min with stem set at 230 ft for 1 hrs

Artesian flow g p m Date

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

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) Steve Mills

Driller/Engineer/Trainee Signature Steve Mills

Driller or Trainee License No 1335

If trainee licensed driller

Drilling Company Waterman Well Drill Inc

Address 106 Berriman Lane

City State Zip Selah WA 98942

Contractors WATERMAN 002203 5/8/02

THE DEPARTMENT OF ECOLOGY DOES NOT GUARANTEE THE DATA AND/OR THE INFORMATION ON THIS WELL REPORT.

Well log for sampled well G9.

Please print, sign and return to the Department of Ecology



Water Well Report

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

Construction/Decommission

☒ Construction 255178

☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number

PROPOSED USE: ☐ DeWater ☒ Domestic ☐ Industrial ☐ Municipal ☐ 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 130 ft.
 Depth of completed well 128 ft.

CONSTRUCTION DETAILS
 Casing: ☒ Welded 1/2" Diam. from 72 ft. to 128 ft.
 Installed: ☐ Liner installed ☐ Diam. from 80 ft. to 128 ft.
☐ Threaded ☐ Diam. from ft. to ft.

Perforations: ☒ Yes ☐ No
 Type of perforating used SKIN SAW
 SIZE of perfor. 6 in. by 1/4 in. and no. of perfor. 30 from 88 ft. to 128 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 20 ft.
 Material used in seal BENTONITE
 Did any strata contain unusable water? ☐ Yes ☒ No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

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

WATER LEVELS: Land-surface elevation above mean sea level _____
 Static level 68 ft. below top of well Date 10/27/06
 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 _____
 Bailor test: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airtest 15 gal./min. with stem set at 120 ft. for 2 hrs.
 Artesian flow _____ g.p.m. Date _____
 Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

Current

Notice of Intent No. W-256326

Unique Ecology Well ID Tag No. APG-215

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City E Buel County KITTITAS

Location NW 1/4 - 1/4 NE 1/4 Sec 01 Twn 7 R 17 or W 1/4 circle one

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

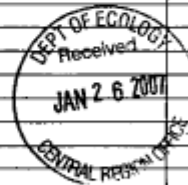
still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 171701051-0002

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
TOP SOIL	0	3
CEMENTED GRAVEL	3	7
CLAY & GRAVEL	7	100
BROKEN CEMENT	100	104
BROWN CLAY & GRAVEL	104	130
WATER		



Start Date 10/27/06

Completed Date 10/28/06

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) _____

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. _____

IF TRAINEE,

Driller's Licensed No. 2428

Driller's Signature [Signature]

Drilling Company HEDDER RIVERS DRILLING

Address P.O. Box 993

City, State, Zip SEACAT, WA 98942

Contractor's

Registration No. HEDDER2590X Date 11/04/06

Ecology is an Equal Opportunity Employer.

ECY 559-1-20 (Rev 2/03)

Nearby well log for sampled well G10.

7/24

WATER WELL REPORT

Start Card No. W085498
Unique Well I.D. # ACW959
Water Right Permit No.

STATE OF WASHINGTON

(1) OWNER: Name _____ Address _____		(10) WELL LOG	
(2) LOCATION OF WELL: County KITTITAS		- N 1/4 SW 1/4 Sec 12 T 17 N., R 17 W	
(2a) STREET ADDRESS OF WELL (or nearest address) _____		LMNP	
(3) PROPOSED USE: DOMESTIC			
(4) TYPE OF WORK: Owner's Number of well (if more than one) _____ Method: ROTARY		Formation: Describe by color, character, size of material and structure, and show thickness of aquifers and the kind and nature of the material in each stratum penetrated, with at least one entry for each change in formation.	
NEW WELL			
(5) DIMENSIONS: Diameter of well 6 inches Drilled 201 ft. Depth of completed well 201 ft.		MATERIAL FROM TO	
(6) CONSTRUCTION DETAILS:			
Casing installed: 6" Dia. from 42 ft. to 181 ft.		TOPSOIL 0 2	
STEEL CASING 4.5" Dia. from 160 ft. to 200 ft.		BROWN CLAY 2 6	
* Dia. from _____ ft. to _____ ft.		BOULDERS 6 8	
		BROKEN BASALT 8 78	
		BROWN CLAY 78 82	
		BASALT 82 93	
		BROWN CLAY 93 96	
		SAND AND GRAVEL 96 98	
		CEMENTED GRAVEL 98 112	
		BASALT 112 127	
		SOFT BASALT 127 136	
		SANDSTONE 136 142	
		BASALT 142 159	
		BROWN CLAY 159 161	
		BROKEN BASALT WITH WATER 161 201	
Perforations: YES Type of perforator used SKILL SAM SIZE of perforations _____ in. by _____ in. 30 perforations from 188 ft. to 200 ft. perforations from _____ ft. to _____ ft. perforations from _____ ft. to _____ ft.			
Screens: NO Manufacturer's Name _____ Model No. _____ Type _____ Diam. slot size from _____ ft. to _____ ft. Diam. slot size from _____ ft. to _____ ft.			
Gravel packed: NO Gravel placed from _____ ft. to _____ ft.			
Surface seal: YES Material used in seal OTHER Did any strata contain unusable water? NO Type of water? _____ Depth of strata _____ ft. Method of sealing strata off OVERBORE			
(7) PUMP: Manufacturer's Name _____ Type _____ H.P. _____			
(8) WATER LEVELS: Land-surface elevation above mean sea level _____ ft. Static level 116 ft. below top of well Date 06/04/96 Artesian Pressure _____ lbs. per square inch Date _____ Artesian water controlled by _____		Work started 05/31/96 Completed 06/04/96	
(9) WELL TESTS: Drawdown is amount water level is lowered below static level. Was a pump test made? NO If yes, by whom? Yield: gal./min with _____ ft. drawdown after _____ hrs. Recovery data Time Water Level Time Water Level Time Water Level Date of test / / Bailer test gal./min. ft. drawdown after _____ hrs. Air test 10 gal./min. w/ stem set at 150 ft. for 1 _____ hrs. Artesian flow g.p.m. _____ Date _____ Temperature of water _____ Was a chemical analysis made? NO		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 PONDEROSA DRILLING (Person, firm, or corporation) (Type or print) ADDRESS 8 6018 BROADWAY [SIGNED] _____ License No. 1908 Contractor's Registration No. PO-WD-WI-246JTE Date 06/10/96	

Nearby well log for sampled well G11.

Please print, sign and return to the Department of Ecology



Water Well Report

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

Construction/Decommission

☐ Construction

☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number

PROPOSED USE: ☐ DeWater ☒ Domestic ☐ Irrigation ☐ Industrial ☐ Test Well ☐ Municipal ☐ 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 140 ft.
 Depth of completed well 140 ft.

CONSTRUCTION DETAILS
 Casing ☒ Welded 6" Diam. from 12 ft. to 70 ft.
 Installed: ☒ Liner installed 4" Diam. from 10 ft. to 140 ft.
☐ Threaded 6" Diam. from 10 ft. to 140 ft.

Perforations: ☒ Yes ☐ No
 Type of perforator used Skill Saw
 SIZE of perfs 7 in. by 1/4 in. and no. of perfs 200 from 100 ft. to 140 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location

Manufacturer's Name
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 22 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 _____ H.P. _____
 Type _____

WELL LEVELS: Land surface elevation above mean sea level _____ ft.
 Static level 35 ft. below top of well Date 4-7-06
 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 to zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

Date of test _____

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

Airtest 15 gal./min. with stem set at 135 ft. for 14 hrs.

Artesian flow _____ g.p.m. Date _____

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

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) Mike Morefield

Driller/Engineer/Trainee Signature [Signature]

Driller or trainee License No. 2361

IF TRAINEE, Driller's Licensed No. _____

Driller's Signature _____

Current Notice of Intent No. W 241929

Unique Ecology Well ID Tag No. ALF 324

Water Right Permit No. A

Property Owner Name _____

Well Street Address _____

City Cu. County Kittitas

Location ne 1/4 ne 1/4 Sec 18 Twn 17 R 18

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

still REQUIRED) Long Deg _____ Long Min/Sec _____

Tax Parcel No. 171818010 0016

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
Top soil	0	3
Hard Black cobbles	3	22
Hard Brown gravel	22	60
Hard Black gravel	60	80
Brown Sandstone & gravel	80	105
Brown sandstone	105	125
Tan sandstone & 1 ft. gravel	125	140
Water		
Pump 10 gal's		
Clean water		

Start Date 4-5-06 Completed Date 4-7-06

Drilling Company Waterman Well Drilling Inc

Address PO Box 246

City, State, Zip Selah Wa 98942

Contractor's WATERW0022DB Date 4/10/06

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

Well log for sampled well G12.

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

Water Right Permit No.

Start Card No. 84420

B

(1) OWNER: Name _____ Address 17

(4) LOCATION OF WELL: County KITITAS WANE N. Sec 13 T. 78 R. 17 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) MANASTASH

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

(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
GRAVEL	0	92
SAND	92	160

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

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

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

(6) CONSTRUCTION DETAILS:

Casing installed: 6 Diam. from 0 ft. to 9.5 ft.
Welded ☒ 4 Diam. from 0 ft. to 160 ft.
Liner installed ☐
Threaded ☐ Diam. from _____ ft. to _____ ft.

Perforations: Yes ☒ No ☐

Type of perforator used SKILSAW

SIZE of perforations 1/8 in. by 7 1/4 in.

120 perforations from 100 ft. to 160 ft.

120 perforations from 100 ft. to 160 ft.

120 perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒

Manufacturer's Name _____

Type _____ Model No. _____

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

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

Gravel packed: Yes ☐ No ☒ Size of gravel _____

Gravel placed from _____ ft. to _____ ft.

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

Material used in seal BENTONITE

Did any strata contain unusable water? Yes ☐ No ☒

Type of water? _____ Depth of strata _____

Method of sealing strata off _____

(7) PUMP: Manufacturer's Name _____

Type _____ H.P. _____

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

Static level 8 ft. below top of well Date 9/12

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.

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

_____ 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 30 gal./min. with stem set at 155 ft. for 1 hrs.

Artesian flow _____ g.p.m. Date _____

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

Work started 9/11, 19. Completed 9/12, 1992

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 BACH DRILLING CO
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address RT5 BOX 1010

(Signed) _____ License No. 1778

Contractor's Registration No. MIK0000354 Date 9/12, 1992

(USE ADDITIONAL SHEETS IF NECESSARY)

Nearby well log for sampled well G13.

Activities

(2a) STREET ADDRESS OF WELL (or nearest address) UMP TAN UM ROAD

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
COBBLES - dirt	0	10
CEMENT GRAVEL	10	80
SANDSTONE GRAVEL	80	100
SAND GRAVEL	100	140
CLAY - SANDSTONE	140	165
SANDSTONE WITH GRAVEL	165	300

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.

93

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

Notice of Intent **W155395**
UNIQUE WELL ID # **AHK605**

Water Right Permit No

(1) OWNER Name Address

(2) LOCATION OF WELL County **KITTITAS**

SE 1/4 **NE** 1/4 Sec **18** T **17** N R **18** WM

(2a) STREET ADDRESS OF WELL (or nearest address)

TAX PARCEL NO **17 18 18010-0004**

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

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

☒ New Well Method ☐ Dug ☐ Bored
☐ Deepened ☐ Cable ☐ Driven
☐ Reconditioned ☒ Rotary ☐ Jetted
☐ Decommission

(5) DIMENSIONS Diameter of well **6** inches
Drilled **162** feet Depth of completed well **162** ft

(6) CONSTRUCTION DETAILS

Casing Installed

☒ Welded **6** Diam from **+3** ft to **157** ft
☐ Liner installed Diam from ft to 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
perforations from ft to ft
perforations from ft to ft

Screens ☐ Yes ☒ No ☐ K Pac Location

Manufacturer's Name

Type Model No
Diam Slot size from ft to ft
Diam Slot size from ft to ft

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

Material placed from ft to ft

Surface seal ☒ Yes ☐ No To what depth? **40** ft

Material used in seal **BENTONITE**

Did any strata contain unusable water? ☐ Yes ☒ No

Type of water? Depth of strata

Method of sealing strata off

(7) PUMP Manufacturer's Name

Type H P

(8) WATER LEVELS Land surface elevation above mean sea level ft

Static level **115** ft below top of well Date **10/1/2002**

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 gal/min with ft drawdown after hrs

Art test **30** gal/min with stem set at **155** ft for **1** hrs

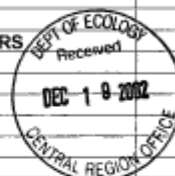
Artesian flow g p m Date

Temperature of water Was a chemical analyses 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
SOIL	0	2
SOIL GRAVEL BOULDERS	2	4
CLAY GRAVEL BOULDERS	4	14
BASALT BROKEN	14	84
CLAY AND GRAVEL LAYERS	84	155
SAND GRAVEL AND BOULDERS	155	162



Work Started **10/1/2002** 19 Completed **10/1/2002** 19

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 **TOM MCGUIRE** License No **0357**
(Licensed Driller/Engineer)

Trainee Name License No

Drilling Company **RICK POULIN WELL DRILLING**

(Signed) *Tom McGuire* License No **0357**
(Licensed Driller/Engineer)

Address **1301 LANCASTER RD SELAH, WA 98942**

Contractor's Registration No **RICKPWD042J2** Date **10/3/02** 19

(USE ADDITIONAL SHEETS IF NECESSARY)

Ecology is an Equal Opportunity and Affirmative Action employer. For special accommodation needs contact the Water Resources Program at (360) 407 6800. The TDD number is (360) 407-6006.

Well log for sampled well G15.



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

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 223 ft. Depth of completed well 223 ft.	
CONSTRUCTION DETAILS Casing ☒ Welded 6" Diam. from +3 ft. to 200 ft. Installed: ☐ Liner installed " Diam. from ft. to ft. ☐ Threaded " Diam. From ft. to ft.	
Perforations: ☐ Yes ☒ No Type of perforator used _____ SIZE of perfs in. by in. and no. of perfs from ft. to ft.	
Screens: ☐ Yes ☒ No ☐ K-Pac Location _____ Manufacturer's Name _____ Type _____ Model No. _____ Diam. Slot size from ft. to ft. Diam. Slot size from ft. to ft.	
Gravel/Filter packed: ☐ Yes ☒ No Size of gravel/sand _____ Materials placed from ft. to ft.	
Surface Seal: ☒ Yes ☐ No To what depth? 18 ft. Material used in seal Bentonite Did any strata contain unsuitable water? ☐ Yes ☒ No Type of water? _____ Depth of strata _____ Method of sealing strata off _____	
PUMP: Manufacturer's Name _____ Type: _____ H.P. _____	
WATER LEVELS: Land-surface elevation above mean sea level ft. Static level 110 ft. below top of well Date 1/21/19 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 20-24 gal./min. with 203 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	

CURRENT

Notice of Intent No. W315791
Unique Ecology Well ID Tag No. BJA293
Water Right Permit No. _____
Property Owner Name _____
Well Street Address _____
City Ellensburg County Kittitas
Location NW 1/4-1/4 SE 1/4 Sec 7 Twn 17 R 18 EWM ☒
(s, t, r Still REQUIRED) Or WWM ☐
Lat/Long _____
Lat Deg _____ Lat Min/Sec _____
Long Deg _____ Long Min/Sec _____
Tax parcel No. (Required) 14213

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, cobbles	0	5
gravel	5	70
sandstone	70	75
gravel	75	110
sandstone	110	120
gravel	120	132
sandstone	132	137
gravel	137	145
sandstone	145	155
gravel	155	180
sandstone	180	184
gravel	184	210
sandstone	210	223

RECEIVED
FEB 07 2019
Dept of Ecology
Central Regional Office

RECEIVED
FEB 07 2019
Dept of Ecology
Central Regional Office

Start Date 1/17/19 Completed Date 1/21/19

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 JEREMY BACH

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 2536

IF TRAINEE: Driller's License No: _____

Driller's Signature: _____

Drilling Company BACH DRILLING COMPANY

Address 3340 WILSON CREEK ROAD

City, State, Zip ELLENSBURG, WA 98926

Contractor's

Registration No. MIKEBDC942R6

Date _____

ECY 050-1-20 (Rev 02-2010) To request ADA accommodation including materials in a format for the visually impaired, call Ecology Water Resources Program at 360-407-6872. Persons with impaired hearing may call Washington Relay Service at 711. Persons with speech disability may call TTY at 877-833-6341.

Well log for sampled well G16.



WATER WELL REPORT

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

Construction/Decommission ("x" in circle)

☒ Construction 261500

☐ Decommission ORIGINAL INSTALLATION Notice of Intent Number _____

PROPOSED USE: ☐ DeWater ☒ Domestic Irrigation ☐ Industrial Test Well ☐ Municipal 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 8-5 1/2 inches, drilled 264 ft.
 Depth of completed well 262 ft.

CONSTRUCTION DETAILS
 Casing: ☒ Welded 5" - Diam. from +1 1/2 ft. to 261 1/2 ft.
 Installed: ☐ Liner installed - Diam. from _____ ft. to _____ ft.
☐ Threaded - Diam. from _____ ft. to _____ ft.

Perforations: ☐ Yes ☒ No
 Type of perforator used _____
 Size of perfor. in. by _____ in. and no. of perfor. from _____ ft. to _____ ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 22 ft.
 Material used in seal Bentonite
 Did any strata contain unstable water? ☐ Yes ☒ No
 Type of water? _____ Depth of strata _____
 Method of sealing strata off _____

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

WATER LEVELS: Land-surface elevation above mean sea level 1905 ft.
 Static level 131 ft. below top of well Date 04-09-07
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)
 Time Water Level Time Water Level Time Water Level

 Date of test _____
 Bailor test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Arrested _____ gal./min. with stem set at 259 ft. for 1 hrs.
 Artesian flow _____ g.p.m. Date 04-09-07
 Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

CURRENT

Notice of Intent No. W227316

Unique Ecology Well ID Tag No. APT 313

Water Right Permit No. _____

Property Owner Name _____

Well Street Address: _____

City Ellensburg County Kittitas

Location SE 1/4-1/4 SE 1/4 Sec 12 Twn17 R17 EWM or WWM ☒ check one

(Lat/Long (s, t, r) Lat Deg N 46 Lat Min/Sec 58.287

Still **REQUIRED**) Long Deg W 120 Long Min/Sec 38.998

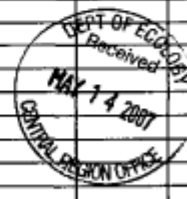
Tax Parcel No. 1717-12040-0010

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
Broken basalt, boulder WB	0	15
Brown clay, broken basalt gravel, cobbles	15	47
Lt. brown / tan clay, broken basalt	47	65
Lt. brown / tan clay	65	94
Brown clay, Broken basalt gravel	94	110
Brown broken basalt	110	124
Lt. brown / tan clay, broken basalt	124	129
Brown broken basalt	129	148
Lt. brown soft - med. sandstone	148	155
Broken basalt / clay / kalichee 1 - 2 gpm	155	172
Brown basalt, clay	172	183
Brown broken basalt gravel, clay 1 - 1 1/2 gpm	183	205
Black hard basalt w/ fractured zones	205	224
Brown basalt, clay	224	233
Black basalt	233	235
Black fine - med. thick sand	235	237
Black broken basalt	237	251
Brown clay / sandstone	251	253
Broken basalt gravel WB @ 258 - 263'	253	263
Lt. brown clay	263	264

****TUBEX (5 1/2" driveshoe)



Start Date 04-06-07

Completed Date 04-09-07

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

☒ Driller ☐ Engineer ☐ Trainee Name (Print) Brett Phythian

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 1249

IF TRAINEE,

Driller's Licensed No. _____

Driller's Signature _____

Drilling Company Tumwater Drilling & Pump Inc. 509-549-5361

Address 9290 Hwy 2 / P.O. Box 777

City, State, Zip Dryden / Leavenworth, WA 98826

Contractor's Registration No. TUMWADP 011 LZ

Date 04-10-2007

Well log for sampled well G17.

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. 080390

Water Right Permit No. _____

OWNER: Name _____

Address _____

(2) LOCATION OF WELL: County KITTITAS S 5 NW 10 T. 17 N. R. 18 W.M.

(2a) STREET ADDRESS OF WELL (or nearest address) _____

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

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

(5) DIMENSIONS: Diameter of well 6 inches.
Drilled 180 feet. Depth of completed well 170 ft.

(6) CONSTRUCTION DETAILS:
Casing installed: 6 Diam. from +2 ft. to 118 ft.
Welded ☒ PVC 4 Diam. from -10 ft. to 170 ft.
Liner installed ☒
Threaded ☐ Diam. from _____ ft. to _____ ft.
Perforations: Yes ☒ No ☐ PVC LINER
Type of perforator used SKILL SAW
Size of perforations 3/32 in. by 6 in.
68 perforations from 110 ft. to 170 ft.
perforations from _____ ft. to _____ ft.
perforations from _____ ft. to _____ ft.

Screens: Yes ☐ No ☒
Manufacturer's Name _____
Type _____ Model No. _____
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Diam. _____ Slot size _____ from _____ ft. to _____ ft.
Gravel packed: Yes ☐ No ☒ Size of gravel _____
Gravel placed from _____ ft. to _____ ft.
Surface seal: Yes ☒ No ☐ To what depth? 40 ft.
Material used in seal BENTONITE SLURRY
Did any strata contain unusable water? Yes ☒ No ☐
Type of water? SURFACE Depth of strata 17'
Method of sealing strata off OVERBORE & BENTONITE SLURRY

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

(8) WATER LEVELS: Land surface elevation above mean sea level _____ ft.
Static level 60 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: 15-20 gal./min. with _____ ft. drawdown after _____ hrs.
" ESTIMATED AIRLIFT " " " " " " " " " " " "

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

Date of test _____

Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
Airtest _____ gal./min. with stem set at _____ ft. for _____ hrs.

Artesian flow _____ g.p.m. Date _____
Temperature of water _____ 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, BROWN, BOULDERS	0	17
RIVER ROCK & SILT, BROWN W/WATER	17	21
GRAVEL & CLAY, RED	21	48
CLAY, RED	48	51
CEMENTED GRAVEL	51	157
CEMENTED GRAVEL W/WATER	157	180

6" DRIVE SHOE UTILIZED

Work started 5/29/91 19. Completed 6/04/91 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 PONDEROSA DRILLING & DEVELOPMENT INC.
(PERSON, FIRM, OR CORPORATION) (TYPE OR PRINT)

Address E. 6010 BROADWAY, SPOKANE, WA 99212

(Signed) Douglas E. Lane License No. 1030
(WELL DRILLER) (DOUGLAS E. LANE)

Contractor's Registration No. PONDEI*248je Date 6/17/91 19.

(USE ADDITIONAL SHEETS IF NECESSARY)

Well log for sampled well G18.

98



WATER WELL REPORT

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

Construction/Decommission (circle)

☒ Construction

☐ Decommission ORIGINAL CONSTRUCTION Notice of Intent Number W170817

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 116 ft
Depth of completed well 116 ft

CONSTRUCTION DETAILS

Casing ☒ Welded 6 Diam from +2 ft to 116 ft
Installed ☐ Liner installed Diam from _____ ft to _____ ft
☐ Threaded Diam from _____ ft to _____ ft

Perforations ☐ Yes ☒ No
Type of perforator used _____
SIZE of perfs _____ in by _____ in and no of perfs _____ from _____ ft to _____ ft

Screens ☐ Yes ☒ No ☐ K Pac Location _____
Manufacturer's Name _____
Type _____ Model No _____
Diam _____ Slot Size _____ from _____ ft to _____ ft
Diam _____ Slot Size _____ from _____ ft to _____ ft

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

Surface Seal ☒ Yes ☐ No To what depth? 8 ft
Materials used in seal Bentonite
Did any strata contain unusable water? ☒ Yes ☐ No
Type of water? Surface Depth of strata 24-67
Method of sealing strata off Casing

PUMP Manufacturer's Name _____
Type _____ H P _____

WATER LEVELS Land surface elevation above mean sea level _____ ft
Static level 11 ft below top of well Date 10/7/03
Artesian pressure _____ lbs per square inch Date _____
Artesian water is controlled by _____
(cap valve etc)

WELL TESTS Drawdown is amount water level is lowered below static level
Was a pump test made? ☐ Yes ☒ No If yes by whom? _____
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs
Yield _____ gal/min with _____ ft drawdown after _____ hrs

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

Time	Water Level	Time	Water Level	Time	Water Level

Date of test _____
Bailer test _____ gal/min with _____ ft drawdown after _____ hrs
Airstest 30 gal/min with stem set at 110 ft for 2 hrs
Artesian flow _____ g p m Date _____
Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

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) Mathew Mathews
Driller/Engineer/Trainee Signature Mathew Mathews
Driller or Trainee License No 1247

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

CURRENT

Notice of Intent No W170817

Unique Ecology Well ID Tag No WAK 972

Water Right Permit No _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location SE 1/4 1/4 SW 1/4 Sec 4 Twn 12 R 18 W of one circle

Lat/Long _____ Lat Deg _____ Lat Min/Sec _____

REQUIRED Long Deg _____ Long Min/Sec _____

Tax Parcel No 17-18-04058-0003

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
Top Soil	0	4
Brown Clay & gravel	4	24
gravel Sand & water	24	67
Sticky Brown Clay	67	98
gravel Clay & water	98	114
gravel & water	114	116



Start Date 10/7/03 Completed Date 10/2/03

Drilling Company MATHEWS Drilling

Address 2317 Rd 10.2 NE

City State Zip Moses Lake Wa 98837

Contractor's Registration No MATHEWDC/03-101

Nearby well log for sampled well G20.

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

Construction/Decommission ("x" in circle)

○ Construction 312836

☐ Decommission *ORIGINAL INSTALLATION* Notice
of Intent Number

CURRENT

Notice of Intent No. W-256024

Unique Ecology Well ID Tag No. BAV-922

Water Right Permit No.

Property Owner Name

Well Street Address

City EBURG County KITSON

Location NE 1/4-1/4 SW 1/4 Sec 10 Twn 17 R 18

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

Still **REQUIRED**) Long Dog Long Min/Sec

Tax Parcel No. 171810030-0012

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
DIRT	0	2
LARGE COARSEST GRAVEL	2	16
BROWN CEMENTED GRAVEL	16	94
BROWN BRISTLE LAYERS	94	103
BROWN CLAY	103	136
BROWN CEMENTED GRAVEL	136	173
WATER		

RECEIVED

SEP 11 2008

SEP 1 1964
DEPARTMENT OF ECOLOGY - CENTRAL REGIONAL OFFICE

Start Date 11/16/07Completed Date 11/20/07

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

☐ Driller ☐ Engineer ☒ Trainee Name (Print) JUSTIN WINSLOW

Driller/Engineer/Trainee Signature *Dustin W. Kunkle*

Driller or trainee License No. T-2900 8

UTRAINEE

Driller's Licensed No. 24281Driller's Signature E. W. SmithDrilling Company. HIDDEN RIVERS DRILLING INC

Address P.O. Box 891

City, State, Zip SELAN, WA 98942

Contractor's _____

Registration No. HIADEP8590K Date 11/20/07

Ecology is an Equal Opportunity Employer

Well log for sampled well G21.



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

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 198 ft.
 Depth of completed well 198 ft.

CONSTRUCTION DETAILS
 Casing ☒ Welded 6" Diam. from +2 1/4 ft. to 162 5 ft.
 Installed: ☒ Liner installed 4 1/2" Diam. from 158 ft. to 198 ft.
☐ Threaded _____ " Diam. From _____ ft. to _____ ft.

Perforations: ☒ Yes ☐ No
 Type of perforator used Saw cut
 SIZE of perfor 1/8 in. by 8 in. and no. of perfor 81 from 158 ft. to 198 ft.

Screens: ☐ Yes ☒ No ☐ K-Pac Location _____
 Manufacturer's Name _____
 Type _____ Model No. _____
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.
 Diam. _____ Slot size _____ from _____ ft. to _____ ft.

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

Surface Seal: ☒ Yes ☐ No To what depth? 198 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 1882 ft.
 Static level 134 ft. below top of well Date 10-02-15
 Artesian pressure _____ lbs. per square inch Date _____
 Artesian water is controlled by _____ (cap, valve, etc.)

WELL TESTS: Drawdown is amount water level is lowered below static level
 Was a pump test made? ☐ Yes ☒ No If yes, by whom? _____
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Yield: _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Recovery data (time taken as zero when pump turned off) (water level measured from well top to water level)

Time	Water Level	Time	Water Level	Time	Water Level
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____

 Date of test _____
 Bailer test _____ gal./min. with _____ ft. drawdown after _____ hrs.
 Airstest 16 gal./min. with stem set at 197 ft. for 1 hrs.
 Artesian flow _____ g.p.m. Date 10-02-15
 Temperature of water _____ Was a chemical analysis made? ☐ Yes ☒ No

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) Brett Phythian

Driller/Engineer/Trainee Signature _____

Driller or trainee License No. 1249

IF TRAINEE: Driller's License No. _____

Driller's Signature: Brett Phythian

CURRENT

Notice of Intent No. WE 21547

Unique Ecology Well ID Tag No. BJB 809

Water Right Permit No. _____

Property Owner Name _____

Well Street Address _____

City Ellensburg County Kittitas

Location SE1/4-1/4 SE1/4 Sec 12 Twn 17 R 17

(s, t, r Still REQUIRED)

EWM ☒

Or
WWM ☐

Lat/Long Lat Deg N47 Lat Min/Sec 58.24

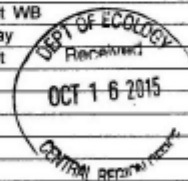
Long Deg W120 Long Min/Sec 38.47

Tax Parcel No. (Required) 375133

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
Basalt cobbles, gravel	0	6
Brown hard clay, broken basalt	6	12
Broken basalt, clay WB	12	19
Brown clay, broken basalt	19	30
Broken basalt WB	30	39
Static = 12'		
Brown clay, broken basalt		
gravel, cobbles	39	83
Brown clay / sandstone	83	91
Brown clay, basalt gravel	91	94
Brown clay / sandstone	94	99
Brown clay, basalt pieces	99	104
Brown clay / sandstone	104	117
Brown clay, basalt pieces	117	123
Brown clay / sandstone	123	129
Broken basalt	129	138
Tan clay / sandstone w/ basalt layers	138	168
Fractured black basalt WB	168	192
Brown sandstone / clay	192	197
Fractured black basalt	197	198

Start Date 09-30-15 Completed Date 10-02-15



ECY 050-1-20 (Rev 02/10) If you need this document in an alternate format, please call the Water Resources Program at 360-407-6872.

Nearby well log for sampled well G22